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NTON COUNTY - MILACA, MINNESOTA

KV TRANSMISSION LINE

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REA ADDENDUM TO JOINT DRAFT
ENVIRONMENTAL IMPACT STATEMENT

Reference - Section 4.5.2 - Public Health, Page 87

It should be noted that Section 4.5.2 represents the viewpoint of the Minnesota Environmental Quality Board.

Based on years of industry operating experience with 230 kV transmission facilities, it is REA's judgment that there will be no harmful effects from electrostatic or electromagnetic fields to humans, animals, or vegetation.

Minnesota
Environmental Quality Board
100 Capitol Square Building
550 Cedar Street
St. Paul, Minnesota 55101
Phone _____

August 10, 1979

TO: WHOM IT MAY CONCERN

RE: UPA-TR-1 Draft Environmental Impact Statement

Enclosed you will find the REA Addendum to the Joint Draft Environmental Impact Statement for the Benton County to Milaca Transmission Line and associated facilities.

This copy of the addendum should be read in conjunction with the Draft Environmental Impact Statement, referencing Section 4.5.2-Public Health, Page 87.

Sincerely,

Michael D. Sullivan

Michael Sullivan
Power Plant Siting Program

AN EQUAL OPPORTUNITY EMPLOYER

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JOINT DRAFT ENVIRONMENTAL IMPACT STATEMENT

FOR A 230 KV TRANSMISSION LINE FROM BENTON COUNTY TO MILACA SUBSTATION

PREPARED BY:

RURAL ELECTRIFICATION ADMINISTRATION
UNITED STATES DEPARTMENT OF AGRICULTURE
WASHINGTON D.C. 20250

POWER PLANT SITING STAFF
ENVIRONMENTAL QUALITY BOARD
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REA DESIGNATION
USDA-REA-EIS (ADM)-79-5

EQB DOCKET #
UPA-TR-1

JULY 1979

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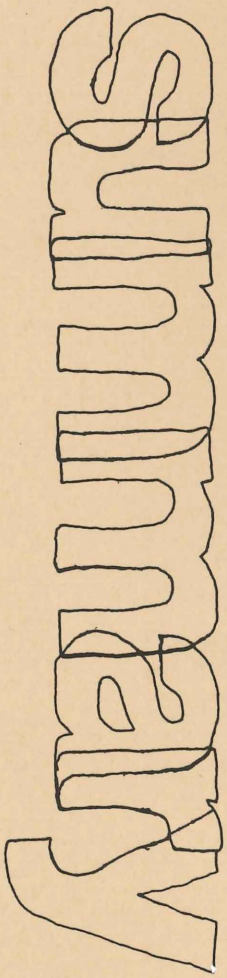
E.I.S. SUMMARY



CHAPTER 1
SUMMARY

1.1 Introduction

United Power Association (UPA) has applied to the Minnesota Environmental Quality Board (MEQB) for a Construction Permit for a single circuit 230,000 volt (230 kV) AC transmission line pursuant to the provisions of the Power Plant Siting Act (Minnesota Statutes, Section 116.51 et. seq. as amended 1977).

In addition, UPA has applied for a loan guarantee from the Rural Electrification Administration (REA) for financing the construction of the proposed transmission facilities. The REA has determined that the proposed action is a major Federal action significantly affecting the quality of the human environment, thus requiring the preparation of a Federal Environmental Impact Statement (EIS).

On February 21, 1979, the MEQB accepted the proposed routes which are included in this evaluation for public hearing, and ordered the preparation of an Environmental Impact Statement. It was determined by REA and the MEQB that a joint Federal-State EIS would be appropriate for this project. Notification of intent to prepare a joint draft EIS appeared in the Federal Register on March 30, 1979, and in the MEQB Monitor on March 19, 1979.

A Federal/State interagency meeting was held on February 28, 1979 at UPA's Elk River Office, to review the project and to identify the relevant environmental issues. A tour of the alternate transmission routes was held on March 1, 1979. Representatives of the following Federal and State agencies attended:

Minnesota Environmental Quality Board
Minnesota Energy Agency
Minnesota Department of Agriculture
Rural Electrification Administration
U.S. Department of the Interior
U.S. Fish and Wildlife Service
U.S. Bureau of Mines
U.S. Environmental Protection Agency
United Power Association
East Central Electric Association

A representative of the Citizens Route Evaluation Committee appointed by the MEQB also attended.

No areas of controversy regarding the project or alternatives were uncovered during the meeting or tour. The U.S. Corps of Engineers indicated that a permit would likely be required for the Rum River crossing, which was the only significant issue arising from the meeting.

The REA and MEQB were identified as joint lead agencies for the preparation of the required EIS for this project pursuant to the requirements of Section 102 (2)(c) of the National Environmental Policy Act of 1979, as amended, and Section 1501.5 (b) of the Council on Environmental Quality regulations. All attending agencies were invited to serve as cooperating agencies in the preparation of the EIS. However, there has been no formal commitment by any of the other agencies which would indicate their desire to be identified as cooperating agencies with REA and MEQB for this project.

The proposed project is being evaluated to assure that reasonable safeguards will be included to protect the welfare of the public and to assure that all practical environmental protection will be incorporated into the prject to minimize the adverse effects of the proposed action. REA loan procedures and MEQB permit compliance will require UPA to comply with all environmental requirements imposed by Federal, State, and local authorities.

1.2 Description of Project

The proposed transmission line will connect the Northern States Power (NSP) Benton County Substation, and a UPA Substation to be constructed on the east side of the City of Milaca. The Benton County Substation is located in Section 35, Township 36N, Range 30W. The Milaca site is located in Section 5, Township 38N, Range 27W, Mille Lacs County, Minnesota. UPA will provide an additional transformer and associated equipment necessary to terminate the proposed HVTL at the Benton County and Milaca Substations. If it is determined that microwave remote control is needed, a microwave tower will be installed at the Benton County Substation to receive communications from the existing UPA tower at Milaca. Depending upon terrain obstructions, a microwave repeater tower may be required between the Milaca and Benton County Substations. Adequate land is available at both sites, so that no additional land will have to be acquired.

In its Application for a Construction Permit, UPA proposed Route A (Segments 1-1A-2-5-5A-5C-7-7A-8-10-10A-11) and Route B (Segments 1-1A-2-3-4-4A-6-7-9-10-10A-11). Two additional routes were proposed by the MEQB's Power Plant Siting staff

(Routes C and D), and several miscellaneous route segment alternatives were added by the Citizen's Route Evaluation Committee (CREC). Route C contains Segments 1-1A-2-3-3A-3B-12-12A-12B-13-11, and Route D consists of Segments 1-1A-1B-1C-1D-9A-10A-11. The CREC segment alternatives are: Segments 3A-4A, 3B-6, 5A-5B-5C, 7A-7B-7C-8C, 8A-8B-8C-11 and 8A-11. The proposed routes range from 24.2 to 38.7 miles in length. The routes are depicted in color on a map in Chapter 1 and also in Chapter 5.

Comparable data have been accumulated and measured for potential centerlines established by UPA for reference referred to as reference centerlines or RCLs on all proposed route segments. In Chapter 5, the proposed routes and the reference centerlines are shown on individual route segment maps and are accompanied by narrative discussions for all of the route segments.

The environmental impact data for the transmission line has been measured for the reference centerline for each route segment. This approach provides a more specific and accurate representation of the potential environmental impacts than would be possible with a general evaluation of the entire width of each route segment. However, each route segment (which vary in width but typically are 1.25 miles wide) contains numerous possible right of way (ROW) alignments, and the right of way ultimately chosen may vary somewhat from those discussed in Chapter 5. Additional information maybe made available at public hearings, by concerned citizens, landowners, communities, and as a result of more detailed field work and surveying. This additional information may require UPA to deviate from the present reference centerline right of way. Any deviation, however, will likely result in the mitigation of environmental impact.

Although UPA indicated a preference for wooden H-frame poles in its Application for a Construction Permit, other types of tower structures and poles have been discussed. Residents of the study area and members of the CREC have shown a preference for single shaft steel or concrete poles. Depending on the structure type designated by the MEQB, 5.5 to 8 poles will be required per mile of route. Typically the structures will be 80-110 feet high, with specific height determined by location, terrain, and other factors such as the need for tangent or angle structures.

The right of way requirements for this transmission line vary from no additional land acquired if the line is double-circuited with an existing line, to 130 feet of new right of way. Where existing road, transmission line or railroad right of way can be shared, the utility estimates that about 60 to 80 feet of additional right of way will be needed.

The right of way will be cleared and maintained to preserve required clearance between the conductors and vegetation growing in the right of way.

1.3 Major Environmental Impacts

As stated earlier, a reference right of way has been located within all of the proposed route segments for purposes of estimating the environmental impacts. The proposed routes have been broken down into a series of route segments which are connected by nodes (a common point connecting two or more segments). In this analysis the terms "link: and "segment" are interchangeable. The length of the various segments are listed in Table 1.1. The following sections summarize the major environmental impacts anticipated in conjunction with the rights of way for the proposed route segments. These sections, organized with regard to MEQB criteria, are more fully detailed in Chapter 5.

In addition, REA has applied criteria set forth in the Historic Preservation Act of 1966, Executive Order 11988 concerning floodplain management, Executive Order 11990 on wetlands, Section 7 of the Rare and Endangered Species Act of 1973, and the United States Secretary of Agriculture's Memorandum 1827 on prime farmland whenever appropriate in this analysis.

A. Existing and Projected Human Settlement

The July 1975 population of the 15 township project study area is approximately 22,000, or 40 people per square mile. The area population has increased by approximately 20 percent over the period 1960 to 1975. Section 2.7 of Chapter 2 provides further data on area population and trends.

The impact of the proposed HVTL on human settlement is expected to be minimal. The project necessarily involves potential effects on future development, especially with regard to visual/aesthetic effects. A positive impact of the proposed project is the assurance of an adequate supply of bulk electrical power to serve the area.

B. Agricultural Land Use

At least 50 percent of the project area is classified as prime agricultural land by the Soil Conservation Service (SCS). However, in the case of the proposed routes, existing linear features and rights of way can be used frequently. These features include a railroad, state highways, various county and township and roads, government survey lines. Nonetheless, all routing alternatives will cross some productive farmland. Based upon an assessment of SCS maps, the proposed routes will cross SCS classified prime farmland between 46 percent and 62 percent of a given route's total length. There is no feasible way to totally avoid productive farmland. REA finds that the need to provide adequate electric service to this area overrides and warrants the use of this productive farmland.

Most of the project study area has been classified as "least suitable for irrigation." None of the proposed routes adversely affect known existing or proposed irrigation systems in the project area.

C. Natural Environment

Natural Areas

The major environmental impact on natural areas and systems will occur along the right of way of the proposed HVTL. The predominant impact anticipated is a change in presently wooded areas to vegetation types dominated by low growing bushes, plants and grasses. Due to the general homogenity of the study area's natural environment, the magnitude of impact in most cases will be directly proportional to the length of the proposed route. None of the routes evaluated in this report affect federally established wildlife management areas located in the study area. If small remnants of original vegetation types such as native prairie exist in the proposed routes, they can be left largely undisturbed even if they constitute a part of the actual right of way which is ultimately selected.

Wetlands

All of the proposed routes have the potential to affect wetland areas. Wetland areas that fall within the selected route should be avoided or spanned if practicable. Where it is impossible to avoid placing structures in a wetland area, UPA will minimize adverse impacts by scheduling construction at a atime and in a manner that will minimize impacts as suggested by U.S. Fish and Wildlife Service.

Floodplains

Due to the presence of several rivers in the study area, the proposed transmission line will cross over some floodplain areas. The exact amount crossed is dependent on the alignment used. Floodplains are shown on the segment maps in Chapter 5, where they are depicted by a dashed red line.

It may be necessary to locate tower structures within a designated floodplain which is defined as the area inundated by a 100 year flood. REA finds that there is no practicable alternative to avoid floodplain areas. In all instances an attempt will be made to span the floodplain rather than locate structures within it. Any structures that may be located within a floodplain will be flood proofed to the extent practicable and will be constructed to minimize the probability of interruption or loss of vital services. In addition, the REA finds that the proposed facility is not a critical facility.

D. Wildlife

Adverse impacts on wildlife will likely be created during construction on any of the possible rights of way within the prooposed routes. Subsequent to construction, impacts on wildlife should be limited to the results of change in habitat within the actual 80-130 foot right of way as it is cleared and maintained by the utility. UPA's right of way managment program, described in Appendix D, will encourage plant species which will provide feed and cover for wildlife. No wildlife habitat areas of special concern are affected by any of the proposed rights of way.

REA has contacted the United States Fish and Wildlife Service (FWS) under Section 7 of the Endangered Species Act of 1973. FWS identified five species that may occur in the study area for which UPA is preparing a biological assessment to determine project effects. REA's finding and a discussion of consultation with FWS, if required, will be included in the final environmental impact statement.

E. Recreational Lands

All of the RCL rights of way will have a minimal impact on recreational lands. No physical disruption will occur and visual impact should be minimal.

F. Recreational Waters

No lakes are crossed by any of the RCL rights of way. The number of stream and river crossings are approximately equal for the various possible routes. All proposed routes cross the Rum River in areas designated as scenic or re-

creational and the actual impact would depend on the specific crossing point selected. Line design and construction practices should emphasize protection of this resource.

G. Historic Preservation

No recognized historical sites or known archaeological sites will be affected by any of the RCL rights of way examined in this analysis. However, at this time REA cannot make a finding of no effect to any historical or archaeological sites that may be within any of these alternative routes. REA will consult with the Minnesota State Historical Preservation Officer in applying the criteria of effect to the route which is designated by the MEQB.

H. Reliability, Cost and Accessibility

Potential reliability problems could arise if the 69 kV line from Princeton to Milaca were paralleled or double circuited along Route D. No other serious reliability problems are anticipated by UPA on any other proposed routes. Depending on the route designated and tower structures selected, the cost of the project could range from approximately $3,400,000 to $8,300,000. This cost range, however, does not include the expenditures related to ROW acquisition. None of the proposed routes should be affected by problems of accessibility.

I. Utilization of Existing Rights of Way

All of the RCL rights of way either parallel, or share existing rights of way for at least 50% of their lengths. Existing rights of way utilized include transmission lines, roads and railroads. See Figures 2.15 and 2.19.

J. Utilization of Survey, Natural Division and Field Boundaries

Where the proposed rights of way represented by the RCLs do not parallel existing rights of way, an attempt has been made to straddle survey and other natural division lines and field boundaries to the greatest extent possible.

K. Potential For Expansion

There is a potential for double circuiting the proposed transmission line with the existing 230 kV line north of the Benton County substation for varying distances depending on the route selected. In addition, it would be possible to install structures capable of expansion in Segment 10-11 to accommodate the possible future extension of the 230 kV system to Rush City, Minnesota.

I. Alternative Structures and Technologies

The type of pole structure selected could have an effect on the magnitude of environmental impacts, including those on agriculture, human settlements, and visual and aesthetic considerations. A comparison of structure types appear in Section 3.2.1 in Chapter 3.

Underground transmission has been considered for this project but does not appear to be economically feasible. In addition, undergrounding could cause heavy environmental impacts with respect to construction, maintenance operations, and the possible effect on soil productivity in the vicinity of buried cables.

1.4 Alternatives

Alternatives to the proposed project, as discussed in Chapter 9, include alternative routes systems and a "no-build" option. Alternative routes and route segments were proposed by the Citizens Route Evaluation Committee and the MEQB Power Plant Siting staff. As discussed in Chapter 9, the "no-build" alternative is not an option available to the MEQB, whose jurisdiction is limited by state statutes to designation of a route and issuance of a construction permit on the proposed routes, or a determination that none of the proposed routes are acceptable. In case of the latter decision, the MEQB would require other routes to be submitted and evaluated.

The REA, however, does have the option of finding that the line is not justified due to potential adverse impacts.

1.5 Permits

A number of federal, state and local agencies have review or permit-granting authority over the routing of the proposed transmission line. It is important to route the line so that responsibilities of all involved agencies are fulfilled. The application for routing the line over various lands and waters must be coordinated in order to minimize conflicts between different regulatory agencies.

The proposed project is regulated to varying degrees by federal, state and local agencies. On a federal level, the U.S. Army Corps of Engineers requires permits for placing fill in wetlands (Section 404 of the Federal Water Pollution Control Act 1974) and for crossing navigable waters (Section 10 of the River and Harbor Act 1899). A number of wetlands exist in the study area, but they should not be adversely affected by the transmission line. Considerable care should be taken during construction of access roads, if required, and structure placement to prevent any change in the drainage systems. Approval of the final

environmental impact statement will be required by Federal agencies which have review and permit-granting authority over this project.

In addition to the construction permit required by the MEQB, several other state permits must be obtained for crossing state waters and highways. Permits for crossing state lands and waters are required by the Minnesota Statute 84.415 as amended by the laws of Minnesota 1973, Chapter 479, and implemented by Chapter 51 of the rules and regulations of the Department of Natural Resources. Water crossing permits are subject to review by the Minnesota Pollution Control Agency. The permits rarely conflict with the MEQB Construction Permit. Instead, they deal more closely with the migration of impacts for each specific crossing.

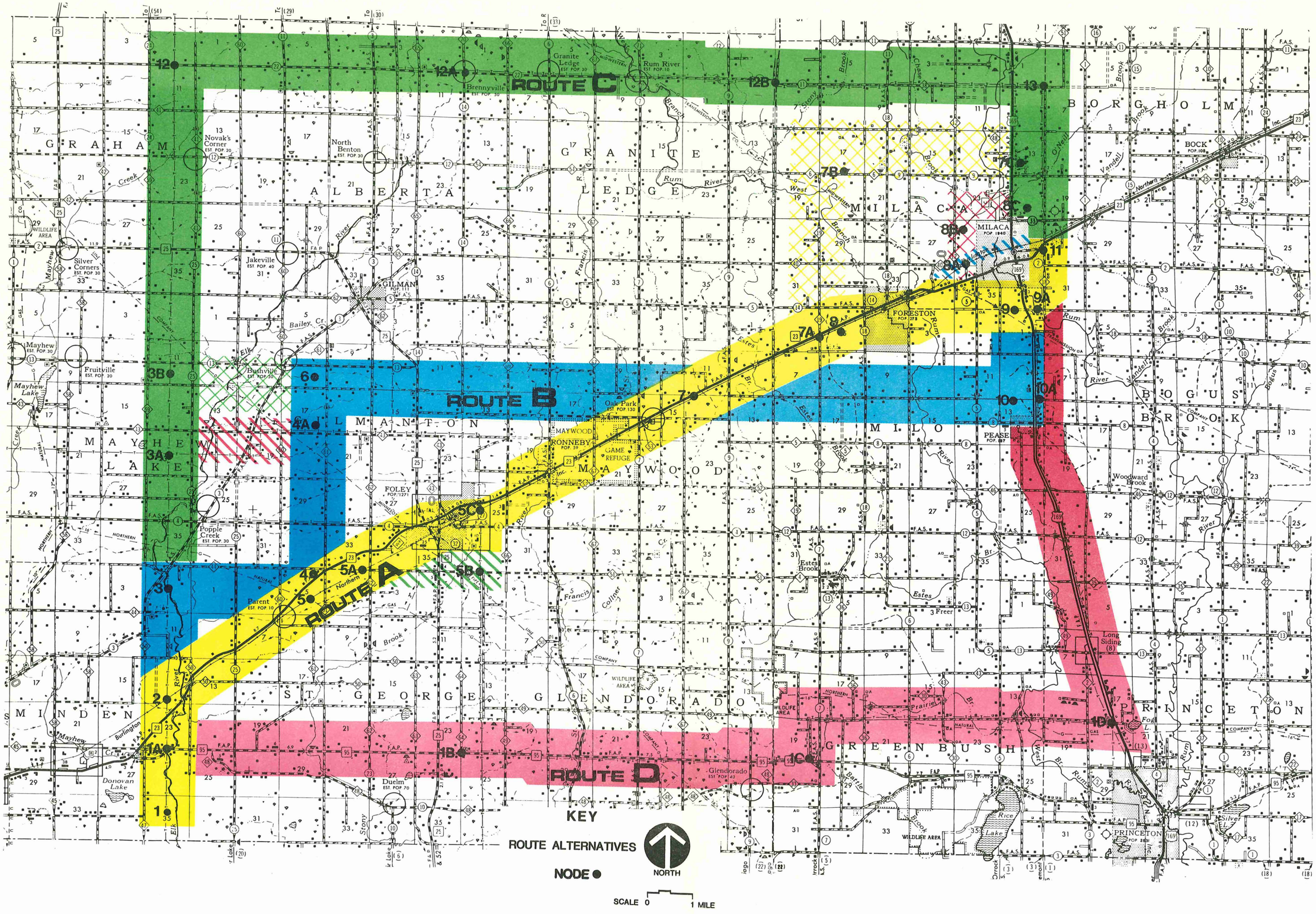
Minnesota Department of Transportation utility permits will be required for each crossing of Trunk Highways 23, 25, 95 and 169, pursuant to Chapter 500, Article II, Section 45 of the Laws of Minnesota.

Although counties have no legal authority governing the routing of transmission lines, an effort has been made in planning this project to conform with county development patterns and regulations. Crossing of any county land will be coordinated between UPA and the appropriate officials in Benton and Mille Lacs Counties.

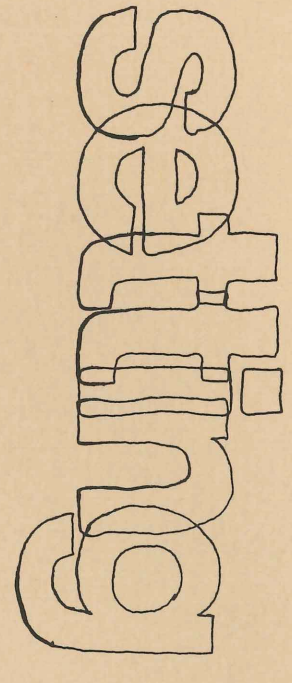
In addition to these permits, the transmission line must not adversely affect airports or related facilities. Both the Minnesota Department of Transportation and the Federal Aviation Administration may review the route for possible conflicts with required airspace or hazards to aircraft around airports.

1.6 Contact with Agencies, Organizations and Individuals

Considerable effort was made to contact agencies, organizations and individuals, both public and private, to explain the project and to obtain information and comments on the various routing propsoals for this report. Appendix A includes a list of these contacts.


ROUTE C
ROUTE B
ROUTE A
ROUTE D
Granite Ledge EST. POP 30
Rum River EST. POP. 10
Brennyville EST. POP. 30
Novak's Corner EST. POP. 20
North Benton EST. POP. 30
Silver Corners EST. POP. 30
Jakeville EST. POP. 40
GILMAN POP. 111
Mayhew EST. POP. 30
Fruitville EST. POP. 20
Bushville EST. POP. 30
Mayhew Lake
Oak Park EST. POP. 130
MAYWOOD
RONNEBY POP. 59
GAME REFUGE
FOLEY POP. 1271
Popple Creek EST. POP. 30
Parent EST. POP. 10
Donovan Lake
Duelm EST. POP. 70
Glendorado EST. POP. 40
MILACA POP. 1940
FORESTON POP. 375
PEASE POP. 887
BOCK POP. 100
Woodward Brook
Long Siding (8)
PRINCETON POP. 2801
Rice Lake
WILDLIFE AREA
GRAHAM LAKE
ALBERTA
GRANITE LEDGE
MILACA
BORGHOLM
MAYHEW LAKE
MANTON
MAYWOOD
MILO
BOGUS BROOK
MINDEN
ST GEORGE
GLENDORADO
GREENBUSH
PRINCETON
KEY
ROUTE ALTERNATIVES
NODE
NORTH
SCALE 0 1 MILE

REGIONAL SETTING



CHAPTER 2

The Regional Setting

2.1 The General Study Area

The proposed high voltage transmission line project crosses two rural, agricultural counties in east central Minnesota. This power line would connect the Benton County Substation northeast of the St. Cloud municipal airport with the Milaca Substation on the eastern side of the City of Milaca.

The possible routes for this 230 kV transmission line extend through most of Benton County and southeastern Mille Lacs County. The exact area affected will depend upon the final route chosen. Consequently, the general study area includes, roughly, an area bounded by the Benton County Substation in the southwest, by Princeton in the southeast, by the intersection of Highway 169 with County Road 11 in the northeast and by the intersection of Highway 25 with the Morrison County line. See Figures 2-1 and 2-2 for details.

This chapter provides a basic regional overview of the study area in order to aid those readers not already familiar with the area to evaluate the information found elsewhere in this report. The reader is referred to the appropriate documents published for example, by the State of Minnesota, the East Central Regional Development Commission, and the Central Minnesota Development Commission for specific detailed information about life in Benton and Mille Lacs Counties.

For data gathering purposes, 15 townships are included within the study area. Some of them, however, are on the fringe of the study area and are unlikely to be affected significantly, if at all, by this project. The study area consists of the following townships:

	Township	Range
Benton County:		
Graham	38	30
Mayhew Lake	37	30
Minden	36	30
Alberta	38	29
Gilmanton	37	29
St. George	36	29
Maywood	37	28
Glendorado	38	28

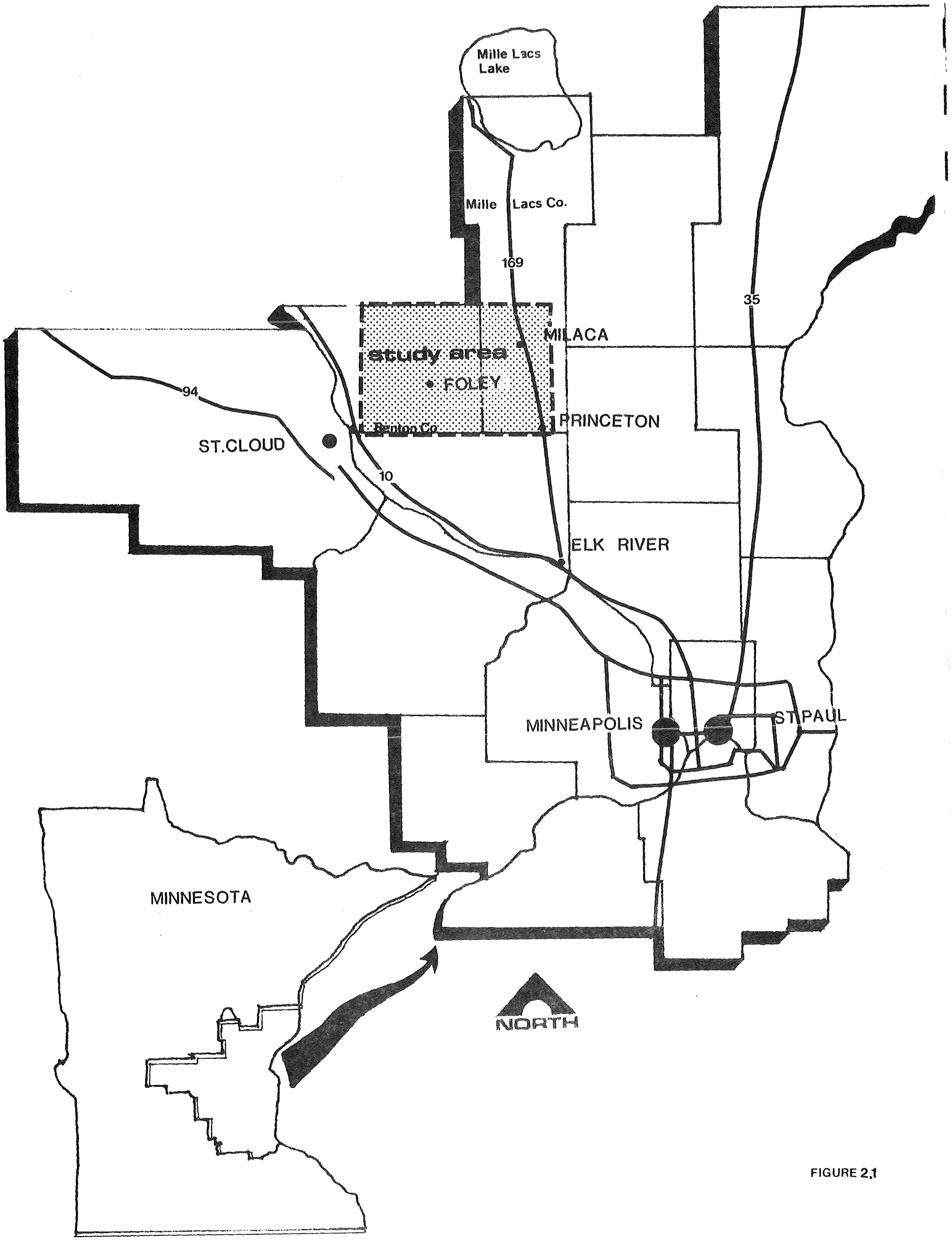
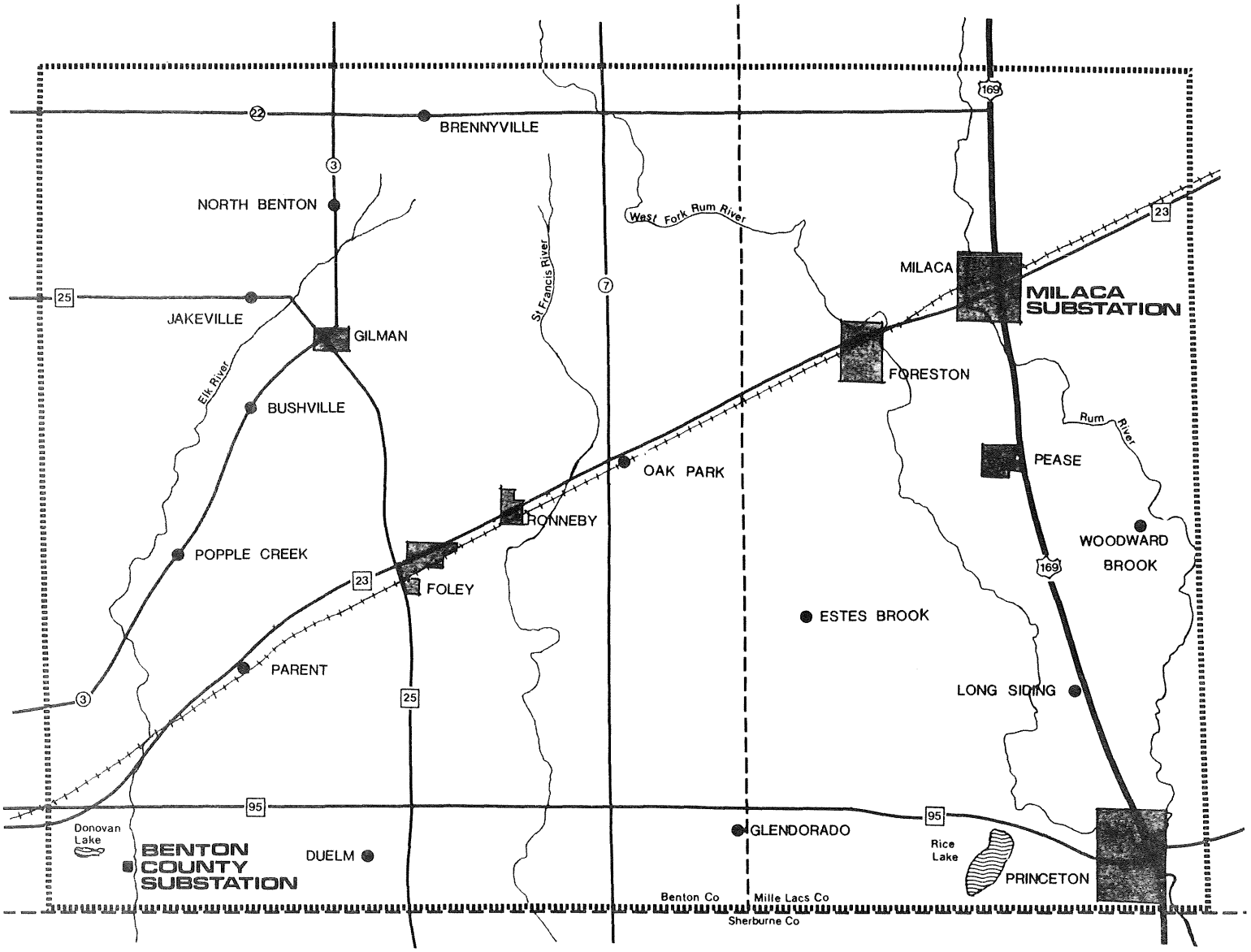

Mille Lacs
Lake
Mille Lacs Co.
169
35
study area
FOLEY
MILACA
PRINCETON
94
ST.CLOUD
Benton Co.
10
ELK RIVER
MINNEAPOLIS
ST.PAUL
MINNESOTA
NORTH

FIGURE 2.1



STUDY AREA

NORTH

Miles

0 1/2 1 2 4

0 1.6 3.2 6.4

Kilometers

FIGURE 2.2

	Township	Range
Mille Lacs County:		
Milaca	38	27
Milo	37	27
Greenbush	36	27
Borgholm	38	26
Bogus Brook	37	26
Princeton	36	26

2.2 Climate

Minnesota has a continental climate characterized by warm, humid summers and cold winters. Continental polar air masses flow into the region throughout the year and prolonged periods of extreme cold occur during the winter when Arctic air intrudes into the state. Conversely, prolonged periods of high temperatures are caused by warm air masses moving northward from the Gulf of Mexico and southeastern United States. Mild dry Pacific Ocean air masses moving eastward across the continent serve to moderate the state's climate throughout the year. The interaction between cold dry air from the north and warm moist air from the south causes marked daily weather changes. The climate within the study area is typical for central Minnesota.

Comprehensive meterological data are available for Whitney Memorial Airport, located at St. Cloud, adjacent to the southwestern corner of the study area. In addition, precipitation and temperature data are recorded at the Milaca Municipal Airport.

The average temperature for December, January, and February at St. Cloud is 13.3 degrees F. with January being the coldest winter month. Extreme low temperatures during this period between -20 and -40 degrees F. are possible. The first measurable snowfall usually occurs in late October and the winter's snowfall remains on the ground until middle or late April. The average temperature for June, July and August is 68.3 degrees F. with July being the warmest month of the year. Extremely hot weather, over 100 degrees F., is possible, but infrequent.

Precipitation is the greatest between May and September. The average annual precipitation at St. Cloud is about 26 inches, 60 percent of which falls during the summer. Precipitation of .01 inches or more can be expected on about 100 days per year. The heaviest rains occur during thunderstorms and may be accompanied by hail and damaging winds. Rainfall intensities of 1.10 inches per hour can be expected about once in two years. However, the average summer storm produces a maximum rainfall of between three to four inches during a 24 hour period. Weather data are summarized in Table 2-1.

TABLE 2-1 - Temperature and precipitation
[All data from Weather Brueau Airport Station, St. Cloud, Minn.]

Month	Temperature				Precipitation				
	Average daily maximum	Average daily minimum	Two years in 10 will have at least 4 days with--		Average total	One year in 10 will have--		Days with snow cover of 1.0 inch or more	Average depth of snow on days with snow cover
			Maximum temperature equal to or higher than--	Minimum temperature equal to or lower than--		Less than--	More than--		
	°F	°F	°F	°F	Inches	Inches	Inches	Number	Inches
January--	21	0	39	-24	0.8	0.2	1.3	28	6
February--	25	3	42	-18	.7	.2	1.6	26	8
March--	37	17	53	- 8	1.2	.4	2.1	22	8
April--	54	32	75	19	2.0	.5	3.6	2	2
May--	67	43	83	31	3.1	1.0	5.7	(1)	0
June--	77	54	91	42	3.9	2.0	8.5	0	0
July--	83	58	96	48	3.1	1.3	5.8	0	0
August--	81	56	93	46	2.9	.8	7.0	0	0
September--	71	47	89	33	3.0	.8	5.0	0	0
October--	59	35	75	22	1.6	.3	3.5	(1)	0
November--	38	20	56	0	1.4	.2	2.3	8	3
December--	25	6	40	-15	.7	.1	1.7	17	5
Year--	53	31	[2]97	[3]-26	24.4	21.0	32.3	103	7

[1] Less than one-half day.
[2] Average annual highest temperature.
[3] Average annual lowest temperature.

SOURCE: Benton County Soil Survey.

United Power Association reports that they have had very little severe storm damage to their transmission lines in the study area. Tornadoes are not common. In 1977 a tornado traveling from St. Cloud to Zimmerman caused minor damage to transmission lines; however, severe damage occurred to local distribution circuits. Other storms have caused temporary outages and pole damage; but the UPA system in this area has been relatively free of ice, wind or tornado damage.

2.3 Geomorphology

The geomorphology of the study area shows the influence of two major geological processes. The first was glacial action and the related deposition of material. The second is stream erosion or downcutting of stream valleys through the glacial drift to the Cambrian and Precambrian igneous and metamorphic rocks that directly underlie the glacial drift at a depth of 50 to 100 feet.

The major geomorphology features of this region are:

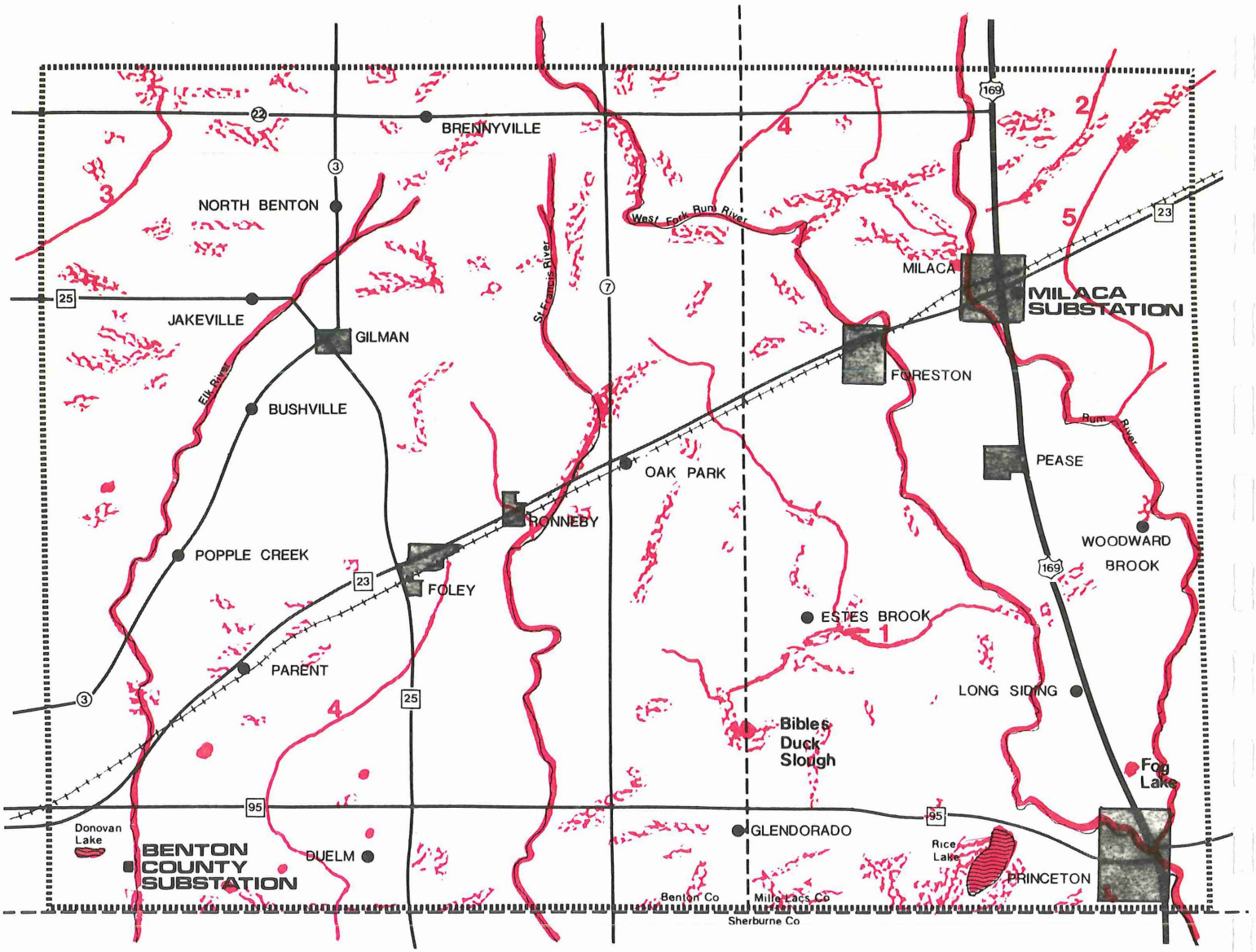
a. Mille Lacs Lake formed along the inner margin of a moraine;

b. The southern edge of the Pierz drumlin field; and

c. The northern edge of the Anoka sand plain which is interspersed with protuding deposits of glacial till.

Most of the study area is covered by undifferentiated glacial drift of Late Wisconsin glacial till and outwash. Gray calcareous till of the Des Moines Lobe covers much of Benton County. Red-brown drift, mostly sandy till, was deposited over the entire Rum River watershed by glacial ice which advanced from the northeast. A later ice advance from the west overrode the southern portion of this watershed, leaving gray, silty till around Princeton. Silt and clay occur along the northern edge of this gray drift, having been deposited in a post-glacial lake that formed when ice blocked southward drainage in the area of Long Siding. Further, drainage around this retreating ice front resulted in the surficial outwash which now covers all but the highest areas of undifferentiated drift in the southern portion of Mille Lacs County. These melt waters randomly deposited large amounts of surficial outwash sand and gravel and formed several valley trains.

In general, the topography of the study area is characterized by long, gentle, uniform slopes associated with glacial ground moraines.



HYDROLOGY

STUDY AREA

WETLANDS

LAKES

1 ESTES BROOK

2 O'NEILL BROOK

3 MAYHEW CREEK

4 STONY BROOK

5 VANDELL BROOK

NORTH

Miles

0 1/2 1 2 4

0 1.6 3.2 6.4

Kilometers

FIGURE 2.3

2.4 Hydrology

Two of Minnesota's major hydrological features, the Mississippi River and Mille Lacs Lake, dominate the region. The principal streams in the study area are, from west to east, the Elk River, the St. Francis River, the West Branch of the Rum River and the Rum River, all of which are tributaries of the Mississippi River. The source of the Rum River is Mille Lacs Lake. The long, low terrain in the area forms few large bodies of surface water. The principal named lakes in the study area are Rice Lake, Fog Lake, Bible's Duck Slough and Donovan Lake. In addition, there are a number of unnamed small lakes. Much of the standing water in the area is contained within the numerous shallow wetlands which are important as waterfowl habitat. See Figure 2-3 for details.

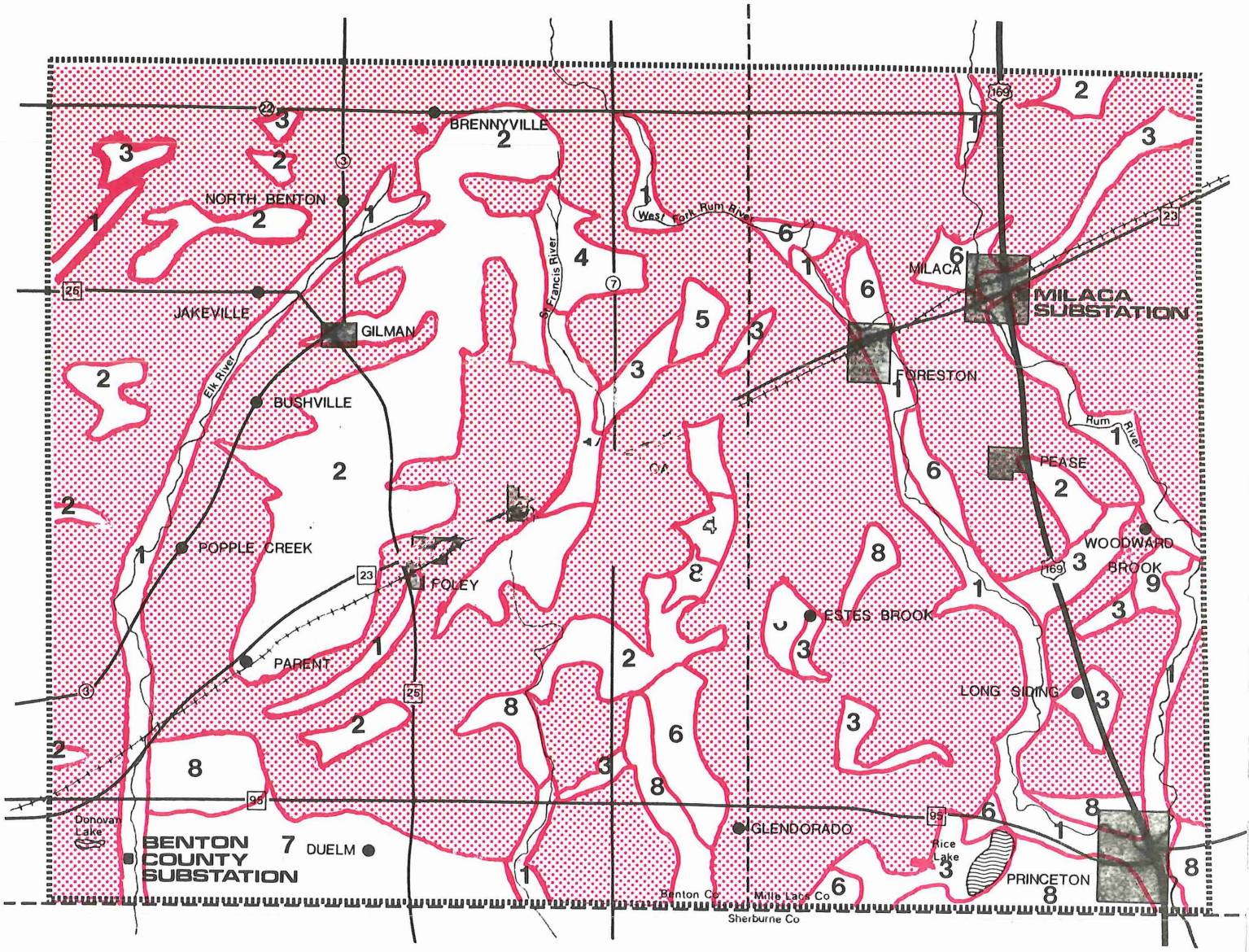
2.5 Soils

Like the overall geomorphic character of the study area, soils are a product of glacial action and related deposition of material and of stream erosion and the deposit of alluvial soils. Soils in this area consist mainly of organic soils in the flood plains and of silty, loamy, or sandy soils in between.

Despite these generalizations, accurate descriptions of soils can be made only at the local level after field inspection. Unfortunately, the three major sources of soil descriptions for this area - the Soil Survey of Benton County, Minnesota (1977), the Soil Survey of Mille Lacs County, Minnesota (1932) and the Minnesota Soil Atlas, "Soil Landscapes and Geomorphic Regions - Stillwater Sheet" (1977) - are not directly comparable. As a result, although the two county surveys provide more detailed information, the Minnesota Soil Atlas is used here because it provides comparable data for the entire study area in sufficient detail for the purpose of this environmental impact assessment.

According to the Minnesota Soil Atlas seven general soil types or soil landscape units are present in the study area:

1. Alluvial soils undifferentiated (A);
2. Organic soils undifferentiated (P);
3. Deep silty or loamy, poorly drained, dark colored soils (LLPD);
4. Deep silty or loamy, well drained, light colored soils (LLWL);
5. Loamy over sandy, poorly drained, dark colored soils (SLPD);



SOILS

- STUDY AREA
- LLWL
- 1 ALLUVIAL
- 2 LLPD
- 3 ORGANIC
- 4 SLPD
- 5 SLPL
- 6 SLWL
- 7 SSWD
- 8 SSWL
- 9 SSPL

NORTH

Miles

1/2 1 2 4

1.6 3.2 6.4

6. Loamy over sandy, well drained light colored soils (SLWL); and

7. Sandy over sandy, well drained, light colored soils (SSWL). The distribution of these soil landscape units in the study area is shown in Figure 2-4.

2.6 Flora and Fauna

2.6.1 Flora

The natural landscape of Benton and Mille Lacs Counties has changed considerably since the beginning of European settlement. In general terms, the natural landscape within the study area was historically part of a transitional zone where northern hardwood forests, mixed oak and grassland, and prairie converged. Today, this landscape is predominantly agricultural. However, substantial natural areas remain along the Rum River, within the three state wildlife management areas, and within 20, 40 and 80 acre parcels of wetlands and woods interspersed amongst cultivated fields. While limited in size, these lands give some tangible evidence of the original character of the natural landscape.

One of the most important tools for the understanding of the distribution of flora and fauna in Minnesota is Francis J. Marschner's map of The Original Vegetation of Minnesota. This map, compiled in 1930 from the field notes taken by the state's original surveyors employed by the United States General Land Office, records the vegetation in the state immediately prior to European settlement.

Marschner identified eight vegetation types within the study area:

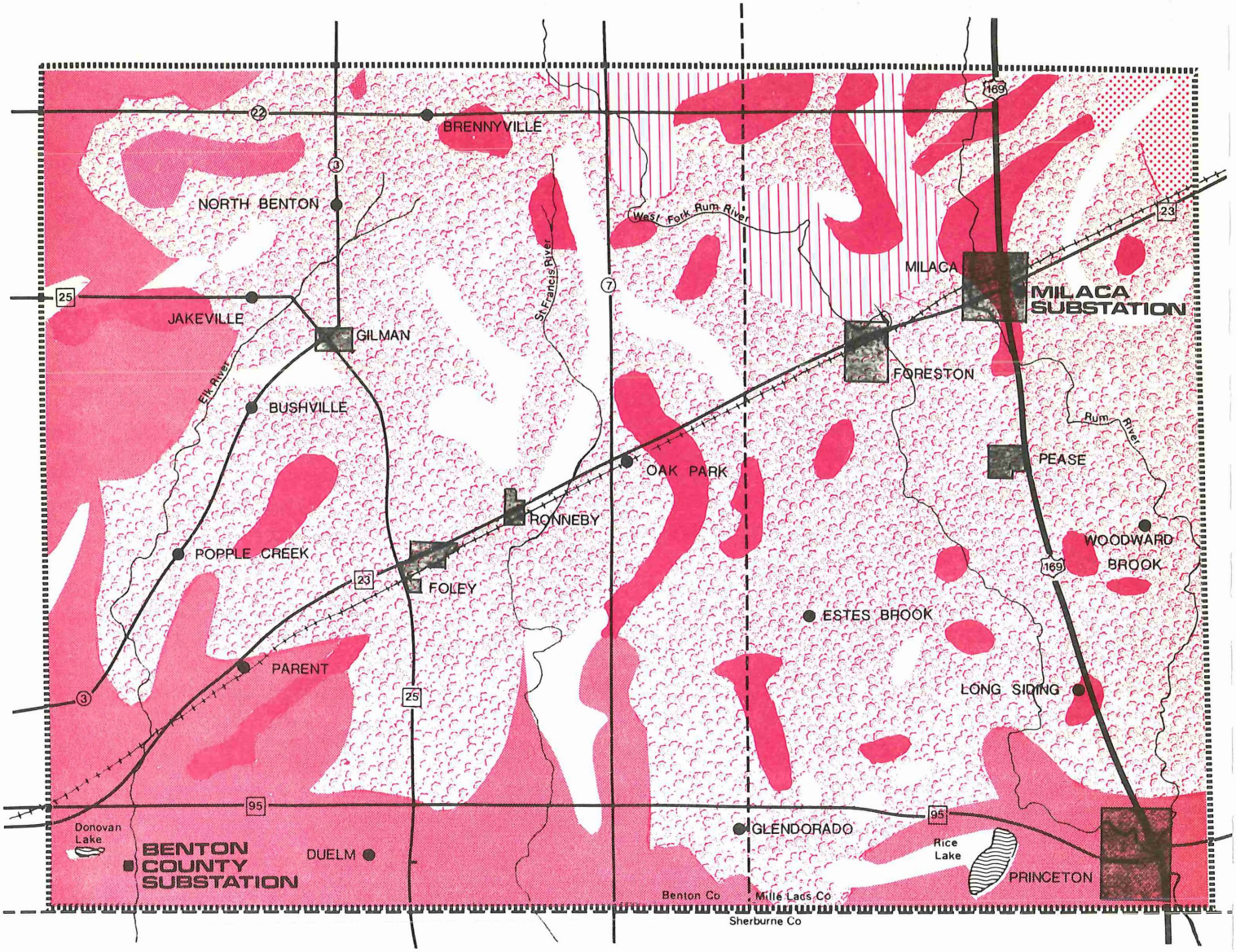
1. wet prairies, marshes and sloughs: marsh-grasses, flags, reeds, rushes with willow and alder brush in places;

2. brush prairie: grass and brush with oak ;

3. oak openings and barrens: scattered trees and groves of oaks of scubby form with some brush and thickets and occasionally pines;

4. mixed hardwood and pine: maple, white pine, basswood, oaks, ash, elm, aspen, birch;

5. aspen-oak land: aspen, generally dense, but small with scattered oak;



MARSHNER'S ORIGINAL VEGETATION OF MINNESOTA

STUDY AREA

BIG WOODS

WET PRAIRIE-BRUSH PRAIRIE

OAK OPENINGS-ASPEN/OAK

MIXED HARDWOOD/PINE

ASPEN/BIRCH

BOG/SWAMP

NORTH

Miles

0 1/2 1 2 4

0 1.6 3.2 6.4

Kilometers

FIGURE 2.5

6. big woods: oaks, elm, basswood, maple, aspen, birch;

7. aspen-birch (conifer): in transition to conifer forests, includes white and Norway pines, birch, balsam, fir, spruce; and

8. conifer bogs and swamps: spruce, tamaracks, cedar and balsam.

Please see figure 2-5 for details.

While Marschner's map is reasonably accurate for its scale and for the time of the original field observation, his vegetation categories may differ somewhat from those used presently. In general terms, the natural vegetation of the study area today consists of a sugar maple and basswood or northern hardwood complex throughout the eastern three-quarters of the area with some pine forest in the extreme northeastern corner of the project area and mixed oak and prairie in the western portion of Benton County. Please see Appendix A for a species list of flora.

2.6.2 Fauna

Wildlife populations are sensitive to changes in their natural habitats. Consequently, the changes in the natural landscape discussed in the previous section have had significant impacts upon both the number and distribution of fauna in the study area. Accordingly, many species have suffered, and some have benefited, from these changes in natural vegetation and the concomitant conversion of the land for agricultural purposes since the beginning of European settlement. For example, the black bear is no longer found in the area and the population of white-tailed deer has been greatly reduced. At the same time, other mammal species, such as squirrels and beaver, have been able to maintain themselves in new habitats on the area's farms, in scattered natural areas, along the rivers, within the wetlands and in the woods interspersed amongst the cultivated fields. Wildlife management practices have benefited migratory waterfowl in particular since they are favored for their recreational value. In addition, the Elk, St. Francis, and Rum Rivers contain a variety of fish species. A general species list for the fauna in the study area is found in Appendix A.

2.6.3 Endangered and Threatened Species

The United States Fish and Wildlife Service reports that based upon information currently available, the following threatened, endangered, or proposed species may be found within the project area:

American Peregrine Falcon, Falco peregrinus anatum,

Arctic Pereguine Falcon, Falco peregrinus tundrius,

Bald Eagle, Heliaeetus laucocephalus,

Dakota Skipper, Hesperia dacotae,

Pennsylvania Smartweed, Polygonum pennsylvanicum.

In accordance with the requirements of the Endangered Species Act of 1973, UPA commissioned a biological assessment to inventory biological populations and habitats in the study area in order to determine whether any of the above mentioned endangered species are likely to be affected adversely by the proposed 230 kV transmission line. Professor Wayland L. Ezell, Professor and Chairperson of the Department of Biological Sciences, St. Cloud State University reported to UPA that none of the five species were residents of the study area. Based on data obtained from state ornithologists, entomologists and plant taxonomists, from museum and herbarium records, from scientific literature, and from a brief field reconnaissance of the proposed route, Ezell concluded that the above-stated threatened, endangered or proposed five species are not found within the project area. Details on the distribution of these five species in Benton and Mille Lacs counties and the proposed route are as follows:

> "The American Peregrine Falcon, Artic Peregrine Falcon and Bald Eagle do not nest in or adjacent to the proposed route. Their only association with the area would involve possible sightings during their migration.
>
> The Dakota Skipper has not been reported from the two-county region. It is associated with the Purple Coneflower (Echinacea angustifolia) which inhabits dry, alkaline prairies on soil of gray drift glacial origin. This soil does not occur in the region of the proposed route which possesses soil of red drift glacial origin. Based on University of Minnesota, St. Paul, herbarium records, Echinacea angustifolia does not occur in the two-county region.
>
> The Pennsylvania Smartweed has not been collected in the two-county region based on herbarium records at the University of Minnesota, St. Paul. The list of endangered and threatened plant species published by the Department of the Interior, Fish and Wildlife Service (Federal Register, Vol. 41, No. 117--Wednesday, June 16, 1976) includes Polygonum pennsylvanicum var. eglandulosum with Ohio as its known range. There are no herbarium data to suggest that this variety occurs in

Minnesota. The variety common to Minnesota is Polygonum pennsylvanicum var. laevignatum, and this variety has not been reported from the two-county region."

In accordance with Section 7(c) of the Endangered Species Act, the United States Fish and Wildlife Service, the Rural Electrification Administration, United Power Association, and the Minnesota Environmental Quality Board will enter into a formal consultation process in order to review Professor Ez ıl's findings. The results of this review will be reported in the final draft of this environmental impact statement.

2.7 Population

2.7.1 Distribution

The study area has a predominantly rural agricultural character, with most of the population scattered throughout the rural townships. The rural population is growing steadily while the population in the local towns is remaining constant or dropping slightly. In Benton County, population growth is being absorbed west of the study area in and around Sauk Rapids and in the eastern portion of St. Cloud's rural-urban fringe.

In 1976 the estimated population of the study area was 21,058. This represents about 40.5% of the total Benton County population and about 65.7% of the total Mille Lacs County population. The 1976 population density was approximately 28 persons per square mile in the Benton County portion of the study area and 55 persons per square mile in southern Mille Lacs County. Larger settlements in the region are Foley, Milaca and Princeton with 1976 populations of 1,119, 1,992, and 2,710 respectively. Table 2-2 summarizes population data for the study area.

2.7.2 Population Change

Table 2-3 shows the components of population change for Benton and Mille Lacs Counties for the period between 1970 and 1977. In general, the population within the study area is growing at a modest rate. Population projections (to the year 2000) for Benton and Mille Lacs Counties in their entirety have been made by the Minnesota Office of State Demographer. These figures appear in Table 2-4.

Unofficial local estimates, however, predict a more rapid rate of growth than indicated by the State Demographer. For example, the East Central Regional Development Commission predicts a population of 27,783 in 2000 for Mille Lacs County. This is 21.3 percent greater than the State Demographer's estimate. Since United States Bureau of Census population estimates for 1976 exceed those projected for 1980 by the State Demographer, it is possible that local projections may not be exaggerated.

TABLE 2-2
POPULATION 1970-1976

AREA	POPULATION		CHANGE 1970 to 1976	
	July 1, 76	April 1, 70	Number	Percent
Minnesota	3,970,576	3,806,103	164,473	4.3
Benton County	22,464	20,841	1,623	7.8
Foley	1,119	1,271	-152	-12.0
Gilman	93	111	-18	-16.2
Ronneby	48	59	-11	-18.6
Alberta Twp.	851	805	46	5.7
Gilmanton Twp.	848	867	-19	-2.2
Glendorado Twp.	744	726	18	2.5
Graham Twp.	746	543	203	37.4
Granite Ledge Twp.	525	609	-84	-13.8
Mayhew Lake Twp.	735	715	20	2.8
Maywood Twp.	956	855	101	11.8
Minden Twp.	1,442	1,307	135	10.3
St. George Twp.	996	888	108	12.2
Mille Lacs Co.	18,190	15,703	2,487	15.8
Foreston	272	273	-1	-0.4
Milaca	1,992	1,940	52	2.7
Pease	126	187	-61	-32.6
Princeton	2,710	2,531	179	7.1
Bogus Brook Twp.	960	761	199	26.1
Borgholm Township	1,023	856	167	19.5
Greenbush Twp.	1,068	794	274	34.5
Milaca Twp.	994	813	181	22.3
Milo Twp.	1,107	920	187	20.3
Princeton Twp.	1,703	1,294	409	31.6

SOURCE: U.S. Bureau of Census, Population Estimates and Projections, Current Population Reports Series P-25, No. 762, Jan. 1979, page 7, 9 and 26.

TABLE 2-3
COMPONENTS OF POPULATION CHANGE, 1970-1977

	Change		Natural Increase			Net Migration	
	Number	%	Births	Deaths	%	Number	%
Minnesota	169,000	4.4	421,000	243,000	4.7	-9,000	-0.2
Benton Co.	2,200	10.4	3,200	1,300	9.2	200	1.1
Mille Lacs Co.	2,700	17.5	1,700	1,400	2.1	2,400	15.4

SOURCE: Table 2, Components of Population Change 1970-1977. Population Estimates for Minnesota Counties 1977, Office of State Demographer, July 1978.

TABLE 2.4
POPULATION PROJECTIONS 1980-2000

	1970 (Census)	1976 (Census list)	1980	1985	1990	1995	2000
Minnesota	3,806,100	3,970,576	4,076,800	4,252,200	4,421,500	4,555,700	4,652,800
Benton Co.	20,800	22,464	23,400	25,200	27,000	28,600	29,700
Mille Lacs Co.	15,700	18,190	17,700	18,800	19,900	21,300	22,900

SOURCE: Table 1, Population Projections By County In Minnesota 1980-2000, Minnesota Population Projections 1970-2000, Office of State Demographer, St. Paul, 1975 and U.S. Bureau of Census, Population Estimates and Projections, Current Population Reports Series P-25, No. 762, Jan. 1979, pages 7, 9, and 26.

2.8 Human Settlements

The study area has a traditional agricultural settlement pattern with no large cities. The majority of its residents live dispersed throughout the rural townships. The balance of the area's population resides in small hamlets or in the cities of Foley, Milaca or Princeton, the three principal regional service centers for the area.

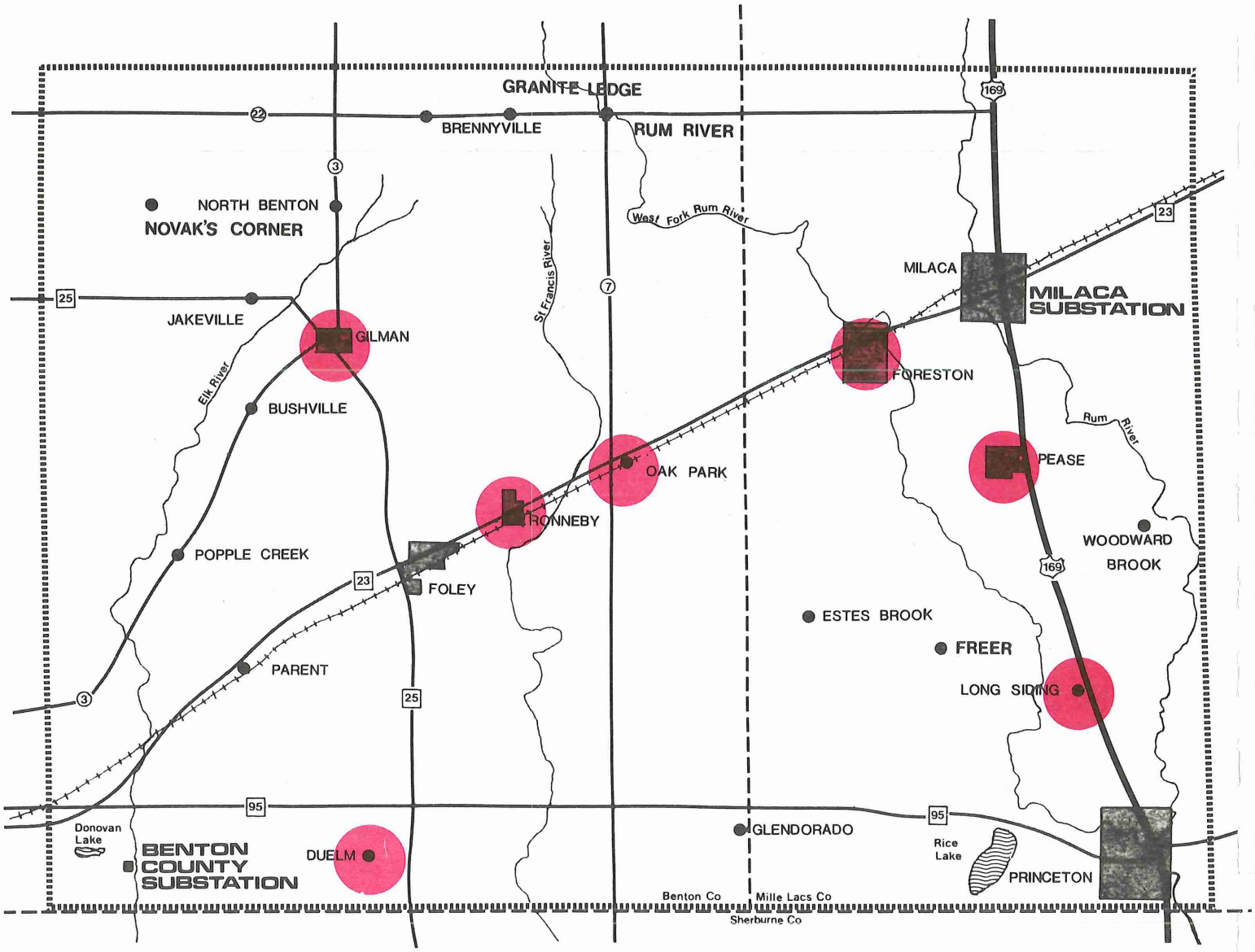
However, a second settlement pattern is interwoven with this basic agricultural one that reflects recent changes in rural society. The economy of the study area is becoming more diversified with non-agricultural activities assuming a larger role in the local economy. Consequently, the rural, non-agricultural population is growing rapidly, especially in the southwestern portion of the study area.

Four human settlement types exist in the study area: rural residences, isolated features, rural junctions, and towns. In addition, the town of Sauk Rapids and the City of St. Cloud are adjacent to the western boundary of the project area. The St. Paul-Minneapolis metropolitan area with its more specialized, higher order economic and cultural activities is within easy travelling distance. Please see Figure 2-6.

The majority of the people likely to be affected by the proposed transmission line are dispersed throughout the countryside and live along county roads and section lines, on farmsteads and in non-farm single family dwellings. Some isolated features are found associated with these dispersed, rural communities such as community halls, churches, cemetaries, schools and private landing strips.

Organized activities are not immediately apparent except at rural junctions where a few houses, a store or a school clustered together provide low order commercial services and foci for the rural community activities. Sixteen rural junctions are within the study area: Brennyville (estimated 1976 population of 50), Granite Ledge (30), Rum River (10), Novak's Corner (20), North Benton (30), Silver Corners (30), Jakeville (40), Mayhew (30), Fruitville(20), Burshville (30), Popple Creek (30), Parent (10), Glendorado (40), Estes Brook (40), Freer (20), and Woodward Brook (20). These localities have more importance as centers of rural social activities and as foci for rural identity than as economic service centers.

More extensive and complex socio-economic functions are found in a few larger rural settlements that serve large populations and hinterlands with a variety of low order wholesaling and retailing services in addition to providing homes for 50 to 100 persons. These hamlets: Ronneby (48), Oak Park (130), Foreston



HUMAN SETTLEMENTS

STUDY AREA

TOWN

HAMLET

RURAL JUNCTION

NORTH

Miles
0 1/2 1 2 4
0 1.6 3.2 6.4
Kilometers

FIGURE 2.6

(272), Pease (126), Gilman (93), Duelm (70) and Long Siding (30) are the smallest organized human settlements in the study area.

The major settlements in the study area are Foley (1,119), Milaca (1,992) and Princeton (2,710). These settlements provide the principal county and regional governmental services, are the site of most wholesaling, retailing, and light industry and are major locations for residences and social activities.

2.9 Government

2.9.1 Governmental Jurisdiction

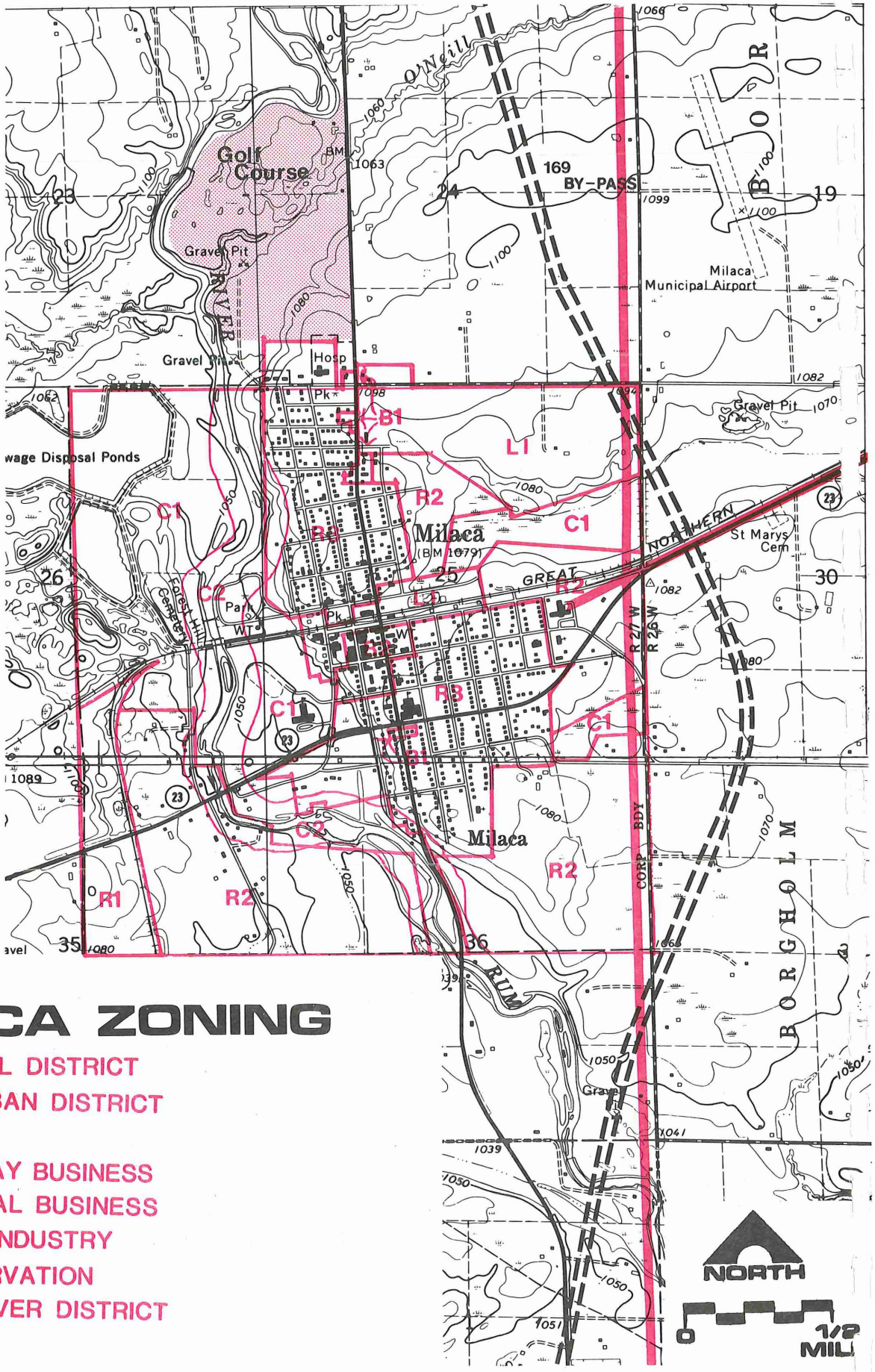
The study area encompasses portions of Benton and Mille Lacs Counties. Benton County is part of the Central Minnesota Regional Development Commission headquartered in St. Cloud. Mille Lacs County is a member of the East Central Regional Development Commission headquartered in Mora.

The settlements of Gilman, Foley, Foreston, Milaca, Princeton and Ronneby are incorporated municipalities. The following townships are organized: Alberta, Gilmanton, Glendorado, Graham, Granite Ledge, Maywood, Mayhew, Lake, Minden and St. George in Benton County and Bogus Creek, Borgholm, Greenbush, Milaca, Milo, and Princeton in Mille Lacs County. No other local jurisdiction has a direct role in transmission line routing process.

2.9.2 Urban Zoning

Amongst the incorporated municipalities within the study area, only the City of Milaca has a municipal zoning ordinance. The City of Foley is in the process of developing one.

Within Milaca, proposed transmission line routes pass through five municipal zones. R-1 is a special residential district on the western edge of the city consisting largely of agricultural land not likely to be served by central water and sewage facilities. R-2 includes areas in the process of suburban residential development where water and sewer facilities are presently available or where the installation of such facilities is feasible. C-1 is a conservation district limited to agriculture and certain other open land uses. C-2, the Rum River district, consists of the Rum River and its adjacent lands within 300 feet of the ordinary high watermark of the river or the landward extent of the flood plain, all of which are regulated by the provisions of the Minnesota Wild and Scenic Rivers Act. I-1 is a light industrial area along the Burlington Northern Railroad tracks in the center of the city. Please see Figure 2-7.



MILACA ZONING

- R1 SPECIAL DISTRICT
- R2 SUBURBAN DISTRICT
- R3 URBAN
- B1 HIGHWAY BUSINESS
- B2 GENERAL BUSINESS
- L1 LIGHT INDUSTRY
- C1 CONSERVATION
- C2 RUM RIVER DISTRICT

FIGURE 2.7

Of particular interest is the Milaca Municipal Airport zoning ordinance established by the Milaca Municipal Joint Airport Zoning Board. The implications of this ordinance are discussed in section 2.12.3.

2.9.3 Rural Zoning

Both Benton and Mille Lacs Counties have rural zoning ordinances that regulate land use. They differ slightly in detail, for instance, Mille Lacs County uses 14 zoning categories and Benton County uses 9. Nevertheless, these ordinances address the same planning issues and are essentially the same in intent and content.

The most important rural zoning categories are agricultural preservation (A-1), agricultural district (A-2), rural residential (R-1) and rural residential (R-2). (Mille Lacs County categories and definitions are used here for illustrative purposes.) Almost all rural land in the study area is zoned either A-1 or A-2. See Figure 2-8 for details.

A-1 zones are established for the purpose of preserving, promoting, maintaining and enhancing the use of the land for agricultural purposes. The minimum lot size is one acre, but the maximum density is one non-farm dwelling per 40 acres. In other words, the land owner can sell only one non-farm dwelling lot per 40 acres of land. The only exception to the density restriction is for non-tillable land, where the minimum lot size remains one acre but without density restrictions. In addition, these restrictions are not applicable to farm dwellings.

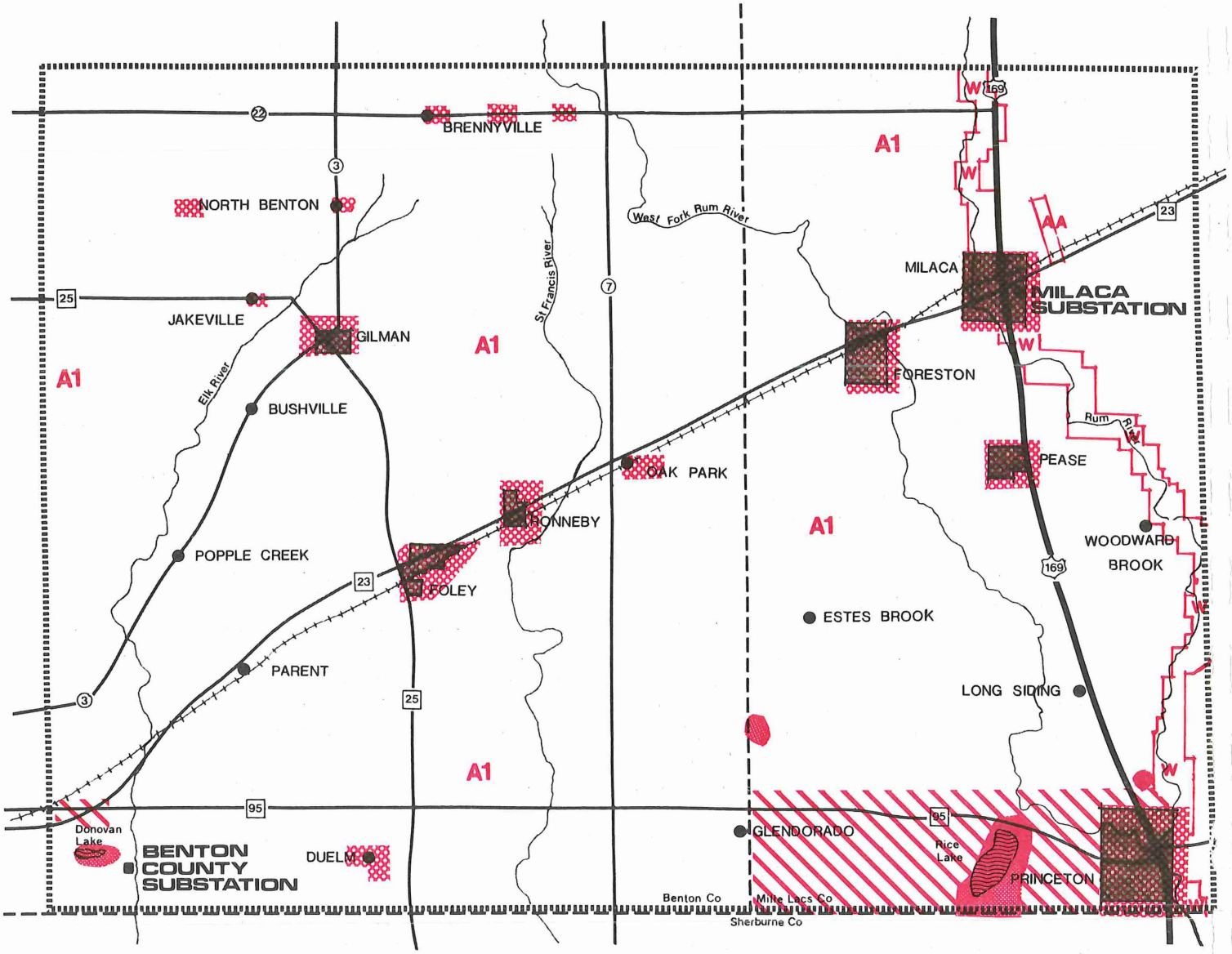
A-2 zones are similar in every respect to the A-1; but the minimum lot size is five acres.

Rural residential zones designate areas that are not prime agricultural lands but are suitable for rural housing and for recreational purposes. The minimum lot size within a R-1 zone is one acre. R-2 districts have minimum lot sizes of two acres.

2.9.4 Flood Plain Zoning

Both Benton and Mille Lacs Counties have flood plain zoning provisions within their county zoning ordinances. In general, these regulations require permits for land use within the flood plain, and restrict construction to areas above the regulatory flood protection elevation; i.e., the probable high watermark.

Flood plains within Benton and Mille Lacs Counties have been delineated in unincorporated areas by flood hazard boundary maps published by the Federal Insurance Administration, United States Department of Housing and Urban Development; i.e. maps



RURAL ZONING

- STUDY AREA
- URBAN
- RESIDENTIAL
- SHORELAND
- W — WILD AND SCENIC RIVER
- AA — AIRPORT APPROACH
- ALL ELSE AGRICULTURAL PRESERVATION

NORTH

Miles
0 1/2 1 2 4
0 1.6 3.2 6.4
Kilometers

FIGURE 2.8

270019 0001-0005, October 21, 1977 for Benton County and 270624 0001-0009, February 2, 1979 for Mille Lacs County. While some wetlands such as Rice Lake are included within flood plain zones, the majority of these areas exist in narrow bands along the major water courses within the study area. Flood plain zones which represent the area likely to be inundated by a 100 year flood, are shown on the route segment maps used in Chapter 5.

2.10 Land Use

Agriculture is the dominant land use within the study area. In addition, substantial, albeit scattered, portions of the study area remain in forests and wetlands. This section surveys the general land use pattern of the area and examines two important indicators of agricultural potential, soil productivity and irrigation, in detail. Together, land use, soil productivity and irrigation portray the general character of the landscape and its present use.

The data used here are derived from Soil Conservation Service studies and from the Minnesota Land Management Information System (MLMIS). The MLMIS data base has been developed over several years and is now operational statewide. Thirteen different items of information or variables are recorded for each of the 1.4 million, 40 acre parcels in the state, which serve as the basic spatial units for the system. Although there are variations within each particular 40 acre parcel, only one general description is designated for each individual parcel. In addition, each of the variables has a number of data levels. For example, nine land use types and 50 different public ownership types are itemized. These thirteen variables include locational, cultural, and physical data. Additional types of data are available for some portions of the state. All these data are available in tabular form and can be represented on computer maps.

2.10.1 General Land Use

The MLMIS land use data are used here to inventory general land use within the study area. The MLMIS has designated one of nine categories of land use for each 40 acre parcel in the state. These designations represent the dominant land use for each parcel based upon aerial photographic interpretation and some field observation. The nine categories used are as follows:

1. forested - where there is at least a 10% crown of decidious or coniferous trees.

2. cultivated - where the area consists predominantly of recently tilled or harvested land;

3. water - where permanent open water is the dominant surface feature;

4. marsh - where the dominant land use is non-forested, vegetated wetlands;

5. urban residential - where the forty acre parcel contains five or more residential buildings and no commercial buildings;

6. extractive - where the dominant activity is the extraction of minerals;

7. pasture and open - where the land is used for pasture or has no other identifiable purpose;

8. urban and non-residential or mixed residential - where a forty acre parcel includes at least one commercial, industrial or institutional development;

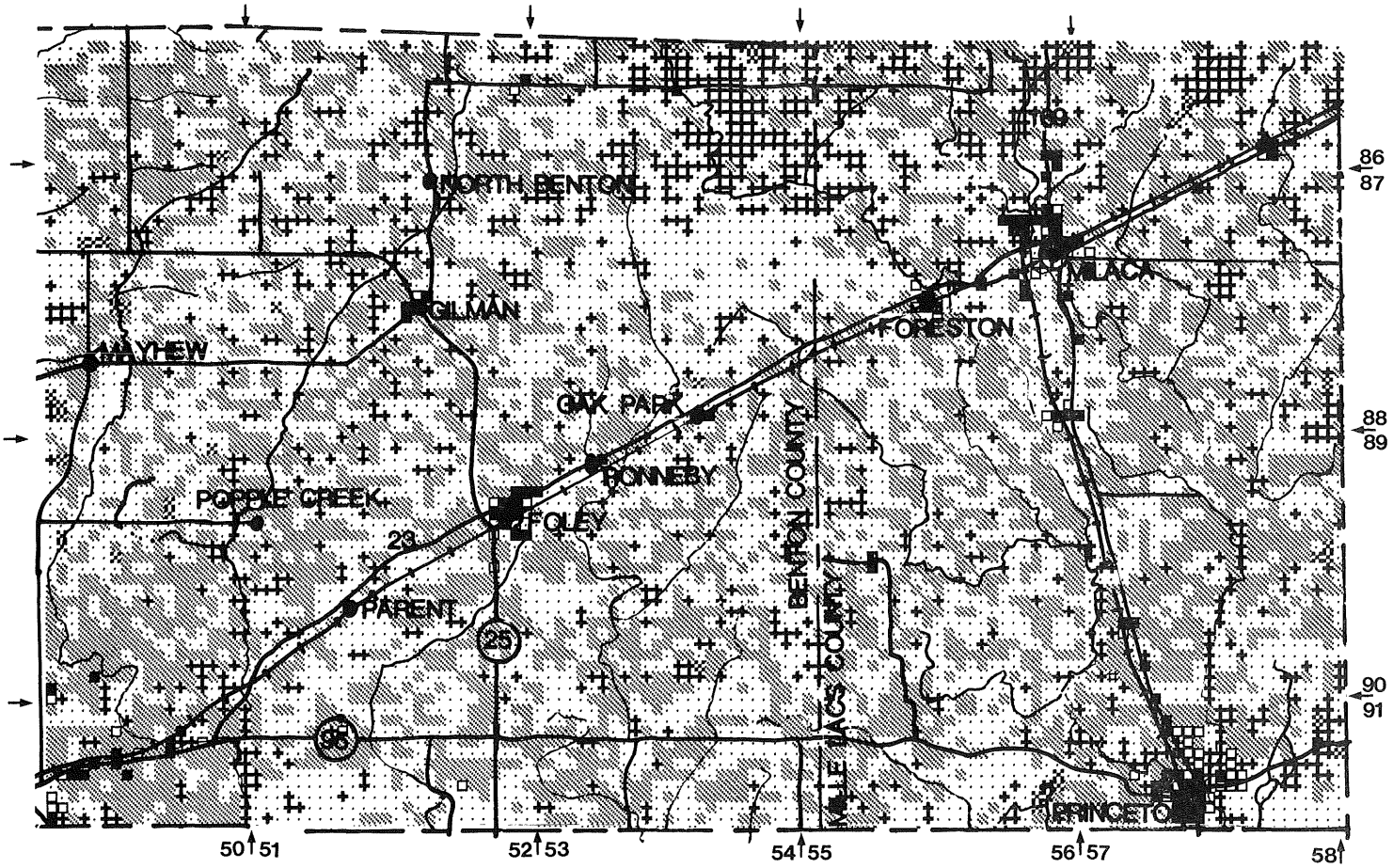
9. transportation - where the dominant land use consists of facilities for the conveyance of people and/or materials such as airports, railroad yards or highway interchanges.

Together these nine categories provide a good general representation of land use.

For the purposes of this study, a general land use map was compiled based upon MLMIS land use data recorded initially on a 40 acre basis. This map, figure 2-9, shows the distribution of the nine land use categories discussed above.

In addition to the map, these data are presented in tabular form in Table 2-5 where the number of 40 acre parcels in each of the nine land use categories are itemized. The project area was divided into five kilometer squares in order to summarize these data. Each of these five kilometer units contains between 132 and 182 40 acre parcels. The number varies because the five kilometer grid is off-center; therefore, some of these 40 acre parcels are counted twice.

Nonetheless, the general land use pattern in different parts of the study area can be compared by examining the proportions of the nine land use variables in each five kilometer square which can be located by the coordinates on the land use map, Figure 2-9. For example, the area around Duelm (row 91, column 52 on the table) with eight parcels of forest, 79 parcels of cultivated land and 69 parcels of pasture is obviously different in character from the area around the settlement of Rum River (row 86, column 54) where there are 87 parcels of forest, 20 parcels of cultivated land, 15 parcels of marsh and 30 parcels of pasture.



LAND USE

MAP-V16 DATE 5/79

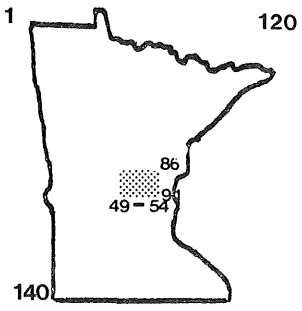
MINNESOTA LAND MANAGEMENT INFORMATION SYSTEM STUDY (MLMIS)

MINNESOTA STATE PLANNING AGENCY

CENTER FOR URBAN AND REGIONAL AFFAIRS
UNIVERSITY OF MINNESOTA

OUTPUT BY-
DOT20 MAP FUNCTION
EPPL 3.9 DATA SYSTEM

FILE CREATED-
MAY, 1977



FREQUENCY	LEVEL	SYMBOL	LEGEND
1180	13.4%	1	FORESTED
3379	38.4%	2	CULTIVATED
12	0.1%	3	WATER
43	0.4%	4	MARSH
56	0.6%	5	URBAN RESIDENTIAL
1	0.0%	6	EXTRACTIVE
4016	45.7%	7	PASTURE/OPEN
97	1.1%	8	MIXED RESIDENTIAL

LAND USE

FIGURE 2.9

UPA-TR-1
STUDY AREA
LAND USE
Table 2-5

Forest	Cult.	Water	Marsh	Urb Res	Extract	Pas/ Open	Urban Mix	Trans.	TTL	ROW	COL
10	82	0	2	0	0	50	0	0	144	86	50
22	74	0	0	1	0	56	3	0	156	86	51
18	51	0	1	1	0	71	2	0	144	86	52
78	37	0	5	0	0	32	0	0	152	86	53
87	20	0	15	0	0	30	0	0	152	86	54
52	43	0	0	0	0	49	0	0	144	86	55
57	50	0	3	0	0	53	1	0	164	86	56
76	22	0	1	0	0	45	0	0	144	86	57
83	22	0	5	0	0	53	0	0	163	86	58
45	52	0	0	1	0	62	5	0	165	86	59
30	53	0	1	0	0	60	0	0	144	87	50
33	53	0	0	0	0	70	0	0	156	87	51
22	58	0	0	0	0	68	0	0	148	87	52
60	24	0	0	0	0	71	1	0	156	87	53
90	29	0	0	0	0	63	0	0	182	87	54
34	53	0	0	0	0	68	1	0	156	87	55
29	58	0	0	1	0	65	10	0	163	87	56
24	45	0	3	1	0	67	4	0	144	87	57
50	33	0	0	0	0	79	1	0	163	87	58
41	47	0	0	0	0	68	0	0	156	87	59
17	39	0	1	0	0	97	0	0	154	88	50
31	54	0	0	2	0	65	4	0	156	88	51
16	47	0	0	0	0	81	0	0	144	88	52
14	25	0	0	0	0	110	0	0	149	88	53
10	38	0	0	0	0	115	0	0	163	88	54
18	48	0	0	3	0	71	4	0	144	88	55
10	51	0	0	7	0	79	15	0	162	88	56
18	76	0	0	0	0	62	0	0	156	88	57
35	36	0	1	0	0	79	0	0	151	88	58
35	28	0	5	0	0	64	0	0	132	88	59
17	64	0	1	0	0	64	0	0	146	89	50
25	71	0	0	0	0	73	0	0	169	89	51
25	71	0	0	0	0	73	0	0	169	89	51
12	61	0	0	0	0	77	3	0	153	89	52
12	54	0	1	0	0	86	3	0	156	89	53
11	71	0	0	0	0	74	0	0	156	89	54

UPA-TR-1 STUDY AREA LAND USE
Table 2-5 - Continued

Forest	Cult	Water	Marsh	Urb Res	Extract	Pas/ Open	Urban Mix	Trans.	TTL	ROW	COL
4	67	0	0	0	0	73	0	0	144	89	55
5	74	0	0	3	0	71	3	0	156	89	56
14	76	0	0	0	0	54	0	0	144	89	57
27	60	0	1	0	0	56	0	0	144	89	58
46	37	2	1	0	0	58	0	0	144	89	59
26	71	0	0	0	0	47	0	0	144	90	50
12	66	0	0	0	0	78	0	0	156	90	51
5	54	0	0	7	0	73	8	0	147	90	52
16	75	0	0	0	0	78	0	0	169	90	53
24	51	0	0	0	0	83	1	0	159	90	54
13	63	0	0	0	0	72	1	0	149	90	55
14	71	0	0	0	0	71	0	0	156	90	56
15	84	0	0	0	0	45	0	0	144	90	57
17	54	0	4	0	0	74	0	0	149	90	58
22	70	19	4	1	0	40	0	0	156	90	59
29	67	0	0	1	0	59	0	0	156	91	50
5	67	0	0	1	0	96	0	0	169	91	51
8	78	1	0	0	0	69	0	0	156	91	52
16	82	0	1	0	0	70	0	0	169	91	53
15	60	0	0	0	0	81	0	0	156	91	54
7	72	0	0	0	0	90	0	0	169	91	55
24	71	0	0	1	1	69	3	0	169	91	56
26	64	1	0	7	0	54	4	0	156	91	57
35	30	5	4	0	0	75	1	0	150	91	58
27	38	0	7	0	0	71	1	0	144	91	59
34	53	0	2	0	0	55	0	0	144	92	50
14	29	3	5	1	0	97	0	0	149	92	51
27	49	0	3	0	0	72	0	0	151	92	52
10	71	1	0	0	0	65	2	0	149	92	53
15	51	0	0	0	0	78	0	0	144	92	54
17	49	0	5	0	0	85	0	0	156	92	55
20	58	0	8	1	0	63	0	0	150	92	56
24	25	3	1	13	0	62	22	0	150	92	57
24	46	0	2	0	0	79	0	0	151	92	58
32	29	18	2	13	0	62	0	0	156	92	59
28	74	0	8	0	0	34	0	0	144	93	50
28	56	6	6	12	0	35	1	0	144	93	51
68	33	4	2	9	0	40	0	0	156	93	52
44	19	0	5	0	0	76	0	0	144	93	53
34	17	0	13	0	0	84	0	0	148	93	54
59	43	1	9	0	0	57	0	0	169	93	55
33	81	0	5	2	0	29	1	0	151	93	56
24	62	2	12	1	0	55	0	0	156	93	57
21	47	8	2	0	0	66	0	0	144	93	58
34	42	0	8	0	0	59	1	0	144	93	59

2.10.2 Soil Productivity

One of the principal factors in determining land use is soil productivity. Soil productivity, in general, is the physical measure of agricultural potential. Consequently, although it is normally expressed only in physical terms, soil productivity is the product both of the physical potential of the land, e.g., the distribution of soil types discussed in Section 2.5, and of the economic potential for agriculture.

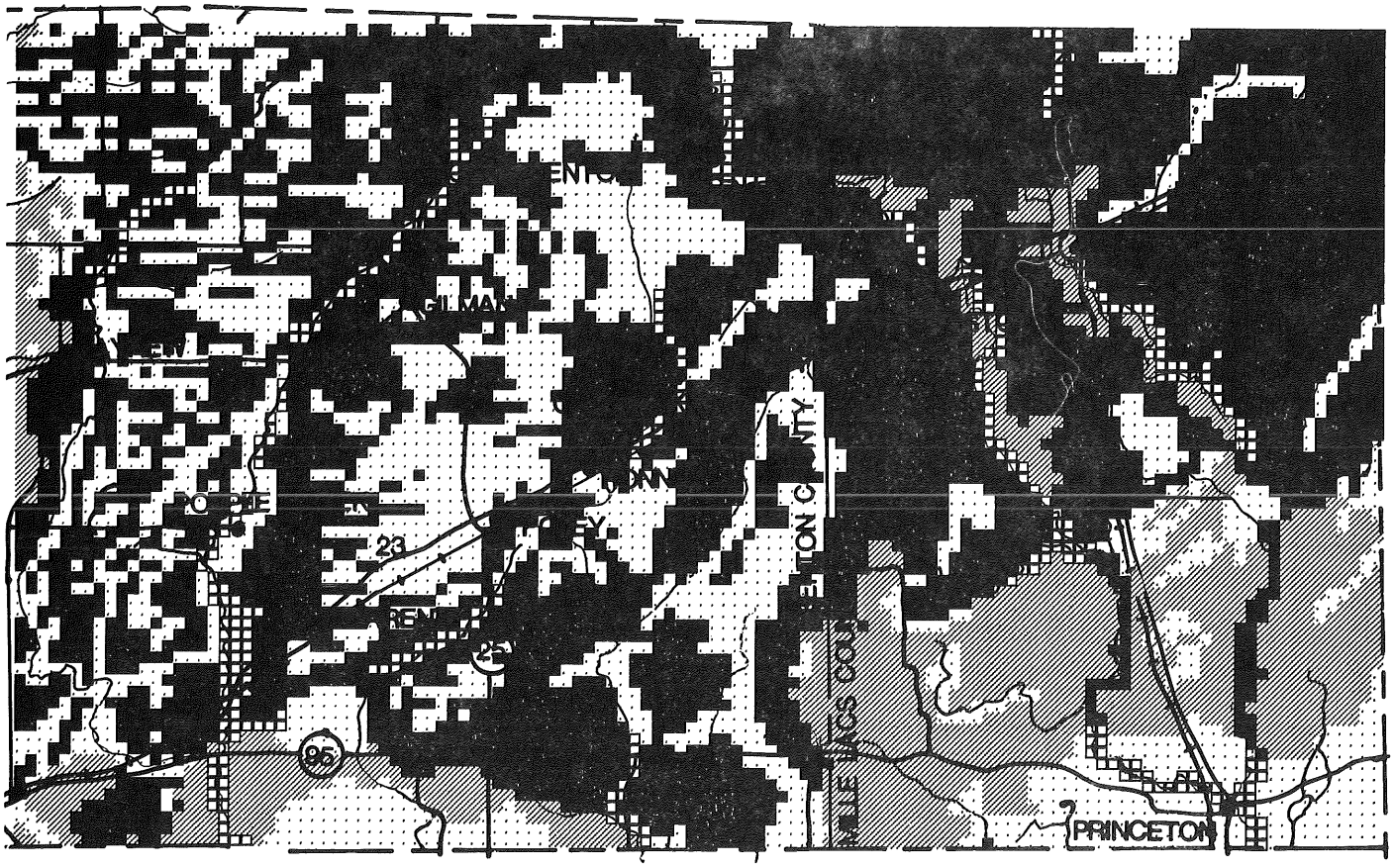
Two measures of soil productivity are used here. One is the climate modified soil productivity system developed by the Minnesota State Planning Agency, described in Section 2.10.2.1. Another measure uses soil capability groupings established by the USDA Soil Conservation Service, described in Section 2.10.2.2. These two measures of soil productivity systems are similar, but they have important differences in detail.

Both systems seek to translate a variety of factors into one index of soil productivity or agricultural potential. Both provide general surveys for regional planning purposes although they are at a scale of generalization that makes their use in local onsite planning difficult. Both evaluate essentially the same list of factors, such as soil, quality, climate, slope and drainage, in order to estimate agricultural potential.

Despite these similarities, there are important differences between these two measurement systems. Field work was conducted at different times using different techniques and assumptions. Varying sources of data were used. For example, the Soil Conservation Service uses its own county surveys while the Minnesota State Planning Agency used the Minnesota Soil Atlas for its soil data. SCS data are collected in small, local units, and organized and evaluated on a county-by-county basis. In contrast, the State of Minnesota system data are organized at the 40 acre level and analyzed at the state-wide level. However, original data collection land units are much larger than the 40 acre cells, therefore, the precision of measurement of the Minnesota State Planning Agency is somewhat less than implied by 40 acre data preservation. Although the two soil productivity systems are similar, they are not directly comparable.

2.10.2.1 Climate Modified Soil Productivity

Climate modified soil productivity is a means to measure the agricultural productivity of land. Like the land use data cited above, data on climate modified soil productivity provide relative, comparative values assigned to 40 acre parcels. Figure 2-10 presents a general estimate of the cropland productivity within the study area based upon this new index.



CLIMATE MODIFIED SOIL PRODUCTIVITY

MAP-V59 DATE-5/79

MINNESOTA LAND MANAGEMENT INFORMATION SYSTEM STUDY (MLMIS)

MINNESOTA STATE PLANNING AGENCY

CENTER FOR URBAN AND REGIONAL AFFAIRS
UNIVERSITY OF MINNESOTA

OUTPUT BY-
DOT30 MAP FUNCTION
EPPL 3.9 DATA SYSTEM

FILE CREATED-
MAY, 1977

FREQUENCY	LEVEL	SYMBOL	LEGEND
12	0.1%	0	WATER
344	2.9%	2	SOIL SCORES 57-75
4854	55.2%	3	SOIL SCORES 38-56
1230	14.0%	4	SOIL SCORES 19-37
2344	26.6%	5	SOIL SCORES 0-18

CLIMATE MODIFIED SOIL PRODUCTIVITY

FIGURE 2.10

The data mapped here are taken from a forthcoming study, Minnesota Crop Land Resources, designed by the State Planning Agency to assess and to inventory cropland productivity. This report produced a mathematical model for the purpose of ranking Minnesota croplands based upon soil characteristics and climate and land use variables. The soil productivity characteristics considered include:

1. texture of soil above and below five feet from the surface;

2. natural drainage conditions;

3. color of soil as an indication of organic content;

4. slope of the soil unit;

5. depth of the rooting zone; and

6. phosphorus/potassium content.

Two climatic variables, average annual precipitation and cumulative growing season heat (growing degree days) were used in the model. Present land use and ownership were considered. The model assumes that land in open or agricultural use under private ownership was more likely to be farmed than, for example, developed land or publicly owned land.

After giving each of these variables a quantitative value, each 40 acre parcel inventoried by MLMIS was given a combined score, ranging from 0 to 94. Therefore, these scores represent a relative value in relation to other ranks on this index. For example, a parcel of land with a score of 82 clearly has more theoretical potential as cropland than a parcel with a rank of 70. At the same time, the difference between a score of 80 and 82 is relatively slight. It is possible, for instance, for a skillful farmer to obtain higher yields on land scored at 80 than his neighbor possessing land ranked at 82. Nevertheless, these scores indicate relative differences in land quality within the study area.

2.10.2.2 Soil Capability Groupings

The Soil Conservation Service supplements its basic soil classification system with soil capability groupings which provide an index of the suitability of soils for most crops. Possible major agricultural development projects, such as large scale reclamation, and speciality croplands are possible. In general, soil quality, growing season, slope, potential for erosion,

drainage and moisture supply are considered. Land is ranked in terms of its ability to economically produce sustained high yields of crops when treated and managed with modern farming methods. Data are analyzed on a county-wide basis using information derived from the Soil Conservation Service's county soil surveys.

The actual capability groups are ordered in terms of the number of limitations or restrictions to the production of high yield crops within a particular county. Thus, SCS capability classes I through VIII indicate progressively greater limitations and narrower choices for practical use.

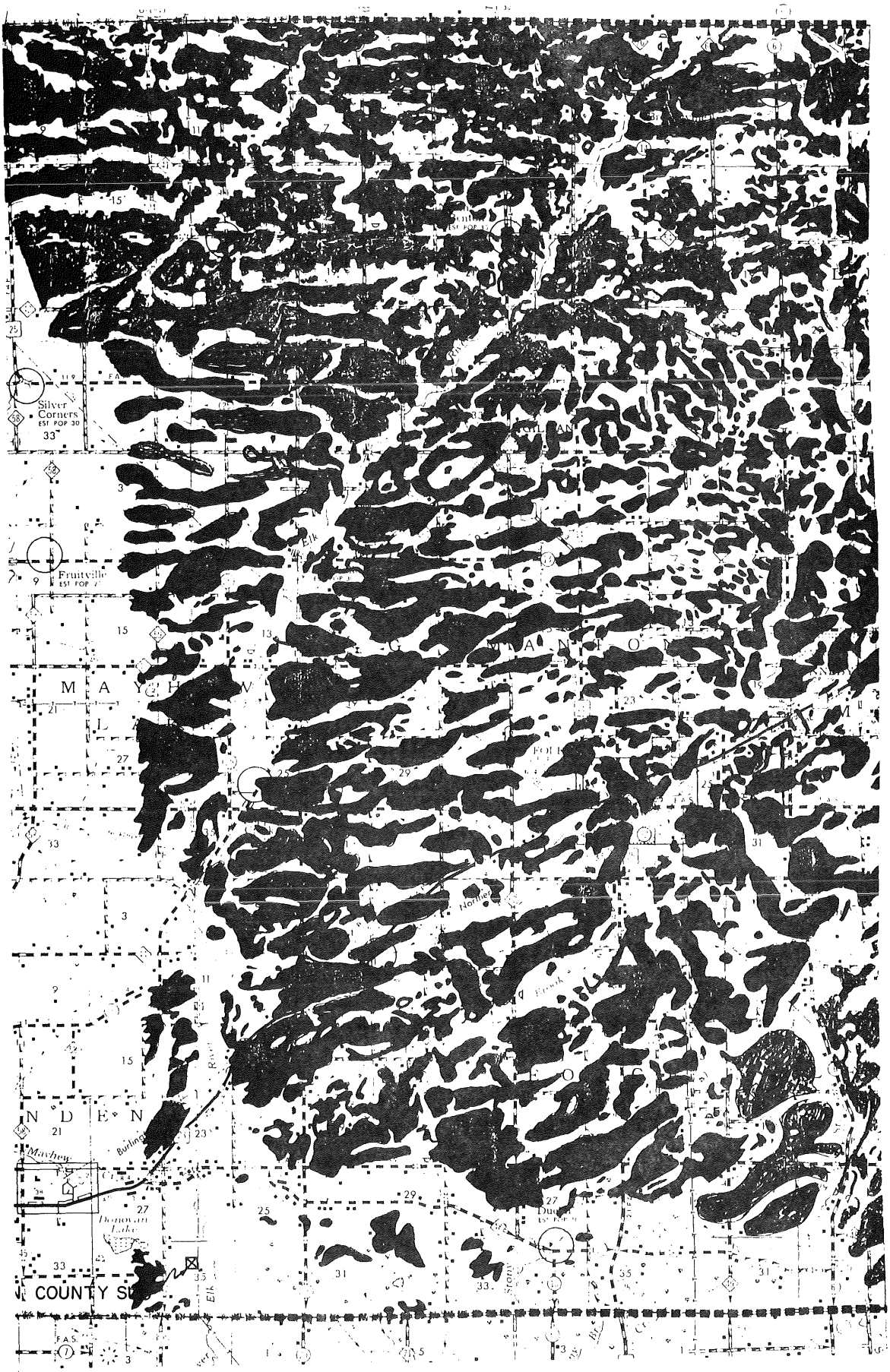
Class I soils have few limitations that restrict their use. (None are in the study area.)
Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.
Class III soils have severe limitations that reduce the choice of plants, require special conservation practices, or both.
Class IV soils have very severe limitations that reduce the choice of plants, require very careful management, or both.
Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use largely to pasture, range, woodland, or wildlife. (None are in the study area).
Class VI soils have severe limitations that make them generally unsuited to cultivation and limit their use largely to pasture or range, woodland, or wildlife.
Class VII soils have very severe limitations that make them unsuited for cultivation and that restrict their use largely to pasture or range, woodland, or wildlife.
Class VIII soils and landforms have limitations that preclude their use for commercial plants and restrict their use to recreation, wildlife, water supply, or aesthetic purposes.

In addition, these capability classes are further subdivided into capability subclasses, which indicate physical limitations such as the risk of erosion, shallow soil, and adverse climate, and into capability units which combine similar groups of soils in convenient groupings for the management purposes. Capability class I and II areas are defined as "prime farmland" by the Soil Conservation Service.

Figure 2-10a illustrates the distribution of SCS-defined "prime farmland" (Class II only) within the study area. This map was compiled by UPA at the request of REA using data supplied by the local offices of the Soil Conservation Service. Soil types identified during the county soil surveys for Benton County and Mille Lacs County were classified according to capability classes by the Soil Conservation Service. Then, UPA extrapolated from these data by plotting all the class II soil shown on the maps within the Soil Conservation Service's county surveys for Benton and Mille Lacs Counties. The result of this procedure is reflected in Figure 2.10a.

Unfortunately, this procedure has not been entirely successful. This map has limited informational value because a majority of the land in the study area was identified as class II land. In addition, since these original data are based upon separate SCS county surveys, the data from the two counties are not directly comparable. Indeed, the data were collected forty years apart using different field data collecting techniques and assumptions. In this regard, discrepancies on this map are obvious along the Benton - Mille Lacs County boundary.

In summary, the two soil rating systems described in sections 2.10.2.1 and 2.10.2.2 both have limitations when applied to a site specific analysis of the potential impacts associated with the construction of a high voltage transmission line. Therefore, while the information presented in conjunction with this discussion is of value in assessing the relative importance of a particular soil, caution should be exercised in placing too much reliance on the data.



FROM UPA APPLICATION
BASED ON SOIL CONSERVATION SERVICE DATA

PRIME FARMLAND

CAPABILITY CLASS II

FIGURE 2.10a

2.10.3 Irrigation

The amount of irrigated farmland has been increasing steadily as farmers attempt to increase profits by improving productivity by compensating for unreliable and inadequate precipitation. Irrigated land in Minnesota increased 1,490 percent between 1967 and 1977 from 25,000 acres to 397,000 acres. Over 95 percent of this acreage is irrigated mechanically with either center pivot or travelling gun systems.

The decision to irrigate depends upon a number of economic and physical factors such as farm parcel size, climate, soil types, and the availability of water. Irrigation is desirable particularly where precipitation is inadequate and/or where the coarse to medium textured soil cannot retain groundwater well. In general, soil type and the availability of water for irrigation are the most important factors in determining the feasibility of irrigation. In Minnesota, most irrigated acreage is on the coarse to medium textured prairie and forest soils formed from glacial outwash. Although these soils are scattered throughout the state, they occur predominantly in central Minnesota.

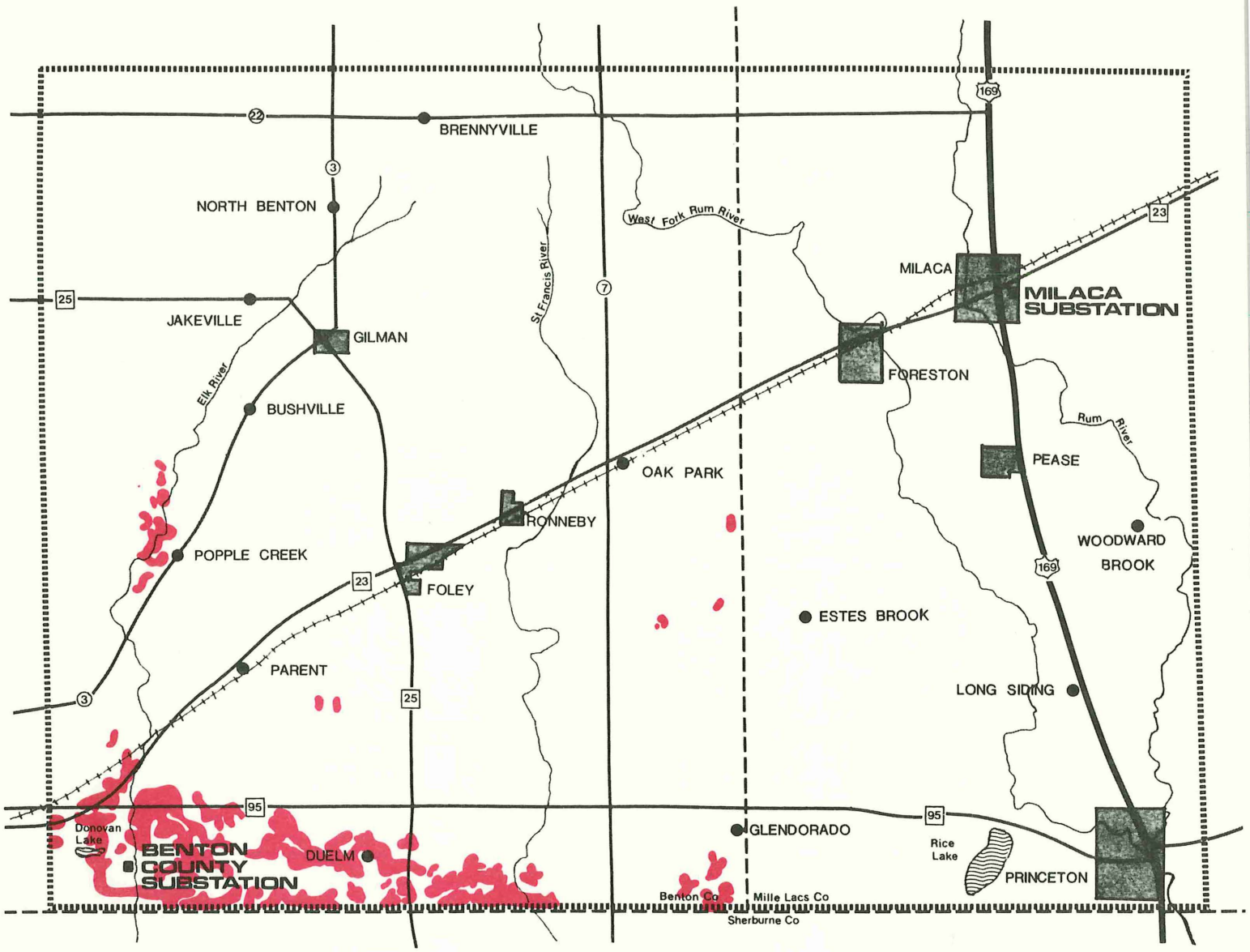
The study area is on the eastern edge of this region. Most of the irrigation within the study area is in the southern portions of Minden, St. George and Glendorado townships and immediately west of Princeton. Figure 2-11 illustrates the distribution of land with potential for irrigation based upon soil types. This distribution corresponds closely with the actual distribution of irrigated parcels as designated by Department of Natural Resources water appropriation permits as shown in Figure 2-12.

2.11 Economic Activities

The study area is predominantly rural and agricultural. However, the economy of this area has become progressively more diversified and more directly related to the metropolitan economies of St. Cloud and Minneapolis-St. Paul in recent years.

2.11.1 Agriculture

Agriculture, the traditional economic activity within Benton County and the southern portion of Mille Lacs County, continues to dominate the socio-economic character of the study area. But the number of farms, the amount of farmland cultivated, and the farm population have decreased in recent years. The role of agriculture is not as dominant as it once was due to the growth of commuting to St. Cloud and to the Twin Cities for employment.



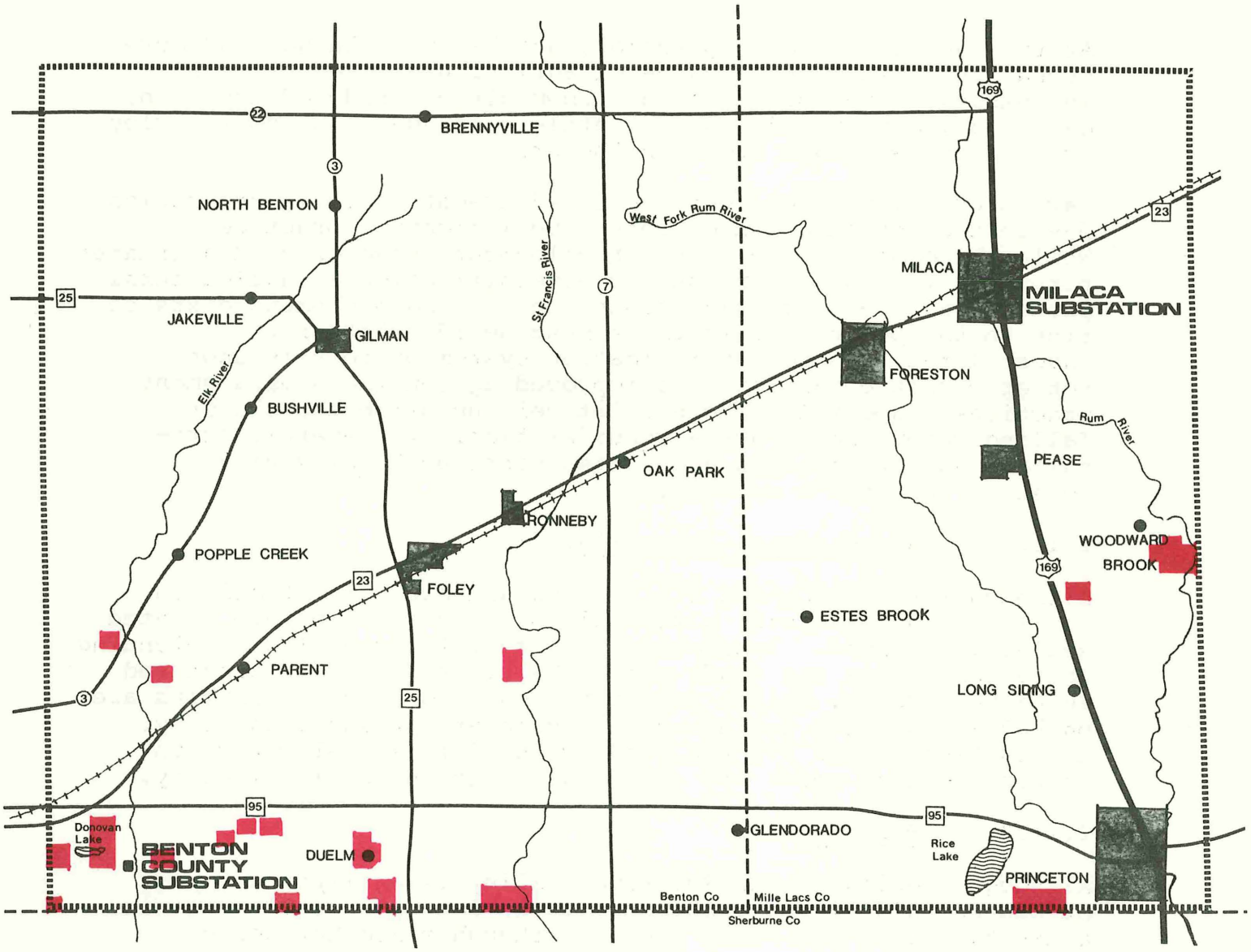
IRRIGABLE SOILS

STUDY AREA

NORTH

Miles
0 1/2 1 2 4
0 1.6 3.2 6.4
Kilometers

FIGURE 2.11



DNR IRRIGATION PERMITS

STUDY AREA

NORTH

Miles
0 1/2 1 2 4
0 1.6 3.2 6.4
Kilometers

FIGURE 2.12

TENTATIVE DATA
SOURCE: DNR WATER APPROPRIATION PERMITS

At the same time, farm operations are becoming larger and more mechanized. The actual value of agricultural production is increasing. The most important commodities produced are corn, oats, hay, dairy products and cattle. In addition, some barley, rye and soybeans are grown in the area.

Farm productivity has been increased dramatically in the region due to the introduction of intensive irrigation practices. While these new technological developments have created a greater potential for the expansion and diversification of agricultural production, they have also caused energy and equipment costs to rise to the point where farmers must decide whether to invest large sums for an irrigation system or to rely upon better market conditions and improved agribusiness management practices, especially where relatively unsuitable soils or falling water tables are a consideration. In general, agriculture and its related activities continue to play vital roles in the area's economy.

2.11.2 Agricultural Processing

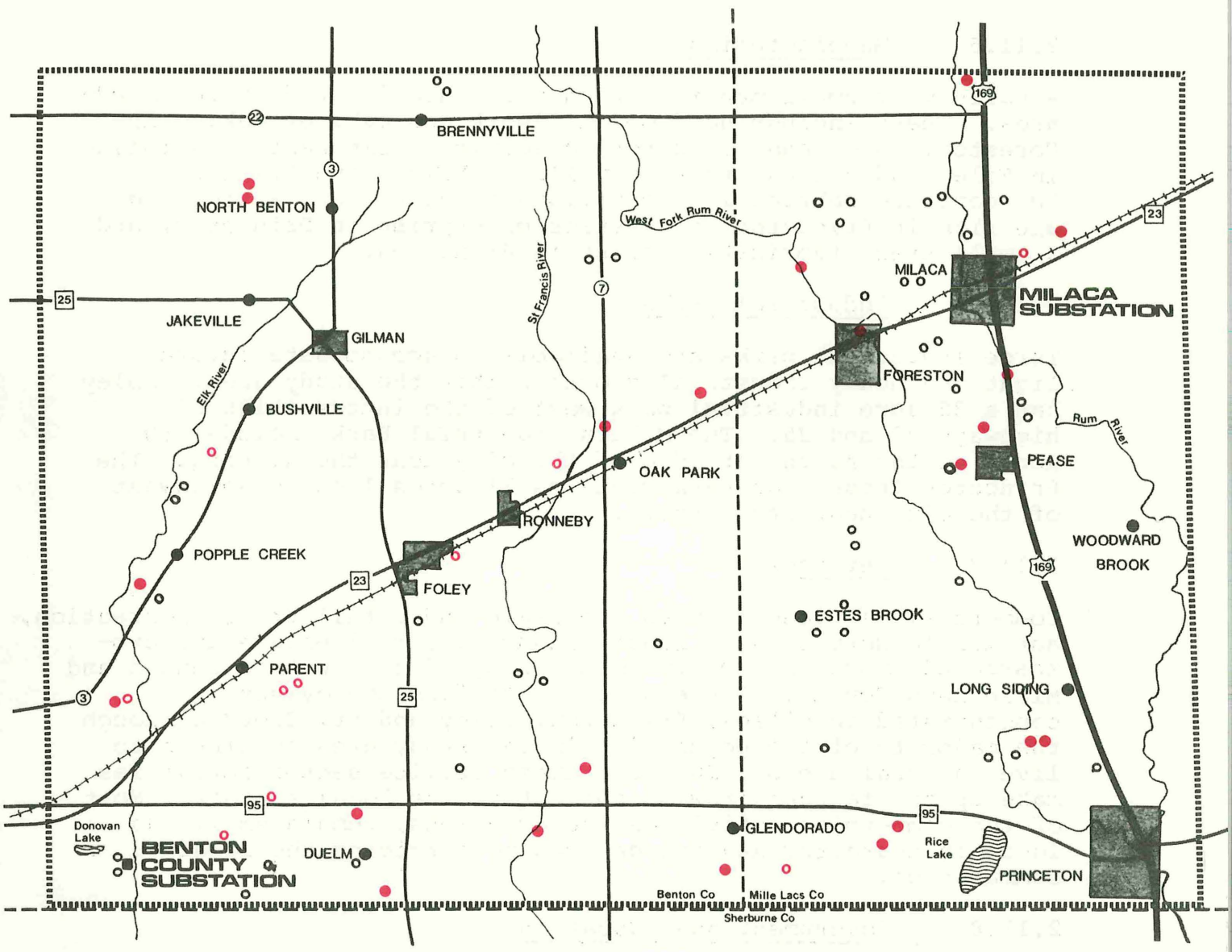
Although farm employment will not expand much, if at all, in the foreseeable future, potential for expansion in farm related activities exists. Presently, five fertilizer mixing or blending operations serve the study area. Dairy products are processed in Gilman, Foley, Milaca and Princeton. Poultry and rabbits are packed in Foreston and ham and sausage are produced in Foley. In addition, there are two feed grain mills and elevators in Princeton which serve the surrounding agricultural community.

2.11.3 Forestry

Although logging in the Rum River Valley is an important part of Minnesota's history, forestry is no longer a vital economic activity within the study area. Although mixed hardwoods are scattered throughout the area, they are small and have limited commercial value. Only one logging and lumber operation remains within the study area.

2.11.4 Sand and Gravel Pits

Mining activities within the project area are limited to sand and gravel extraction. Deposits of buried sand and gravel occur randomly within the undifferentiated drift of late Wisconsin glacial till and outwash. Consequently, economically viable sand and gravel pits are plentiful in the study area. See Figure 2-13 which locates presently active and inactive pits operated by or for the Minnesota Department of Transportation and private pits shown on the United State Geological Survey topographic sheets.



SAND AND GRAVEL PITS

STUDY AREA

ACTIVE PITS — FROM MNDOT

INACTIVE PITS — FROM MNDOT

OTHER — FROM USGS

NORTH

Miles

0 1/2 1 2 4

0 1.6 3.2 6.4

Kilometers

FIGURE 2.13

2.11.5 Manufacturing

A variety of small manufacturing firms are located in the study area. These include hardwood millwork and cabinet making in Foreston, Foley and Princeton; electrical components assembling in Foley and Milaca; textile mills in Milaca and Princeton; two concrete fabrication operations in Princeton; a tool and die firm in Princeton; a plastics enterprise in Princeton; and a small steel fabrication plant in Princeton.

2.11.6 Industrial Parks

Three industrial parks are available to accommodate future light and heavy industrial growth within the study area. Foley has a 35 acre industrial park west of the intersection of highways 23 and 25. The Milaca Industrial Park includes 50 acres on the northeast edge of the city near the airport. The Princeton Industrial Park contains 71 acres located southwest of the city near its airport.

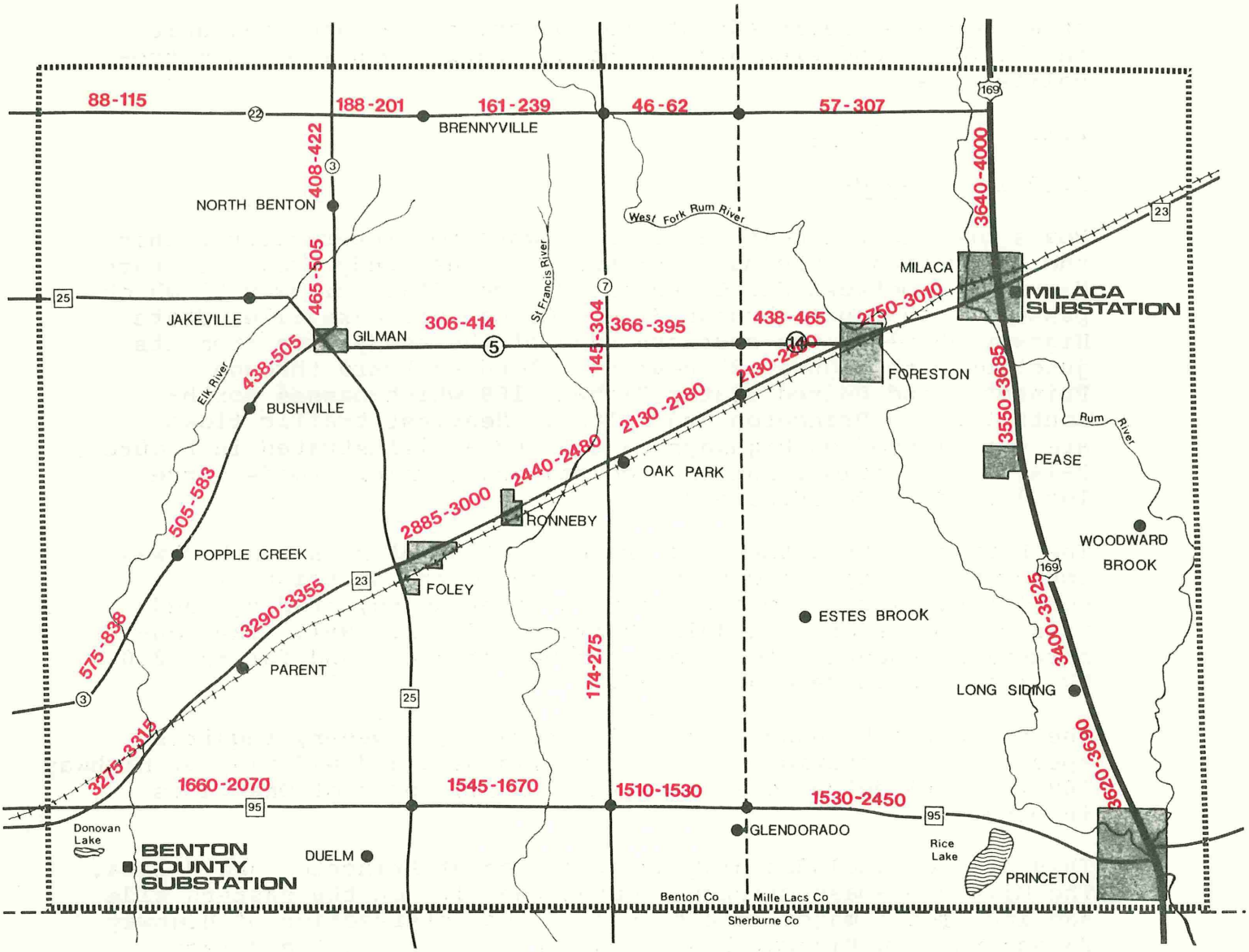
2.11.7 Services

Commercial services such as wholesale and retail trade, recreation, automobile servicing, finance, insurance, real estate and professional services provide the majority of jobs within Benton and Mille Lacs County. Consequently, off-farm employment is concentrated in Milaca, Princeton, Foley and St. Cloud although the majority of the population in the study area continues to live in rural areas. In fact, these service sector activities make up the fastest growing segment of the local economy. Most of the commercial activities, nevertheless, remain small and local in character and are devoted to servicing the local communities.

2.11.8 Government and Education

Government services within the study area are concentrated in Foley and Milaca, the respective county seats of Benton and Mille Lacs Counties. In addition to a variety of municipal and county offices located there, the United States Government administers its Agricultural Stabilization and Conservation and its Soil Conservation Service programs from offices in both Foley and Milaca and the Farmers Home Administration program from Milaca. The Minnesota Department of Transportation maintains facilities in Milaca and the Minnesota National Guard has armories in Milaca and Princeton.

The study area is served by a normal compliment of elementary and secondary schools. In addition, there are a few, small private religious schools in the area. There are also vocational-technical schools located in Milaca and Princeton. Numerous



HIGHWAY TRAFFIC FLOW

STUDY AREA

NORTH

Miles
0 1/2 1 2 4
0 1.6 3.2 6.4
Kilometers

FIGURE 2.14

SOURCE: D.O.T. 1976 AVERAGE DAILY TRAFFIC VOLUMES

other post-secondary educational opportunities are available in the St. Cloud area and in the St. Paul - Minneapolis metropolitan area.

2.12 Utilities

2.12.1 Roads

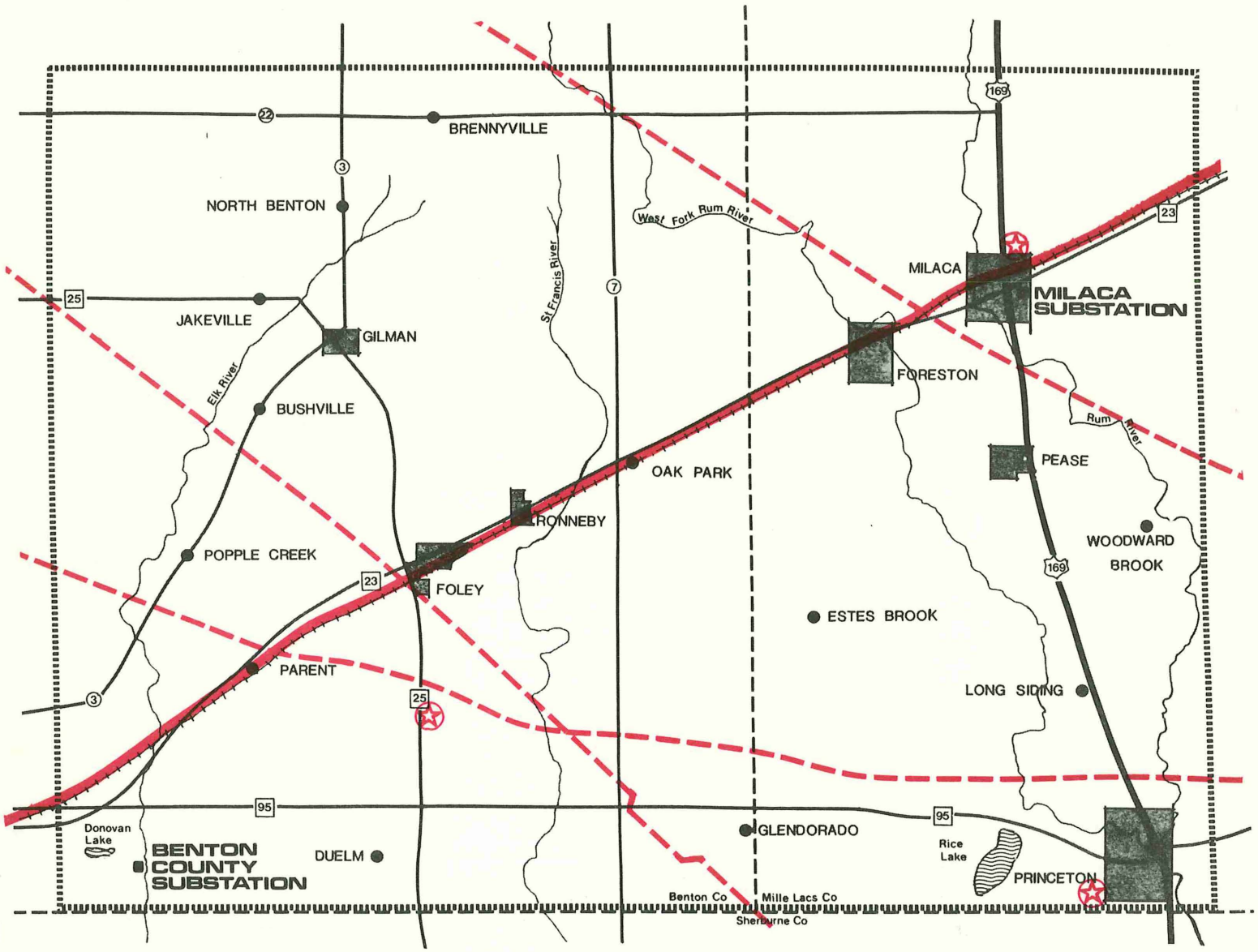
Roads provide the most familiar network for interaction within the study area. The major highways in the study area are State Highway 23 between St. Cloud and Milaca, State Highway 25 which passes north-south through Foley, Gilman and Jakeville, State Highway 95 along the southern edge of the study area from its junction with Highway 23 near St. Cloud eastward through Princeton and United States Highway 169 which passes north-south through Princeton and Milaca. Heaviest traffic flows are experienced on Highways 23 and 169 as illustrated in Figure 2-14. In addition, numerous county and township roads serve local needs. See Figure 2-15.

The Minnesota Department of Transportation plans seven highway improvement projects within the proposed transmission line corridors. These projects involve resurfacing, grading, and bridge replacement scheduled between 1979 and 1981. The construction schedules for these highway projects and for the 230 kV line need to be coordinated.

The principal highway project in the area, however, requires special consideration. A major realignment and widening of Highway 169 from Princeton to a point immediately south of Onamia is in progress.

This project includes highway by-passes at Princeton and Milaca. The Milaca by-pass circumnavigates the city on the eastern side and includes a major interchange at the intersection of Highway 23 and the new Highway 169 alignment adjacent to the Milaca Substation. Consequently, transmission lines approaching the substation from both the north and the south must cross over the new Highway 169 alignment. Again the precise location and construction schedules for these projects need to be negotiated and coordinated.

Two particular limitations must be considered when crossing the new Milaca by-pass. The tower structures may not be higher than 1200 feet mean sea level elevation or approximately 100 feet above the ground due to airspace restrictions placed upon the area by the Milaca airport zoning ordinance discussed in Section 2.12.3. This may be difficult because federal regulations, title 23, part 645.206 (e), prohibit the placement of



UTILITIES

- STUDY AREA
- LANDING FIELDS
- RAILROADS
- PIPELINES

NORTH

Miles
0 1/2 1 2 4
0 1.6 3.2 6.4
Kilometers

FIGURE 2.15

NOTES:

1. TOPOGRAPHIC CONTOUR INTERVALS ARE 10 FEET DATUM IS MEAN SEA LEVEL ELEVATION
2. THE AERIAL CONTOURS ILLUSTRATE THE HEIGHT LIMITATIONS WITHIN EACH ZONE
3. A SLOPE, SUCH AS 40:1, EXPRESSES THE HORIZONTAL DISTANCE OF 40 FEET TO THE VERTICAL DISTANCE OF 1 FOOT
4. EXISTING TOPOGRAPHIC SYMBOLS ARE THOSE USED BY THE U.S. GEOLOGICAL SURVEY
5. IN THOSE AREAS WHERE EXISTING TERRAIN OR TREES PENETRATE ONE OR MORE OF THE IMAGINARY SURFACES THE HEIGHT OF STRUCTURES SHALL BE RESTRICTED ONLY TO THE HEIGHT OF THE TREES OR TERRAIN WHICH PROVIDES A NATURAL SHIELD TO THE STRUCTURE.

LEGEND:

ULTIMATE RUNWAY
ZONE BOUNDARY
TOPOGRAPHIC CONTOURS
AERIAL CONTOURS
SECTION LINES

1100
1300

north

FIGURE 2.16

MILACA MUNICIPAL AIRPORT ZONING PLAN

MILACA, MINNESOTA

MILACA MUNICIPAL AIRPORT ZONING BOARD

APPROVAL _____ DATE 1-3-13

APPROVAL _____ DATE 1-3-13

APPROVAL _____ DATE 2-6-13

REVISIONS		
NO.	DESCRIPTION	DATE

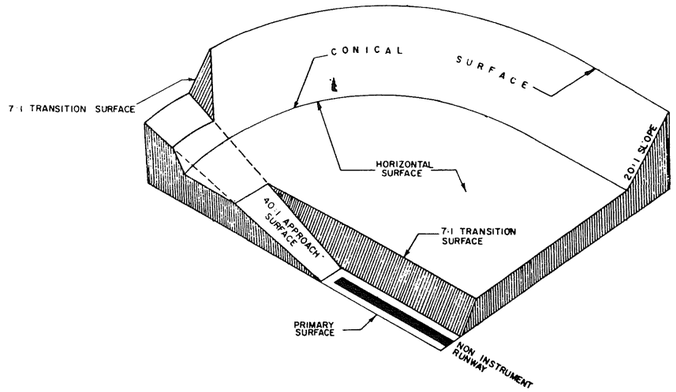
DRAWN BY: LKA

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED ENGINEER UNDER STATE OF MINNESOTA STATUTES SECTIONS 326.02 TO 326.15

NAME _____

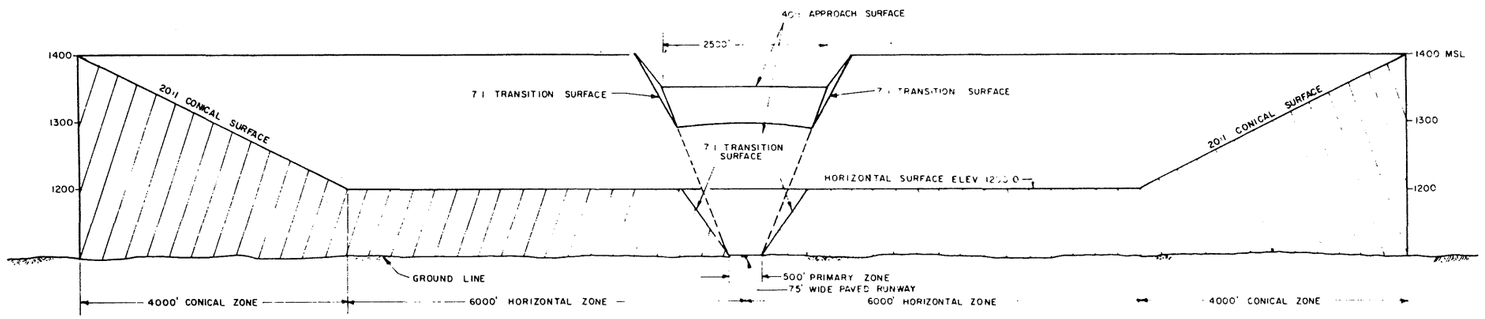
DATE 1/8/13 REG. NO. 21723

AIRSPACE ZONING PLAN 1 OF 3

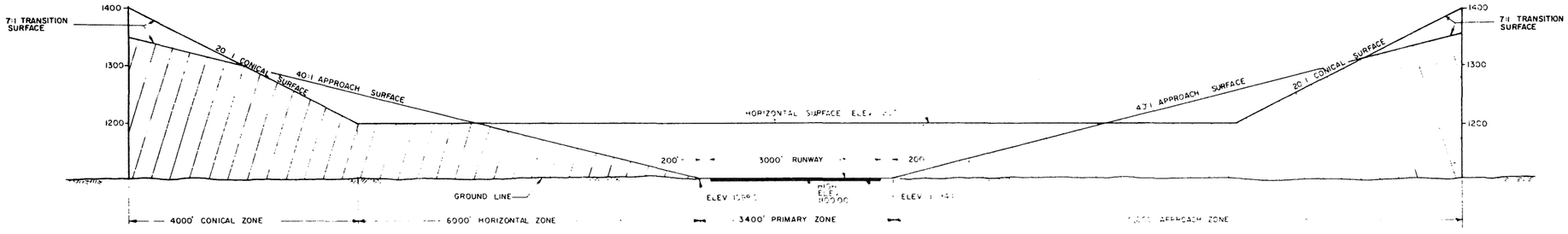


PERSPECTIVE VIEW SHOWING IMAGINARY SURFACES

NO SCALE



SECTION B-B



SECTION A-A

FIGURE 2.17

CIVIL / MUNICIPAL / PLANNING — ENVIRONMENTAL / LAND SURVEYING / SOIL EXPLORATION	REVISIONS	DESIGNED BY LGK	CITY OF MILACA, MINNESOTA
consulting engineers diversified inc. P.O. Box 2, Osseo, Minnesota 55369	SCALE HORIZ 1"=1000' VERT. 1"=100'	CHECKED BY	MUNICIPAL AIRPORT ZONING MAP
		DRAWN BY LKA	AIRSPACE SECTIONS
		DATE	SHEET 2 OF 6 SHEETS — FILE NO. MI9:08-3B

FIGURE 2.18

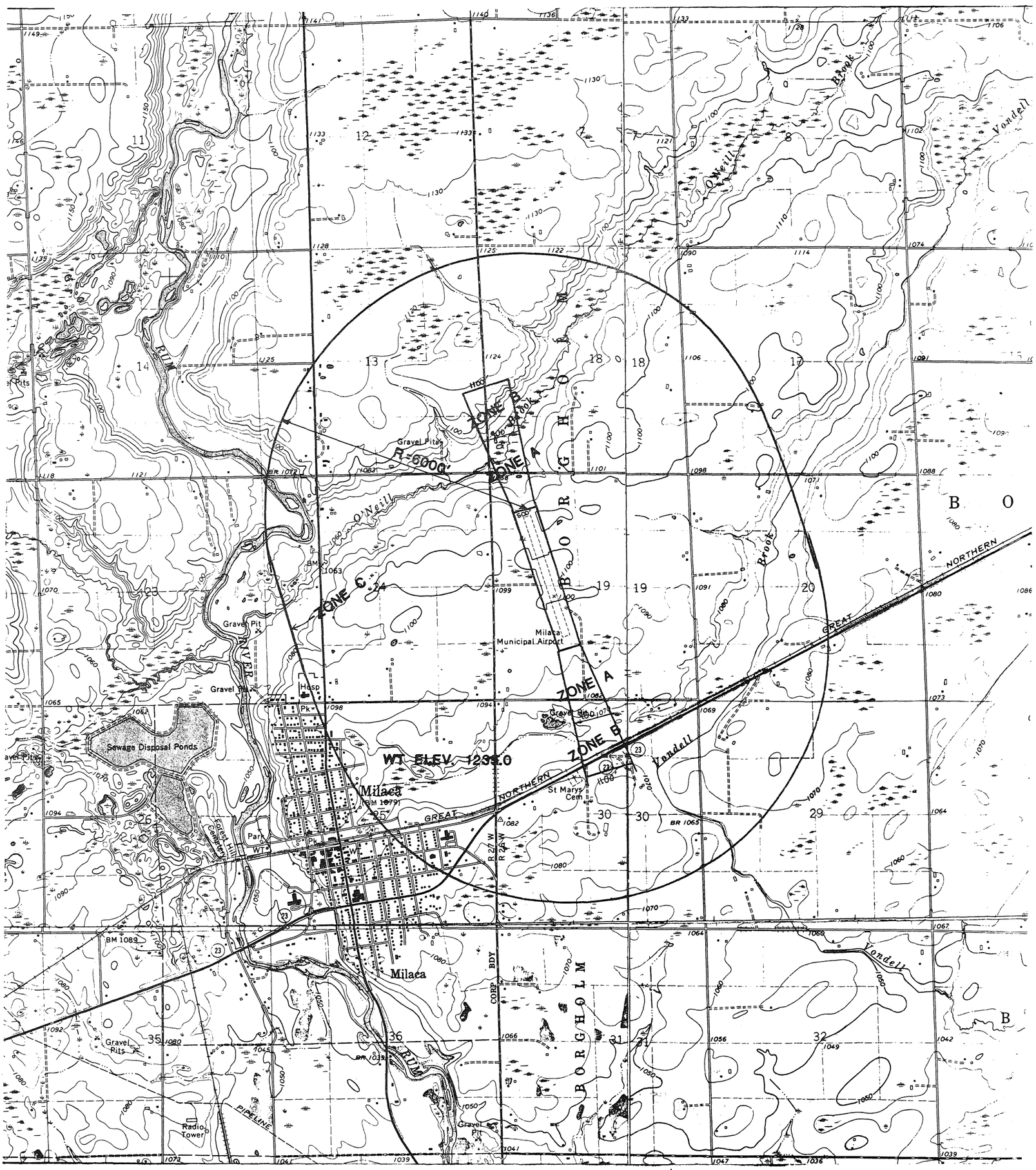
north

NOTES:

1. TOPOGRAPHIC CONTOUR INTERVALS ARE 10 FEET. DATUM IS MEAN SEA LEVEL ELEVATION.
2. EXISTING TOPOGRAPHIC SYMBOLS ARE THOSE USED BY THE U.S. GEOLOGICAL SURVEY.

LEGEND:

ULTIMATE RUNWAY
ZONE BOUNDARY
TOPOGRAPHIC CONTOUR — 1350
SECTION LINES — QR —



consulting engineers diversified inc.
P.O. Box 2, Otsego, Minnesota 55369

ENVIRONMENTAL
LAND SURVEYING
SOIL EXPLORATION

REVISIONS

SCALE: HORZ 1" = 1000' VERT

DESIGNED BY LGK
CHECKED BY
DRAWN BY LKA

CITY OF MILACA, MINNESOTA
MUNICIPAL AIRPORT ZONING PLAN
LAND USE SAFETY ZONING PLAN

DATE
SHEET 3 OF 3 SHEETS
FILE NO MI9:08-3B

transmission line structures on highway rights of way. This may require the length of the span between structures to be greater than is feasible, if these structures are to remain shorter than 100 feet tall.

2.12.2 Railroads

The Burlington Northern Railroad maintains a rail line from St. Cloud through Foley and Milaca to Brook Park. Approximately five trains, depending upon demand, make round trips (called the Brook Park turnaround) along this route each week. Freight is delivered along the route and some cars are left in Brook Park to be carried northward by other trains. Then, the train returns to St. Cloud. Between 50 and 100 cars are handled each week. See Figure 2-15.

2.12.3 Airports

St. Cloud's Whitney Memorial Airport, located one mile southeast of the Benton County Substation, is the most important aeronautical facility in the region. Municipal airports also serve Milaca and Princeton. In addition, there is a private airstrip adjacent to Highway 169 north of Milaca and one proposed for a location south of Foley in Section 11 of St. George Township.

None of these facilities are within proposed route corridors; however, all approaches to the Milaca Substation must comply with zoning regulations established for the Milaca Municipal Airport which currently has a 2900 foot turf runway that is to be replaced with a 3000 foot paved runway. See Figure 2-15.

The Milaca airport zoning ordinance regulates land use and airspace use in order to minimize airport hazards and to prevent the construction of obstructions in the vicinity of the aiprort. There are five airspace zones, which are horizontal, geometric planes at specified elevation, and three land use zones.

The airspace zones prohibit structures and trees above a height limit established in the ordinance. These height limits, measured in relation to the elevation of the runway, range from nil for the Primary Zone for the first 200 feet beyond the ends of the runway to 100 feet above the runway or 1200 feet above mean sea level within the radii of two 6000 feet arcs from the runway surface in the case of the Horizontal Zone. In addition, three proportional zones, at radius 20:1, 40:1 and 7:1, extend for 4,000, 2,500, and a few hundred feet

respectively for the conical zone, the Approach Zone, and the Transitional Zone. These zones are illustrated on the airspace zoning map and the airspace zoning cross sections. See Figure 2-16 and 2-17.

In practical terms, the Horizontal Zone is the most important. It prevents the erection of objects higher than 1200 feet mean sea level, about 100 feet in height, for a wide area on the northeastern side of Milaca. For example, the Milaca water tower and the present 69 kV transmission lines west of the airport and along Highway 23 would not be permitted today. Since the Milaca Substation is located within the Horizontal Zone, no new tower structures higher than 1200 feet elevation can be built. The choice of poles used near the Milaca Substation must be made with the zoning ordinance in mind because tower structures normally used for 230 kV transmission lines vary in above ground height from 80 to 110 feet, depending upon the design, location and structure type.

The Milaca airport zoning ordinance has three land use or safety zones that prohibit or restrict buildings and activities near the airport. The boundaries of these safety zones corresponds on the ground to the areas covered by the airspace zones.

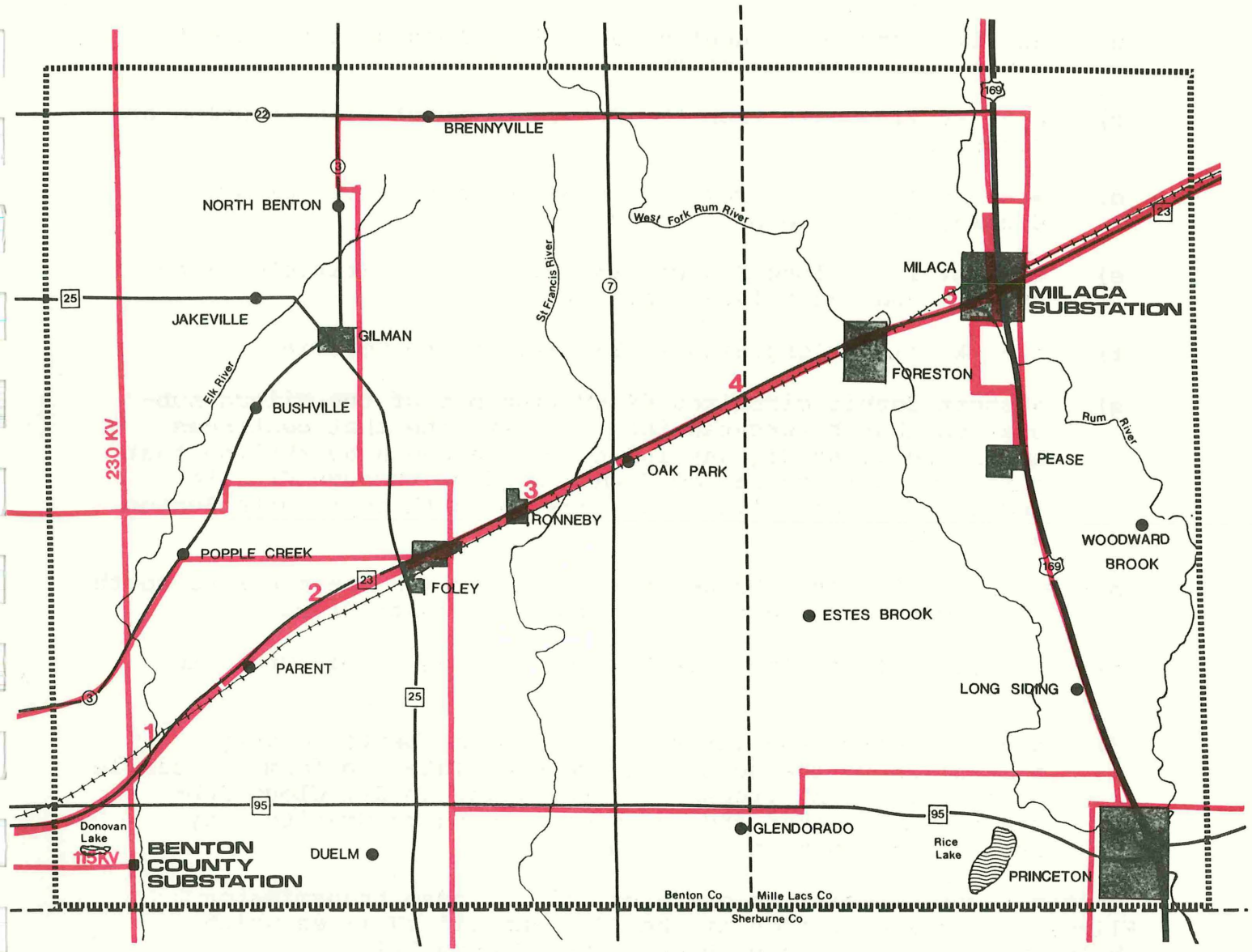
Thus, Safety Zone A regulates land use under the same area that the Primary Zone regulates for heights. In both cases, no permanent objects or activities are allowed since these zones encompass the first 2000 feet at the ends of the runway. Safety Zone B includes a conically shaped area 1000 feet beyond the Safety Zone A. Building sizes are restricted and many kinds of structures and activities are prohibited in Safety Zone B. In contrast, Safety Zone C includes the ground area below the Horizontal Zone, but poses no restrictions other than the 100 foot height regulation established by the Horizontal Zone. See the enclosed land use safety zoning plan, Figure 2-18, for detailed locations.

The primary impact of these land use zones upon the proposed transmission lines is to make the proposed reference centerline parallel to the existing 69 kV line immediately west of the Milaca airport impossible. This route passes through both Safety Zone A and Safety Zone B.

2.12.4 Transmission Lines

In addition to local electrical distribution lines, the following transmission lines exist within the study area:

a) a 230 kV line north-south from the Benton County substation to Princeton;



TRANSMISSION AND TELEPHONE LINES

STUDY AREA

EXISTING POWER LINES

LONG DISTANCE TELEPHONE CABLE

1 REPEATER SECTIONS

NORTH

Miles
0 1/2 1 2 4
0 1.6 3.2 6.4
Kilometers

FIGURE 2.19

b) an Elk River to Princeton 69 kV line feeding the Princeton substation from the south;

c) a 69 kV line east from the Princeton substation to Delbo and Cambridge;

d) a 69 kV line west from the Princeton substation along Highway 95 to Duelm;

e) a 69 kV line along Highway 169 between the Princeton substation and the Milaca substation;

f) a 69 kV line along Highway 23 eastward to Ogilvie;

g) a short double circuited 69 kV line out of the Milaca substation that bifurcates into a 69 kV line that continues northward along Highway 169 to Onamia and a 69 kV line that turns westward to follow County Road 22 through Granite Ledge and Brennyville, then goes south through North Benton and Gilman;

h) a 69 kV line from Becker through Foley and Duelm splits south of Gilman going west to Mayhew and north to Gilman;

i) a 34.5 kV line from Sauk Rapids, through Popple Creek to Foley; and

j) a double circuited 115 kV line from the Benton County substation to the west that branches later to form two single circuited 115 kV lines, the first going to St. Cloud Substation and Becker and the second going to Granite City Substation and West St. Cloud.

United Power Association operates all of these transmission lines with the exception of the 34.5 and 115 kV lines which belong to Northern States Power. See Figure 2-19.

2.12.5 Pipelines

Two natural gas pipelines and one petroleum pipeline traverse the study area. Northern Natural Gas operates a 16 inch natural gas pipeline between North Branch and the intersection of this line with a north-south line approximately 10 miles west of Foley. Midwest Gas Transmission Company transports natural gas through a 24 inch pipeline from the northwest corner of the state southeastward through Chisago County enroute to Marshfield, Wisconsin. In addition, crude petroleum is transported by the Minnesota Pipeline Company through a 16 inch pipeline for 256 miles between Clearbrook and Cottage Grove.

All of these pipelines will be crossed by the proposed 230 kV transmission line at one point or another as Figure 2.15 illustrates. However, there will be no noticeable impact upon them.

2.12.6 Radio and Television Stations

The following television stations serve the study area:

KCMT, Alexandria, Channel 7, 316 kw visual, 63.1 kw auditory;

KMSP, Minneapolis-St. Paul, Channel 9, 187.26 kw visual, 191.76 KW auditory;

KSTP-TV, Minneapolis-St. Paul, Channel 5, 100 kw visual, 15.1 kw auditory;

KTCA, Minneapolis-St. Paul, Channel 2, 100 kw visual, 20 kw auditory;

WCCO, Minneapolis-St. Paul, Channel 4, 100 kw visual, 15.1 kw auditory;

WTCN, Minneapolis-St. Paul, Channel 11, 316 kw visual, 45.7 kw auditory.

The following local radio stations serve the study area in addition to numerous ones from the Minneapolis-St. Paul area:

KABG (FM), 105.5 mhz, Cambridge, 3 kw;

WQPM (AM), 1300 khz, Princeton, 1 kw;

WQPM (FM), 106.3 mhz, Princeton, 3 kw;

KCLD (AM), 1450 khz, St. Cloud, 1 kw;

KCLD(FM) 104.7 mhz, St. Cloud, 100 kw;

WJON (AM) 1240 khz, St. Cloud, 1 kw;

WWJO (FM) 98.1 mhz, St. Cloud, 100 kw;

WHMH (FM) 101.7 mhz, Sauk Rapids, 3 kw;

WVAL (AM) 800 khz, Sauk Rapids, 250 kw;

The problem of possible radio and television interference caused by the 230 kV transmission line is discussed in Section 4.3.3.

2.12.7 Long Distance Telephone Cables

Three telephone companies operate their own long distance telephone facilities in conjunction with their ubiquitious local telephone lines in the study area. Northwestern Bell Telephone Company maintains long distance telephone cables buried along the southern shoulder of Highway 23 between St. Cloud, through Milaca, to Pine City. The Sherburne County Rural Telephone Company has long distance facilities in the vicinity of Highway 95 in Glendorado and Greenbush Townships. Continential Telephone of Minnesota maintains long distance cables between Milaca and Pease. See Figure 2.19 for details. The impact of the 230 kV transmission line upon long distance telephone service is discussed in Section 4.3.2.

2.13 Archaeological and Historical Sites

No officially designated archaeological or historical sites exist within the proposed transmission line route corridors.

There are no known archaeological sites within the study area. Currently, the Minnesota Historical Society is conducting a comprehensive statewide survey of archaeological and historical sites; however, Benton and Mille Lacs Counties have not been surveyed yet. However, archaeological site surveying experience throughout Minnesota shows a high correlation between prehistoric archaeolgoical sites and permanent natural water courses, such as lakes and rivers, that exist now or did in the past. In addition, a recent literature survey commissioned by the Minnesota Department of Natural Resources, A Cultural Resource Records Check of the Rum River, indicates a number of possible historical and archaeological sites on the shores of the Rum River. Therefore, although there are no known archaeological sites within the study area, the data are incomplete. Future field research may unearth some sites.

The Mille Lacs County Courthouse in Milaca and the Great Northern Railroad Depot in Princeton are listed on the National Register of Historic Places. A charcoal kiln on the western edge of Ronneby is a candidate for national historic registration. Other historic places within or near the proposed route corridors include the Benton County Courthouse and St. John's Catholic Church in Foley, the site of an early sawmill on the west bank of the Rum River at the Forest Hill Cemetary in Milaca, and the Lutheran Church and cemetary on county road 3 southwest of Popple Creek.

2.14 Parks

There are no national, state or county parks within the study area.

2.15 PUBLIC, DESIGNATED NATURAL AREAS

2.15.1 Federal Lands

There are no federally designated natural areas such as wilderness areas or national wildlife management areas within the study area.

2.15.2 State Lands

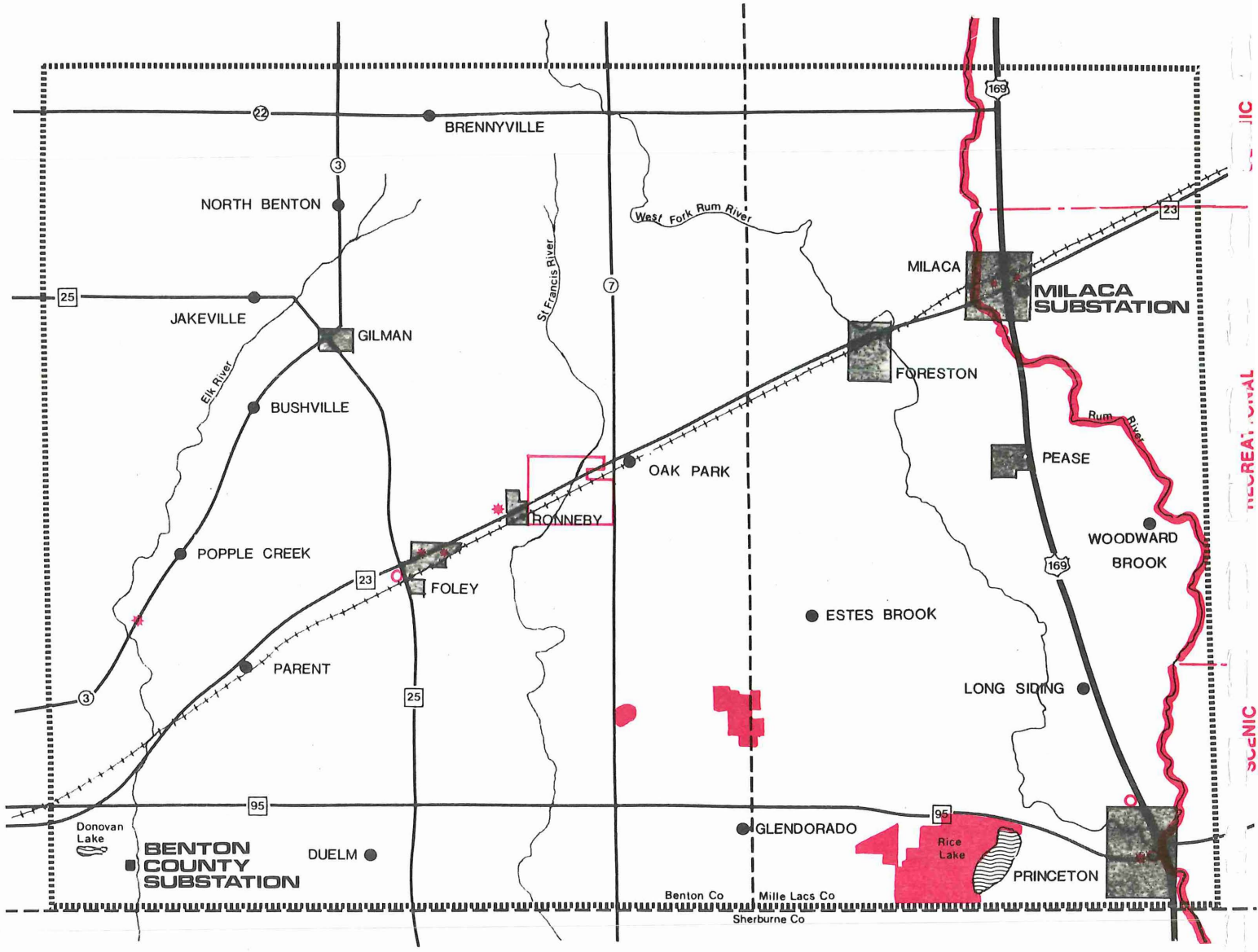
State designated natural areas within the study area are limited to the Rum River Wild and Scenic River, the Maywood Game Refuge, a state rest area south of Milaca on Highway 169, and three state wildlife management areas. Please see Figure 2-20.

2.15.3 Rum River Wild and Scenic River

The entire length of the Rum River and its adjacent land is designated under the Minnesota Wild and Scenic Rivers Act in recognition of the natural attributes, scientific value, history and recreational value of the river. The Department of Natural Resources regulates land use and sets minimum standards for new development along the Rum River's banks and for any river crossings. However, this project is not required to obtain a river crossing permit under the Minnesota Wild and Scenic Rivers Act because it is exempted due to its size by Minnesota Regulation N.R. 79 i (1) (bb). Notwithstanding this fact, the Department of Natural Resources believes that the applicant should comply with all the requirements of Minnesota Regulations N.R., 79(i) of the Minnesota Wild and Scenic Rivers Act to the greatest extent possible during the route selection process and construction of this line.

Those portions of the Rum River and adjacent lands from the Mille Lacs CSAH 20 bridge to the Mille Lacs CSAH 9 bridge, and from the Mille Lacs CSAH 13 bridge to the southern border of the Anoka County Fairgrounds in the City of Anoka, are classified scenic. The portion of the river between the CSAH 9 bridge and the CSAH 13 bridge is classified recreational. See Figure 2-20 for details.

The Department of Natural Resources is in the process of purchasing scenic easements in order to further guarantee the preservation of scenic qualities of the Rum River. These scenic easements give the Department of Natural Resources development rights, usually, to about 400 feet from the shore. The standard scenic easement contract prohibits the property owner from altering the natural landscape or erecting buildings within the scenic easement area without written permission form the Commissioner of Natural Resources. In addition, the owner cannot grant any other easements for any purpose, including roads and transmission lines, without the written authorization from the Commissioner of Natural Resources.



PUBLIC, DESIGNATED NATURAL AREAS

- STUDY AREA
- D.N.R. WILDLIFE MANAGEMENT AREAS
- STATUTORY GAME REFUGE
- STATE REST AREAS
- OTHER PUBLIC REST AREAS
- HISTORIC SITES
- WILD AND SCENIC RIVER

NORTH

Miles
0 1/2 1 2
0 1.6 3.2 6.4
Kilometers

FIGURE 2.20

Presently, a scenic easement is held on property owned by the Forest Hill Cemetary a quarter mile north of the railroad tracks on the west bank of the Rum River in Milaca. This property, however, is not within a route corridor. But the Department of Natural Resources recently signed an option to purchase a scenic easement for property located in Township 38N, Range 27W, Section 1 which is within the northern most proposed crossing area.

2.15.4 State Wildlife Management Areas

The Department of Natural Resources administers three wildlife management areas within the study area in order to preserve wetlands and to provide migratory waterfowl habitat. These management areas are:

1. Kunkel State Wildlife Management Area consisting of 1,947 acres in Mille Lacs and Sherburne Counties west of Rice Lake;

2. Ben Lacs State Wildlife Management Area consisting of 531 acres straddling the Benton and Mille Lacs County boundary; and

3. Bible's State Wildlife Management Area, a 68 acre parcel surrounding Bible's Slough in Glendorado Township. None of these areas are crossed by any of the proposed transmission line routes.

Unlike the state wildlife management areas, the Maywood Game Refuge is not owned or managed by the Minnesota Department of Natural Resources. Fifty private landowners around Ronneby participate in the Minnesota state game refuge program that encourages wildlife management on private agricultural land. No hunting is allowed.

2.16 Private Natural Areas

2.16.1 Nature Conservancy Areas

The Nature Conservancy, Minnesota Chapter owns or manages no properties within the study area. However, Professor Max Partch of the Department of Biology, St. Cloud State University surveyed the natural area of Benton County for the Nature Conservancy in 1973. Partch identified six parcels within the study area with significant, undisturbed natural features. Of these, only one, the Nix Woods, an 80 acre parcel on Highway 23 in St. George Township, is within a proposed transmission line corridor.

2.16.2 Private Wildlife Management Areas

Wildlife management is part of good agricultural land management. On occasion, therefore, private landowners organize themselves explicitly in order to protect wildlife and to improve habitats. The Stoney Brook Wildlife Management Area, a 1600 acre area in St. George Township, is an example. There, 27 property owners have joined together in order to improve wildlife habitat and to prohibit hunting, trapping and other forms of trespass on their lands. North of Milaca, in section 11 of Milaca Township, another landowner has posted 30 acres and built two large dikes in an effort to encourage wildlife populations. Less formal and smaller, privately owned natural areas on individual farms are scattered throughout the study area. These latter parcels are more likely to be affected accidently than the larger, formally designated wildlife areas when the proposed transmission line crosses agricultural land.

description

PROJECT DESCRIPTION

CHAPTER 3
PROJECT DESCRIPTION

3.1 Project Purpose and Need

3.1.1 Project Summary

An Application for a Construction Permit for a 230 kV alternating current high voltage transmission line (HVTL) and associated facilities was submitted by UPA to the Minnesota Environmental Quality Board (MEQB) pursuant to the provisions of the Minnesota Power Plant Siting Act (Minn. Stat. 1977, Sects. 116C.51 et seq. and 6 MCAR § 3.071-3.082: Rules for Routing High Voltage Transmission Lines and Siting Large Electric Power Generating Plants. The application was accepted by the MEQB on September 21, 1978.

Transmission Line

The proposed 230 kV transmission line would connect an existing substation which is located about five miles east of Sauk Rapids in Benton County with a substation to be upgraded by UPA on the east side of Milaca in Mille Lacs County. Depending on the route used, the proposed line would range from approximately 24.2 miles to 38.7 miles in length.

The transmission line consists of three conductors (phases) and two shield wires (for lightning protection). These conductors and wires are to be supported by structures as designated in the MEQB routing process. In its application, UPA has proposed the use of double wood pole H-frame structures, although the use of single shaft steel, concrete or wood poles is also under consideration. The right of way requirement for the proposed HVTL would vary from 80 to 130 feet, depending on the type of pole structures used and the availability of existing rights of way which can be paralleled or jointly used by the proposed line.

Associated Facilities

The Benton County substation occupies a 10 acre site and is presently owned by Northern States Power (NSP). The proposed project would require an expansion of the existing facilities to accommodate an additional transformer, busses, circuit breakers, a dead end structure, and associated equipment. The substation site in Milaca, which presently contains a 69 kV switchyard, is a 20 acre tract of land on the east side of the city. Equipment will be installed to serve the proposed 230 kV line and four existing incoming 69 kV lines. The substation will have designed capacity to serve two additional 69 kV and a new 230 kV line if projected load growth materializes.

Need

The proposed 230 kV transmission line would benefit East Central Electric Association (ECEA) and several other neighboring member cooperatives of UPA. The existing 69 kV system is presently over-stressed as a result of land growth in the service area of ECEA, and in parts of the areas served by Anoka, North Pine and Mille Lacs Cooperatives. UPA states that there also is an inadequate bulk power source in the western part of the ECEA service area. Their studies indicate that the heavy loading of the 69 kV system has created a potential for low voltage conditions over a 2500 square mile area, and has contributed to a high level of line loss on the 69 kV circuit serving the area. The proposed HVTL would help to maintain reliable service and adequate voltages on the 69 kV transmission system, assure adequate capacity for existing and projected load growths, and conserve resources by reducing line losses and by transporting surplus power to certain municipal utilities at off peak times.

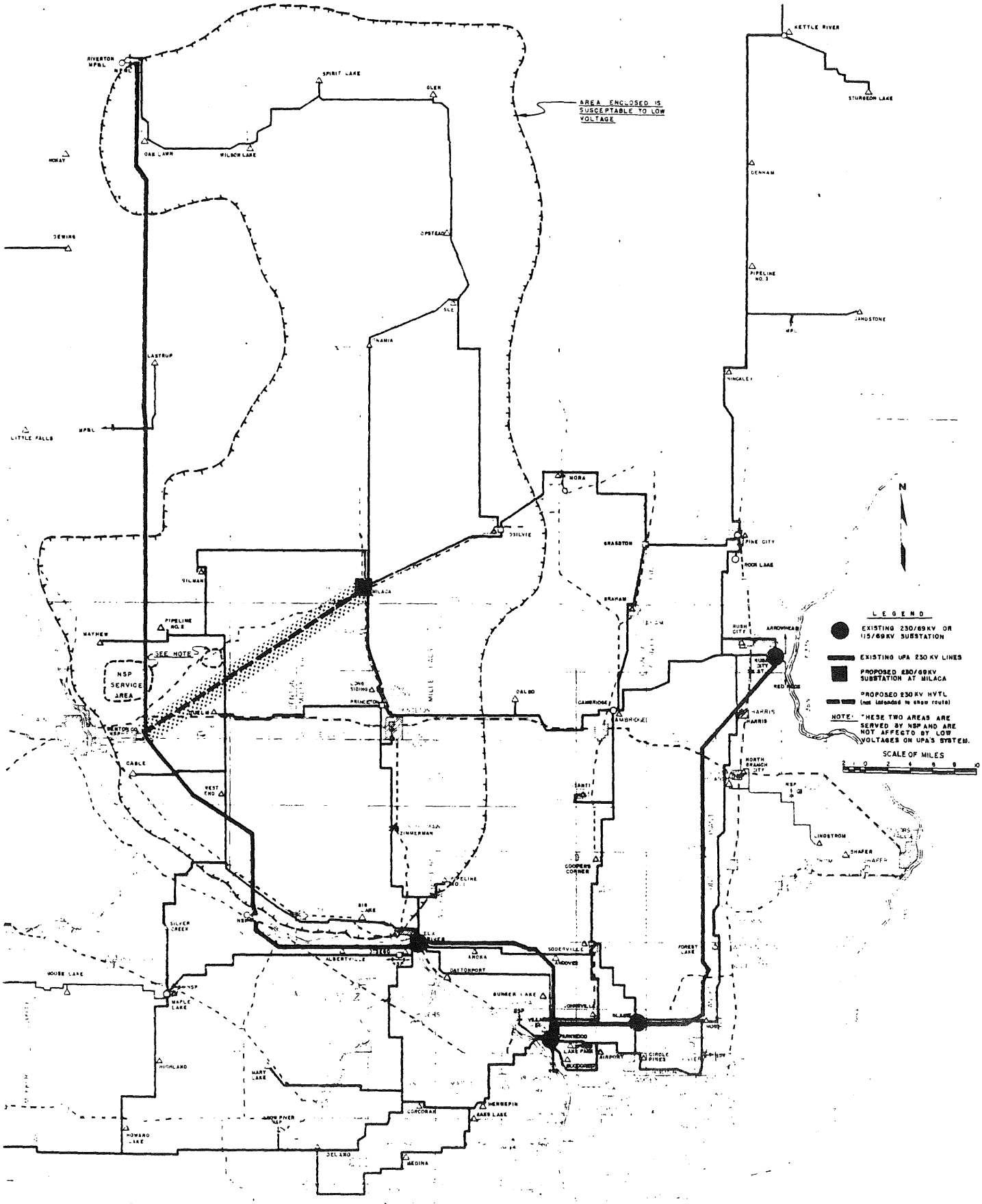
Figure 3-1 shows the 69 kV subtransmission system, the existing transmission substations, and the proposed 230/69 kV substation in Milaca.

In its application, UPA has offered evidence to justify the need for the proposed HVTL and associated substation facilities from several different standpoints. These are discussed in Sections 3.1.2 through 3.1.4.

3.1.2 Reliability

At the present time, the 69 kV system serving East Central Electric Association (ECEA) primarily receives power from two substations: Elk River in the south and Rush City in the east. The western half of the ECEA service area, which includes most of Benton and Mille Lacs Counties, does not have bulk input substations and relies on the existing 69 kV system to transport its power into this area. This places a heavy load on various 69 kV circuits, particularly those in the Elk River area, according to UPA system planners.

If an outage occurs on one of these heavily loaded 69 kV circuits, the remaining circuits in the system will pick up the load which was carried on the outaged line. However, this places an extra burden on these remaining circuits since they are heavily loaded under normal conditions. UPA studies show that low voltages can occur in certain areas during such an outage condition because the power flow is rerouted over longer than normal circuits. In addition, extra line losses will occur in these circuits due to the increased load they are carrying.



EXISTING TRANSMISSION NETWORK AND PROPOSED HVTL

FIGURE 3.1

The low voltage conditions will have direct effects on the local consumer. Some of these effects include dim lights, shrinking television pictures, overheating or possible burnout of any motor driven device such as a refrigerator, well pump, furnace motor or freezer, and inadequate heat output from electric heaters.

Figure 3-2 shows a composite of the general area which could be affected by low voltages during an outage (single contingency) somewhere on the UPA 69 kV subtransmission system. The shaded area shows the extent of low voltages for a specific single contingency, in this case an outage on the Elk River Pipeline Tap. The area indicated with horizontal lines represents the situation with a double contingency (two outages).

UPA system planners assert that the proposed project will also improve the reliability of transformer equipment in the ECEA service area.

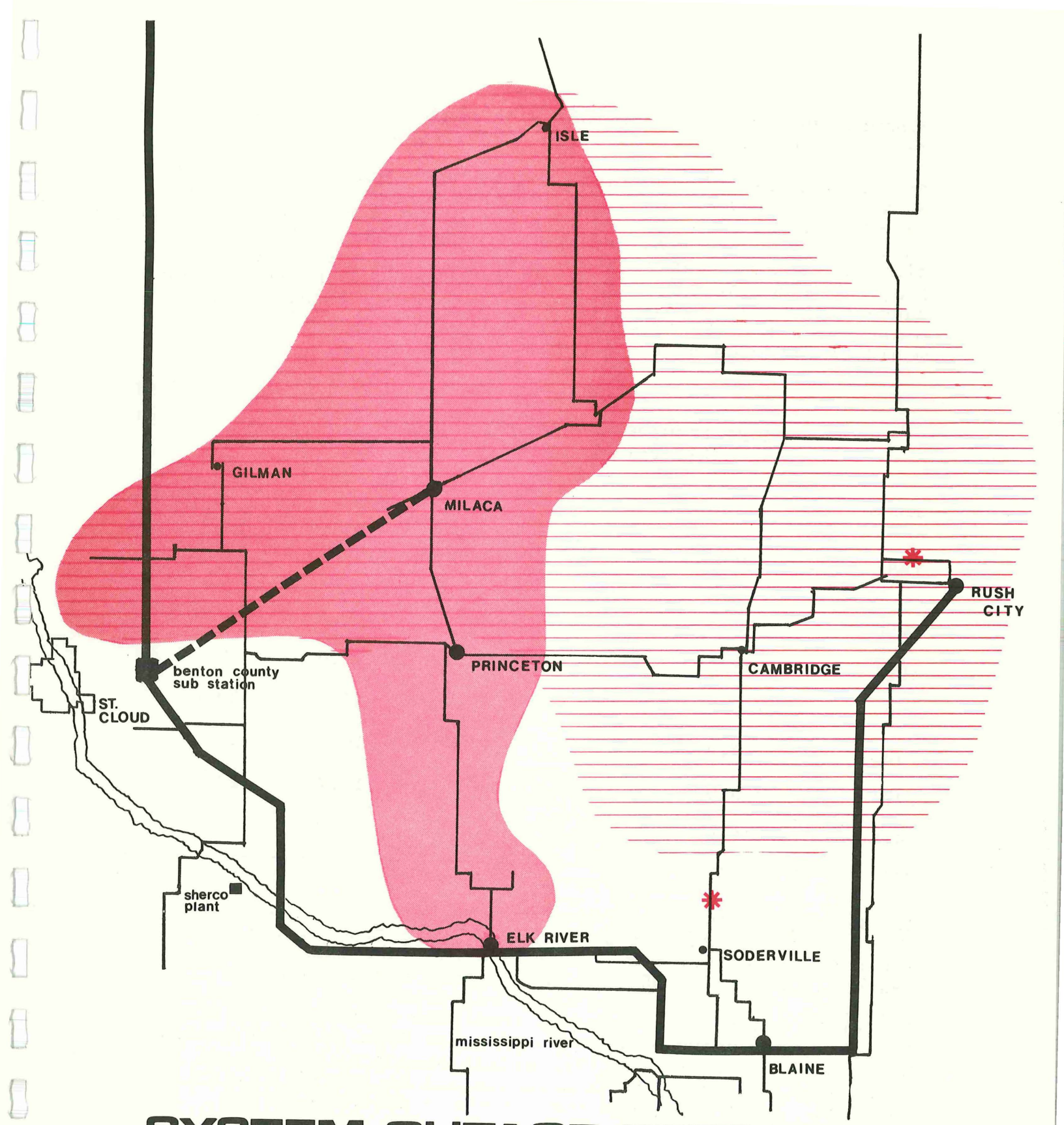
The Milaca 230/69 substation will provide support for the near future to the Elk River and Rush City areas in the event of the loss of a transformer at these stations. Until load growth requires increased substation reliability, the Milaca substation can provide the required back up for these stations, postponing the need to provide spare transformers at Elk River and Rush City.

3.1.3 Capacity for Projected Load Growth

Historical growth trends for the UPA generation and transmission system show a load growth of approximately 10% per year. Projections carried out with REA-approved and other methodologies by UPA staff and consultants indicate that load growth in the Milaca area is expected to continue at a similar rate through 1985. Based on these projections, UPA states that the Milaca 230/69 kV substation and associated 230 kV HVTL will provide adequate 230/69 kV transformer capacity and voltage support for anticipated future loads. In addition, UPA's Application for a Construction Permit indicates that every reasonable effort is being made to prolong the usefulness of the existing subtransmission system.

Load Forecasts

The demand and energy projections for UPA are prepared in compliance with the REA forecasting procedures and are based on a projection of electrical consumption. UPA and all other REA



SYSTEM OUTAGE EFFECTS

OUTAGE: RUSH CITY 230/69 KV TRANSFORMER AND SODERVILLE TAP

OUTAGE: ELK RIVER-PIPELINE TAP

OUTAGE POINTS

FIGURE 3.2

financed utilities must comply with these procedures in order to receive loan guarantees for the financing of new facilities.

The forecasting of electrical requirements which is required by REA is called a "Power Requirements Study" (PRS). The PRS is carried out with the use of a set of procedures and methodologies established by the REA, and must be submitted by all REA financed cooperatives every three years. The most recent UPA PRS, covering the years 1980-1985, was approved by the REA on January 5, 1978. Table 3-1 contains 1978 PRS forecasts of power needs for the five UPA distribution cooperatives which would be affected by the proposed HVTL.

TABLE 3-1

POWER REQUIREMENTS STUDY FORECAST
(All Values in MW's)

YEAR	ANOKA	EAST CENTRAL	WRIGHT HENNEPIN	NORTH PINE	MILLE LACS
1980	173.0	87.5	68.4	14.3	17.8
1981	192.6	93.8	76.4	15.0	19.2
1982	214.5	100.6	85.4	15.8	20.8
1983	238.8	107.9	95.4	16.6	22.5
1984	265.9	115.7	106.5	17.4	24.3
1985	296.0	124.0	119.0	18.3	26.2

In its application for a Construction Permit, UPA indicated that additional studies were done to determine if the HVTL would still be required if the load was less than that forecasted in the 1978 PRS. To obtain this reduced load estimate, a seasonal trend model was used which included actual 1977-1978 winter peak data not available in the PRS forecast. The utility concluded that the proposed HVTL is still needed to be in service before the 1981 winter season to meet loads forecasted by the adjusted estimate and to provide reliable service. Table 3-2 shows the forecasts produced by the seasonal trend model.

TABLE 3-2

LINEAR TREND FORECAST
(All Values in MW's)

YEAR	ANOKA		EAST CENTRAL		WRIGHT-HENNEPIN		NORTH PINE		MILLE LACS	
	M	H	M	H	M	H	M	H	M	H
1980	136.5	151.9	81.5	87.4	60.7	66.1	13.0	14.0	16.4	18.3
1981	145.0	161.1	85.2	91.4	64.4	70.0	13.8	14.7	17.2	19.2
1982	153.5	170.3	88.8	95.3	68.0	73.9	14.4	15.2	18.0	20.1
1983	162.0	179.6	92.5	99.5	71.7	77.9	15.0	15.7	18.8	21.0
1984	170.4	188.9	96.1	103.3	75.3	81.8	15.5	16.2	19.6	21.9
1985	178.9	198.2	99.8	107.3	79.0	85.8	16.0	16.7	20.4	22.8

M = Mean Forecast
H = Higher or upper limit (there is a 97.5% probability that the higher limit will not be exceeded)

3.1.4 Conservation and Economics

Reduction in Line Losses

The 69 kV subtransmission system serving the Milaca area was designed and built in the early 1950's and 1960's. As the demand for electricity and the subsequent load placed on the existing circuit increases beyond that for which the lines were designed, the efficiency of the conductors diminishes and line losses of substantial magnitude can occur. Losses in transmission lines occur when current passes through the conductor, creating a heating effect. This heating effect is not proportional to the current flowing through the conductor; rather it increases by a ratio of the current multiplied by itself. For example, an attempt to produce more power by increasing the current by 33% is accompanied by a 78% increase in line loss.

The 69 kV transmission lines, being of relatively low voltage in comparison to 230 kV lines, have to carry larger currents to deliver the same amount of power to the Milaca area. The effect of carrying the large currents over a 69 kV line is to cause substantial increases in losses for small increases of power flow on the line.

The pattern of losses generally follows the load use pattern, but is disproportionately high at peak use times. To counteract the higher losses at peak time, a greater margin of surplus power must be produced by peak generation units. This increases the likelihood that inefficient generating units within the UPA system, using relatively expensive fuel oil, will be called upon to produce power at peak times.

UPA states that the amount of oil saved by reducing the system losses, and the subsequent savings to UPA customers, can be substantial. With the proposed HVTL and Milaca substation in operation, the expected loss reduction and equivalent dollar savings are as follow:

Period	MW SAVED	Estimated Savings
(Nov. through Oct.)		
1981	6.71	$1,148,000
1982	8.06	$1,460,000
1983	9.69	$1,854,000

Conservation Benefits to Municipal Utilities

Two of the nine municipal utilities which are interconnected with UPA, Princeton and Mora, are in need of additional transmission support. The proposed 230 kV HVTL and substation at Milaca will effectively strengthen the 69 kV transmission system and improve its capability to transport surplus generation at off peak times to these utilities. This will help to reduce the reliance by these utilities on expensive oil or gas generation from their own units.

3.2 Design Parameters and Standards

3.2.1 Structures

In its application for a Construction Permit, UPA proposed the use of wooden, two-pole H-frame structures for the entire length of the designated route. During the Citizens' Route Evaluation Committee Process, other structure types were discussed, including single shaft steel or concrete poles. The final determination of the type of structure used will be made by the MEQB when the Construction Permit is issued.

Figures 3-3 and 3-4 depict typical lattice steel, single pole, and wooden H-frame single circuit structures of the size which could be used for the proposed transmission line. Double circuit structure configurations are also shown. The above ground height of the various structures ranges from 70 feet to 115 feet for single circuit poles, and from 105 feet to 140 feet for double circuit structures. Below ground lengths are usually equal to 10 percent of the above ground height, plus two feet. The height of individual structures will vary with topography, soil conditions and span length and will be determined at the time of final design of the line. Depending on the route and pole type, additional design modifications may be required to deal with problems such as clearance over existing commercial structures, congested rights of way, and paralleling or double circuiting of existing lines.

A series of angle and dead end structure designs will be required in addition to the tangent or straight designs depicted in Figures 3-3 and 3-4. Guying will be required for angle structures in most instances.

The utility indicates that structures can be selectively spotted as to exact location in order to minimize impacts, once the final centerline location is determined. UPA states that structure design will meet or exceed the guidelines of the National Electrical Safety Code (NESC), 1977 edition.

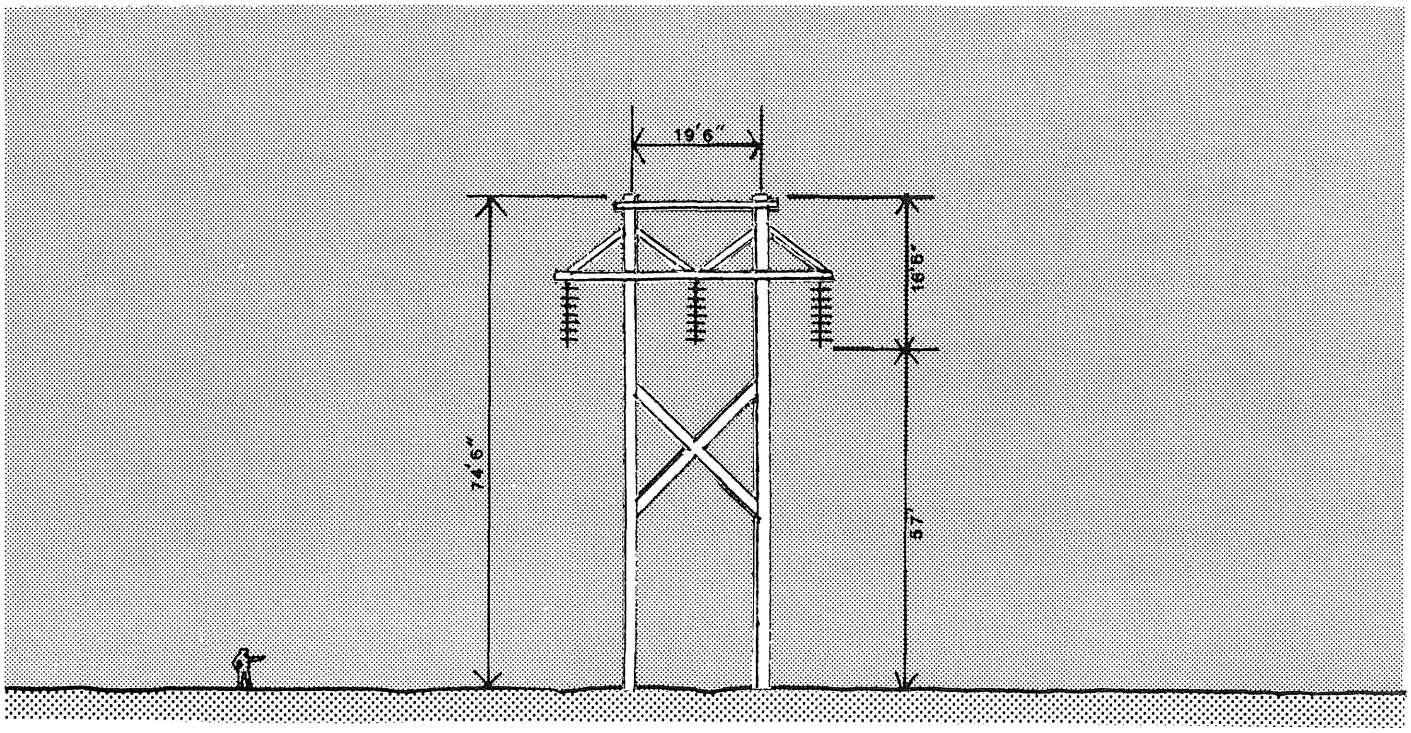
Table 3-3 compares a number of characteristics associated with the various types of pole structures under consideration.

3.2.2 Conductors

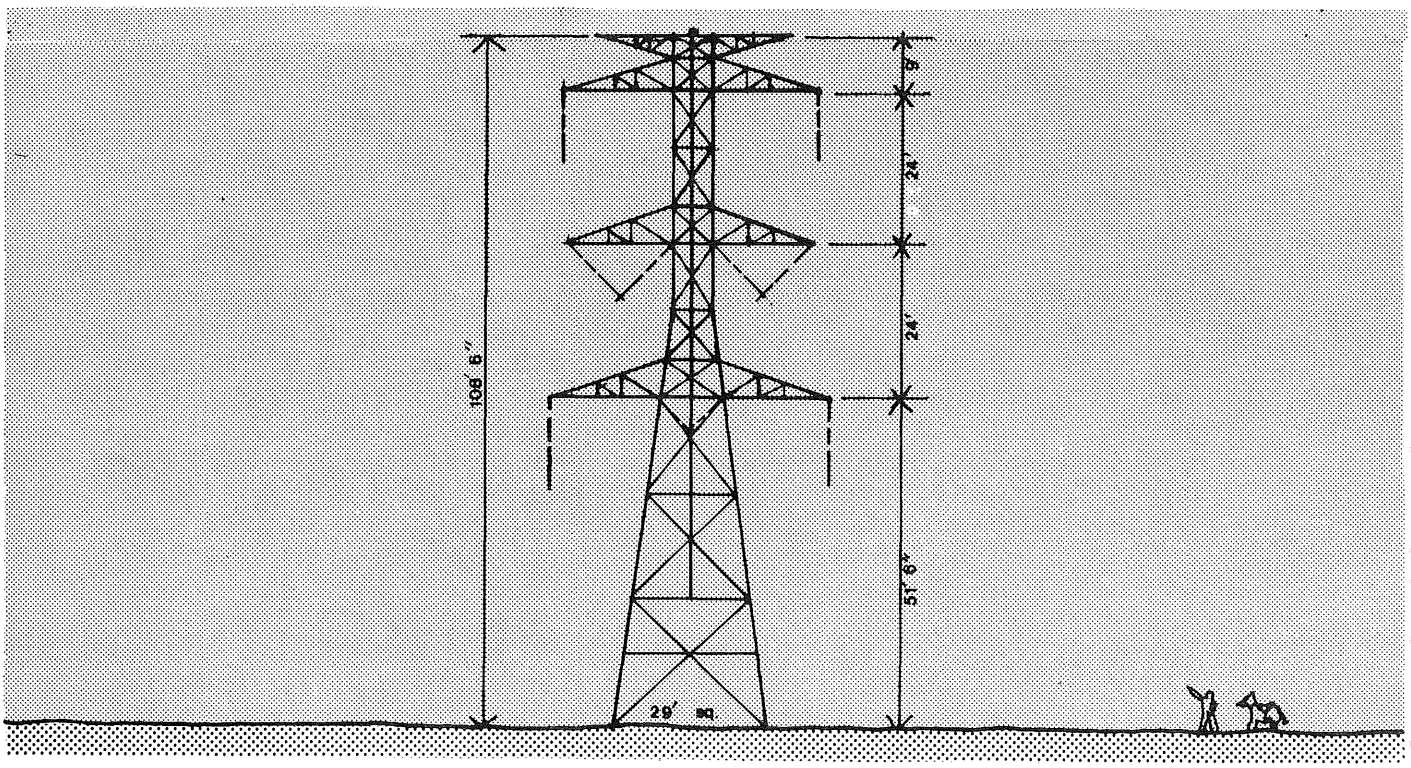
The line design indicated by UPA in its application consists of three single conductor phases using 1,272,000 circular mil (1272 MCM) aluminum steel-reinforced conductor (ACSR) with seven steel core strands and 45 outer aluminum strands. The industry code word for this conductor is "Bittern." The conductor has an overall diameter of 1.345 inches and weighs 1.44 pounds per linear foot. However, the possibility of the designation of different structures and/or routes longer than those specified in the Application, may change the final overall design of the project. This, in turn, may influence the final selection of the conductor size and design. For example, a long route of expensive design, may result in the utility seeking some offsetting economy which could involve conductor design and size.

3.2.3 Line Design

A minimum clearance of 28 feet between the ground and conductors at 212 degrees Fahrenheit conductor temperature will be maintained. Distances between structures will be approximately

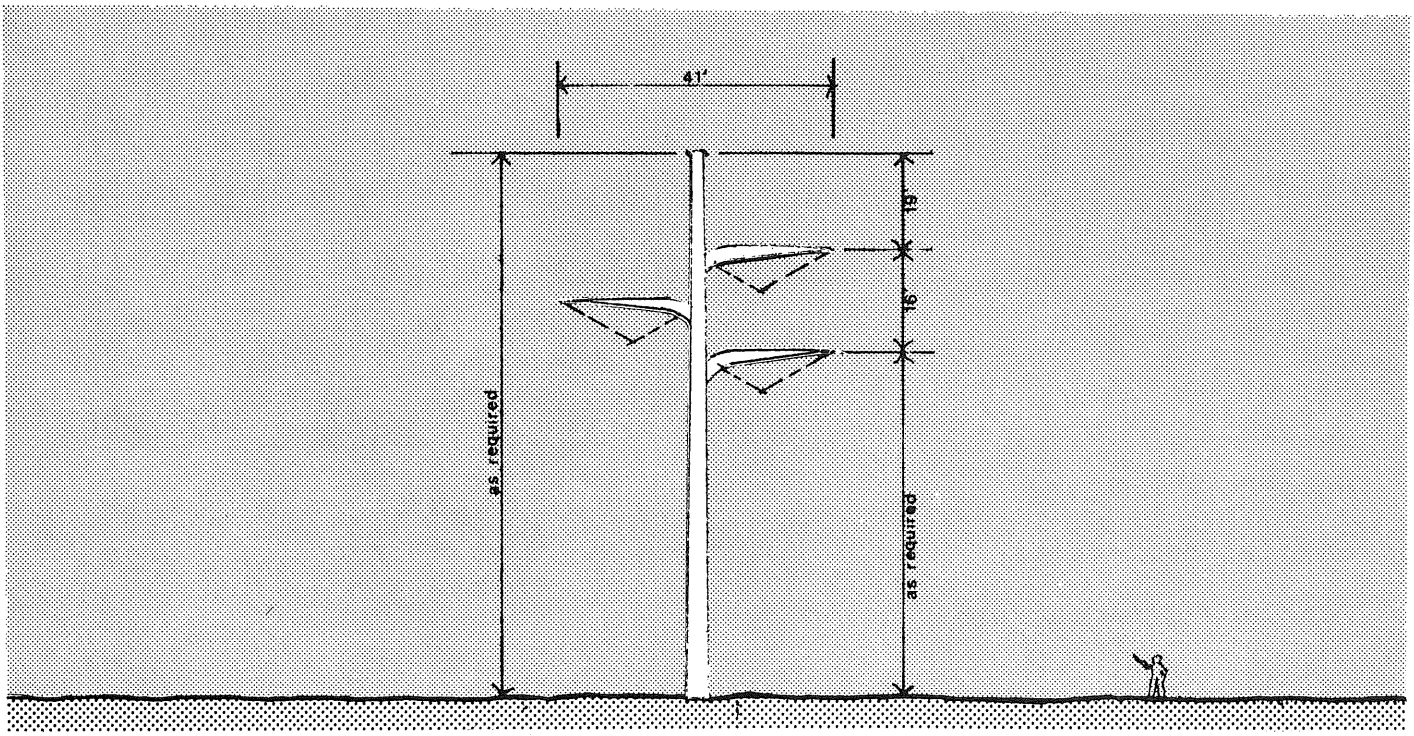


TYPICAL SINGLE CIRCUIT WOOD STRUCTURE

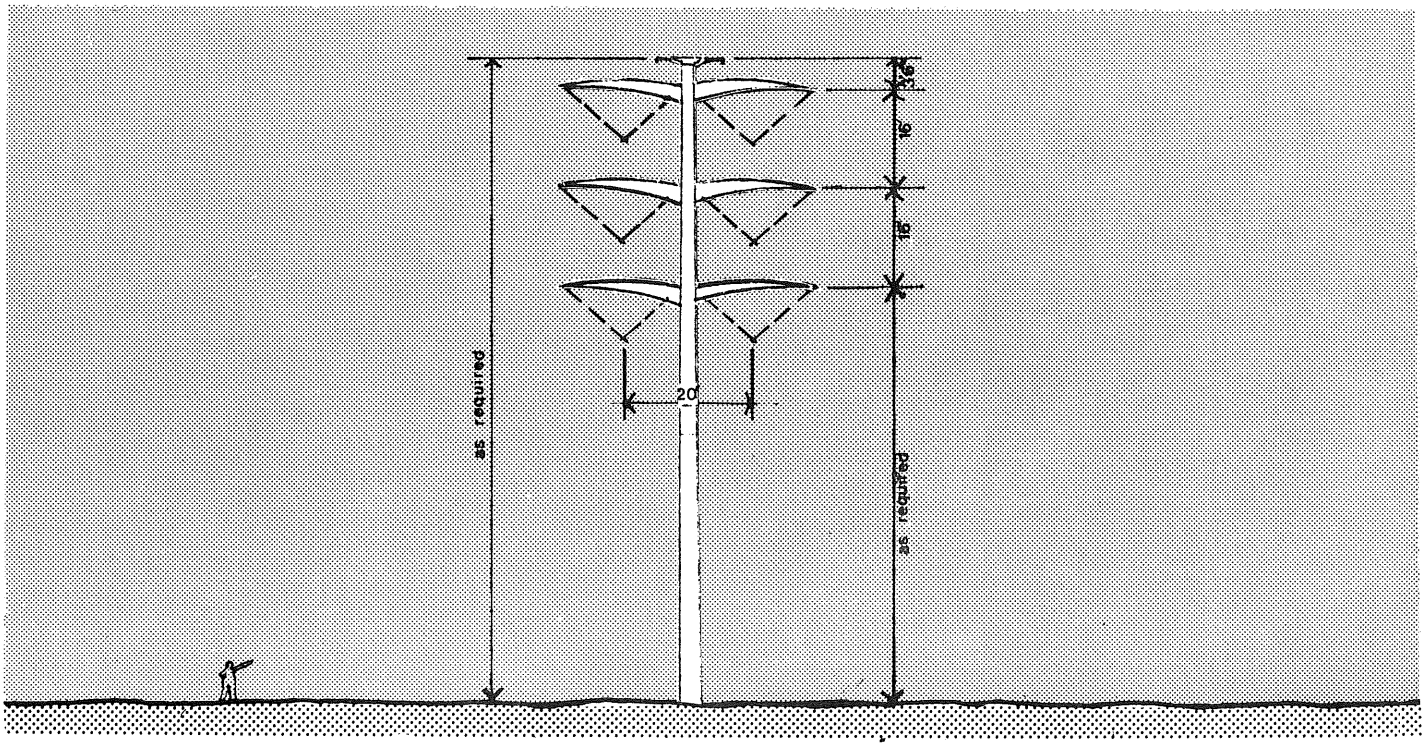


TYPICAL DOUBLE CIRCUIT LATTICE STRUCTURE

FIGURE 3,3



TYPICAL SINGLE CIRCUIT STEEL STRUCTURE



TYPICAL DOUBLE CIRCUIT STEEL STRUCTURE

FIGURE 3.4

TABLE 3-3

MATERIAL REQUIREMENTS

(per mile)

Structure Type	Estimated Material Requirements*			
	Wood	Steel	Concrete	Limestone
Wood Pole H-Frame	50	1		
Single Shaft-Steel		35	7	20
Single Shaft-Concrete		5	185	20
Lattice Steel		38	100	

*Wood and steel requirements are in tons. Concrete and limestone requirements are in cubic yards.

SOURCE: UPA (1979)

800 feet, but could vary slightly depending on the pole structure designated (See Table 3-4). Structure height and spans will also vary depending upon topography and environmental constraints, such as agricultural field crossings, stream crossings and required angles. In urban areas, line design may be modified by using shorter spans and taller poles to insure clearance of existing buildings in a congested right of way.

3.2.4 Right of Way Requirements

For single circuit design, the required right of way will normally vary from 120 to 130 feet, depending upon the type of poles used. According to utility estimates, where the transmission line can parallel or share existing rights of way, the amount of additional right of way to be acquired will be reduced to about 80 feet.

3.2.5 Material Requirements

The construction of the proposed transmission line and associated facilities will require the use of both renewable and nonrenewable resources. Renewable resources include the wooden poles, crossarms and braces utilized in the H-frame structures of wooden poles, if designated by the MEQB. Other types of pole structures (steel or single shaft and reinforced concrete) conductors, shield wires, and related hardware would require the use of nonrenewable resources. These material requirements are listed in Table 3-3.

3.3 Expansion of the Benton County and Milaca Substations

3.3.1 Benton County Substation

The existing Benton County 230/115 kV Substation was built on the 230 kV circuit which connects Monticello with Riverton to the north. A double circuit 115 kV line owned by Northern States Power Company (NSP) originates from this facility to serve the St. Cloud area.

The substation is to be expanded to accommodate an additional transformer, busses, circuit breakers, dead end structure, and associated equipment. The existing site, owned by NSP, includes 10 acres, which is adequate for the proposed expansion.

In addition to the Applicant's planned HVTL, NSP plans to make application for a 345 kV transmission line from the Sherburne County Generating Station to the Benton County Substation.

Microwave remote control may be required by the Benton County Substation. If such control is needed, a microwave tower will be installed at the Benton County Substation to receive communications from the existing UPA tower at Milaca. An intermediate repeater tower may be necessary depending upon terrain obstructions.

3.3.2 Milaca Substation

The existing 69 kV switchyard located on the east side of the City of Milaca occupies a portion of a 7-acre site on the south side of Highway 23 (Figure 3-5). A preliminary list of equipment to be installed at this site includes the following:

1. autotransformer, 230/69 kV, 60/80/100/112 MVA;
2. air break switch, 230 kV;
3. deadend structure, 230 kV;
4. bus structures, 230 kV;
5. relay and control panels;
6. supervisory control and data acquisition equipment;
7. control buildings;
8. switches, 69 kV; and
9. structure additions for 69 kV oil circuit breaker.

The substation design will allow for two future 69 kV transmission lines, one to a projected distribution substation at Day, east of Milaca, and the other to Oak Park to the west. Current plans assume a need for these substations in the early 1990's, based upon the pattern of load growth in the area. It is possible that these 69 kV lines and distribution substations may never be required if the projected load growth does not occur.

Provision will also be made for a 230 kV circuit to Rush City. This circuit is projected for the mid-1980's. This line would be constructed if existing facilities can no longer provide firm support to the Milaca area or if it is needed to supply bulk delivery requirements for the rest of the UPA system.

The Milaca 230/69 kV Substation will provide a tie from the 230 kV system to UPA's 69 kV transmission grid. Based on the overall system requirements, UPA considers this site the most suitable location for this substation.

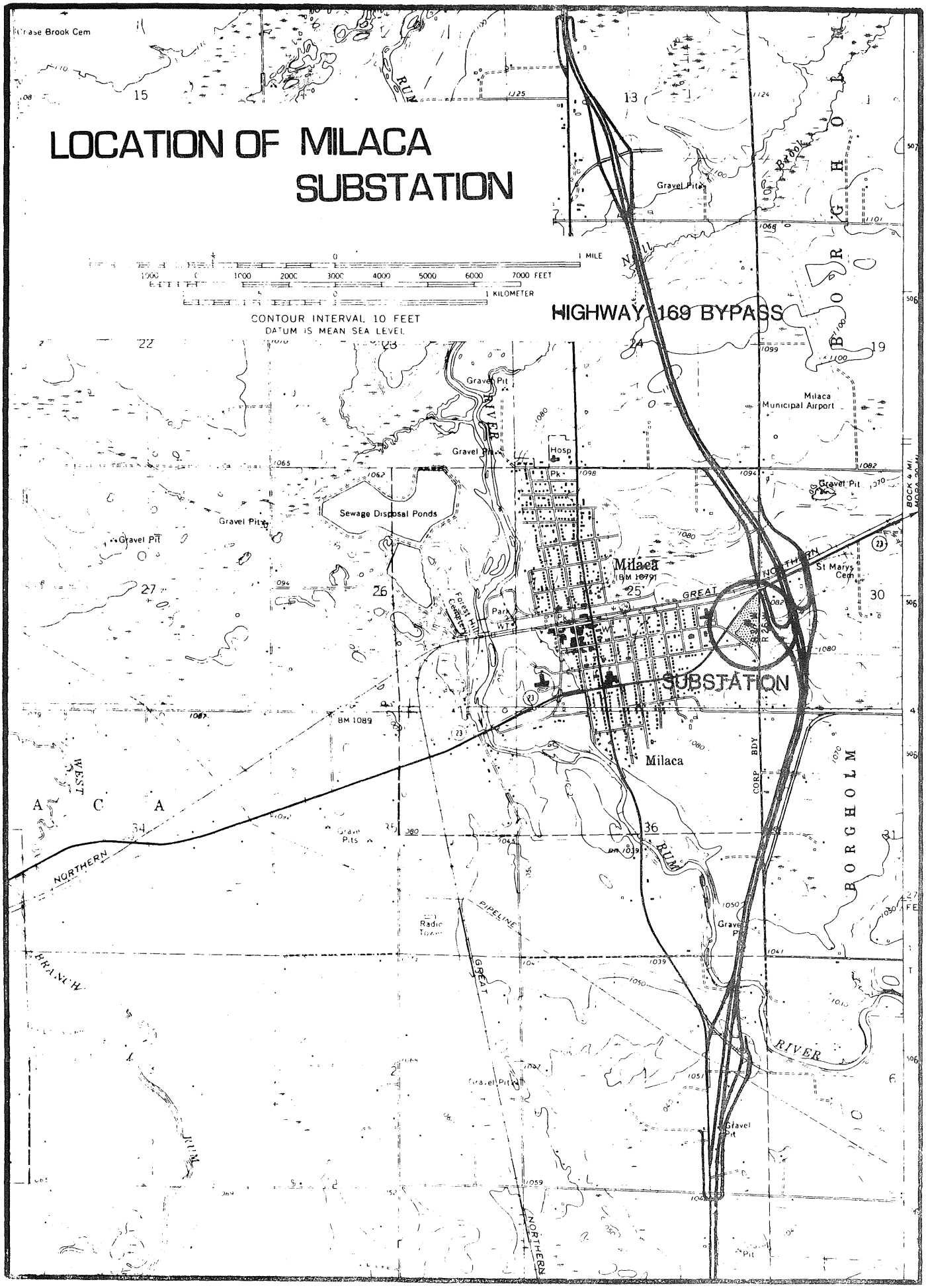

LOCATION OF MILACA SUBSTATION
HIGHWAY 169 BYPASS
SUBSTATION
Milaca
Milaca Municipal Airport
Sewage Disposal Ponds
Gravel Pit
Gravel Pits
Hosp
Park
St Marys Cem
BM 1089
BM 1079
NORTHERN
GREAT
RIVER
PIPELINE
CONTOUR INTERVAL 10 FEET
DATUM IS MEAN SEA LEVEL
1 MILE
1 KILOMETER

FIGURE 3.5

3.4 Construction Sequence and Procedures

The following material is based on information contained in UPA's Application for a Construction Permit.

3.4.1 Centerline Alignment

Following MEQB designation of a route, the Applicant's engineering, right of way and environmental personnel will determine the exact alignment of the HVTL within the route. The alignment will be determined by use of aerial photography, and by field investigation, particularly in critical areas or where photography is not sufficient.

Once a centerline alignment has been established, a plan view and ground profile drawing of the area traversed by the transmission line will be prepared from aerial photography by photogrammetric processes. In areas of dense ground cover, or where additional information to adequately describe the location of the transmission line is required, field survey crews will be used. The property owners will be contacted by UPA right of way agents prior to the survey to obtain written permission for this activity on their property.

3.4.2 Right of Way Acquisition

Once the exact alignment has been established, UPA will identify the owners of all lands for which easements are required for construction of the HVTL. Right of way agents from UPA will contact each property owner and attempt to acquire an easement by negotiation. Provisions for settlement of damages to crops, fences, livestock, roads and fields by construction activities will be discussed at that time.

Reasonable efforts will be made to secure easement rights by negotiation with the landowner. In the event a satisfactory settlement cannot be reached in a reasonable amount of time, to maintain the project schedule, UPA will initiate condemnation proceedings to acquire the easements.

3.4.3 Right of Way Clearing

Right of way clearing will follow U.S. Department of Agriculture/ Department of Interior clearing guidelines as stated in the publication Criteria for Electric Transmission Systems whenever possible. Following the acquisition of right of way, construction activities will commence and proceed in as continuous a manner as possible. The following general construction sequence will take place:

The first activity will be a ground survey to stake the centerline of the HVTL. Staking for right of way clearing will also be done at this time in areas requiring clearing. Clearing contractors will then proceed to clear the right of way as required.

Clearing of the right of way, the first major phase of transmission line construction, is necessary to provide required clearances from ground to conductor, to eliminate possible hazards to the line from falling trees, and to facilitate construction operations.

The width of the right of way will normally be 130 feet. Where the HVTL line will closely parallel and share an existing right of way, UPA estimates that the required new right of way will be 60-80 feet wide.

In general the right of way will be cleared of trees to the widths mentioned above. Tall or dangerous trees outside the cleared right of way which present a potential hazard to the line will also be removed. Where the HVTL passes through areas of low brush or swamp, the right of way clearing will normally be reduced in width to approximately the center one-third of the right of way. At major roads and stream crossings, selective cutting will be used. Such areas will be designated by the Applicant and selective cutting requirements made part of clearing contracts. Appendix F contains excerpts from REA's standard right of way clearing specifications that will be followed in the construction of the HVTL.

3.4.4 Foundation Installation

Concrete foundations may be required for the poles for the proposed HVTL, if structures other than steel lattice towers or wooden H-frame poles are designated by the MEQB. In addition, foundations for anchors used with guy wires will be required for angle structures.

The reinforced concrete drilled shafts would be dug using a vehicle mounted drilling rig capable of augering holes three to eight feet in diameter. During the drilling, the hole would be kept open by means of either temporary steel casing or a bentonite slurry. When the hole has been drilled to design depth, the reinforcing steel would be placed, and ready mix cement trucks would deliver concrete to the site for placement. The 15 to 40 cubic yards of soil excavated for each structure site would be leveled evenly around the site, or if necessary, it would be hauled away and disposed of. Alternate foundations types such as spread foundations or foundations supported on pilings may be required at structure sites where soil conditions would not support the basic foundation type.

3.4.5 Structure Erection

HVTL construction is done by separate work crews organized so that each step of construction proceeds in an orderly fashion. The poles, crossarms and braces are hauled from storage areas to structure sites by a material handling crew. Another crew will install guy anchors for angle structures. A structure assembly crew will assemble the H-frame tangent structures on the ground at the structure site. An erection crew will dig the pole holes, raise the structures into place and set them.

3.4.6 Conductor Stringing

Prior to the stringing operation, stringing dollies, which are neoprene lined sheaves, must be hung on each structure along with the required insulator assemblies.

Temporary structures, known as "guard poles", consisting of two wood poles with a crossarm between, are placed at all locations where the transmission line crosses roads, railroads or existing overhead facilities.

Lead lines of polypropylene rope are then installed between the structures in the section to be strung and are placed in the stringing dollies.

The stringing and sagging of the shield wires and conductors require 20 to 30 men and specialized equipment. A normal stringing operation will entail stringing 2 to 4 miles of line in one set-up of equipment, and will require one to three weeks to complete.

At one end of the operation, the tugger, mounted on a truck or semi-trailer, is moved into position. The tugger consists of a series of motor driven drums and reels that pull the conductors into position. At the other end of the set-up, the tensioner, also mounted on a truck or semi-trailer, is moved into position along with the conductor trailers, reel strands and reels of conductor. The tensioner consists of two motor driven wheels per conductor, which provide breaking action during the stringing operation to prevent the conductor from touching the ground, and to pull the conductor up to proper sag.

Before the conductors are strung, steel cables and shield wires are attached to the lead lines, and the tugger reels up the lead line pulling the steel cable and shield wires into position. Temporary anchors are used to secure them until the set-up is completed. The conductors are then strung, one phase at a time,

which results in either two or three conductors being strung in one operation. When all conductors and shield wires have been pulled into position, they are pulled up to the proper sag, and final attachments are made at each structure.

The construction activities discussed will be performed sequentially. It will take several months to complete all construction activities in any one section of line. Activities will not be continuous but will occur periodically as different crews move from site to site.

3.4.7 Right of Way Cleanup

Construction cleanup will be conducted on a continuous basis and will include removing excess materials and general construction debris, repairing damages done on the right of way, removing temporary guard poles, and such other activities which may be required by the MEQB in the construction permit. Construction damage settlements will then be negotiated between UPA and the individual property owners.

3.5 Right of Way and Line Maintenance

Following construction cleanup, the right of way will be restored where necessary. Restoration practices will include: grading to restore natural ground surfaces; seeding the cleared right of way with low growing species that will not endanger the line or that will benefit wildlife; and seeding those temporary access roads that will not be retained by landowners. Where the centerline of the HVTL crosses cultivated cropland or pasture land, the right of way will be available to the landowner to continue former agricultural activities.

The right of way restoration and on going maintenance programs seek to stabilize soils and control vegetation by preventing re-establishment of tall-growing species that could create a safety hazard to the HVTL or jeopardize its reliability. The Applicant will consult with the local offices of the Soil Conservation Service regarding erosion control and seeding requirements.

The general management practices outlined in the UPA Transmission Line Right of Way Management Policy (Appendix D) indicate that on uncultivated land the central portion of the right of way will be maintained in a grassy-herbacious cover. Supplemental plantings of clover and grass mixtures with potential wildlife food value will be used where desirable grasses are lacking. The outer portions of the right of way will be managed to encourage a variety of herbs, shrubs and low growing trees which have a

potential value to the wildlife found in the area. Special management practices may be used in certain unique instances and locations, such as wetlands.

Line maintenance includes routine and emergency maintenance and repair of electrical equipment, conductors and structures. UPA's maintenance program is based on a knowledge of local conditions and regularly scheduled inspections.

An aerial line patrol is conducted at six week intervals on the entire UPA system. Both aerial and ground inspection will be used to identify problems such as damaged insulators, washed-out roads, hazardous vegetation and other materials in the right of way. Emergency crews are available to repair damage so that service can be restored and system reliability maintained.

3.6 Abandonment and Restoration of Right of Way

In the event that the HVTL should no longer be needed, the transmission line will be removed. All structures will be dismantled and the conductors and other materials will be removed from the right of way. In areas where this activity could create potential for soil erosion, grading and reseeding will be performed. In natural areas, the process of vegetative succession will return the right of way substantially to its original condition. If structures reqiring foundations are designated by the MEQB, foundations will be removed to below grade to the extent required to avoid interference with existing land use.

3.7 Construction Permit

The Construction Permit issued by MEQB will establish the specific standards to which the Applicant must adhere in construction of the HVTL on the route designated by the MEQB.

3.8 Electrical Effects

The effects associated with the electrical phenomena of high voltage transmission lines can be split into three broad categories: corona effects; field effects; and proximity effects. These effects include audible noise, interference with radio and television reception in the form of "static" or "snow," and shocks ranging from annoying to fatal. Long term health problems have also been claimed to be an effect of the electrical phenomena. Electrical phenomena depend upon the current the transmission line is carrying, the voltage of the line, the weather conditions, and the design of the transmission line.

This section will characterize these electrical phenomena as they relate to this specific transmission line proposal and outline some methods of reducing these phenomena. Chapter Four will consider the general adverse effects of these phenomena and Chapter Five will consider the adverse effects in more detail as they relate to the proposed project, and the possibilities for reducing these adverse effects.

3.8.1 Corona

Corona is an electrical phenomenon occurring around the conductor and related hardware when the electrical field strength at the conductor surface exceeds a certain critical value; namely, the electrical breakdown strength of the surrounding air. This breakdown strength is highly variable, dependent on a number of atmospheric and climatic conditions, including air pressure, relative humidity, and wind. Corona does not normally occur at voltages below 345 kV.

All corona effects represent electric energy losses that must be made up by generation. The effects of corona include:

a. audible noise, characterized by a hissing or cracking sound with a hum occasionally superimposed;

b. electromagnetic interference, commonly known as static, which can disrupt AM radio and television reception in areas of marginal reception;

c. production of ozone and nitrous oxides in the air surrounding the conductors;

d. occasional visible light; and

e. conductor vibration.

Corona has been studied for many years. Sufficient knowledge is now available to minimize corona effects through engineering design and maintenance. This is more thoroughly discussed in Section 3.8.4.1

3.8.2 Field Effects

An operating high voltage alternating current overhead transmission line has associated electric and magnetic fields. Both are capable, through different "coupling" mechanisms, of inducing static charges and/or currents in nearby conductive objects. With respect to public health and safety, the electrical field is a predominant concern during normal

operation; only during a line to ground fault (a short circuit between a conductor and the ground) is the magnetic field of major concern. The normal magnetic field can, however, interfere with telephone and railroad communications equipment near the line.

3.8.2.1 Electric Fields

The electric field induces a voltage and current on conductive objects located within the field. It is present whenever the line is electrically energized; its strength is a function of the line geometry and operational voltage. The voltage that the field will induce on an object depends on the size of the object, the strength of the field, and how well the object is grounded.

According to the Applicant, the maximum electric field at ground level caused by the proposed line will be 2.82 kV/m (kilovolts per meter). This will occur about 25 feet from the centerline of the right of way. The maximum field strength at ground level at the edge of the right of way is predicted to be 0.87 kV/m. These values assume a specific design and may change slightly for other line designs. These ground level field strengths decrease with increased line height; therefore, these maximums would occur generally only near the center of each span. Also, the ground level electric field decreases with an increased distance from the line. For reference, the Minnesota Environmental Quality Board has established 8 kV/m as the maximum field strength at one meter or 39.37 inches above the ground for higher voltage transmission lines.

An electric field can induce a voltage on conductive objects. The principal known problem with this induced voltage is with large metallic objects such as farm equipment, vehicles, structures with large metal components, wire fences, etc. If such an object is not adequately grounded when a person touches it, a current can flow through the person's body to the ground. This can, depending on the circumstances, be potentially hazardous or simply result in an annoying shock similar to "carpet shock." For lines operating at 230 kV or below, this is not generally regarded to be a problem. This phenomenon is more thoroughly explored in Chapter Four.

Other concerns relating to the electric fields are the possibility of accidential fuel ignition from a spark and possible long term health effects from long term exposure to these low strength fields. These concerns are also discussed in more detail in Chapter Four.

3.8.2.2 Magnetic Fields

The magnetic field associated with transmission line operation can induce currents and voltage in long, parallel conductors such as fences or telephone cables. The induced voltage is dependent on line geometry, the current carried on the line, the distance to the conducting object, the length of parallel, the grounding of the conducting object, and the shielding of the conducting object. According to United Power Association, the maximum calculated ground level magnetic field produced by the normal operating current is 0.15 gauss.

The one situation representing a potential public safety hazard is associated with a line-to-ground fault (a short circuit between a conductor and the ground, that causes extremely high and unequal currents to flow in the conductors. This high current induces hazardous voltages on parallel conductors for as long as the fault continues. Normally such a fault will cause the line to be disconnected from its power supply within about one-fourth of a second.

The operation of telephone cables and other cable communication systems can be affected by both the magnetic fields occurring during normal operations and the much larger magnetic fields occurring during a fault. These effects are more fully discussed in Chapter Four.

3.8.3 Physical Proximity Electrical Hazards

Since the transmission line will operate at 230,000 volts, physical contact with the line would be fatal. Touching any equipment in direct contact with the line would likewise be hazardous. These concerns are discussed more fully in Chapter Four.

3.8.4 Mitigating Measures for Electrical Effects

When the electrical effects of a high voltage transmission line are a problem, they can be reduced in a number of ways. Some of these measures, however, may reduce one effect (for example, electric fields), while increasing another effect, (for example, magnetic fields). Thus, electrical effects cannot be eliminated entirely, but some compensation or design adjustments can be made to minimize them.

3.8.4.1 Corona Reduction Measures

Electric field strength at the conductor surface is the only variable that affects corona loss that can be controlled by the utility. In addition, the utility can control the impacts of corona effects by controlling the distance between the conductor and any people, animals, or crops. Since corona is not a problem for 230 kV transmission lines, these mitigating measures will not be discussed further.

3.8.4.2 Electric Field Reduction Measures

If the ground level electric field is a problem, its strength can be reduced by lowering the line's operating voltage, by moving the conductors further away from the ground, or by adding shielding between the line and the ground.

As mentioned previously, the electric field of a transmission line is a function of the voltage of the transmission line. Therefore, reducing the voltage of the transmission line will reduce the electric field cause by the transmission line. Reducing the operating voltage would require an increase in the current carried by the line (assuming the capacity for transmitting power is to remain the same). This increased current would require larger conductors and, therefore, increase the cost of the line, increase the energy losses of the line, and increase the magnetic fields caused by the line. Because of the greatly increased costs and energy losses accompanying a reduction in voltage, this method of reducing the electric field strength is normally not utilized.

The electric field strength under a transmission line is roughly proportional to the inverse of the distance from the transmission line conductors. Therefore, the higher the conductors are the lower the field strength at ground level will be. Another commonly used method of controlling exposure to the electric fields is to increase the width of the right of way to reduce the electric field strength at the edge of the right of way.

The third way to control the ground level electric field strength is to install ground wires between the conductors and the ground. These wires "shield" the ground from the electric field. This method is normally used only in extreme cases.

3.8.4.3 Magnetic Field Reduction Measures

Magnetic Fields During Normal Operation

When the normal magnetic fields caused by a high voltage transmission line are a problem, the only ways of reducing the field strength at the object, short of reducing the current in the transmission line, are to either move the conductors further away from the object experiencing the problems or to shield the object from the magnetic field.

As in the case of the electric field, increasing the distance between the transmission line conductors and the object affected by the magnetic field will reduce the strength of the magnetic field. This can be done either by increasing vertical or horizontal distance between the conductors and the object, or

by moving the object. If this is not a practical solution, the object, e.g., a communications cable, can be electrically shielded by a metallic sheath. The exact combination of these measures used depends on the specific conditions encountered.

Magnetic Fields During Faults

As mentioned previously, the magnetic field during a ground fault is much greater than during normal operations. Besides using the measures mentioned above, the effects of these magnetic fields can be reduced by insuring that the transmission line is de-energized as quickly as possible when a fault occurs. Presently available protection equipment will accomplish this in less than a quarter of a second.

3.9 Cost Analysis

The costs of electrical transmission arise from two general activities: construction and operation. The costs which will be examined in this section will be primarily those associated with the basic construction costs of this project. The costs will also vary depending on the characteristics (including length) of the route which is designated. Operational costs depend upon maintenance requirements, line losses, and assessed taxes. These, too, vary with the length of the line.

3.9.1 Construction Costs

The various components of construction costs are described in the following sections. Table 3-4 includes an estimation of design, engineering, materials, right of way clearing and construction costs.

Since precise cost estimation is largely dependent on such factors as the final design and location of the line, the figures given are only approximations, and should be used only for relative comparison among pole types.

The cost of constructing the HVTL on any of the proposed routes, using wooden H-frame structures, is estimated to be approximately $110,000 per mile (including structures and labor, only, in 1978 dollars).

Lattice towers would cost approximately $161,000 per mile. Reinforced concrete single shaft pole structures are estimated to cost about $135,000 per mile, while single shaft steel poles would be approximately $216,000 per mile.

Right of way clearing and preparation is estimated by the Applicant to cost $11,000 per mile in areas which are heavily wooded, and approximately $7,000 per mile over right of way which requires only light to moderate clearing. This cost is included in the amounts listed above for the various pole types.

3.9.2 Right of Way Land Costs

The actual cost of easements for the final right of way will depend on a number of different factors, including: present land use, number and type of structures to be placed on a parcel of land, terrain, accessibility, prevailing market prices, and the arrangements negotiated between the landowner and the utility. However UPA roughly estimates that the right of way land easement costs will range from $500,000 to $610,000 for the five main routes under consideration (Routes A, A', B, C and D).

3.9.3 Other Associated Costs

Two of the proposed routes, A and D, contain long distance telephone cables and/or railroad facilities which could be affected by the placement of the HVTL in those routes.

Induced current from the electromagnetic field of the energized transmission line, and the possibility of large current surges in the vicinity of the telephone cables in the event of a fault on the HVTL make it necessary to take measures to protect these facilities. This problem is more thoroughly discussed in Section 3.7.3, Chapter 4 and Chapter 5.

Protective measures, which range from adding grounding or shielding to the affected facilities, to completely relocating portions or all of the Northwestern Bell telephone cable along Highway 23, could substantially increase the costs associated with the construction of the HVTL on Route A. Additional expenses, but of much lower magnitude, may also be necessary on Route D to protect a length of telephone cable along Highway 95.

Telephone Cables

The total replacement cost for relocating the Northwestern Bell cable on Route A could be as much as $850,000. However, since the existing cables are 10 yeas old, about half their projected life, and since new and better cables would be installed in the new location, the actual depreciated cost charged to the HVTL project would be only a portion of this to figure. In the cases such as this, the apportionment of expenses are typically a matter of negotiation between the utilities involved.

Railroad Signal System

Although the Burlington Northern Railroad tracks along Route A are not presently equipped with road crossing signals, it is possible that a system will be added in the future. Burlington Northern estimates that the cost of protecting the railroad signals from induction interference ranges from $17,000 to $172,000 (1978 dollars), depending on the method used. If the railroad installs the signals after the HVTL is built, it is likely that this expense would be shared by BNRR and the utility.

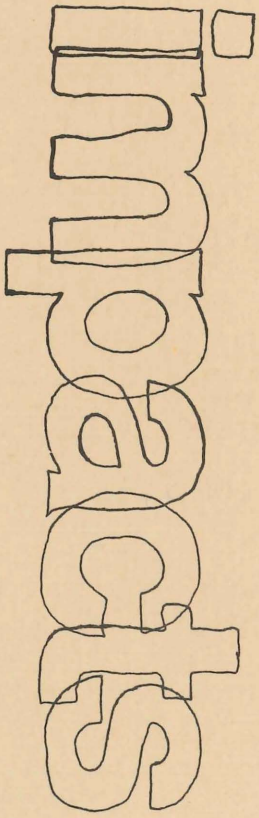
TABLE 3-4

		Characteristics				Foundation Requirements		Material and Installation[2] Cost/Structure (1978 dollars)					
		# Per Mile	Total Above Ground Height	Land area Per Base	# guys (range) On guyed structures	Direct embed	Concrete	Tangent[3]	light (3-30°) angle guyed	light (3-30°) angle unguyed	heavy (30-90°) angle guyed	heavy (30-60°) angle unguyed[4]	total[5] cost per mi.
Single Circuit (S.C.)	H-Frames	6.4	70-90'	44-88 ft^2	2 - 20	Yes		14,500	5,500	NA	7,900	NA	140,000
	Lattice Towers	5.5	85-110'	900 - 1000 ft^2	NA	No	Yes	25,000	NA	37,000	NA	58,000	161,000
	Steel Poles	5.5	95-115'	10-50 ft^2	1 - 14	Yes		33,700	9,200	61,600	15,800	165,000	216,000
	Concrete Poles	6.5	90-110'	10-50 ft^2	1 - 14	Yes		21,000	6,500	NA	11,200	NA	135,000
Double Circuit 23 /230[1]	H-Frame	NOT APPLICABLE											
	Lattice Towers	5.5	115-140'	1500 - 2000 ft^2	NA	No	Yes	Use multiplier of 1.3 x S.C.					
	Steel Poles Possible 2 Poles	6.5	105-120'	15-100 ft^2	1 - 14	Yes		Use multiplier of 1.7 x S.C.					
	Concrete Poles Possible 2 Poles	8.	95-105'	15-100 ft^2	1 - 14	No	Yes	Use multiplier of 1.6 x S.C.					

1 Add to these figures, if appropriate, the cost of $40,000 per mile (1978 dollars) to remove the MR line.
2 Any costs given here are to be used only for relative comparison among themselves.
3 These costs are costs/structure for a line with only tangent structures, i.e., conductor and other misc. construction costs are included. These costs exclude Engineering, Administration and ROW/Environmental costs.
4 Preliminary estimate only; detailed design of each application is required.
5 Includes design, engineering, ROW clearing and construction costs; does not include costs for ROW easements and environmental requirements.

SOURCE: UPA

GENERAL ENVIRONMENTAL AND SOCIAL IMPACTS



CHAPTER 4
GENERAL ENVIRONMENTAL AND SOCIAL IMPACTS

4.1 Introduction

Various impacts on the natural and human environment, human settlement patterns and economic activities have been attributed to high voltage transmission lines and associated facilities. The impacts, which may be direct or indirect, can occur at any of several phases of the project. Impacts on the natural or man-modified environment can be brought about by:

a. Acquiring land or property rights to accommodate the transmission facilities;

b. Installing the facilities, including clearing and preparing construction sites and access routes, delivering materials, building tower foundations, assembling and erecting towers, stringing conductors, and laying counterpoise;

c. The physical presence of the facilities;

d. Operating the facilities;

e. Maintaining and repairing the facilities; and

f. Managing the land on which the facilities are located.

Chapter 4 will describe, from a general standpoint, the spectrum of the impacts which could result from the proposed project. Chapter 5 describes the features of each proposed route segment, and summarizes the type and magnitude of various impacts which might be expected to occur on each of the five basic routes under consideration.

4.2 Impact on Human Settlement

High voltage transmission lines may cause a variety of potential impacts on the human urban environment. Generally, the impacts are confined to the right of way and land immediately adjacent to the right of way. Effects of the visual impact of a transmission line, however, are related to local features, including topography and land use, and may extend some distance from the right of way. The main types of potential impact on human settlement which have been attributed to HVTLs are identified in the following paragraphs.

4.2.1 Population Centers

Urban areas and residential dwellings place numerous constraints on transmission line routing. The National Electrical Safety Code and the Minnesota State Electrical Code specify minimum safety clearances to be maintained between transmission line conductors and all buildings and structures. These clearance standards vary with the type of structure and land use of the area crossed by the right of way. It is often not possible to locate transmission line routes through urban concentrations without the acquisition and removal of existing structures, particularly in residential areas. In addition, required safety clearances prevent the possibility of most types of new construction within the right of way for a 230 kV transmission line.

Activities during the construction of the transmission line also constitute a temporary negative impact in areas of concentrated population. These include the traffic, noise, dust and physical disruption which can occur with any construction project.

4.2.2 Land Use

High voltage transmission lines may influence urban land use patterns, particularly in areas that are not fully developed. The tangible impacts upon adjacent lands are difficult to measure, however, due to the large number of variables which can precipitate land use changes. Nonetheless, it is clear that HVTLs cause physical disruptions, linear constraints along the right of way for future land uses, and negetative public attitudes toward an area crossed by a transmission line. In addition, there is a possibility that land values may diminish as a result of the real and perceived effects of HVTL's.

However, the consequences of a transmission line right of way may not be entirely negative. In some situations, it may be possible to combine careful line routing with effective land use planning to take advantage of the linearity of transmission lines as a buffer or as a transition between different land uses.

In general, the impact of a high voltage transmission line on land use depends upon the perceived compatibility of the line with the setting. The greatest adverse impacts tend to be associated with the placement of HVTLs in low density residential areas; the least impacts occur when lines cross industrial or certain types of institutional lands, e.g., sewage treatment facilities or transportation corridors.

4.2.3 Easements and Land Values

The construction of a high voltage transmission line changes the use and character of the land over which it passes, and the purchase of a utility right of way alters the landowner's rights to his property. But it is not entirely clear to what extent the presence of the transmission line and the easement influence the future real estate value of the property.

Once the precise location of the transmission line is determined, the utility must acquire, whether by voluntary sale or by involuntary eminent domain proceedings, an easement, i.e. legal property rights, for the use of required rights of way. Since the transmission line uses only a portion of the land over which it passes, fee simple ownership is not necessary. However, negotiated easement prices can be equal to or more than the normal purchase price for the land itself, and may include additional payments based on the number and type of poles on a parcel of land. In addition, the utility is liable for specific damages to crops and to the land caused by construction and maintenance of the transmission line.

The most immediate legal consequence of granting an easement to the utility is the loss of rights to the land. Thus, when the landowner sells his property, he is selling something less than what he originally purchased. The purchaser of the land acquires the obligations in the form of rights relinquished by the original owner. In this respect the presence of a utility easement, obviously, lowers the real estate value of the land.

In addition to these legal implications, the actual presence and operation of the transmission line may have an influence upon the selling price of the property.

As discussed in Section 4.3.1, transmission lines may create land management difficulties when located on agricultural land. The landowner must adjust his operations in order to minimize safety hazards, loss of productive crop land and loss of time. In addition, the transmission line is an obstacle which may make future changes such as the installation of a new irrigation system or the subdivision of property for housing difficult or impossible. The consequent loss of opportunities could have an impact upon the value of the land, especially for a new owner who may wish to alter the present land use.

Finally, the impact of transmission lines upon aesthetic values, especially in residential and scenic areas, may have an important influence upon future land values. Since few potential buyers are likely to perceive transmission lines to be aesthetically pleasing, the existence of the line may tend to depress the land values.

Studies of the impact of utility easements upon land values have been inconclusive. Due to the large number of variables which affect land value, no reliable quantitative measure is yet available. Nevertheless, it is likely that the presence of high voltage transmission lines do not add to land values and in most cases would tend to depress them.

4.2.4 Transportation Systems

Airports and communication facilities may be affected by transmission lines. The Federal Aviation Administration and Minnesota Department of Aeronautics have established relatively complex restrictions on the distance and orientation of any structure located within airport approach zones. Power line equipment may also affect ground-to-air communication and navigation systems as well as other types of communication facilities, such as radio and television towers, microwave communications, VORTAC and VOR nondirectional beacon systems. The transmission line could affect these facilities by absorption and consequent re-radiation of radio waves, attenuation of radio waves caused by the physical obstruction of transmission equipment, and reflection of radio waves of certain frequencies. Transmission lines may also affect existing and potential transportation networks, particularly highways. In certain cases it may be desirable to construct HVTLs adjacent to highways in order to reduce the amount of land needed for right of way, and to avoid impacts on other land uses. However, transmission lines constructed on or immediately adjacent to highway right of way may interfere with highway expansion or improvement plans, and may require costly relocation of HVTL towers. Access to a transmission line which is located along a controlled access freeway is often difficult and may require the construction of additional access roads over private property. Transmission lines which parallel major highways can also adversely affect the scenic value of these highways. Where scenic easements have been acquired to enhance or protect the scenic value of a highway, the routing of a HVTL parallel to the highway conflicts directly with the intent behind the acquisition of those easements. Finally, Federal laws and regulations continue to restrict the placement of HVTL structures on the right of way of federally funded limited access highways.

4.2.5 Significant Historical and Archaeological Sites

The potential impact that a HVTL may have upon an historical or archaeological site depends upon the individual characteristics of the site, and the amount of damage caused by the line. The general impact upon the area's historical and archaeological resources depends upon the significance of the individual site.

Physical destruction or the need to relocate or salvage the feature are the most extreme consequences of the construction of a transmission line. In other instances, the impact can be more subtle. The visual impact of a HVTL within the vicinity of an historical site, although secondary and subjectively measured, can be important, especially where the historical feature has architectural significance.

The construction of transmission lines can damage archaeological sites. Clearing rights of way and the placement of power line poles in undisturbed or minimally disturbed locations can adversely affect the scientific value of these sites. This is less likely to happen where road construction and other modern developments have already disturbed the ground. Accordingly, the Minnesota Historical Society is specifically concerned about lines that may be built in undisturbed areas. The State Historic Preservation Officer may request that an archaeological site survey be conducted after the final route and right of way are determined. This survey may lead to minor right of way location changes or salvage archaeology, where necessary.

4.2.6 Visual and Aesthetic Values

High voltage transmission lines are generally considered to affect natural beauty and scenic resources adversely. Visual impact depends upon the siting of the transmission line, prevailing land use, topography, and existing round cover as well as subjectively measured aesthetic values. Scenic areas are typically those which contain a diversity of land forms, vegetation, water and wildlife. The visual impact of transmission lines is also greater in open areas where towers can be seen for long distances. Conversely, it is generally accepted that relatively little visual impact results from a transmission line which traverses an area where existing land uses have already altered or destroyed the scenery. Impacts can be mitigated by structure selection and placement.

4.2.7 Socioeconomic Effects

The socioeconomic impacts of a transmission line during the construction phase are generally considered to be minimal. The impact of the construction on the local labor force is negligible since almost all the work is done by non-local personnel. Because work on a high voltage transmission line is constantly shifting in location and is relatively short in duration, the impact on an area's housing and public services is usually not noticeable. Expenditures in any one locality during the construction period are comparatively small and limited to spending on food and lodging, gasoline and entertainment.

Once the HVTL is operational, its socioeconomic effects are generally negligible except for increases in the local tax base. A relatively small number of utility personnel are required to maintain and inspect the line. Much of the inspection is done by air. Right of way management occurs periodically, but requires only a minimal input of labor.

The effect on the local tax base is proportional to the size of an area's tax valuation prior to the construction of the HVTL. In rural areas with relatively small tax bases, the added valuation resulting from transmission lines can be significant. The exact amount of taxes contributed to the local economy by a HVTL depends on several factors, including the total value of the line, the proportion of total value located within a specific taxing unit, and the mill levy of the taxing unit. In addition, state personal property tax laws specify by formula the allocation of taxes among the various local taxing units.

4.3 Impact on Economic Activities

4.3.1 Impact on Agricultural Operations

The impact of the construction and operation of transmission lines on productive farmland has been the subject of an increasing number of studies in response to the growing conflicts which have arisen over the routing of utilities through agricultural areas. This section reviews those impacts identified in recent studies which are felt to affect farm operations from an economic standpoint. Other impacts, specifically health and safety effects, and the impact on agricultural land values are discussed in sections 4.5 and 4.2.2.1 respectively.

4.3.1.1 Potential Temporary Impacts from Construction Activities

a. Soils

Agricultural land is primarily susceptible to two kinds of temporary impacts during the construction and maintenance of transmission facilities: soil compaction and soil erosion.

Soil Compaction

Compaction alters the soil structure, which determines water content and water transmission in soils, the level of aeration and transfer of gasses, and the ability of a soil to transmit or retain heat. Adverse soil conditions resulting from the impairment of any of these properties can affect plant growth and reduce crop yields.

Compaction of soils is a general and ongoing problem in most types of cropland due to mechanized farming practices and the trend toward larger and heavier farm machines. However, compaction associated with transmission line construction can be particularly severe along a right of way where traffic from heavy construction equipment and trucks is concentrated, subjecting soils to stresses which often are much greater than those associated with farm machinery. Table 4-1 compares compaction pressures of typical construction equipment and farm machinery.

On transmission line construction sites, truck traffic is primarily responsible for soil compaction. The trucks used in the construction process are usually heavily laden with materials and cement, and often have to make many passes across fields. Other kinds of machinery typically used in the construction of a transmission line, such as cranes and augers to erect tower structures, may cause greater compaction than a truck with a single pass over a field, but they are used less frequently. With both trucks and heavier equipment, the first pass of a wheel on a loose soil does about 80 percent of the total compaction which would result from four passes over the same spot. However, later passes of equipment frequently travel upon untouched soil, so that the percentage of soil area compacted can increase with each pass of a vehicle.

TABLE 4-1
COMPACTION PRESSURES OF TYPICAL CONSTRUCTION & FARM EQUIPMENT

EQUIPMENT	WEIGHT (POUNDS)	GROUND PRESSURE (psi)
50 Ton Crane and Auger	125,000	7.65
955 Cat Loader	32,000	11.10
35 Ton Crane	74,920	7.59
60 Ton Crane	128,940	9.80
90 Ton Crane	234,325	12.10
D8 Cat W/Blade	70,000	12.50
D8 Sag Cats	75,000	12.13
2 Wheel Tractor (without dual tires)	15,000	9.5
2 Wheel Tractor (with dual tires)	15,000	5.3
4-Wheel Drive Tractor	30,000	11.3

SOURCE: Minnesota Department of Agriculture: High Voltage Transmission Lines: Agricultural Issues and Impacts, 1979.

The condition of the soil at the time of construction can affect the amount of compaction which occurs. Freshly tilled and very wet soils are particularly susceptible to severe compaction. Proper construction scheduling helps to mitigate this problem.

Erosion

Right of way clearing, grading, and other disturbance of the soil during construction can increase the possibility of soil erosion. A number of different factors including slope, type of soil, and local rainfall influence the potential for soil erosion. In general, steep, silty, impermeable and unconsolidated soils are most prone to erosion. These soils are often associated with present and former river systems, with some glacial outwash deposits, and with rugged terrain. Sandy, well-sorted permeable soils, rich in organics, blocky or granular in shape, on gently sloping terrain are more resistant to erosion.

Specific practices used during construction including soil contouring, careful backfilling, and seeding and mulching of the affected area can help to minimize erosion.

b. Vegetation

The effects of construction on pasture vegetation are short term, especially in areas with adequate rainfall, and the restoration of forage crops normally is easily done. Field crops, however, can be expected to be destroyed in the right of way and in those areas where construction equipment must travel across fields due to the lack of access roads. Compensation to the farmer for lost or damaged crops will be required by the construction permit.

c. Other Temporary Impacts

The movement of heavy vehicles across fields can damage or destroy drainage tiles unless the location of the tile network is known and avoided by all equipment operations during the construction of a transmission line. While the utility must repair all damaged tiles, a broken tile may not be readily apparent to the farm operator. Ensuing drainage problems could develop in affected fields and destroy crops or reduce yields. Precautionary or remedial measures on the part of the construction contractor to locate, and protect, or avoid drainage tiles, or to replace them when damage occurs, will mitigate this impact.

4.3.1.2 Potential Long-Term Impacts

a. Cropland Lost to Production

The area of cropland lost due to the presence of a transmission line tower varies widely with the size and type of tower or pole, structure location, line orientation,

crop and cropping patterns, terrain, equipment, and farming practices. In a recent study of compatibility between agriculture and transmission lines[1], researchers at the University of Minnesota estimated the amount of land that can be lost to production.

On the average, 644 square feet per H/K frame structure, 2213 square feet per lattice tower, and 97 square feet per single shaft structure of cropland were left barren under those 230 kV lines observed in the study. The research also examined differences in cropland loss due to the location of the structure and type of crop. Tables 4-2 and 4-3 summarize these impacts as measured on transmission lines in the MAPP* region.

In general, the area lost to production increases as the size of the structure increases for H/K frame structures; the area increases and then remains relatively constant for lattice towers. It remains approximately constant for single shaft poles as their size increases; however, data for single shaft poles was very limited in this study. Losses for structures in row crops tend to be larger than those in small grains and forages, due in part to the lesser maneuverability of row crop equipment.

The presence of guy wires, which are commonly used for corner or angle structures with H/K frame and single shaft poles, greatly increases the amount of land lost to production. The comparision between the results measured for tangent H/K frames and modified H/K frames in Table 4-2 illustrates the potential difference in loss. Guy wires appear to have additional effects on field operating patterns and present a safety hazard. Use of stubbed guys (pole-mounted guy wires) can diminish the interference and hazards associated with guying.

b. Impacts on Field Operations

Transmission line poles placed on the edge or within cultivated fields cause a farmer to spend additional time to complete various field operations due to the interruptions and extra

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1 Robert G. Gustafson, et. al., Report of an Investigation of Electric Power Transmission and Agricultural Compatability in the MAPP*Region, Agricultural Experiment Station, University of Minnesota, 1978.

* Mid-Continent Area Power Pool

Table 4-2
Average Area Lost From Production (Ft^2) by Structure Type and Location

Structure	No Boundary within 100 ft	Boundary within 100 ft	Head-land**	Straddling Boundary	Adjacent to Boundary	In Corner	On Corner
161							
H/K Frame	487 (88)*	536 (96)	630(19)	481 (42)	687 (91)	701(12)	208 (4)
Modified							
H/K Frame	1,425 (3)	3,900 (5)	1,300 (1)	580 (1)	2,090 (8)	5,510 (2)	--
230							
H/K Frame	678 (60)	545 (158)	576(40)	380 (13)	929 (23)	491(35)	--
Lattice	2,454 (143)	1,893 (63)	2,274(13)	2,271 (43)	2,060 (23)	2,263(13)	1,920 (2)
Modified							
H/K Frame	1,918 (2)	2,396 (7)	2,626 (2)	2,548 (1)	--	1,017 (3)	--
345							
H/K Frame	988 (337)	799 (167)	1,009(37)	1,264 (20)	954 (50)	1,170(18)	146 (2)
Lattice	1,557 (80)	1,835 (56)	1,114 (3)	1,597 (16)	1,743 (6)	1,554(11)	--
Modified							
H/K Frame	--	1,487 (4)	4,678 (3)	3,310 (1)	4,878 (4)	1,480 (3)	--
Single Pole	112 (13)	88 (8)	--	80 (2)	91 (1)	--	--

* Bracketed numbers indicate numbers of observations.
** A headland is the area at the end of a field commonly used for turning.

SOURCE: Report of an Investigation of Electric Power Transmission and Agricultural Compatibility in the MAPP Region, University of Minnesota Agricultural Experiment Station, 1978.

TABLE 4-3
Average Land Lost from Production by General Crop Type and Structure Type and Size.

Structure Type	Structure Width (Ft.)	Land Lost From Production (Ft^2)					
		Tangent Structures			Corner Structures		
		Row Crop	Small Grain	Forages	Row Crop	Small Grain	Forages
H/K Frame	0-19	636	360	302	-	-	-
	20-24	732	604	366	-	-	-
	25-29	1,051	316	320	-	-	-
	35-	77	-	-	-	-	-
Single Pole	0-19	97	99	93	-	-	-
Steel Lattice	0-19	1,734	1,061	570	-	-	-
	20-24	2,012	1,127	785	2,604	-	618
	25-29	2,812	2,004	1,830	4,015	-	4,416
	30-34	2,514	1,557	1,538	3,635	787	1,756
	35-	2,562	1,145	1,658	1,651	-	-
Modified* H/K Frame	0-19	-	-	-	-	-	630
	20-24	1,167	2,268	-	-	-	112
	25-29	1,587	821	-	3,968	-	168
	30-34	5,871	885	10,080	2,818	1,300	860
	35-	4,680	-	900	2,543	-	-

* Structures commonly used as corners for H/K Frame lines. Consist of two or more poles located on a straight line possibly with supporting guy wires.

SOURCE: Report of an Investigation of Electric Power Transmission and Agricultural Compatibility in the MAPP Region, University of Minnesota Agricultural Experiment Station, 1978.

trips required to clear the structures. A number of studies have been made to estimate the additional time spent to work around transmission line poles. In a study based on interviews with 60 farmers in 1969, responses ranged from an additional 30 minutes to three hours per year per structure, with one hour being the most common response. The larger and more complex farm machinery prevalent today could increase those times. Increased times for individual operations from the 1969 study are shown in Table 4-4. Using a different type of survey, however, a 1977 study conducted by the same consultant showed an average time loss of about 30 minutes per year per structure.

The presence of structures within cultivated land also exacerbates the problem of soil compaction from farm equipment. The increased number of passes necessary to till, plant, cultivate and harvest crops through and around pole structures is likely to create paths around the towers with excessively compacted soil. Field operations around and through structures increase the risk of damage to equipment. If damage does occur, there is both a cost to the farmer for the repair of the equipment, and the inconvenience and loss of valuable time during critical farming periods while equipment is not operational.

Weed problems normally occur around transmission line towers and poles where weed control through cultivation is impossible. These areas must be hand sprayed to prevent propagation and spread of weeds throughout the field. The extra time and labor involved in the hand operations will raise production costs slightly.

c. Impacts on Irrigated Farmland

The potential conflict between irrigation systems and rights of way for transmission lines constitutes one of the most significant impacts that these facilities may have on farm operations.

Recent studies conducted by the University of Minnesota School of Agriculture evaluated the possible effects of transmission line rights of way on irrigated land, irrigation costs, monetary return to the farmer, and safety of operations.[2] The results of this analysis are summarized below.

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2 Robert G. Gustafson et. al. (1978). See footnote 1.

TABLE 4-4
Time Loss Studies Results

Operation	Location	Structure Type	Extra time/tower
Plowing	Illinois	Steel towers	6 minutes
Harrowing	Missouri	Steel towers	50 seconds
Corn Planting (4-row planter)	Illinois	Steel towers diagonally in field	5 min., 28 sec.
Corn Planting (4-row planter)	Missouri	Steel towers openlegs*	1 min., 10 sec.
Corn Planting (4-row planter)	Indiana	Steel towers	2 min., 9 sec.
Corn Planting (6-row planter)	Iowa	2-pole structures	3 minutes
Disking (12 ft. disk)	Illinois	H-poles, parallel	10 seconds
Disking & Harrowing (Tandem)	Illinois	2-pole structures	40 seconds
Cultivation (soybeans)	Indiana	Steel towers diagonally in field	49 seconds

*Operator was able to work under the structure.

SOURCE: A Preliminary Study of Powerline Damages, Doane Agricultural Service, Inc., St. Louis, Missouri, 1969.

These studies focus on the compatibility of transmission lines with the two most common sprinkler systems, the center pivot and traveling gun types. Center pivot systems consist of a pivot point which is anchored, a water supply pipe which is supported on electric or hydraulic powered drive units, sprinklers located in a fixed or variable pattern on top of the supply pipe, and, in many cases, an end gun located on the outer end of the supply pipe. This supply pipe is commonly 10 to 15 feet above the ground. Center pivot systems are most efficient when used in square (rather than rectangular) fields in order to maximize the amount of crop watered. Typically, one system will cover 126 acres of a square 160 acre field.

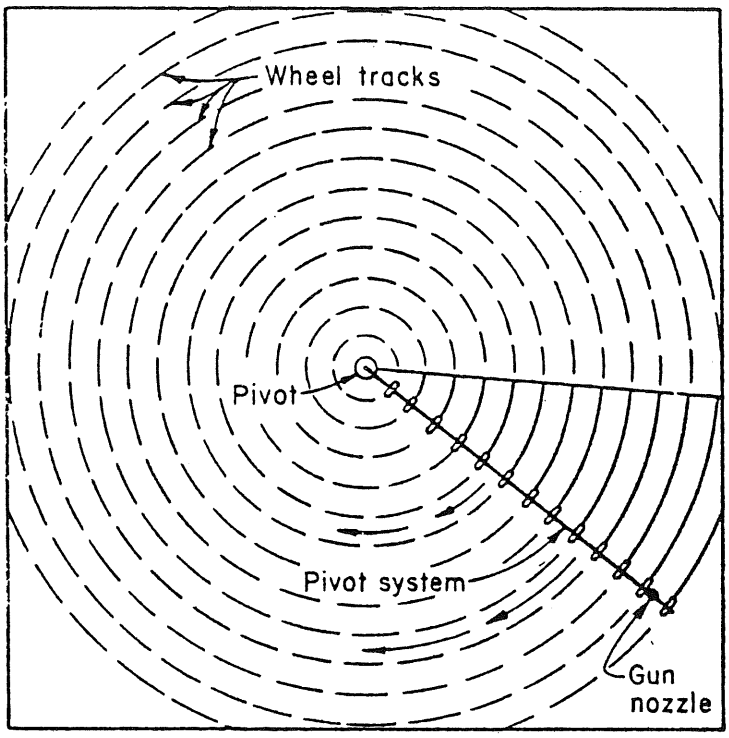
Travelling gun systems consist of a high pressure, large capacity gun which is mounted on a carriage, a flexible water-supply hose, a reel to wind hose onto, a power unit, and a winch supplied with cable. The carriage is pulled in a straight line across the field by means of attaching one end of the cable to an anchor located at the end of each lane and allowing the power unit to wind up the cable, pulling the carriage toward the anchor. The lanes in which the carriage travels are usually 10 to 12 feet wide and are commonly spaced such that 8, 9, or 10 lanes will allow coverage of a one-half mile wide strip. One travelling gun system is usually adequate to irrigate 80 acres. Figure 4-1 shows the typical application of each of these systems to a quarter section field.

Land Lost to Irrigation Due to Transmission Right of Way

The amount of land lost from irrigation due to the presence of a transmission line right of way varies with right of way width and orientation and the type of irrigation system used.

When using center pivot systems, the least amount of land loss occurs when the centerline of the right of way coincides with the quarter section boundary so that the pivot point can be located so as to maximize the area irrigated. The next best situation occurs when the field is cut diagonally with the centerline of the right of way through the field midpoint, and the pivot points are located at the opposite corners of the field. In contrast, the greatest land loss occurs when the full right of way is located adjacent to -- but not straddling -- the field boundary, and the center pivot is fixed at the center of the field. In avoiding the right of way, the center pivot creates a sprinkling pattern which leaves a pie-shaped wedge adjacent to the right of way unwatered (see Figure 4-2).

CENTER PIVOT SYSTEM



Typical Irrigation Systems

TRAVELING GUN SYSTEM

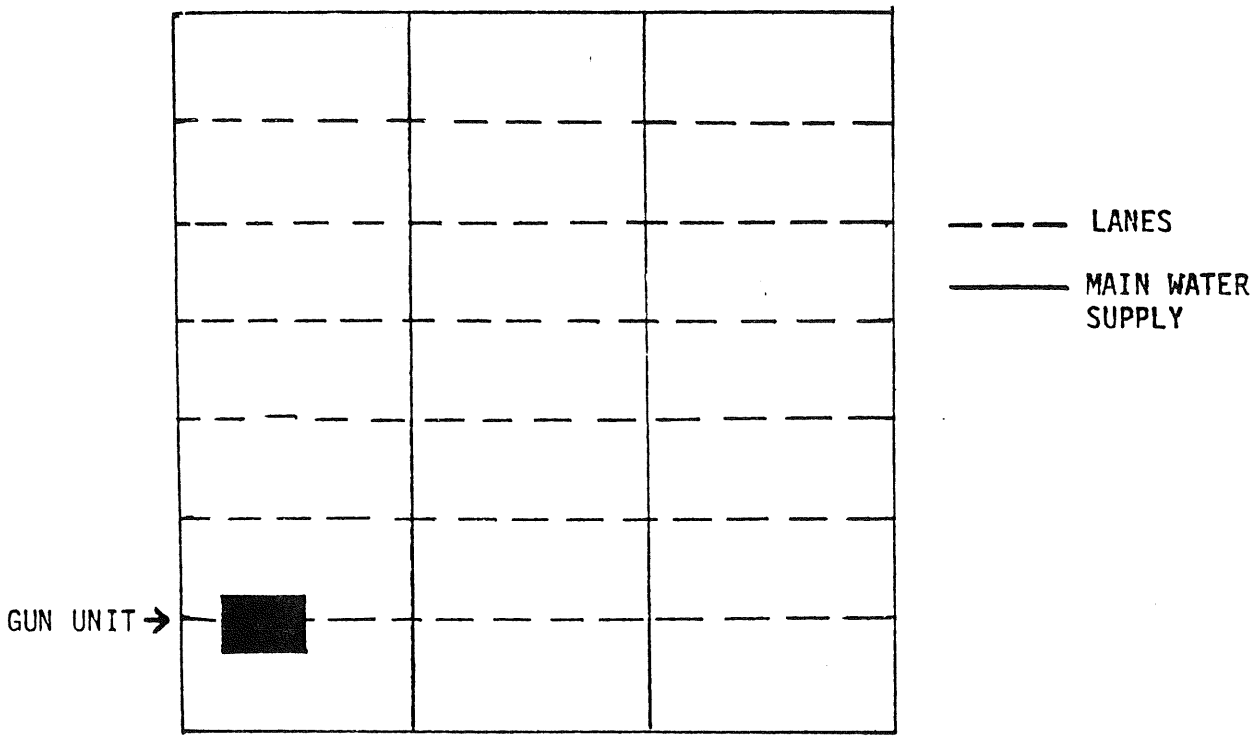
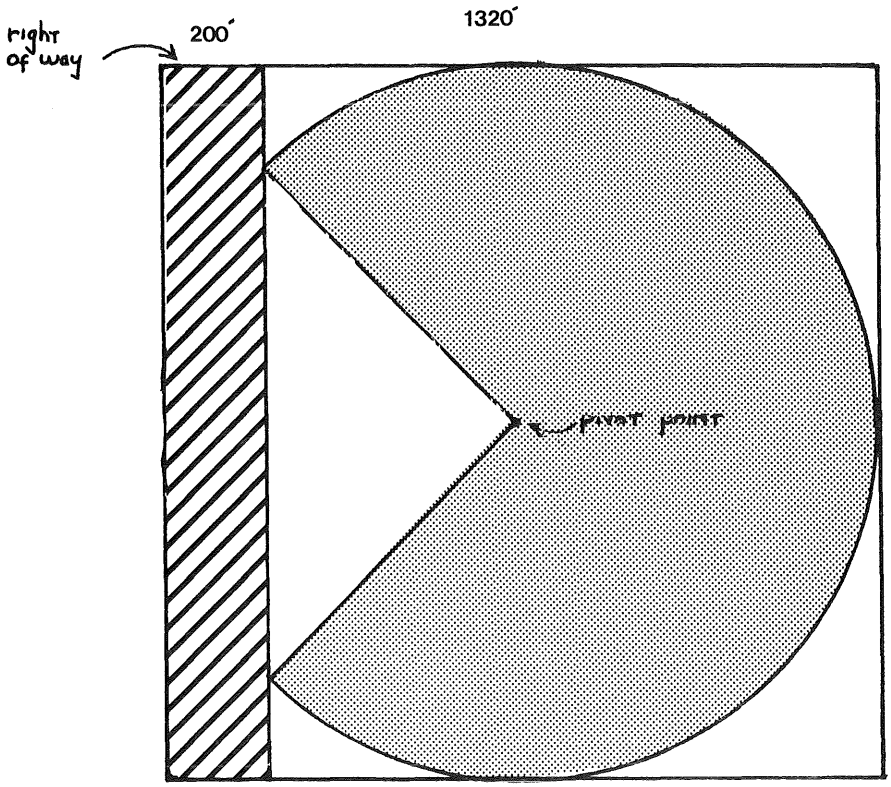


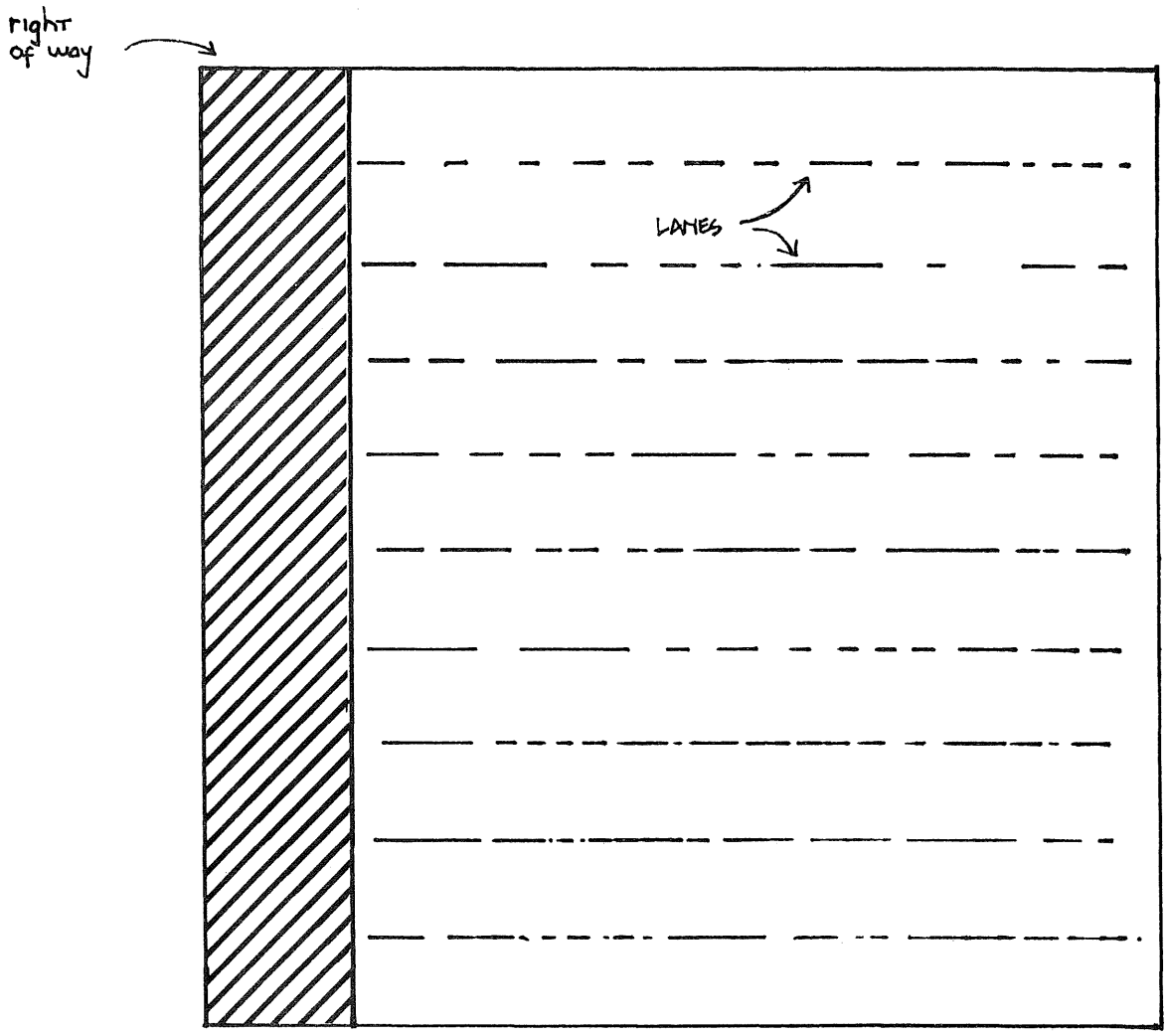
FIGURE 4,1

Worst Case Situation
ROW Parallel to Boundary;
Pivot Point Fixed at Field Center



ACRES ADEQUATELY IRRIGATED (72.2% OF IRRIGABLE AREA)

FIGURE 4.2

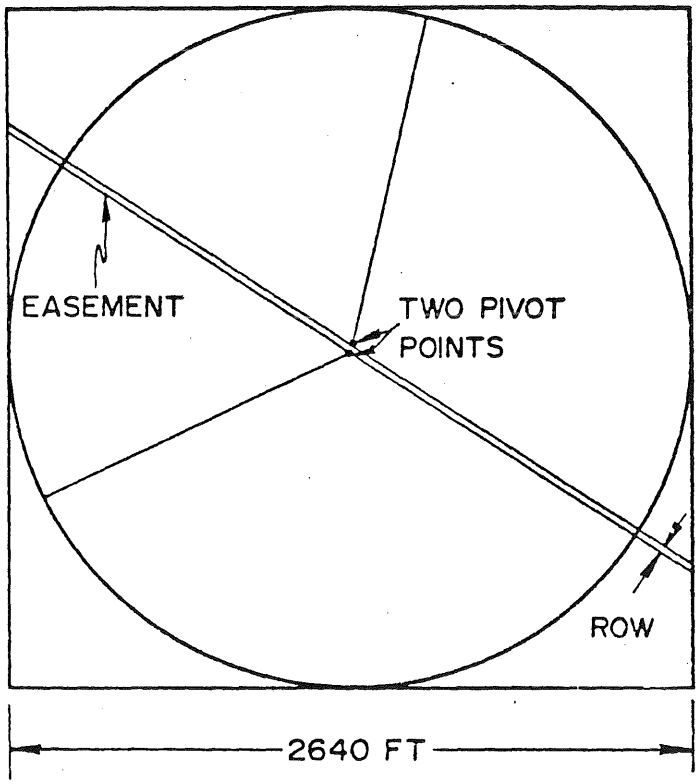


Worst Case Situation

Traveling Gun Irrigation System and

Transmission Line ROW

FIGURE 4.3



Two Center Pivot Systems Operating in a "Windshield Wiper" Setup for a R-O-W Passing Near the Center of the Field.

FIGURE 4.4

Travelling gun systems can irrigate a larger portion of the field than center pivots. In general, a larger area can be irrigated when the lanes run parallel to the right of way than if they are perpendicular to it. The least amount of land loss occurs when the centerline of the right of way coincides with the field boundary and the lanes parallel the right of way. Land loss is greatest when the right of way is parallel to, but not on the field boundary, and the lanes run perpendicular to the right of way. See Figure 4-3 for diagrams of these irrigation patterns.

While the amount of land that cannot be irrigated due to the presence of a transmission line along the edge of an irrigated field is significant, the annual operating costs of irrigation are not noticibly affected. The annual costs per acre irrigated are relatively constant, and a reduction in irrigated acreage is accompanied by reductions in the size or amount of equipment and energy needed to irrigate that acreage. A large increase in operating costs per acre irrigated occurs, however, when the right of way runs diagonally across a field which then must be irrigated by two center pivot systems (see Figure 4.4).

Monetary Impact of a Right of Way Crossing Irrigated Land

To determine the approximate financial impact of a reduction in irrigated acreage when a transmission line crosses irrigated farmland, researchers at the University of Minnesota evaluated nine possible interactions, using a variety of assumptions about the location of the right of way, type of system and the status of the loan used to finance the capital cost of the system. Table 4-5 summarizes the average annual dollar losses associated with the presence of a transmission line on an irrigated field. In order to provide a perspective of the long-term cost of a right of way to the farmer, the present value of the average loss for a 15 year period (assuming an eight percent interest rate) is also presented.

The study concludes that the loss in revenue associated with the location of a transmission line right of way on irrigated land is much more significant than that for non-irrigated land. It also appeared that location of the right of way centerline on the quarter section line has less total effect than placement of the full right of way on one side but adjacent to the line.

Table 4-5. Present Worth of Average Loss Over a 15 Year Period (8% Interest)

	160 acre field		
Assumption	Ave. Annual Return/Acre	Annual Loss Due to R-O-W	15 Year Loss (Present Worth)
1-Dryland, with ROW	$20.50	$ 7.43	$ 64.00
2-Pivot, without ROW	55.93	----	-----
3-C. Pivot, All ROW in Field	51.83	656.00	5,615.00
4-C. Pivot, 1/2 ROW in Field	54.35	235.00	2,164.00
5-C. Pivot, All ROW in field No Loan	93.08	1,032.00	8,835.00
6-C. Pivot, 1/2 ROW in Field, No Loan	97.44	335.00	2,864.00
7-T. Gun, without ROW	41.68	------	-----
8-T. Gun, with ROW	39.20	2,677.00*	22,911.00
9-T. Gun, with ROW, No Loan	87.40	1,943.00*	16,627.00

*Assumes a center pivot system would be used if R-O-W was not present.

Source: Robert G. Gustafson, et. al. (1978). See Footnote 1.

Safety of Irrigation Operations Near a Transmission Right of Way

Potentially hazardous situations can develop when an irrigation system is located in close proximity to, and particularly when it parallels, a high voltage transmission line. Accidental contact between conductors and irrigation equipment is an obvious hazard which can be avoided by controlling or selecting systems to maintain adequate clearances. A study conducted by Bonneville Power Administration found that when a stream of water ejected from a high-volume irrigation nozzle is directed into a high voltage transmission line, flashover from the conductor to the irrigation tower can be initiated if the water bridges the clearance gap between the tower and the conductor. However, the maintenance of adequate clearance between individual irrigation systems and nearby conductors can minimize the possibility of this type of flashover. The possibility of the irrigation equipment carrying leakage currents transmitted by a stream of water contacting a conductor is enhanced when

fertilizers or other substances, which reduce the resistivity of water, are present in the irrigation water. However, dangerous levels of current can be avoided by sufficient grounding of the equipment or by maintaining clearance between the water spray and the conductor.

d. Impacts on Aerial Application of Pesticides and Fertilizers

The placement of transmission lines in or adjacent to fields where crops are treated by aerial application of pesticides and fertilizers can reduce the effectiveness of the treatment. Pilots must pull up sooner to avoid lines located at the edges of fields, resulting in greater drift of the application material and poorer coverage. This can be compensated for with double applications, but the cost of additional pesticide or fertilizer and the time involved to double back increase the cost per acre of treating such fields.

Transmission lines also pose a real hazard to pilots treating crops. Lines which cross fields diagonally are a particular problem because it is more difficult for a pilot to judge the location of the lines as he flies over a field, thus, increasing the possibility of an accident.

Studies by the Minnesota Department of Agriculture indicate that farmers can expect to pay more for aerial applications on fields with high voltage transmission lines on or bordering them.

e. Removal of Windrows

Locating the right of way along a field boundary which is lined with mature trees to provide a windbreak for adjacent fields can have a long term adverse impact on agricultural land. In most cases, windrow trees exceed the height limitations for objects within the ROW and would be removed during the right of way clearance phase of the construction of the HVTL.

In areas such as central Minnesota, where the land is relatively flat and open, wind can cause a significant amount of soil erosion. To prevent this erosion, many farmers have planted windrows or retained native trees along field boundaries. Removal of the windrow trees along the ROW of a transmission line damages or eliminates the protection which these trees provide, greatly increasing the potential for wind erosion of soils.

Little can be done to minimize this long term impact. It may be possible to replace the original windrow trees with species which at maturity do not exceed the height limitations for objects in the ROW. A second measure could be to locate the ROW adjacent to, rather than centered on, field boundaries when windrows are present; however, such an action could result in increasing another type of impact (e.g., loss of cropland).

f. Effect of Transmission Lines on Future Farming Practices

The presence of transmission lines may restrict the farmer's ability to modify or adapt farm operations to future trends in agricultural practices. In particular, transmission lines may prevent or limit the consolidation of fields for more efficient management and operation, the use of larger, more efficient equipment, and the installation or expansion of irrigation equipment.

4.3.2 Telephone and Railroad Communications

Whenever a communications cable is parallel and relatively close to a high voltage transmission line, the transmission line causes or "induces" a voltage and current to appear on the communications cable. The induced voltage and current vary depending upon the voltage of the transmission line, the current on the transmission line, the separation between the transmission line and the communication cable, and the distance that the transmission line parallels the telephone cable.

Telephone Operations

This effect occurs on all telephone cables that parallel high voltage transmission lines. However, it is much more of a problem on "toll" or long distance service cables than on distribution cables serving individual subscribers. The electronic equipment used with toll cables is much more sensitive to this extra voltage and current than the equipment used with cables serving individual subscribers. In addition, the telephone company is unable to use some of the protective devices on toll cables that are available for cables serving subscribers. Toll cables are continuous from one end to the other; subscriber cables end in each town. Since the effects of high voltage transmission lines are cumulative for the entire length of the cable, this causes higher voltages on toll cables.

Finally, if the voltage or current causes a problem on a toll cable, more people are affected. If a cable that services individual subscribers goes out of service, only service to those

subscribers is affected. If a toll cable goes out of service, all individuals served by that cable will be unable to call anyone outside of their telephone exchange. In short, toll telephone cables are more sensitive to voltages and currents caused by transmission lines, are more vulnerable, are harder to protect, and cause problems for more people if they fail.

All telephone cables are protected to some extent from these induced voltages and currents. A metal sheath around the cable, actually part of the cable, provides electrical shielding. This sheath is connected to grounding electrodes to provide additional shielding. "Protectors," similar to lightning arresters, protect the individual wires of the cable from high voltages. When the voltage on the wires is greater than about 300 volts, these protectors temporarily short the wires to ground, reducing the voltage. When the effects of proposed transmission lines are estimated by Northwestern Bell, it is assumed that these protection methods are all in use and in good condition.

Northwestern Bell Telephone has a toll cable buried in the south shoulder of Highway 23 from St. Cloud through Milaca to Pine City. This cable provides long distance service to all the telephone subscribers along this portion of Highway 23, including those served by companies other than Northwestern Bell.

The repeater buildings for this cable are on the north side of the road; the cable crosses under the road at these locations. Generally, the cable is about 40 feet south of the center line of the road. This means that the cable is about 135 feet from the proposed transmission line right of way where the railroad and highway rights of way are adjacent to one another.

The major problem that would be caused by the proposed transmission line is related to the current and voltage that would appear on the toll cable when there are "faults" (lightning strikes, short circuits, etc.) on the transmission line. These faults cause larger amounts of current to appear on the transmission line. This current, in turn, induces large currents and voltages on the toll cable. While the voltage and current caused by these faults would not harm the cable itself, it would cause the electronic equipment to fail isolating the communities along this cable from telephone service to any other towns. The time without service could range from a few seconds where automatic corrections can solve the problem to at least a day when equipment replacements are needed. Extra noise or interference on the toll cable may also be caused by the normal voltage and current on the transmission line. This has not been thoroughly explored by Northwestern Bell engineers.

According to Northwestern Bell, a fault would cause from 4800 volts to 21,700 volts to be induced on the St. Cloud to Milaca toll cable. This voltage would cause equipment damage and a potential, albeit one with a low probability, safety hazard to telephone company service workers.

A fault would also cause some problems with individual subscriber lines. A fault would cause the telephones near the line and those on the cables near the line to be out of service. A rough estimate is that about 100 telephone services would be affected by a severe fault. According to Northwestern Bell, repair time for the damage caused by these faults would vary from 1/2 hour to four hours, depending on exact circumstances.

Railroad Communications

Electrical interference with railroad communications may occur when a HVTL is located near railroad tracks and facilities. On a railroad system such as that in the study area, the communications and signalling systems are, for the most part, 12 volt dc and are usually located underground. Some mitigative measures would be required in order to minimize the susceptibility of these systems to the fields produced by the proposed transmission lines.

4.3.3 Television and Radio Operations

Radio Interference

Very few problems have been experienced with 230 kV or lower. In most circumstances, the level of transmission-line induced radio interference is not significant in comparison with the strength of the broadcast signal. Most radio stations have sufficient broadcast signal-to-noise ratios to insure that interference is not a problem.

If radio interference from transmission line corona does occur, satisfactory reception from AM radio stations presently providing good reception can be obtained by the addition or appropriate modification of the receiving antenna system.

Interference to FM broadcast station reception is generally not a problem because 1) corona generated radio frequency noise currents decrease in magnitude with increasing radio frequencies and are quite small at the FM broadcast band frequencies of 88-109 MHz, and 2) the excellent interference rejection properties inherent in FM radio systems make them virtually immune to amplitude-type disturbances.

Citizen's Band (CB) radio stations operate on a number of frequencies near 27 MHz. Radio noise from transmission line corona is decreased by approximately 48 dB, about a 250 times reduction, between 1 MHz to 27 MHz.

Calculations by UPA show that a vertical antenna radiating 0.1 watt would produce a signal strength of approximately 65 dB, above 1 microvolt per meter, at a distance of one mile. Most CB radios intended for serious communications have a power rating of several watts. Furthermore, directional rotary antennas are used frequently which increase the effective power transmitted in a given direction.

A 63 dB signal strength would give a signal-to-noise ratio of approximately 50 dB at the edge of the right of way under wet conductor conditions. The signal to noise ratio adequate for voice communication is only 16 dB. A 16 dB signal to noise ratio is described as "background 'noise'; very evident but speech easily understood." Thus, according to UPA information, interference to CB radio communications from transmission line corona generated radio noise should be negligible outside the right of way.

A two-way mobile radio located immediately adjacent to and behind a large metallic structure such as a steel tower may experience interference because of signal blocking effects. Movement of either mobile unit so that the metallic structure is not immediately between the two units should restore communications. This would generally require a movement of less than 50 feet by the mobile radio unit adjacent to a metallic tower. Because no lattice steel towers are proposed by UPA for the subject HVTL, this is not expected to be a problem.

Television Interference

Corona generated radio frequency noise is quite small in the very high frequency range used for television transmission. As a result, TV interference from covona generated by this HVTL generally will be negligible.

Loose and/or damaged hardware may also cause TV interference. If television or radio interference is caused by the HVTL in those areas where good reception is presently obtained, UPA will inspect and repair any loose or damaged hardware in the transmission line or take such other necessary action to restore reception to the present level including the appropriate modification of receiving antenna systems, if necessary.

4.3.4 Railroad Operations

Railroad corridors are often considered as suitable locations for transmission lines. However, a number of problems can arise when high voltage transmission lines are placed in close proximity to actively used railroad routes. Although the potential for adverse impacts is proportional to the distance involved, the amount of train activity on a given line, and the size and voltage of the HVTL, the following general problems might be encountered:

1. Poles and/or conductors within the right of way could interfere with track and right of way maintenance equipment. A hazardous situation could result from contact with metal equipment and energized conductors.

2. Derailed cars might strike and knock down pole structures. Tank cars containing flammable substances would be particularly susceptible to sparks from a downed line.

3. The electrical field of the transmission line may interfere with train signals at grade crossings, and with the train communication system.

The railroad industry's major concern is that sharing the right of way with the actual power line structures would compromise the safety of the trains and maintenance equipment.

4.4 Impacts on the Natural Environment

High voltage transmission facilities, wherever they are located, cause some changes in the existing natural environment. As noted above, these changes can be brought about by the construction process, the physical presence of the line, operation, maintenance and repair of the facilities, or by management of the line right of way. The level of impact varies both with the type of activity, and with the nature of the existing environmental features.

4.4.1 Impacts on Vegetation and Soils

The most severe impacts on soils and vegetation occur during the construction phase of a transmission line project. Construction impacts include damage to vegetation; rutting and compaction of soils by the heavy vehicles used to erect towers and string conductor; removal of topsoil during excavation for towers with subsequent mixing of subsoils with topsoil, which reduces its productivity; and clearing of non-compatible species, e.g., trees which are or will grow to be too close to the conductors.

Depending on the slope and type of soil, activities during the construction phase can precipitate soil erosion, leading to soil loss and the leaching of needed soil nutrients. Excess concrete and concrete truck washout water left on the construction site can change soil pH, reducing soil productivity, or in severe cases, rendering the soil temporarily sterile.

Impacts on soil and vegetation during the operation and maintenance of the transmission line or its right of way are generally much less severe. Management of the right of way requires occasional cutting of non-compatible species, and the application of herbicides to control weeds and undesirable species. Periodic maintenance of the line, or repair of a fault would require repair vehicles to enter the right of way with some temporary damage possible to vegetation, especially in those areas without permanent access roads.

Studies which have been conducted to examine the effects of electrical fields on vegetation indicate that certain plants, generally those with sharp-tipped or narrow leaves, can be susceptible to low levels of leaf damage from ozone created by conductors in corona, and by an effect in which the leaves themselves are in corona.[3] However, the damage noted has been very minor and is similar to that which can be caused by other natural phenomena such as water stress, disease, and fertilizers. Damage generally occurs at high gradient levels above 25 kV/m. Since the estimated maximum gradient on a 230 kV transmission line is 2.82 kV/m at 25 feet from centerline assuming a maximum operating line voltage of 242 kV, very little corona damage should occur.

Certain types of vegetative systems, such as wetlands, are particularly susceptible to damage during construction of a transmission line. Wetlands are extremely productive communities that provide breeding and spawning grounds for many species of birds and other wildlife, and also perform many other necessary functions within the local ecosystem. They are quite fragile and should be preserved as closely as possible in their natural state. Damage from construction vehicles and intrusion by access roads could easily disrupt the water and nutrient circulation and subsequently ruin large parts of the wetland. Where possible, it is desirable for transmission lines to span wetland areas completely so as to preclude the possibility of a significant impact.

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3 J.W. Bankoske, H.B. Graves and G.W. McKee, "The Effects of High Voltage Electric Fields on the Growth and Development of Plants and Animals," as reported in Proceedings of the First National Symposium on Environmental Concerns in Rights of Way Management, 1976, PP 111-124.

In woodland areas, the number and type of trees that will be eliminated are of concern. Important considerations include the frequency of distribution, life span, and time to maturity of the types of trees affected. It is potentially more serious to eliminate stands of long-lived trees requiring many years to reach full growth than vegetation that will replace itself more readily.

4.4.2 Impacts on Wildlife

The most significant impacts of a transmission line on wildlife are related to the destruction of habitat during construction or the maintenance of a cleared right of way. However, most studies indicate that these impacts tend to be temporary, with the original wildlife populations gradually reestablishing themselves or even expanding along rights of way after construction activity has ceased and restoration of vegetative cover occurs. Transmission line rights of way, due to their edge effect, have been shown to provide abundant food and valuable cover for many species of wildlife. This benefit can be enhanced in wooded areas by the use of selective cutting, rather than clearcutting techniques.

Maintenance of the right of way through the application of herbicides can have both positive and negative impacts. Studies conducted for Edison Electric Institute (1976) assessed chemically sprayed transmission line rights of ways for actual and potential wildlife use. Results indicated that rights of way are comparable or superior in wildlife foods to adjacent unsprayed plots, and that chemically treated rights of way showed greater wildlife use than adjacent old-field habitats. Other studies, however, indicate that on clear-cut rights of way, which have had a long history of spraying, an "herbicide climax" consisting of dense low-growing species can develop and dominate.[4] The vegetative diversity of the right of way diminishes, and a corresponding reduction of the number and types of animals using the area generally occurs. This result can usually be avoided by selective clearing and by carrying out a selective herbicide spraying program for right of way maintenance.

Impacts on Bird Populations

Documented impacts of transmission lines on birds range from a temporary disturbance of bird life during construction of the line, to attrition of populations due to destruction of

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[4] Kenneth L. Carvell, "The Effects of Herbicidal Management of Electric Transmission Line Rights of Way on Plant Communities," as reported in Proceedings of the First National Symposium on Environmental Concerns in Right of Way Management, 1976, pp 177-182.

habitat, to death caused by electrocution or collision for larger raptor species and waterfowl. The magnitude of the potential impacts would depend on the type of habitat crossed and the size and type of the original bird population. Important mating, feeding or nesting grounds, and bird sanctuaries represent the most sensitive areas. Transmission lines located in major flyways can also be particularly hazardous for large birds, especially waterfowl, due to an increase in the probability of collisions. Line and right of way maintenance which occurs during the breeding season can be hazardous to bird life in and near the transmission line rights of way, since most species are particularly vulnerable at this time. Impacts from these activities include destruction of nests and young birds, and the secondary effects of drifting herbicide spray which can injure fauna as well as flora.

4.4.3 Impacts on Water

Aquatic ecosystems which are located near or crossed by transmission lines can sustain damage during the construction process or be adversely affected by changes in water quality as a result of activities during construction and operation of the line. Potential impacts include the introduction of sediment and other pollutants during construction, increased runoff pollutants (including herbicide residues), and the possibility of temporary shore or channel modification where construction equipment has to enter the body of water. Most of these impacts are relatively temporary, being restricted to the construction phase, and can be mitigated with adequate care during right of way design and construction.

4.4.4 Impacts on Recreational Resources

The impact of high voltage transmission lines on recreational lands and waters is primarily one of visual disruption in areas which typically are notable for natural scenic beauty. The degree of impact would depend on the topography, vegetative cover, the size and type of towers, distance of the line from the recreational area, and subjective factors such as the attitude of the viewer toward transmission lines.

4.5 Public Safety and Health[5]

4.5.1 Public Safety

Accidental contact with flashover

Accidental direct contact of a conducting object with the conductor of a high voltage transmission line, or by accidental flash-

[5] The majority of this section is based on: Public Health and Safety Effects of High Voltage Overhead Transmission Lines; an Analysis for the Minnesota Environmental Quality Board, by the Minnesota Department of Health, October, 1977, authored by Robert S. Banks, Charlene M. Kanniainen, and Richard Clark.

over from a conductor to a conducting object, can cause electrocution. The hazards associated with accidental contact or flashover have been summarized below. Although this summary concentrates on agricultural operations, since this is the major area of concern, it also applies to any similar operations.

> "Accidental contact of a grounded conducting object with a conductor presents an obvious safety hazard. . . . Contact can result in a current passing from the conductor through a person to ground. This problem is not unique to high voltage lines. Local distribution lines and service drops present more potential problems for contact because they are located much closer to the ground. Movement of tall objects, such as elevators or grain augers which may be near any electrical lines, require caution. Handling of irrigation pipe is another instance where caution to avoid contact is necessary. If clearance requirements for flashover . . . are met, direct contact with EHV transmission lines should not be encountered . . . [a utility] has recommended that no part of the equipment or load pass any closer to the conductors than 8 feet for 115 kV, 10 feet for 230 kV, and 15 feet for 500 kV." [6]

By adding the clearance requirements, in this case 10 feet, to the height of the largest farm equipment that is likely to be used under the transmission line, the minimum safe conductor clearance can be calculated. Based on a Minnesota Department of Agriculture report, the maximum equipment height expected to be used for farming under a transmission line is 15 feet; this translates to a 25 foot minimum clearance for a 230 kV transmission line. UPA has proposed a 28 foot clearance.

Field Effects

Besides the hazards of electrocution, AC overhead high voltage transmission lines produce electric and magnetic fields that, through various "coupling" mechansims, cause small amounts of electrical energy to be transferred to conductive objects within the fields. Such objects include vehicles and other non-stationary equipment, wire fences, structures, and biological organisms.

For AC lines, the vertical steady-state electric field and the transient magnetic field are primary concerns. These fields can, however, be considered as independent phenomena. Corona effects are completely separate and do not enter into any analysis

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6 Robert J. Gustafson, et. al., op. cit., pp. 72,74.

of field effects. Alternating current steady-state magnetic fields do not appear to be of concern in most cases; transient magnetic fields may cause a safety problem.

One other concern that is often expressed is the possible interference with cardiac pacemakers. Pacemakers in operation today are generally unaffected by magnetic fields of less than 1 gauss. The proposed transmission line will create a maximum field of 0.15 gauss at ground level. This is well within safety levels.

Energy can be transferred to biological organisms including human subjects via the coupling mechanisms associated with these fields either directly or indirectly. Direct exposure has been a matter of considerable public concern and is considered in the next section.

Indirect exposure occurs where some other conductive object, wholly or partially insulated from ground, is the collector of the transferred energy, either from electric or magnetic fields. In this situation, the hazard occurs when a grounded person comes into contact with the object. The person is then exposed to the passage of electrical energy through his or her body. Most conductive objects usually found in the proximity of transmission lines are not capable of collecting sufficient energy to constitute a primary shock hazard, although very large vehicles in the proximity of AC transmission lines can be somewhat above the let-go threshold.* As a result, greater clearances should be maintained in the proximity of public roads where necessary.

Adequate grounding of conductive objects can eliminate potential shock hazard. Electric and non-electric wire fences, metal buildings, and stationary structures can, where necessary, be readily grounded to reduce the level of perception of shcok current This is more thoroughly discussed in Chapter 5.

Vehicles and other non-stationary equipment are not as readily grounded and, therefore, can present a secondary shock hazard. Such shocks, while not physiologically harmful, can be annoying, painful and, if frequently occurring, fatiguing. Secondary

* "let-go threshold" is defined as the highest current in a hand-to-hand or hand-to-foot pathway from which the subject retains sufficient muscular control to release an energized electrode held in the hand. This threshold varies in proportion to body weight.

shocks can cause involuntary muscular reactions, which can be hazardous if the person is working near machinery or looses his/her balance. Maintaining an adequate clearance will minimize this problem. Nevertheless, this does not seem to be a problem with lines under 345 kV.

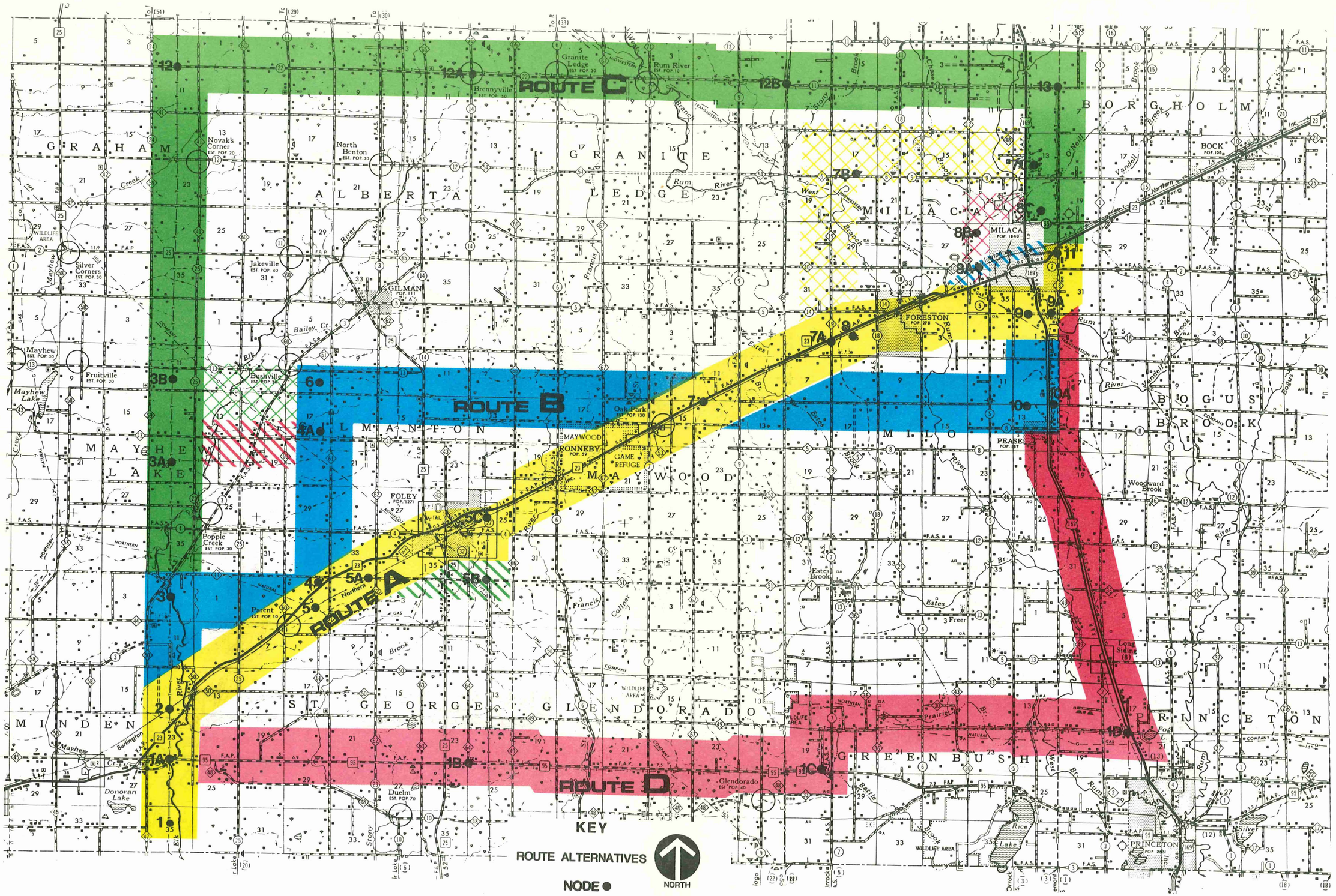
The voltage built up on an ungrounded vehicle has the theoretical possibility of causing fuel ignition. If a vehicle near the line were refueled from a metal can, there is a possibility of a spark from the vehicle to the can igniting fuel vapors. There are currently no regulations relating to this concern but UPA does recommend that no refueling be done within the right of way.

4.5.2 Public Health

Adverse health effects resulting from the direct exposure of humans to the high voltage overhead transmission line field environment are a matter of considerable public concern. Although it is not possible to say that there is no risk, the Minnesota Department of Health study cited above states that thus far both epidemiological and laboratory studies have failed for various reasons to indicate that the energy transferred directly from transmission lines to humans is a health hazard. The authors. of the MDOH Study conclude that there is no evidence suggesting any effect on health or upon one's sense of well-being from the intermittent exposure experienced in the transmission line environment. No theoretical basis for the presumption of effects has been postulated. This is a particularly important point, for it forces research into the biological effects of power frequency fields to be exploratory or observational, rather than rigorous experimental studies designed to accept or reject specific hypotheses.

While AC electric fields are not strong enough to cause tissue heating or nerve stimulation, the possibility of more indirect effects has prompted research in this area. Human and animal studies on the biological effects of AC electric fields have generally yielded conflicting results. One major reason for discrepencies is differing experimental exposure parameters; i.e. frequency, gradient and exposure duration. In addition, many experiments have not had adequate experimental design, controls for extraneous or interfering variables, and statistical analyses of experimental data.

Biological effects,if they exist, are likely to be subtle; recognition of true effects demands investigation utilizing a systematic, interdisciplinary approach to assure well-designed, closely controlled research. At the time of this analysis, such a comprehensive study is not available.


ROUTE C
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ROUTE D
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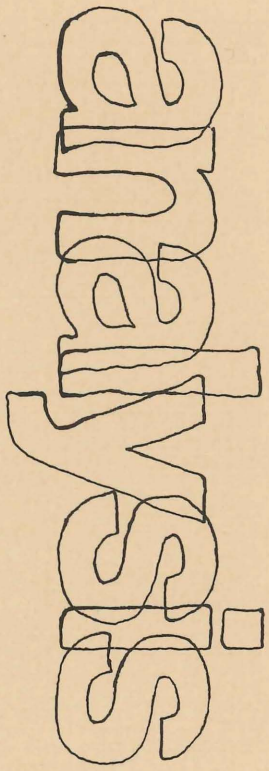
GRAHAM
GRANITE LEDGE
BORGHOLM
MILACA
MAYHEW LAKE
LAMPTON
MAYWOOD
MILO
BOGUS BROOK
MINDEN
ST GEORGE
GLENDORADO
GREENBUSH
PRINCETON
Granite Ledge EST. POP 30
Rum River EST. POP 10
Brennyville EST. POP 50
Novak's Corner EST. POP 20
North Benton EST. POP 30
Jakeville EST. POP 40
Silver Corners EST. POP 30
GILMAN POP. 111
Mayhew EST. POP 30
Fruitville EST. POP 20
Bushville EST. POP 30
Mayhew Lake
Oak Park EST. POP 130
MAYWOOD
RONNEBY POP. 59
GAME REFUGE
FOLEY POP. 1271
Popple Creek EST. POP 30
Parent EST. POP 10
Donovan Lake
Duelm EST. POP 70
Glendorado EST. POP 40
MILACA POP. 1840
FORESTON POP. 278
PEASE POP. 187
BOCK POP. 108
PRINCETON POP. 4284
Long Siding (6)
Rice Lake
Silver Lake
WILDLIFE AREA
GAME REFUGE
Rum River
Mayhew Creek
Bailey Cr.
Elk River
Stony Brook
Estes Brook
Woodward Brook
Vandell Brook
O'Neil Brook
Chase Brook
Francis Collner Brook
Prairie Br.
West Br. Rum River
Bartlett Brook
Burlington Northern
Northern Natural Gas Co.
Northern Natural Gas Co. Transmission
Northern States Power Co.
Midwestern Gas Transmission Co.
Great Lakes Gas Transmission Co.
F.A.S.
F.A.P.
KEY
ROUTE ALTERNATIVES
NODE
NORTH
SCALE 0
1 MILE

ENVIRONMENTAL ANALYSIS FOR THE PROPOSED ACTION



CHAPTER 5
ENVIRONMENTAL ANALYSIS OF THE PROPOSED ACTION

5.1 Route Selection Process

The proposed routes and route segments discussed in this section are the product of the route alternative selection process required by the Minnesota Power Plant Siting Act, as amended in 1977, and the accompanying agency Rules for Routing High Voltage Transmission Lines and Siting Large Electric Power Generating Plants.

The "routes" referred to in this study are defined in the Power Plant Siting Act as "the location of a high voltage transmission line between two end points [with] a variable width of up to 1.25 miles;" a "route segment" is a portion of a route. For ease of analysis, the proposed routes and route segments have been divided into sections by a system of nodes (a common point of intersection of two or more segments which are numbered from 1 through 11. Most of the routes follow a sequence of nodes which progress from low to high numbers or use letters of the alphabet to indicate directional sequence (i.e., 1, 1A, 1B, etc.).

Two routes (A and B) were submitted by UPA in its Application for a Construction Permit. These routes were developed by the Applicant after an extensive effort including field and aerial review of the study area; public meetings with local governmental units, interested citizens and groups; formation of a Select Citizens' Committee; and discussions with public agencies on the county, state and federal levels.

In its Application, UPA states that the route alternatives were based on the criteria contained in the Power Plant Siting Act and the MEQB Rules; existing land uses, particularly with regard to urbanized areas and agricultural activities such as irrigation; the availability of "open" land (a road, section line, quarter line, sixteenth line or field line was considered open if the transmission line could be built on or near it while remaining at least 300 feet from residences); the availability of existing rights of way; considerations of the overall length of a route; and the absence of serious environmental constraints.

These considerations led to a preference by UPA for Route A, which parallels Highway 23 and the Burlington Northern railroad tracks from a point 2 1/2 miles north of the Benton County Substation to a point near Foreston, and then travels directly east and then north into the Milaca Substation.

Route A connects nodes 1, 1A, 2, 5, 5A, 5C, 7, 7A, 8, 10 and 11 as shown on the Route Segment map at the beginning of this chapter.

Route B, UPA's alternative route proposal, makes use of county and township roads and section lines, and as shown on Figure 5-1, connects Nodes 1, 1A, 2, 3, 4, 4A, 6, 7, 9, 10 and 11.

Several alternatives to the route proposed by the utility were developed by the Citizens' Route Evaluation Committee (a group composed of residents from the affected area which was established by the Board), and the Power Plant Siting staff. Route C (Nodes 1, 1A, 2, 3, 3A, 3B, 12, 12A, 12B 13 and 11) follows an existing 230 kV transmission line north from the Benton County Substation, turns east along a county road and a 69 kV subtransmission line, and enters Milaca from the north. Route D basically follows Highway 95 and a 69 kV line east of the substation to the intersection with Highway 169, then parallels that highway (and a 69 kV line) north into Milaca. Route D connects Nodes 1, 1A, 1B, 1C, 1D, 9A, 10A, and 11.

In addition to the four main routes, several route segments were proposed by the Citizens' Route Evaluation Committee (CREC):

Nodes 5A-5B-5C
(to circumvent Foley)

Nodes 3A-4A and Nodes 3B-6
(basically the same as Route B, but with a longer parallel of the existing 230 kV line)

Nodes 7A-7B-7C-8C-11, Nodes 8A-8B-8C-4 and Nodes 8A-11
(to provide alternative approaches into the Milaca substation).

These routes and route segments were approved by the MEQB on February 21, 1979 for a public hearing. A map depicting all of the route alternatives and nodes appears at the beginning of Chapter 5.

5.2 Identification of Specific Impacts

In order to assess the actual impacts which could result from the placement of the 230 kV transmission line on any of the proposed routes, a segment-by-segment environmental evaluation was carried out. This investigation included:

a. cartographic review of the routes using USGS 7 1/2" quad topographic maps and aerial photos at the scale of one inch = 400 feet;

b. field survey and data check by automobile and foot;

c. aerial review of all proposed routes and route segments.

The route segments were assessed according to a checklist of environmental, land use, topographical and line design features. Table 5-1 describes the features which were measured and lists the data which were tabulated for each route segment. A summary comparing the main routes for some of the more important factors from this checklist appears in Section 5.3.

Data for the various segments were calculated on the basis of a reference centerline established by the utility. This approach was used in order to approximate the impact of the actual transmission line and right of way.

As indicated above, the reference centerlines were selected by UPA, based on the utility's preliminary planning and engineering criteria. Depending on final engineering and design, however, the reference centerline may not represent the final alignment of the actual right of way. Its purpose in this analysis is largely to provide a means of assessing the potential impact of the proposed project on a facsimile of the actual right of way. Therefore, while it is recognized that the environmental features and potential impacts discussed in this section may vary slightly with those associated with the right of way which is ultimately used, they should be reasonably accurate approximations. In cases where it is necessary to assure certain critical impacts are minimized, the MEQB may designate the route width to constrain the centerline location to whatever degree is necessary.

The individual route segments to be examined in terms of specific impact are shown on separate U.S. Geological Survey maps (at a scale of one inch=2000 feet) contained in this section adjacent to the narrative. A single map may cover more than one section of a route (in the case of relatively short sections); conversely with certain long sections, the map has been segmented in order to include the whole segment on a single page. On the segment maps, the route boundary is described by the wide black line, the segment reference centerline under discussion by a yellow line, other reference centerlines which may occur on the same map by a thin black line, existing 230 kV transmission lines by a blue line, and existing 69 kV lines by a red line. Floodplain elevations (100 year flood) are indicated by a dashed red line.

The data presented in Table 5-1 was calculated by the Environmental and Land Division of UPA, and verified by Power Plant Siting staff. In some data categories which were tabulated (e.g., wetlands), the figures listed are estimations based on a comparison of aerial photographs, USGS topographical maps, and field observation. Some minor discrepancies in these data may be present; however, these should be relatively insignificant in magnitude.

Table 5-1

ROUTE A	1-1A	1A-2	2-5	5-5A	5A-5C-	5C-7	7-7A	7A-10	10-11		Totals				
Length (miles)	1.27	1.05	3.86	1.48	2.82	5.17	3.12	4.85	1.76		25.4				
Diagonal length	0	0	0	0	0	0	0	0.57	0		0.57				
# Angles 3°-30°	1	1	8	1	0	0	1	1	1		14				
# Angles 30°-90°	0	0	0	0	0	0	0	2	2		4				
# Homes in ROW	0	0	0	0	0	0	1	0	1		2				
# Homes 500' from ROW	0	2	6	1	75+	35+	8	8	10		145+				
# Farmsteads in ROW	0	0	0	0	0	0	0	0	0		0				
# Farmsteads 500' from ROW	0	1	2	1	3	6	7	6	3		29				
Length in conc. setting	0	0	0	0	1.29	0	0	0	0.9		2.19				
Church/cemetary within 500' of ROW	0	0	0	0	2	2	0	1	0		5				
Length thru land zoned or planned for residential	0	0	0	0	1.29	1.90	0	1.0	0.9		5.09				
# Airports 5280'	0	0	0	0	0	0	0	0	0		0				
Length thru recreational area	0	0	0	0	0	0	0	0	0		0				
Length cultivated fields crossed	0	0	0	0	0	0	0	0.53	0		0.53				
Length cultivated fields bordered	0.12	0.34	2.86	0.28	1.29	2.85	2.52	3.09	0.67		14.0				
Length pasture crossed	0	0	0	0	0	0	0	0	0		0				

Note: all lengths given in miles unless otherwise specified.

Table 5-1

ROUTE A, continued	1-1A	1A-2	2-5	5-5A	5A-5C	5C 7	7-7A	7A 10	10-11		Totals
Length pasture bordered	0.30	0.40	0.45	0.40	0.57	0	0.28	1.50	0.55		4.45
# center pivot systems bordered	0	0	0	0	0	0	0	0	0		0
Length thru Irig. land	0	0	0	0	0	0	0	0	0		0
Length potentially Irig. land	1.27	0.25	0	0	0	0	0	0	0		1.52
Length Windrows removed	0	0	0.85	0	0.94	0	0.36	0	0		2.15
Length in or bordering woodland	0.76	0.10	0.24	0.68	0.07	1.12	0.15	0.56	0.48		4.16
Acres woodlands cleared	5.51	1.54	1.74	4.95	0.41	8.15	1.10	1.76	3.30		28.5
Length 230 kV paralleled	1.27	1.05	0	0	0	0	0	0	0		2.33
Length 69 kV paralleled	0	0	0	0	0	0	0	0	0.87		0.87
# unpaved road crossings	0	0	3	1	0	1	1	1	1		7
Length unpaved paralleled within 200'	0	0	0	0	0	0	0	0.63	1.14		1.77
# 2 lane paved road crossings	1	1	1	1	2	3	1	2	1		13
Length 2 lane par. 200'	0	0	3.50	1.48	0.51	5.17	3.12	0.61	0.36		14.8
# RR crossings	0	0	0	0	0	0	0	0	0		0
Length RR par. 500'	0	0	3.86	1.48	2.82	5.17	3.12	0	0		16.5
Length within 500' of Northwestern Bell cable	0	0	3.67	0	0	5.17	3.12	0	0		12.0

Table 5-1

ROUTE A, continued	1-1A	1A-2	2-5	5-5A	5A 5C	5C-7	7-7A	7A-10	10-11		Totals				
NWB repeater hut within 500'	0	0	1	0	1	1	0	1	0		4				
Length joint use ROW	1.27	1.05	3.86	1.48	2.82	5.17	3.12	1.23	1.52		21.5				
# Streams crossed	5	1	1	0	0	2	1	1	1		12				
Length in wetlands	0	0	0	0	0	0.23	0.05	0.51	0		0.79				
#lakes crossed	0	0	0	0	0	0	0	0	0		0				
Length within 1000' of wildlife area	0	0	0	0	0	2.03	0	0	0		2.03				
# Acres Wldlf area crossed	0	0	0	0	0	24.	0	0	0		24.				
# gravel - mining	1	0	0	0	0	0	0	0	0		1				
# historic sites within 1000'	0	0	0	0	2	1	0	0	0		3				
# St, Fed, Co., Municipal Pks Crossed	0	0	0	0	0	0	0	0	0		0				
Length line 1000' of St., Fed., Co., Munic., pks	0	0	0	0	0	0	0	0	0		0				
# Fed., St. Wildlife areas crossed	0	0	0	0	0	1	0	0	0		1				
Length ROW 1000' of St., Fed., Wildlife area	0	0	0	0	0	1.7	0	0	0		1.7				
# Crossings Fed., St., wild, scenic or recreat. river	0	0	0	0	0	0	0	0	1		1				
# State scientific/natural areas crossed	0	0	0	0	0	0	0	0	0		0				

Table 5-1

ROUTE B	1-1A	1A-2	2-3	3-4	4-4A	4A-6	6-7	7-9	9-10	10-10A	10A-11		Totals		
Length (miles)	1.27	1.05	2.35	3.29	3.16	1.21	8.64	7.10	2.06	0.38	1.39		31.9		
Diagonal length	0	0	0	0.53	0	0	0.30	0	0.23	0	0		1.51		
# Angles 3°-30°	1	1	0	1	0	0	0	1	0	0	1		5		
# Angles 30°-90°	0	0	0	3	1	0	3	0	2	1	1		11		
# Homes in ROW	0	0	1	0	0	0	0	3	0	1	0		5		
# Homes 500' from ROW	0	2	1	1	0	0	4	9	1	1	9		28		
# Farmsteads in ROW	0	0	0	0	0	0	0	3	0	0	0		3		
# Farmsteads 500' from ROW	0	1	1	1	0	0	4	9	0	0	3		19		
Length in conc. setting	0	0	0	0	0	0	0	0	0	0	0.9		0.9		
Church/cemetary within 500' of ROW	0	0	0	0	0	0	0	0	0	0	0		0		
Length thru land zoned or planned for residential	0	0	0	0	0	0	0	0	0	0	0.9		0.9		
# Airports 5280'	0	0	0	0	0	0	0	0	0	0	0		0		
Length thru recreational area	0	0	0	0	0	0	0	0	0	0	0		0		
Length cultivated fields crossed	0	0	0.37	1.03	1.38	0	0.49	0	0.32	0	0		2.56		
Length cultivated fields bordered	0.12	0.34	1.42	1.30	0.65	0.83	5.11	4.77	0.17	0.13	0.54		15.4		
Length pasture crossed	0	0	0	0	0.23	0.23	0.36	0	0.70	0	0		1.52		

Note: all lengths given in miles unless otherwise specified.

Table 5-1
ROUTE B, continued

	1-1A	1A-2	2-3	3-4	4 4A	4A 6	6 7	7-9	9 10	10-10A	10A-11		Totals	
Length pasture bordered	0.30	0.40	0	0.23	0	0	0.85	0.92	0.48	0.09	0.46		3.73	
# center pivot systems bordered	0	0	0	0	0	0	0	0	0	0	0		0	
Length thru Irig. land	0	0	0	0	0	0	0	0	0	0	0		0	
Length potentially Irig. land	1.27	0.25	0	0	0	0	0	0	0	0	0		1.52	
Length Windrows removed	0	0	0	0	0	0	0	0	0.12	0	0		0.12	
Length in or bordering woodland	0.76	0.10	0.24	1.70	0.95	0.23	2.05	0.53	0.69	0.12	0.36		7.73	
Acres woodlands cleared	5.51	1.54	1.76	18.2	6.89	1.67	18.9	3.90	5.02	0.87	2.43		66.7	
Length 230 kV paralleled	1.27	1.05	2.35	0	0	0	0	0	0	0	0		4.67	
Length 69 kV paralleled	0	0	0	0	0	0	0	0	0	0	0.87		0.87	
# unpaved road crossings	0	0	2	1	2	1	5	3	1	0	1		16	
Length unpaved paralleled within 200'	0	0	0	0	0	0	0	5.5	0	0	1.14		6.64	
# 2 lane paved road crossings	1	1	1	1	1	0	4	3	0	1	0		13	
Length 2 lane par. 200'	0	0	0	0	0	0	0	0	0	0	0.36		0.36	
# RR crossings	0	0	0	0	0	0	0	0	0	0	0		0	
Length RR par. 500'	0	0	0	0	0	0	0	0	0	0	0		0	
Length within 500' of Northwestern Bell cable	0	0	0	0	0	0	0	0	0	0	0		0	

Table 5-1

ROUTE B, continued	1-1A	1A 2	2 3	3-4	4-4A	4A 6	6 7	7-9	9-10	10-10A	10A 11		Totals		
NWB repeater hut within 500'	0	0	0	0	0	0	0	0	0	0	0		0		
Length joint use ROW	1.27	1.05	2.35	0	0	0	0.5	5.5	0	0	1.52		12.2		
# Streams crossed	5	1	2	3	0	0	2	2	0	1	0		16		
Length in wetlands	0	0	0.14	0.5	0.10	0.10	0.71	0.69	0.07	0	0		2.31		
#lakes crossed	0	0	0	0	0	0	0	0	0	0	0		0		
Length within 1000' of wildlife area	0	0	0	0	0	0	0	0	0	0	0		0		
# Acres Wldlf area crossed	0	0	0	0	0	0	0	0	0	0	0		0		
# gravel - mining	1	0	0	0	0	0	2	0	0	0	0		3		
# historic sites within 1000'	0	0	0	0	0	0	0	0	0	0	0		0		
# St, Fed, Co., Municipal Pks Crossed	0	0	0	0	0	0	0	0	0	0	0		0		
Length line 1000' of St., Fed., Co., Munic., pks	0	0	0	0	0	0	0	0	0	0	0		0		
# Fed., St. Wildlife areas crossed	0	0	0	0	0	0	0	0	0	0	0		0		
Length ROW 1000' of St., Fed., Wildlife area	0	0	0	0	0	0	0	0	0	0	0		0		
# Crossings Fed., St., wild, scenic or recreat. river	0	0	0	0	0	0	0	0	0	1	0		1		
# State scientific/natural areas crossed	0	0	0	0	0	0	0	0	0	0	0		0		

Table 5-1

ROUTE C	1-1A	1A-2	2-3	3-3A	3A-3B	3B-12	12-12A	12A-12B	12B-13	13-11		Totals			
Length (miles)	1.27	1.05	2.35	3.00	1.73	6.73	6.36	6.80	5.87	3.54		38.7			
Diagonal length	0	0	0	0	0	0	0	0	0	0		0			
# Angles 3°-30°	1	1	0	3	0	0	0	0	0	2		7			
# Angles 30°-90°	0	0	0	1	0	0	0	2	2	2		7			
# Homes in ROW	0	0	1	1	0	0	3	8	3	2		18			
# Homes 500' from ROW	0	2	1	3	1	2	11	19	13	12		64			
# Farmsteads in ROW	0	0	0	0	0	0	3	8	3	2		16			
# Farmsteads 500' from ROW	0	1	1	0	1	2	11	19	13	7		55			
Length in conc. setting	0	0	0	0	0	0	0	0	0	0.61		0.61			
Church/cemetary within 500' of ROW	0	0	0	0	0	0	0	1	0	0		1			
Length thru land zoned or planned for residential	0	0	0	0	0	0	0.25	1.25	0	0.42		1.92			
# Airports 5280'	1	0	0	0	0	0	0	0	0	3		4			
Length thru recreational area	0	0	0	0	0	0	0	0.10	0	0		0.10			
Length cultivated fields crossed	0	0	0.37	0.68	0	1.14	0	0	0	0		2.19			
Length cultivated fields bordered	0.12	0.34	1.42	0.77	1.50	1.20	3.65	3.09	3.29	1.32		16.7			
Length pasture crossed	0	0	0	0.19	0	0.95	0	0	0	0		1.14			

Note: all lengths given in miles unless otherwise specified.

a

Table 5-1
ROUTE C, continued

	1-1A	1A-2	2-3	3-3A	3A-3B	3B-12	12-12A	12A-12B	12B 13	13 11		Totals		
Length pasture bordered	0.30	0.40	0	0	0.23	0.60	0.38	0.44	0.43	0.29		3.07		
# center pivot systems bordered	0	0	0	0	0	0	0	0	0	0		0		
Length thru Irig. land	0	0	0	0	0	0	0	0	0	0		0		
Length potentially Irig. land	1.27	0.25	0	0	0	0	0	0	0	0		1.52		
Length Windrows removed	0	0	0	0	0	0	0	0	0	0		0		
Length in or bordering woodland	0.76	0.10	0.24	1.17	0	1.40	0.55	2.55	1.53	0.99		9.29		
Acres woodlands cleared	5.51	1.54	1.76	8.50	0	10.2	4.02	18.5	11.1	7.24		68.4		
Length 230 kV paralleled	1.27	1.05	2.35	3.00	1.73	6.73	0	0	0	0		16.1		
Length 69 kV paralleled	0	0	0	0	0	0	1.90	6.80	5.87	3.54		18.1		
# unpaved road crossings	0	0	2	3	3	5	5	2	2	3		23		
Length unpaved paralleled within 200'	0	0	0	0	0	0	0	3.2	5.33	3.34		11.9		
# 2 lane paved road crossings	1	1	1	1	0	3	2	4	2	2		17		
Length 2 lane par. 200'	0	0	0	0	0	0	6.36	3.6	0	0		9.96		
# RR crossings	0	0	0	0	0	0	0	0	0	1		1		
Length RR par. 500'	0	0	0	0	0	0	0	0	0	0		0		
Length within 500' of Northwestern Bell cable	0	0	0	0	0	0	0	0	0	0		0		

Table 5-1

ROUTE C, continued

	1-1A	1A-2	2-3	3-3A	3A-3B	3B 12	12-12A	12A-12B	12B-13	13-11		Totals			
NWB repeater hut within 500'	0	0	0	0	0	0	0	0	0	0		0			
Length joint use ROW	1.27	1.05	2.35	3.00	1.73	6.73	6.36	6.80	5.87	3.54		38.70			
# Streams crossed	5	1	2	7	0	1	1	4	2	1		24			
Length in wetlands	0	0	0.14	0	0.90	0.33	0.60	0.27	0.25	0		2.45			
#lakes crossed	0	0	0	0	0	0	0	0	0	0		0			
Length within 1000' of wildlife area	0	0	0	0	0	0	0	0	0	0		0			
# Acres Wldlf area crossed	0	0	0	0	0	0	0	0	0	0		0			
# gravel - mining	1	0	0	0	0	0	0	0	0	0		1			
# historic sites within 1000'	0	0	0	0	0	0	0	0	0	0		0			
# St, Fed, Co., Municipal Pks Crossed	0	0	0	0	0	0	0	1	0	0		1			
Length line 1000' of St., Fed., Co., Munic., pks	0	0	0	0	0	0	0	0.38	0	0		0.38			
# Fed., St. Wildlife areas crossed	0	0	0	0	0	0	0	0	0	0		0			
Length ROW 1000' of St., Fed., Wildlife area	0	0	0	0	0	0	0	0	0	0		0			
# Crossings Fed., St., wild, scenic or recreat. river	0	0	0	0	0	0	0	0	1	0		1			
# State scientific/natural areas crossed	0	0	0	0	0	0	0	0	0	0		0			

Table 5-1

ROUTE D	1-1A	1A-1B	1B-1C	1C-1D	1D-9A	9A-10A	10A-11		Totals
Length (miles)	1.27	6.42	6.21	7.53	7.33	2.02	1.39		32.2
Diagonal length	0	0	0	0	0	0.17	0		0.17
# Angles 3°-30°	1	0	0	4	1	1	2		9
# Angles 30°-90°	0	1	4	5	4	3	0		17
# Homes in ROW	0	7	6	7	1	1	0		22
# Homes 500' from ROW	0	33	23	25	18	9	7		115
# Farmsteads in ROW	0	4	6	5	1	1	0		17
# Farmsteads 500' from ROW	0	11	19	23	9	4	5		71
Length in conc. setting	0	0	0	0	0	0	0.8		0.8
Church/cemetary within 500' of ROW	0	0	0	0	0	0	0		0
Length thru land zoned or planned for residential	0	0	0	0	0	0	0.8		0.8
# Airports 5280'	0	0	0	0	0	0	0		0
Length thru recreational area	0	0	0	0	0	0	0		0
Length cultivated fields crossed	0	0	0	0	0	0	0		0
Length cultivated fields bordered	0.12	5.18	5.26	4.88	5.33	1.10	0.45		22.3
Length pasture crossed	0	0	0	0	0	0	0		0

Note: all lengths given in miles unless otherwise specified.

Table 5-1

ROUTE D, continued

	1-1A	1A-1B	1B-1C	1C-1D	1D-9A	9A-10A	10A-11		Totals
Length pasture bordered	0.30	0.09	0.26	0.25	0.92	0.37	0.41		2.6
# center pivot systems bordered	0	0	0	0	0	0	0		0
Length thru Irig. land	0	0	0	0	0	0	0		0
Length potentially Irig. land	1.27	3.5	0	0	0	0	0		4.77
Length Windrows removed	0	1.91	0	0	0	0	0		1.91
Length in or bordering woodland	0.76	0.26	0.38	1.12	0.29	0.11	0.36		3.28
Acres woodlands cleared	5.51	1.89	2.75	8.82	2.15	0.77	2.62		24.5
Length 230 kV paralleled	1.27	0	0	0	0	0	0		1.27
Length 69 kV paralleled	0	0	6.21	7.53	7.33	1.17	0.83		23.1
# unpaved road crossings	0	3	4	9	5	2	1		24
Length unpaved paralleled within 200'	0	0	0	0	0	0	0.83		0.83
# 2 lane paved road crossings	1	3	4	2	2	2	1		15
Length 2 lane par. 200'	0	6.42	6.21	6.56	7.33	1.87	0.38		27.8
# RR crossings	0	0	0	0	0	0	0		0
Length RR par. 500'	0	0	0	0	0	0	0		0
Length within 500' of Northwestern Bell cable	0	0	0	0	0	0	0		0

Table 5-1

ROUTE D, continued	1-1A	1A-1B	1B-1C	1C-1D	1D-9A	9A-10A	10A-11	Totals
NWB repeater hut within 500'	0	0	0	0	0	0	0	0
Length joint use ROW	1.27	6.42	6.21	7.53	7.33	2.02	1.33	32.1
# Streams crossed	5	1	1	1	0	0	0	8
Length in wetlands	0	0	0.33	0.58	0.41	0	0	1.32
#lakes crossed	0	0	0	0	0	0	0	0
Length within looo' of wildlife area	0	2.36	0	0	0	0	0	2.36
# Acres Wldlf area crossed	0	14.4	0	0	0	0	0	14.4
# gravel - mining	1	0	0	0	0	0	1	2
# historic sites within 1000'	0	0	0	0	1	0	0	1
# St, Fed, Co., Municipal Pks Crossed	0	0	0	0	0	0	0	0
Length line 1000' of St., Fed., Co., Munic., pks	0	0	0	0	0	0	0	0
# Fed., St. Wildlife areas crossed	0	0	0	0	0	0	0	0
Length ROW 1000' of St., Fed., Wildlife area	0	0	0	0	0	0	0	0
# Crossings Fed., St., wild, scenic or recreat. river	0	0	0	0	0	1	0	1
# State scientific/natural areas crossed	0	0	0	0	0	0	0	0

Table 5-1
MISCELLANEOUS ROUTE SEGMENTS

	3B-6	3A-4A	5A-5B	5B-5C	7A-8A	7A-7B	7B-7C	7C-8C	8C-11	8A-8B	8A-11	8B-8C			
Length (miles)	3.37	3.90	2.77	1.45	3.65	3.83	3.79	1.10	0.89	0.86	1.82	1.50			
Diagonal length	0	0	0	0	0	0.58	0.33	0	0	0	0	0			
# Angles 3°-30°	0	0	0	0	2	0	0	1	1	1	3	1			
# Angles 30°-90°	2	4	1	1	0	3	2	1	1	0	1	1			
# Homes in ROW	0	2	2	0	1	0	0	1	0	0	0	0			
# Homes 500' from ROW	2	6	12	2	12	6	3	2	1	0	70+	0			
# Farmsteads in ROW	0	2	1	0	0	0	0	0	0	0	0	0			
# Farmsteads 500' from ROW	2	6	7	2	1	6	3	1	1	0	0	0			
Length in conc. setting	0	0	0	0	1.10	0	0	0	0.89	0	1.1	0			
Church/cemetary within 500' of ROW	0	0	0	0	0	0	0	0	0	0	0	0			
Length thru land zoned or planned for residential	0	0	0	0	1.1	0	0	0	0.89	0	1.48	0.25			
# Airports 5280'	0	0	0	0	0	0	0	1	1	0	0	0			
Length thru recreational area	0	0	0	0	0	0	0	0	0	0	0	0			
Length cultivated fields crossed	0.97	0	0	0.69	0	0	0.29	0.08	0	0.36	0	0			
Length cultivated fields bordered	5	2.41	1.99	0.38	1.91	1.70	3.51	0.67	0.72	0.24	0	0.67			
Length pasture crossed	0.66	0	0	0	0	0	0	0	0	0	0	0			

Note: all lengths given in miles unless otherwise specified.

Table 5-1
MISCELLANEOUS
ROUTE SEGMENTS, continued

	3B-6	3A-4A	5A-5B	5B-5C	7A-8A	7A-7B	7B-7C	7C-8C	8C-11	8A-8B	8A-11	8B-8C		
Length pasture bordered	0.81	0.63	0	0	0.67	0.36	0.47	0.05	0	0	0.17	0		
# center pivot systems bordered	0	0	0	0	0	0	0	0	0	0	0	0		
Length thru Irig. land	0	0	0	0	0	0	0	0	0	0	0	0		
Length potentially Irig. land	0	0	0	0	0	0	0	0	0	0	0	0		
Length Windrows remcved	0	0	0	0	0.48	0.25	0.28	0	0	0	0	0.12		
Length in or bordering woodland	0.19	0.39	0.40	0.19	0.15	1.06	1.31	0	0	0.37	0.48	0		
Acres woodlands cleared	1.38	2.84	2.89	1.30	1.10	11.2	8.5	0	0	1.81	3.50	0		
Length 230 kV paralleled	0	0	0	0	0	0	0	0	0	0	0	0		
Length 69 kV paralleled	0	3.90	0	1.45	0	0	0	0	0.30	0	0	0		
# unpaved road crossings	0	2	0	0	2	3	2	1	1	1	0	0		
Length unpaved paralleled within 200'	0	0	1.77	0	0	2.58	0	0	0	0	0	0		
# 2 lane paved road crossings	2	3	2	1	2	1	0	0	1	0	3	1		
Length 2 lane par. 200'	0	1.5	1.0	0	2.62	0	0	0.97	0.67	0	0.75	0		
# RR crossings	0	0	0	0	0	1	0	0	1	1	0	0		
Length RR par. 500'	0	0	0	0	3.65	0	0	0	0	0	1.68	0		
Length within 500' of Northwestern Bell cable	0	0	0	0	1.95	0	0	0	0	0	0	0		

Table 5-1
MISCELLANEOUS
ROUTE SEGMENTS, continued

	3B-6	3A-4A	5A-5B	5B-5C	7A-8A	7A-7B	7B-7C	7C-8C	8C-11	8A-8B	8A-11	8B-8C			
NWB repeater hut within 500'	0	0	0	0	1	0	0	0	0	0	0	0			
Length joint use ROW	0	3.90	2.77	0	3.65	2.58	0	0.97	0.89	0	1.68	0			
# Streams crossed	1	1	1	0	1	1	1	1	0	0	1	1			
Length in wetlands	0	0.19	0.15	0.24	0.21	0.67	0.25	0.05	0	0.12	0	0.61			
#lakes crossed	0	0	0	0	0	0	0	0	0	0	0	0			
Length within 1000' of wildlife area	0	0	0	0	0	0	0	0	0	0	0	0			
# Acres Wldlf area crossed	0	0	0	0	0	0	0	0	0	0	0	0			
# gravel - mining	0	0	0	0	0	0	0	0	0	0	0	0			
# historic sites within 1000'	0	0	0	0	0	0	0	0	0	0	0	0			
# St, Fed, Co., Municipal Pks Crossed	0	0	0	0	0	0	0	0	0	0	0	0			
Length line 1000' of St., Fed., Co., Munic., pks	0	0	0	0	0	0	0	0	0	0	0.71	0			
# Fed., St. Wildlife areas crossed	0	0	0	0	0	0	0	0	0	0	0	0			
Length ROW 1000' of St., Fed., Wildlife area	0	0	0	0	0	0	0	0	0	0	0	0			
# Crossings Fed., St., wild, scenic or recreat. river	0	0	0	0	0	0	0	0	0	0	1	1			
# State scientific/natural areas crossed	0	0	0	0	0	0	0	0	0	0	0	0			

The narrative discussion for each segment includes comments regarding soil productivity, based on the computer-generated map of climate-modified soil productivity classes shown in Figure 2-10. A description of how the map was developed, and how it is to be interpreted, appears in Chapter 2 (Section 2.10.2). This feature was not calculated for each segment due to the generalizations inherent in the computer mapping process which make precise measurement (e.g. of the amount of land in a specific productivity class) somewhat meaningless.

In the following route segment discussions, the four main routes (A, B, C and D) are discussed sequentially and in their entirety, except where a segment common to more than one route has been covered previously. Route A', which is included in Section 5.3 (Summary of Route Impacts), is identical to Route A to Node 8, then uses a different approach into and through Milaca (8-8A-11). The miscellaneous route segments which were added by the CREC are discussed at the end of this Section; in most cases they can be substituted for original segments in most of the four main routes.

The criteria and considerations which are represented in the checklist are in no way ranked or prioritized, and no attempt will be made in this analysis to do so. In any transmission line routing, it is generally impossible to meet all criteria or to solve all conflicts which may arise with a particular route alignment. Any solution to the problem of locating the required facilities would be one of compromise in some cases; of tradeoff in others. Compromise would involve finding locations where most concerns are partially overcome, but few, if any, are fully satisfied. Trade-offs, on the other hand, imply the satisfying of foremost concerns to the potential detriment of others.

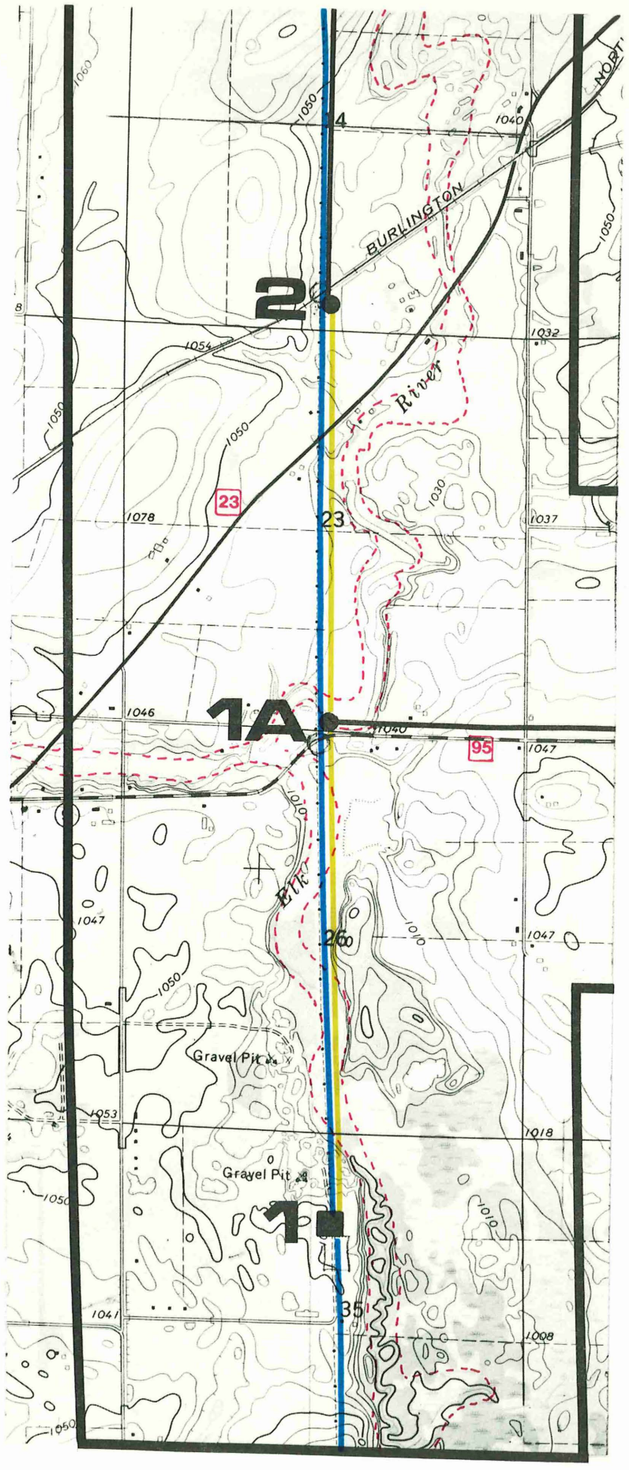
route A

Segment 1-1A

Segment 1-1A, which is common to all of the proposed routes, is 1.27 miles in length, and parallels an existing UPA 230 kV transmission line north of the Benton County Substation. The existing line is single circuit and constructed on wooden H-frame towers on a 150 right of way (ROW). The application for a Construction Permit indicates that the proposed HVTL would be constructed east of the existing line utilizing overlapping ROW's and poles placed in tandem with those presently in place. With this design, UPA estimates that 70 feet of additional ROW would have to be acquired.

No residences or farmsteads are within the ROW of the proposed centerline, or within an area 500 feet from the centerline. No cultivated fields or pastures are crossed by the proposed ROW,

PROPOSED ROUTE SEGMENT 1·1A·2



ROUTE BOUNDARY
SEGMENT REFERENCE CENTERLINE
NODE
REFERENCE CENTERLINE
EXISTING 69 KV LINE
EXISTING 230 KV LINE
FLOOD HAZARD ZONE

NORTH

0 1/2 MILE

PROPOSED ROUTE SEGMENT 1·1A·2

although a small amount of cropland (0.12 miles) and pasture (0.30 miles) borders the ROW. Although there are no irrigation systems adjacent to or within the ROW area, soil conditions for the entire length of this link make irrigation potentially feasible. While soil productivity ratings for the study area show this area to contain soils in the highest ranked group for the study area, the terrain and tree cover tend to limit agricultural uses to pasture in the immediate vicinity of the proposed centerline for part of the distance between Nodes 1 and 1A.

The orientation of the proposed centerline in this link coincide with the slight valley and floodplain adjacent to the Elk River, one of the larger streams in the study area. As a result, the Elk River would have to be crossed five times if the proposed line occupied a ROW parallel to and east of the existing line. The stream course meanders, and over time has cut a shallow valley which varies in width from approximately 100 feet to 1000 feet. The stream valley is moderately wooded with diversified hardwood species, predominantly oak, maple and cottonwood. The proposed centerline crosses 0.76 miles of wooded land, requiring a total clearing of 5.51 acres.

Two gravel pits, one active and one dormant, are located to the west of the existing line but would not be affected by the location of the proposed HVTL.

While the Elk River carries enough water to be suitable for canoeing for most of the boating season, it is not a designated recreational river and there is no public land adjacent to it in this segment.

Segment 1A-2:

Segment 1A-2 again represents the common egress from the Benton County Substation for all but Route D. This link is 1.05 miles long, and is similarly located on the east side and adjacent to the existing 230 kV line for its entire length. Right of way requirements and design features are identical to those described in Segment 1-1A. The ROW crosses State Highway 23 once. This segment terminates at the point of intersection with the Burlington Northern railroad track (Node 2).

Two homes and a farmstead are within 500 feet of the proposed ROW; no buildings are located within this ROW.

Soils crossed by the proposed ROW are again within the group holding the highest soil productivity scores for the study area (57-75). However, irregularity in the terrain due to the presence of the Elk River and its flood plain reduce the potential

for crop production in the immediate vicinity of the centerline, which borders 0.34 miles of cultivated land in this link. The remainder of the land along the proposed ROW is in pasture or is presently fallow. No irrigation systems are crossed or bordered by the ROW, although the southernmost 0.25 miles of this link is potentially irrigable.

The Elk River is crossed once in the segment. While much of the bottomland along the river is poorly drained and wet, especially in the spring, the proposed ROW crosses no wetland in segment 1A-2. One-tenth of a mile of wooded land is crossed, required 1.54 acres to be cleared for the ROW.

There are no designated public lands in this segment.

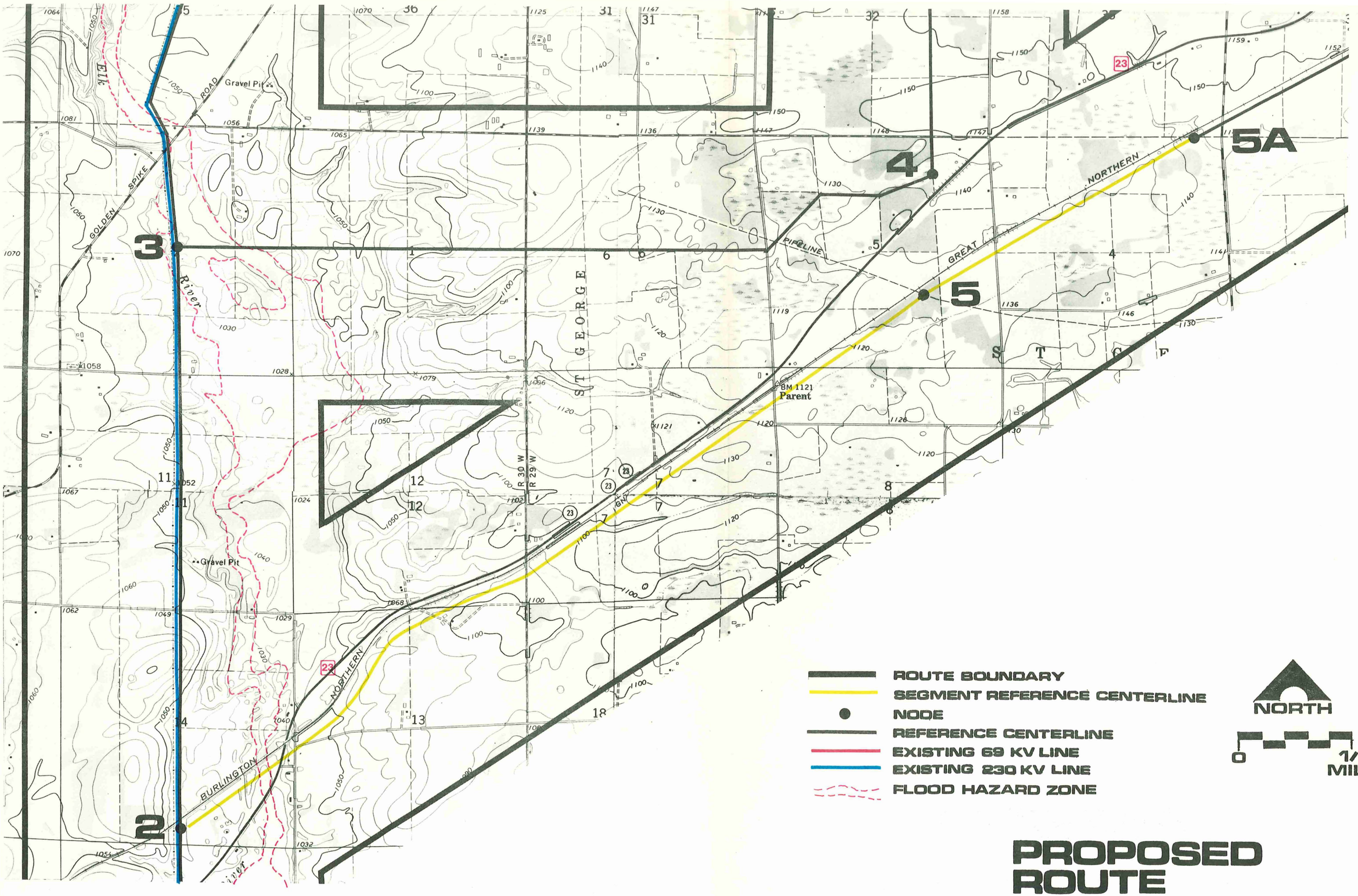
Segment 2-5

In this segment, the reference centerline (RCL) used to approximate the likely location of the ROW turns eastward along the south side of the Burlington Northern railroad tracks. Proceeding in a northeasterly direction, the RCL parallels the railroad tracks for the entire distance to Node 5, a total of 3.86 miles. Approximately 0.40 of a mile east of Node 2, the tracks and the RCL cross over to the south side of Highway 23. As drawn by UPA, the RCL remains south of both the highway and the tracks, with a ROW immediately adjacent to the Burlington Northern ROW. A new ROW in this segment could vary from 70 to 120 feet in width, depending on whether the Burlington Northern railroad ROW is shared with the HVTL ROW.

A total of eight light (3-30°) angles would be required in this section of line to parallel the S-shaped curve made by the railroad tracks.

Highway 23 is also the location of a buried long distance telephone cable owned by Northwestern Bell, Inc. This cable is buried in the south edge of the highway ROW (40-50 feet from highway centerline) for the entire distance to Milaca. Electrical field interference and the possibility of large induced voltages could occur on the cable in the event of a fault on the proposed HVTL if the HVTL closely parallels the cable. Adequate separation (with present shielding) occurs only for short distances at the beginning and end of the segment; the cable is within 500 feet of the RCL for a total of 3.67 miles. In addition, a telephone repeater hut is located just north of Highway 23 one half mile west of Parent.

PROPOSED ROUTE SEGMENT 2·5·5A



PROPOSED ROUTE SEGMENT 2·5·5A

No homes or farmsteads are within the ROW defined by the RCL; six homes and two farmsteads are within 500 feet of the ROW. No additional human settlement impacts are anticipated in this segment.

Soils in segment 2-5A are listed as upland sandy loams of the Mora-Ronneby-Parent association. General soil productivity based on climate-modified grouped rankings is high over most of the route area in this segment. The RCL borders 2.86 miles of cultivated fields, 0.45 miles of pasture and 0.24 miles of wooded land between Nodes 2 and 5. Construction of the proposed HVTL would require the removal of trees on 1.76 acres of wooded land, and 0.85 miles of field windows.

The RCL crosses the Elk River once (the river is also crossed by a 25 foot high railroad bridge at this point). A small grass/cattail wetland is crossed by the RCL just east of Parent.

No designated public recreational lands, wildlife areas or historical or archeological sites occur within the intended ROW in this segment.

Segment 5-5A

The RCL in this segment is 1.48 miles long, and extends from the diagonal intersection of the Burlington Northern tracks and a natural gas pipeline to a point approximately 0.20 miles west of County Road 62. The RCL continues to be located south of, and immediately adjacent to the BNRR tracks. One light angle (3-30°) structure would be required in this segment.

There is an average separation of 2000 feet between the NWB telephone cable on Highway 23 and the proposed ROW, reducing the need for any special measures to protect the cable.

The RCL crosses one unpaved township road and one paved two lane county road in this segment.

No residential dwellings or farmsteads are located within the ROW in this section; one home and one farmstead lie within 500 feet of the ROW.

Just east of the unpaved township road, a large metal garage associated with a nearby residence lies within the proposed ROW.

Soils within the route segment between nodes 5 and 5A are classified as generally poorly drained upland loams. Soil productivity ratings for 40 acre cells fall within the lowest study area groupings (0-18). The terrain tends to be flat, with

vegetative cover typically pasture or grass type wetlands. Occasional small groups of hardwoods spot the area. The RCL borders 0.28 miles of cultivated fields, 0.40 miles of pasture and 0.68 miles of wooded land. No wetland is crossed by the RCL. Right of way clearing would remove approximately 4.95 acres of trees in this section.

There are no designated public or protected lands within this segment.

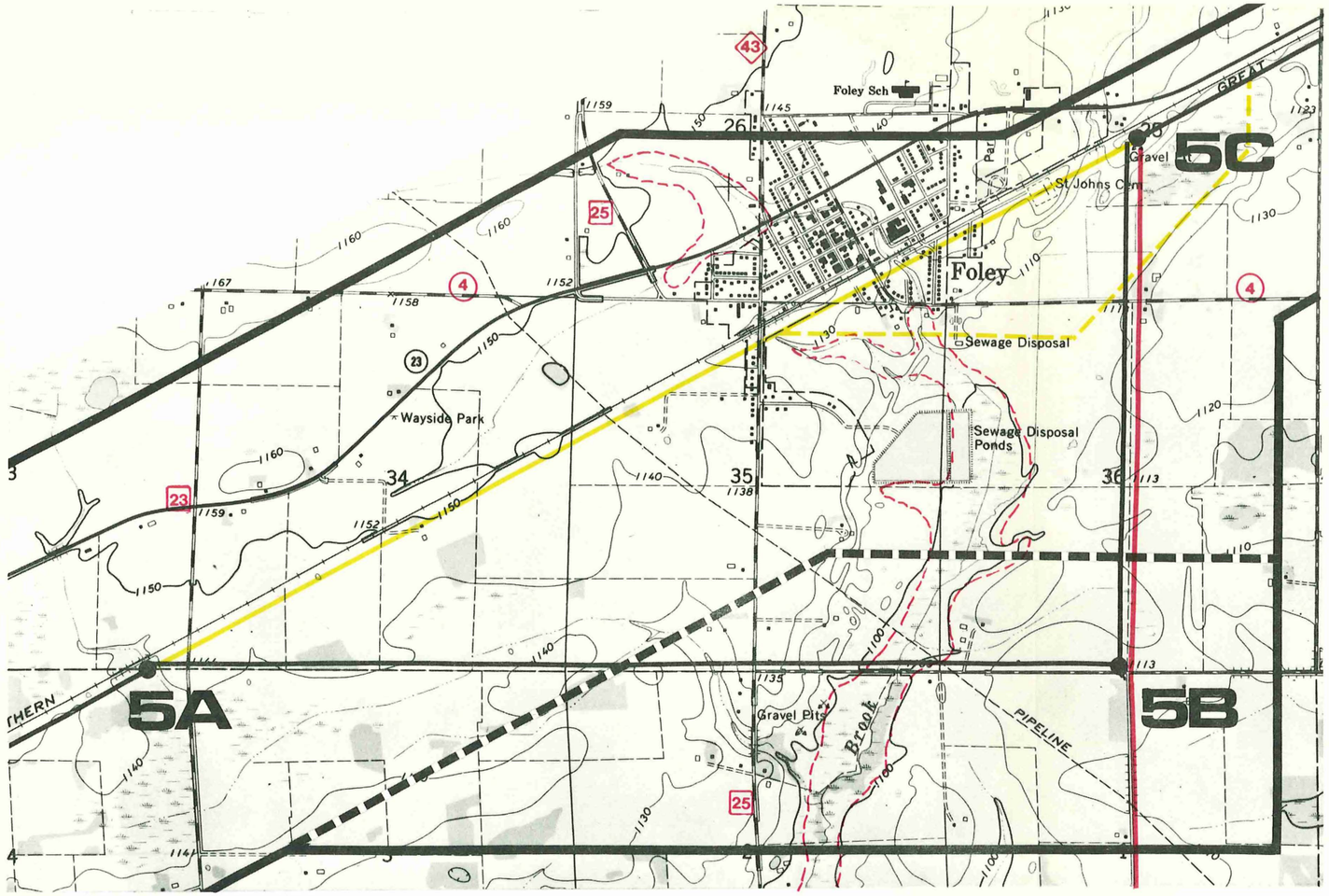
Route Segment 5A-5C

Two possible ROW alignments have been discussed for Segment 5A-5C, the first representing UPA's preferred route through the City of Foley and the second a proposal developed by the Citizens' Route Evaluation Committee. The RCL drawn by UPA to represent their preliminary choice for the location of a ROW is again adjacent to and abutting or overlapping the south side of the BNRR track ROW. The length of this segment is 2.82 miles. The RCL as drawn crosses four paved two lane roads, including State Highway 25. In addition, several paved residential and two gravel roads would be crossed by the proposed HVTL.

Much of the original residential and commercial development in Foley occurred north of the railroad tracks. However, in recent times, a moderate amount of development (mostly residential) has taken place south of the BNRR tracks, and the city has extended its original boundaries by several annexations. Due to the greater availability of open land, continued growth in some areas south of the tracks can be expected. Existing residential dwellings south of the tracks (in the vicinity of the RCL) are largely concentrated on the eastern half of the City near County Road 4. A significant number of residences would be affected by the placement of the HVTL on or near the RCL. Including houses north of the tracks, there are approximately 75 houses and three farmsteads within 500 feet of the RCL, although there are no homes actually in the 120 foot wide ROW shown by UPA. An additional 45 homes are within 1000 feet of the ROW. East of County Road 4, the proposed ROW would encroach upon a residential street which is parallel to the railroad tracks. In this area, it is possible that use of the BNRR ROW for structures may be required in order to provide adequate clearance to homes. Nine homes and two garages along this street are within 110-150 feet from the centerline of the railroad tracks.

The residential street terminates on the east side of Foley at St. John's Cemetary. Space for a ROW along the RCL is again minimal in this location, and it may be necessary to locate poles on the BNRR ROW in order to avoid the cemetary.

PROPOSED
ROUTE
SEGMENT 5A·5C



ROUTE BOUNDARY
SEGMENT REFERENCE CENTERLINE
NODE
REFERENCE CENTERLINE
EXISTING 69 KV LINE
FLOOD HAZARD ZONE

NORTH

0 1/2 MILE

PROPOSED ROUTE SEGMENT 5A·5C

A church and a city park north of the railroad tracks are within 500 feet of the RCL. A number of commercial enterprises are located within 500 feet of the RCL, including a grain storage facility, a lumber yard, and bulk fuel storage tanks. (Electric codes, including the National Electric Safety Code (NESC) do not address safe clearances between bulk fuel storage and HVTLs).

Although several small farms remain within the Foley City limits, most of the agricultural activity in this segment is located west of Foley. The RCL borders 1.29 miles of cultivated fields, and 0.57 miles of pasture. Required ROW clearing would remove 0.94 miles of windrow trees located parallel to the RCL in this segment. Soils in this area, (which continues to be relatively flat), are poorly drained upland loams, with a generalized productivity rating of less than 18 across most of this segment.

No wetlands are crossed by the RCL in this segment. Only a small amount of tree clearing is required (0.41 acres).

Two historic sites are located within 1000 feet of the RCL as drawn, St. John's Catholic church and the Benton County Courthouse. Both sites are located in central Foley north of the railroad tracks. Visual impact of the proposed HVTL should be minimal for these sites due to the level of urbanization already existing in Foley, and two intervening trees and buildings.

A second ROW alignment for this segment (indicated by a dashed yellow line on the map) would leave the BNRR tracks at the point of intersection with County Road 43 (the business route into Foley), and proceed directly east across an open field in the vicinity of an unused sewage treatment plant. Turning to the northeast, the ROW would cross an existing north-south 69 kV line, and an angle north-north east to the Burlington Northern Railroad tracks. This alignment avoids the gravel pit area, a cabinet making business, and a home located close to the railroad tracks. The distance of this proposed ROW is 1.75 miles, while the RCL is 1.5 miles in length.

No homes are within this proposed ROW, although 9 homes are within 500 feet. A turkey hatchery and a Senior Citizens' Home are located approximately 250 feet south of the ROW defined by the RCL alignment.

Much of the land crossed by this deviation from the railroad tracks is owned by the City of Foley, and is largely undeveloped at the present time. Due to wet soil conditions, much of this land is not considered developable by the city. A small portion of the land east of County Road 43 which is crossed by the CREC right of way is under cultivation (0.30 miles).

The CREC ROW crosses 0.60 miles of wetland, and a small intermittent stream which subsequently becomes Stoney Brook one mile south of Foley. In turning northeast the intersection with the 69 kV line to return to the RCL, the alternative ROW is aligned diagonally with respect to prevailing land divisions for a distance of 0.65 miles. However, the land crossed diagonally is largely rough uncultivated land characterized by wet soils and high water table. A small amount of wooded land is crossed by this proprosed ROW (0.25 miles), requiring the clearing of 3.6 acres of trees.

Segment 5C-7

Segment 5C-7 is 5.17 miles long and parallels the south side of BNRR railroad tracks and Highway 23 for the entire distance. As in previous segments, UPA estimates that 70 feet of right of way width would be required (assuming ROW overlap with BNRR land). The RCL crosses over two paved and three unpaved local roads.

The route segment passes south of Ronneby, a small community of 59 persons, and through the unincorporated settlement of Oak Park (population 130). No residences are located within the ROW; however, approximately 35 homes and six farmsteads are located within 500 feet of the ROW. 1.90 miles of RCL pass through land zoned or planned for residential development. In Oak Park, available ROW is reduced due to presence of a local street lined with residences and several buildings (including a grain processing facility) immediately south of the tracks. The RCL as drawn would cross over these buildings. Two churches (one in Ronneby, and one in Oak Park) are located within 1000 feet of the RCL.

A total of 2.85 miles of the RCL border cultivated land. Soils through this sector are predominantely upland sandy loams, which are often poorly drained where flat terrain exists in conjunction with high water table. Where drainage is adequate, generalized soil productivity scores are relatively high for the study area (in the range of 38-56).

Numerous wetlands of varying size are scattered throughout the route segment between Nodes 5C and 7. However, total wetland area crossed by the RCL is low (0.23 miles). The RCL crosses two branches of the St. Francis River east of Ronneby. The RCL crosses a number of small groves of trees (a total of 1.12 miles though wooded areas), resulting in the clearing of 8.15 acres of wooded land.

In the vicinity of Ronneby, the RCL crosses 2.03 miles of a statutory wildlife area (the Maywood Game Refuge). Land within this area is privately owned and large portions are under

cultivation. The area is not managed as a game refuge and its status as such is being reconsidered by the Department of Natural Resources.

Ronneby is also the site of an abandoned charcoal kiln which is considered an historic feature by the State Historical Society. The kiln is within 1500 feet of the RCL but intervening terrain and trees screen the location of the ROW from the site of the kiln.

No other designated public lands occur within this segment.

The NWB telephone cable is located within 250 feet of the RCL for the entire distance between the two nodes, and a repeater hut is situated north of the highway about one-half mile west of Oak Park.

Segment 7-7A

Segment 7-7A is 3.12 miles long, with the RCL located just south and parallel to the BNRR tracks. The tracks and Highway 23 are paralleled for the entire distance. One light angle structure would be required in this segment. The RCL crosses County Road 9 (a 2-lane paved road) and an unpaved township road. NWB telephone cable is again located within 250 feet of the RCL throughout the segment.

Within this segment, one home is located within the ROW, and an additional eight residences and seven farmsteads are within 500 feet of the ROW.

The RCL borders cultivated fields for 2.52 miles and pasture land for 0.28 miles. Soils in the section are largely sandy loams, often poorly drained or wet. Generalized soil productivity ratings increase from west to east in this segment, with an indication of moderate to highly productive soils prevalent over the eastern half of the area crossed by the RCL. 0.36 miles of windrow trees occur in close proximity to the RCL and would be removed in clearing a ROW.

The RCL crosses 0.15 miles of woodland, requiring removal of 1.10 acres of trees. Only a minimal amount of wetland is encountered by the RCL (0.05 miles); one stream (Estes Brook) is crossed.

There are no public recreational lands, wildlife areas, historical sites or other designated public lands in this segment.

Segment 7A-8-10

This segment represents UPA's original proposed approach into the Milaca Substation. From Node 7A, the RCL continues along the BNRR tracks for approximately 0.57 miles to Node 8, then turns eastward along a half section line for 1.8 miles. From a point just west of the West Branch of the Rum River, the RCL turns northeast along a 45° diagonal for 0.57 miles and intersects a section line which is also the boundary between Milaca and Milo Townships. The RCL proceeds east along this line for a total of 1.70 miles to Node 10. The total length of this segment is 4.85 miles. One light angle (3-30°) and 2 heavy angles (30-90°) would be required. The RCL crosses one unpaved road and two paved two lane roads. Local roads are paralleled for a total of 1.24 miles.

By turning eastward at Node 8, the RCL avoids crossing the developed part of the City of Foreston (as well as Milaca's urbanized area). It does however, cross land within the Foreston corporate city limits which is zoned for residential development (a total of 1.0 miles). Nevertheless, development of this area would appear to be unlikely for some time. No homes or farmsteads lie within the ROW along this alignment; eight homes and six farmsteads are located within 500 feet of the ROW. The St. Louis Cemetary southeast of Foreston is approximately 450 feet north of the RCL.

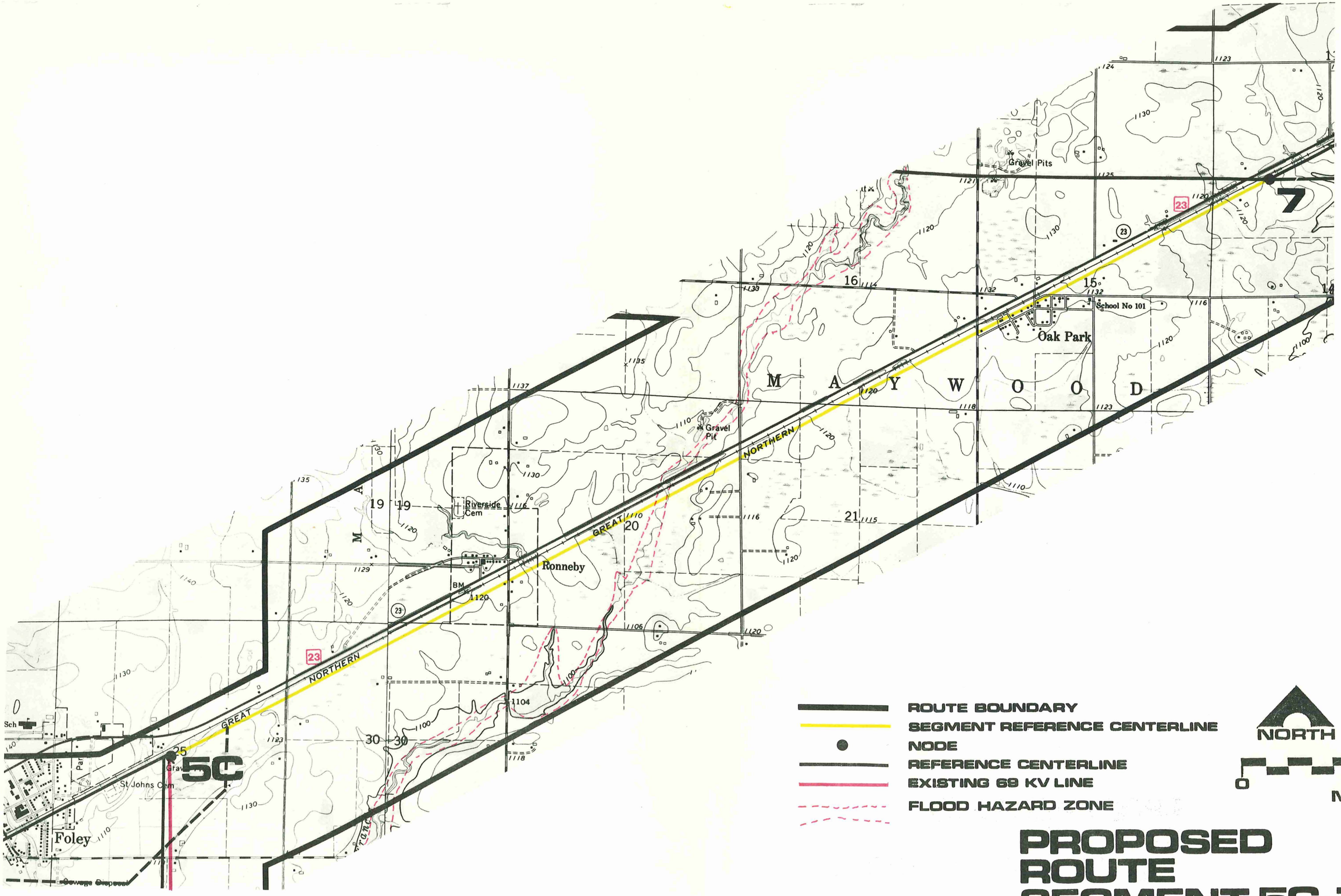
Most of the land in the vicinity of the RCL is presently in use for agricultural purposes. The RCL crosses 0.53 miles of cultivated fields, borders fields for 3.09 miles and borders pasture land for 1.50 miles. Soils throughout this segment fall in the upper range of scores for soil productivity in the study area (38-75). The terrain is essentially flat, with soils generally in the Freer-Freeon-Adolph group of light-textured loams with variable drainage.

The RCL crosses 0.56 miles of woodland, requiring 1.76 acres to be cleared of trees. The RCL passes through 0.51 miles of wetland. Vegetation in these wetland areas varies but typically consists ofcattails and sedges or willow, alder and other wetland brush species. The West Branch of the Rum River is crossed once by the RCL. This stream is one of the major rivers in the study area, but has no special scenic or recreational designations. No designated wildlife areas, public lands or historic sites occur within this segment.

Segment 10-10A-11

The RCL continues east along the township line to Node 10A, a distance of 2500 feet, crossing present Highway 169 alignment. West of the intersection with Highway 169, the RCL is located on the roadbed of an abandoned township road. East of the highway, the RCL crosses a cultivated field, the Rum River and

PROPOSED ROUTE SEGMENT 5C·7



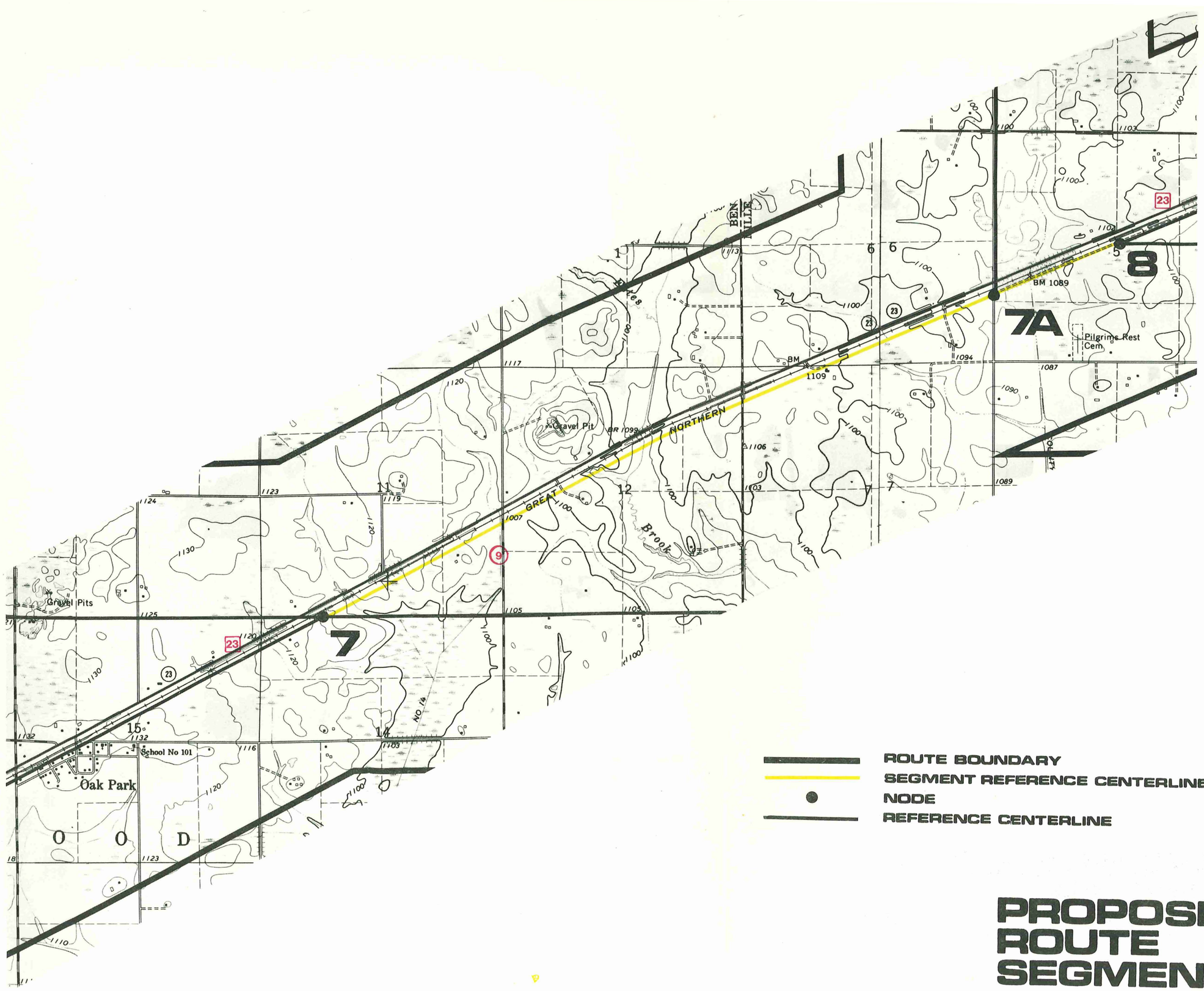
ROUTE BOUNDARY
SEGMENT REFERENCE CENTERLINE
NODE
REFERENCE CENTERLINE
EXISTING 69 KV LINE
FLOOD HAZARD ZONE

NORTH

0 1/2 MILE

PROPOSED ROUTE SEGMENT 5C·7

PROPOSED ROUTE SEGMENT 7·7A·8



PROPOSED ROUTE SEGMENT 7·7A·8

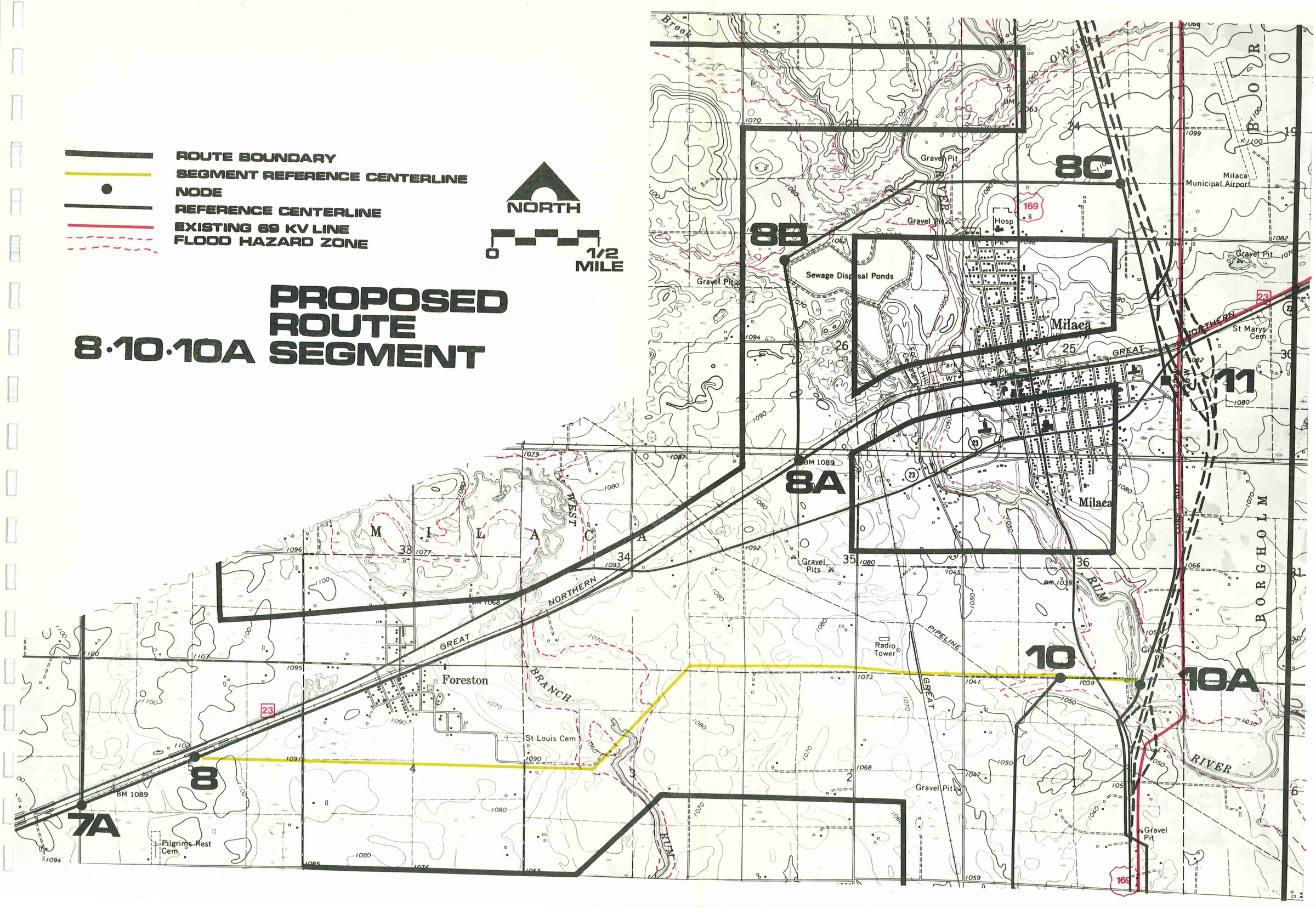
PROPOSED ROUTE SEGMENT 8·10·10A

ROUTE BOUNDARY
SEGMENT REFERENCE CENTERLINE
NODE
REFERENCE CENTERLINE
EXISTING 69 KV LINE
FLOOD HAZARD ZONE

NORTH

0 1/2 MILE

PROPOSED ROUTE 8·10·10A SEGMENT



a small woodland. A small seasonal home is located within the RCL right of way. One residence is located just north of the ROW, and a second home is approximately 450 feet south of the ROW in this area.

In the vicinity of the point of crossing, the Rum River is a designated recreational river (see Chapter 2). However, the HVTL would be partially screened by trees on both sides of the river at the point of crossing, and should cause only a minimal visual impact.

North of Node 10A, the RCL alignment is identical to that described in Segment 10A-11, Route D.

route B

Segments 1-1A, 1A-2

See discussion for Route A.

Segment 2-3

This segment extends from the intersection of the Burlington Northern Railroad tracks north on a right of way adjoining that for UPA's existing 230 kV line to the midpoint of Section 2 (St. George Township). The distance covered is 2.35 miles. The utility specifies that the distance between the centerline of the existing 230 kV line and the centerline of the proposed HVTL would be about 70 feet. With two separate single circuit lines, an additional 55-60 feet of ROW would have to be acquired, with the remaining required ROW to be shared with the existing line. No new ROW would be required if the existing line were double circuited. No angles are required in this segment. Two unpaved local roads are crossed by the proposed ROW.

One home located along this segment would fall within the proposed ROW; one house and one farmstead are within 500 feet of the ROW. No other human settlement impacts are likely in this segment.

The agricultural landscape in this segment is a mixture of cultivated fields and pasture, with scattered trees and small groves of woodland evenly dispersed over the length of the RCL. A total of 0.37 miles of cultivated fields is crossed, and an additional 1.47 miles is bordered. 0.72 miles of pasture is crossed.

The terrain through which the RCL crosses is hilly, with the RCL generally bordering the rise which forms the western side of the Elk Creek lowlands. Soils are generally a combination of deep, poorly drained loams and upland sandy loams; while soils are rated highly in terms of productivity potential, the terrain and drainage are limiting factors for agricultural use. The soil is poorly suited for irrigation according to SCS criteria.

The RCL crosses the Elk River twice in this segment, in an area just south of Node 3. The RCL would cross or border 0.24 miles of woodland, which in terms of ROW clearing, would result in the removal of 1.76 acres of trees. Only a slight amount of wetland is crossed (0.14 miles), although poor drainage along the Elk River bottomlands could make soil and vegetation in some non-wetland areas similarly vulnerable to damage during the construction phase.

No designated public recreational, wildlife or historic areas are located within this segment.

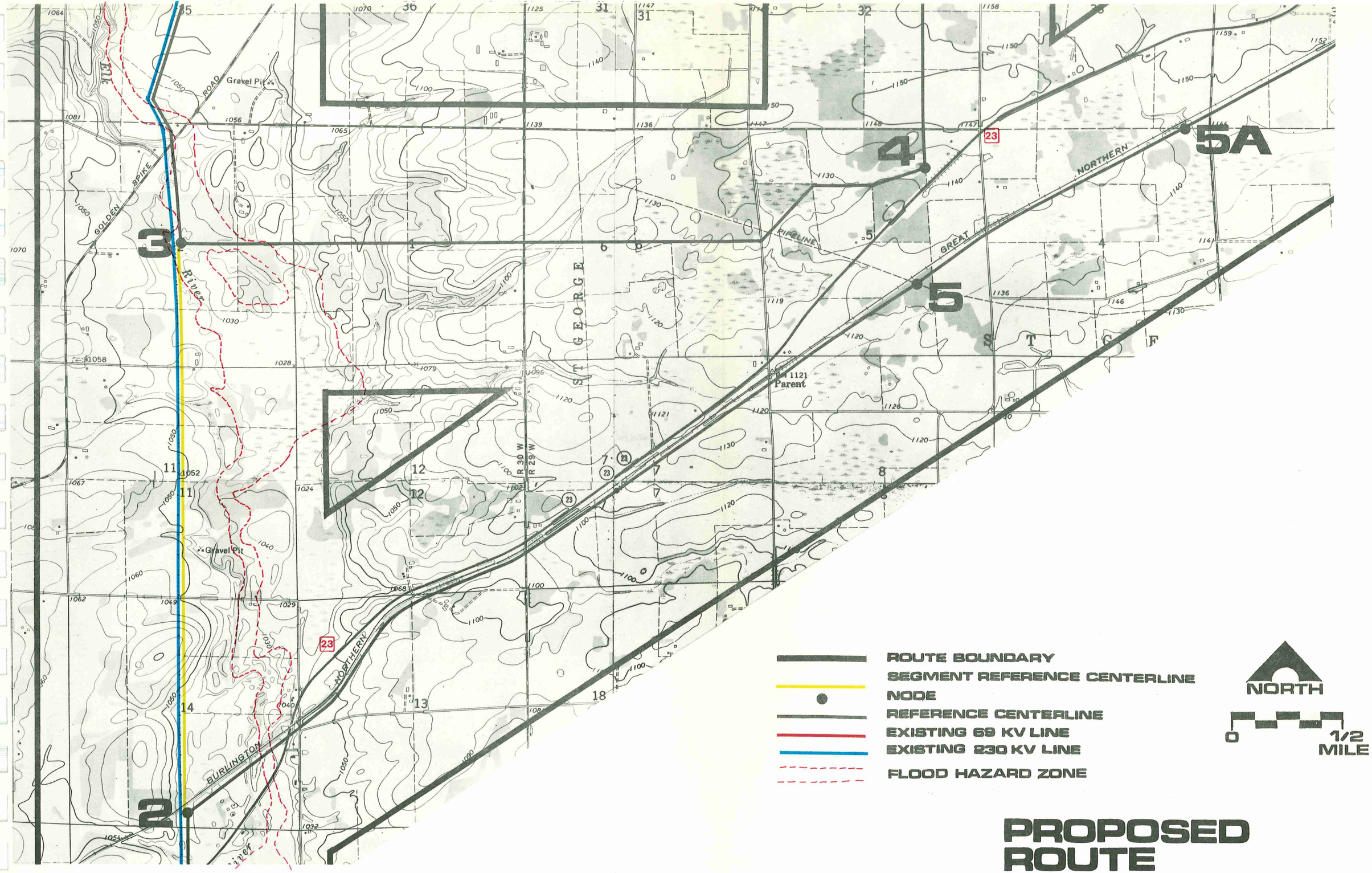
Segment 3-4

At Node 3, the RCL for Route C makes a 90° turn away from the existing 230 kV line, and travels directly east for a distance of 2.5 miles to an unpaved county road (#60) north of Parent. From that point, the RCL travels an additional 0.79 miles in a northeasterly diagonal and step-like fashion to Node 4. The total distance of this segment is 3.29 miles; 0.53 miles of the RCL are oriented on a diagonal (neither east-west nor north-south). This alignment requires one light (3-30°) angle and three heavy (30-90°) angles. The ROW described by this RCL is intended to follow field boundaries as much as possible; however, approximately 1.03 miles of RCL as drawn cross, rather than border, fields. The diagonal portions of the segment generally follow an intermittent stream/drainage ditch, so that the diagonal is not located within cultivated fields. The RCL crosses over one paved two lane county road, and one unpaved road.

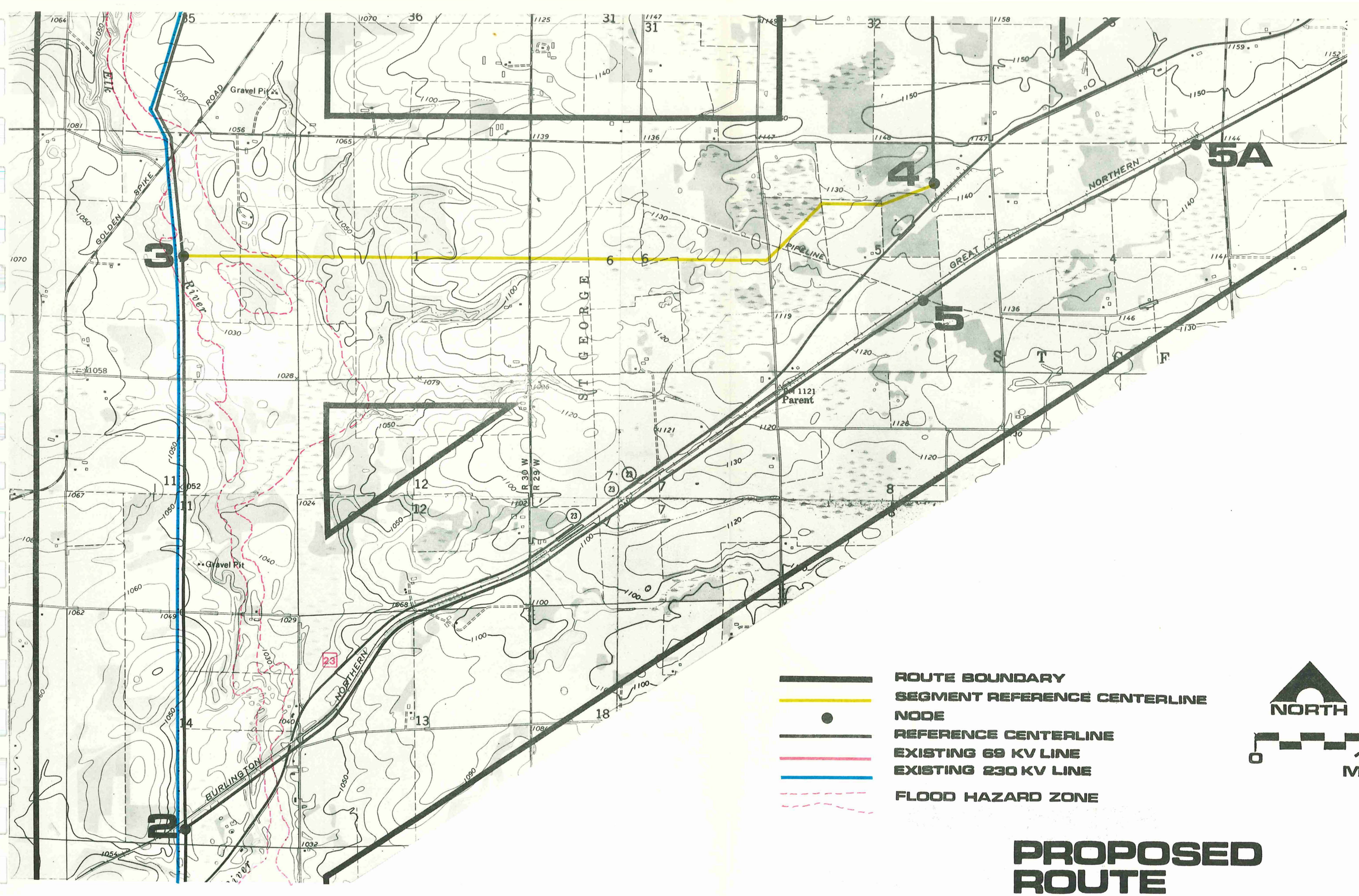
No homes or farmsteads are located within proposed ROW; however, one home and farmstead are within 500 feet of the ROW in this segment.

The land crossed by the RCL is largely in cultivation (1.03 miles of fields are crossed; 1.30 miles of field are bordered), with only 0.23 miles of pasture and 1.70 miles of wooded land affected in this link. Soils are rated as potentially moderately productive (productivity scores of between 38 and 56) and generally

PROPOSED ROUTE SEGMENT 2·3


ROUTE BOUNDARY
SEGMENT REFERENCE CENTERLINE
NODE
REFERENCE CENTERLINE
EXISTING 69 KV LINE
EXISTING 230 KV LINE
FLOOD HAZARD ZONE
NORTH
0
1/2
MILE
PROPOSED
ROUTE
SEGMENT 2-3
2
3
4
5
5A
GEORGE
R 30 W
R 29 W
Gravel Pit
Gravel Pit
Parent
GOLDEN SPIKE ROAD
NORTHERN
GREAT NORTHERN
PIPELINE
BURLINGTON
23

PROPOSED ROUTE SEGMENT 3·4



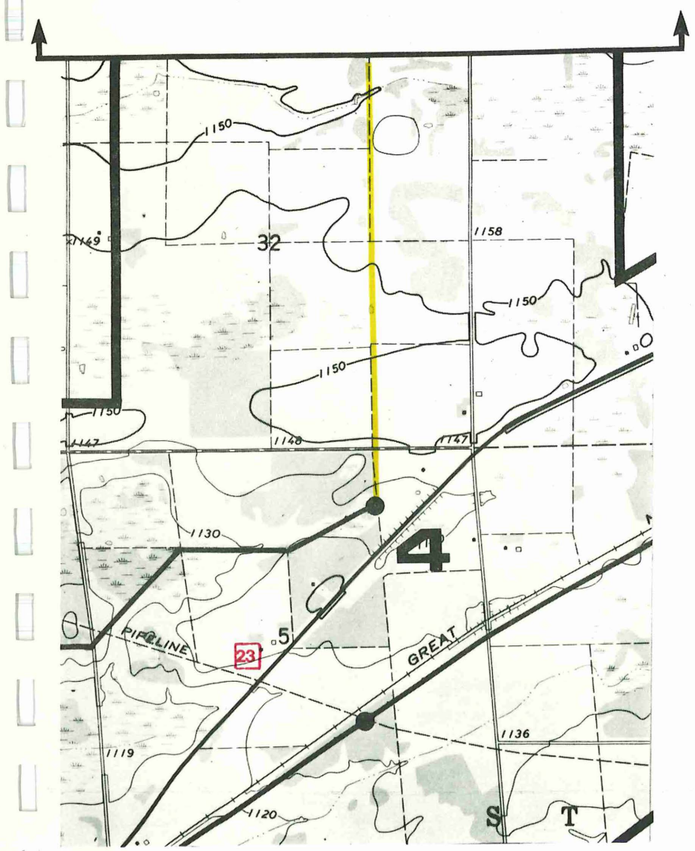
ROUTE BOUNDARY
SEGMENT REFERENCE CENTERLINE
NODE
REFERENCE CENTERLINE
EXISTING 69 KV LINE
EXISTING 230 KV LINE
FLOOD HAZARD ZONE

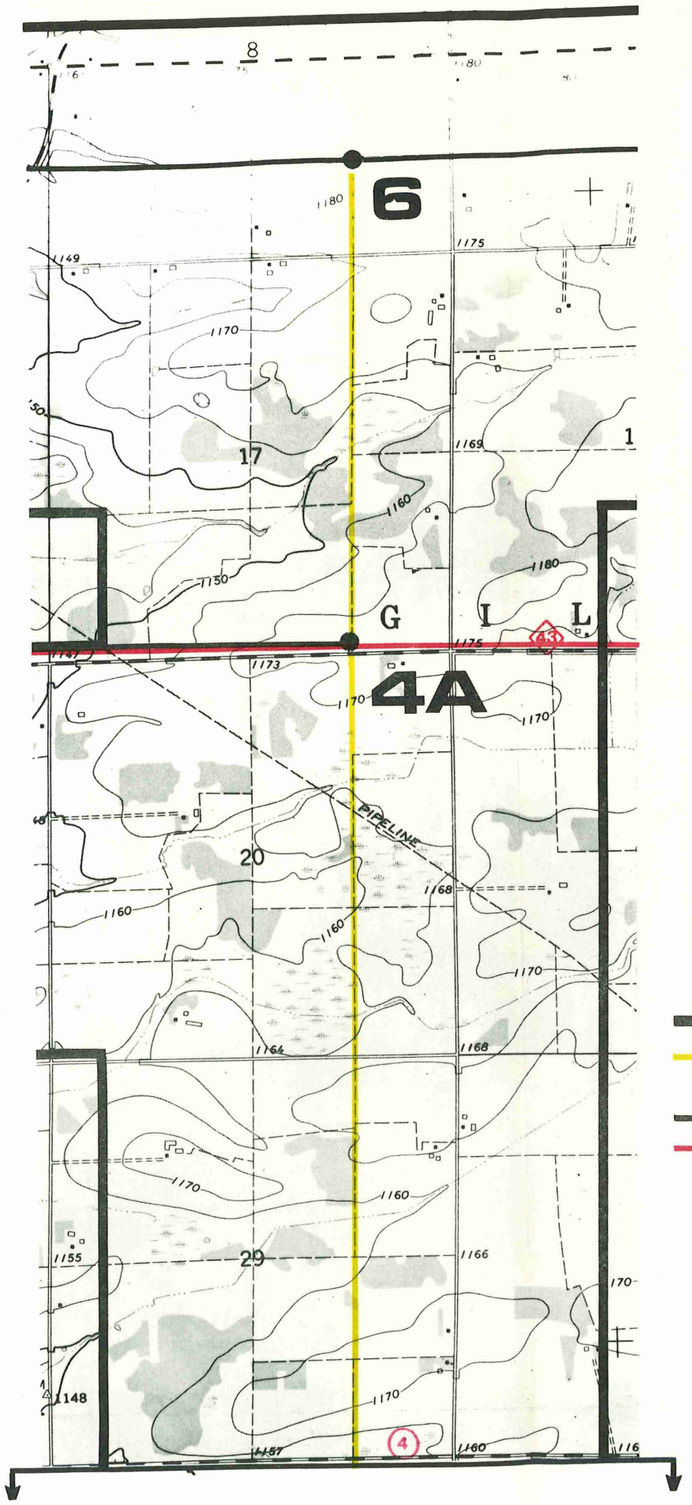
NORTH

0 1/2 MILE

PROPOSED ROUTE SEGMENT 3-4

PROPOSED ROUTE SEGMENT 4·4A·6





ROUTE BOUNDARY
SEGMENT REFERENCE CENTERLINE
NODE
REFERENCE CENTERLINE
EXISTING 69 KV LINE

NORTH

0 1/2 MILE

PROPOSED ROUTE SEGMENT 4·4A·6

consist of sandy upland loams, some poorly drained. Terrain in the western half of the segment is generally rolling and hilly, but flattens out and becomes relatively level moving from west to east toward Node 4. Concommitantly, drainage worsens and much of the terrain in Sections 5 and 6 is lowland or wetland. A total of 0.50 miles of actual wetland is crossed by the RCL.

The RCL crosses or borders a significant amount of woodland in this segment (1.70 miles). Right of way clearing would remove 18.2 acres of trees. Several of the stands of trees in this portion of the study area are significant in that they represent relatively untouched remnants of the original hardwood forests which covered this part of Minnesota prior to settlement. One such area, located in the northeast quarter of Section 5 (known as Nix Woods) is under consideration for acquisition by the Nature Conservancy. As drawn, the RCL crosses through this Woods for a total of 1400 feet, in the vicinity of a marshy clearing.

Three streams (the Elk River and two intermittent creeks) are crossed by the RCL in this link. No public recreational, wildlife or historic areas are located within this segment.

Segment 4-4A-6

From Node 4, this segment covers a total of 4.37 miles north along the east 1/16th line of Sections 32, 29, 20 and 8, Gilmanton Township to Node 6. This orientation for the RCL was chosen in order to follow field boundaries and to avoid homes and farms along County Road 61. With no existing ROW available to share, the full 120-130 feet of ROW would be required in this link, with the intent being to straddle field lines with the ROW. One heavy angle (at Node 4) is required along this stretch. The RCL crosses one paved two lane road (County Road 4) and three unpaved roads between Nodes 4 and 6.

Three homes are located within 500 feet of the ROW; no homes are within the ROW area.

Land use is agricultural, with a mixture of cultivated fields and pasture. Lands and vegetative cover affected by the RCL are: cultivated fields (1.38 miles crossed; 1.48 miles bordered); pasture (0.46 miles crossed); woodland (2.65 miles crossed or bordered); and wetland (0.20 miles crossed). The soils in this section of the study area are typically poorly drained upland loams of the Parent-Renneby-Prebish group. Estimated soil productivity potential in this segment is generally low compared to other soils in the study area. The terrain over this segment is generally flat or slightly rolling, and open with small scattered groves of trees.

No designated public recreational, or wildlife lands, or historically significant sites occur within this route segment.

Segment 6-7

The distance of the RCL in this segment is 8.64 miles. As proposed, the RCL travels east from Node 6 along the south 1/16th line of sections 8, 9 and part of 10 for approximately 1 1/4 miles, then drops diagonally to the south to follow section lines for the remainder of the segment to Node 7 at Highway 23. As drawn, there is a total of 1.0 miles of existing ROW available for sharing (along a township road). The proposed HVTL would require the full 120-130 feet of ROW for the remainder of the distance between the two nodes. Three heavy angles would be required with the alignment as shown on the accompanying map. A total of 0.30 miles is along a northwest-southeast diagonal, located across a low-lying and slough-like area in Section 10 (Gilmanton Township). Five unpaved roads and four paved two lane roads are crossed in this segment.

No farmsteads or homes lie within the ROW area for the RCL shown; a total of four homes and four farmsteads are located within 500 feet of the ROW.

A large percentage of the land crossed by the RCL is adjacent to cultivated fields (5.11 miles); an additional 0.36 miles of pasture land is crossed, and 0.85 miles is bordered by the RCL. Soils in this segment (mostly upland loams) vary markedly along this segment in terms of the estimated productivity, with drainage an important factor in this variation. The terrain is flat with only occasional slight variations in elevation. Scattered groups of hardwoods remain, although they are generally small-sized and insignificant as natural areas. A total of 2.05 miles of wooded land is crossed or bordered by the RCL, requiring a total clearing of 18.9 acres of trees and tall brush in this segment. The RCL crosses 0.71 miles of mixed sedge and willow type wetland. Two streams are crossed, the east and west branches of the St. Francis River.

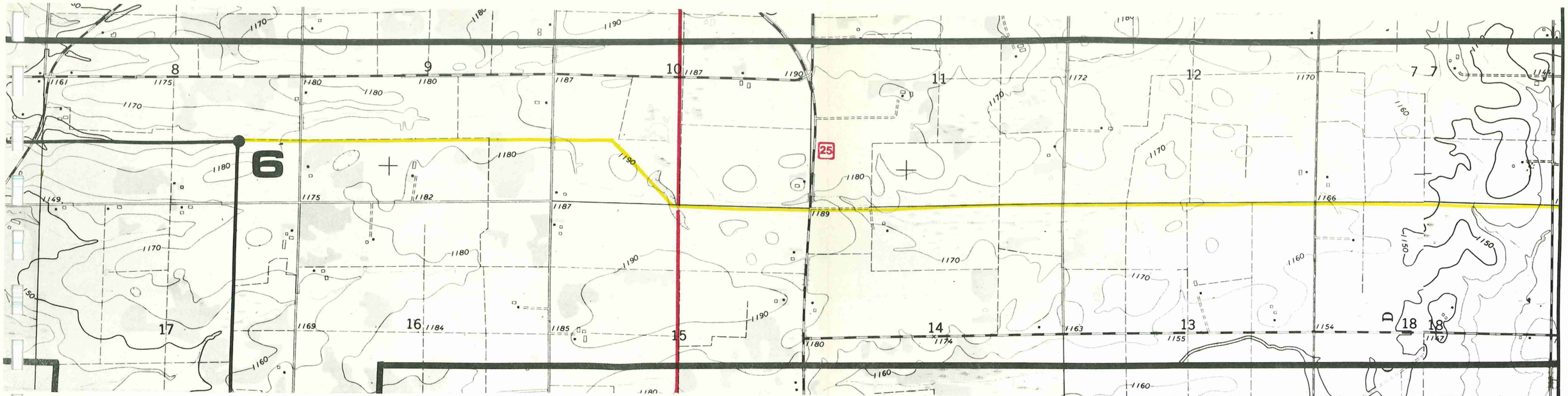
The alignment of the RCL is adjacent to a small gravel pit operation in Section 10 (Maywood Township).

No public lands used for recreation or wildlife refuge are located within this segment. No recognized historical or archeologically significant sites have been identified in this segment.

Segment 7-9

From Node 7, this segment follows the north side of a section line and road directly east for 7.10 miles to an intersection with the abandoned road-bed of the Great Northern railroad

PROPOSED ROUTE SEGMENT 6·7



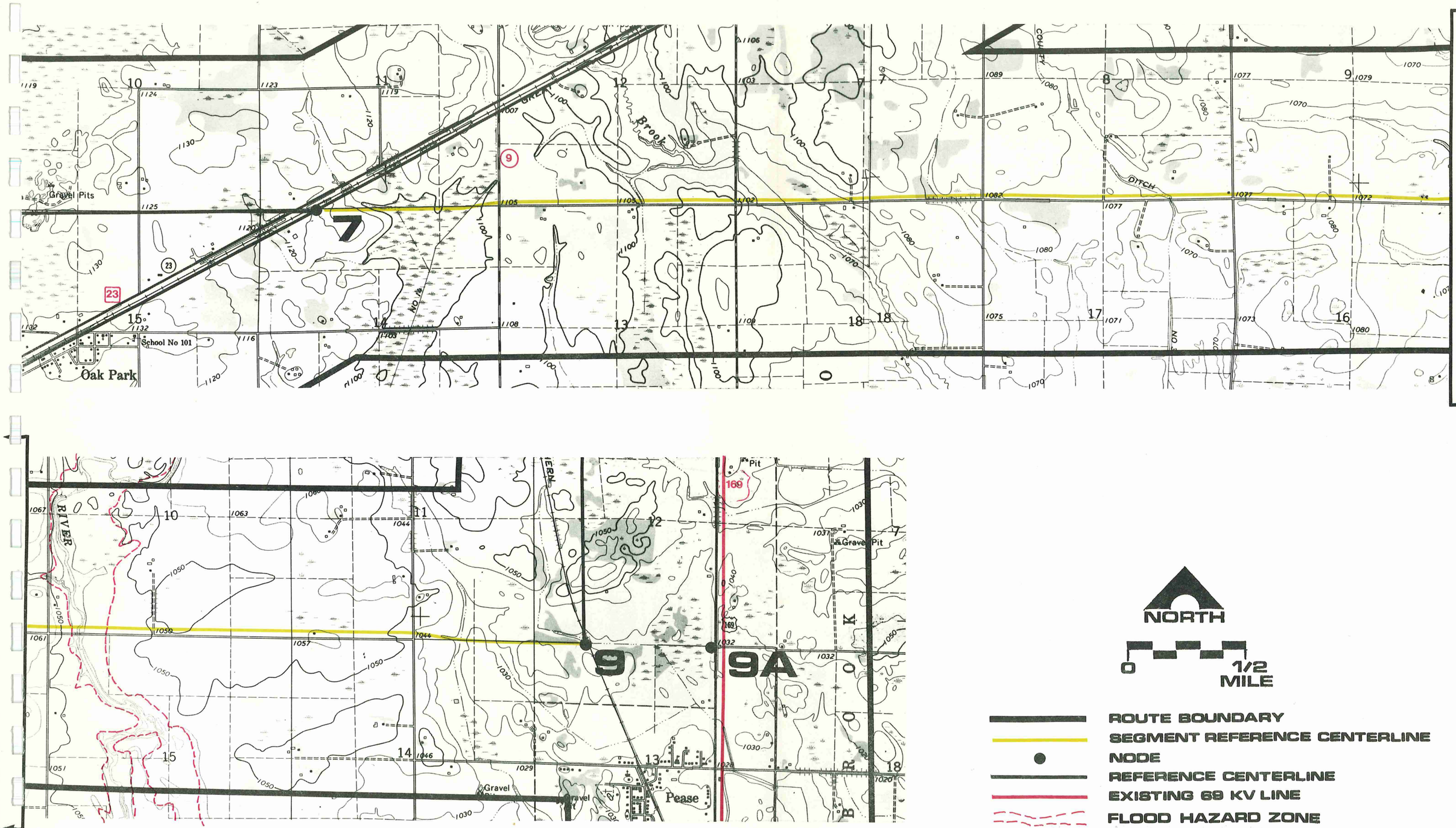
NORTH

0 1/2 MILE

ROUTE BOUNDARY
SEGMENT REFERENCE CENTERLINE
NODE
REFERENCE CENTERLINE
EXISTING 69 KV LINE
FLOOD HAZARD ZONE

PROPOSED ROUTE SEGMENT 6·7

PROPOSED ROUTE SEGMENT 7·9



NORTH

0 1/2 MILE

ROUTE BOUNDARY

SEGMENT REFERENCE CENTERLINE

NODE

REFERENCE CENTERLINE

EXISTING 69 KV LINE

FLOOD HAZARD ZONE

PROPOSED ROUTE SEGMENT 7·9

south of Milaca. The section line road is paralleled for a total of 5.50 miles. Right of way requirements for the portion adjacent to the road would be approximately 70 feet. This alignment would require one minor angle. The RCL crosses three paved two lane roads and three unpaved roads.

Three homes and three farmsteads lie within ROW; an additional nine homes and nine farmsteads are within 500 feet of the ROW.

Of the total distance of 7.10 miles, 4.77 miles are adjacent to cultivated fields, and 0.92 miles border pasture land. The terrain is generally gently rolling with minimal tree cover. Soils are typically variably drained light textured loams; ratings for climate-modified soil productivity indicate a preponderance of moderately high soil productivity when compared to other parts of the study area.

For the alignment shown on the topographical map, the RCL crosses or borders 0.53 miles of wooded land, corresponding with 3.90 acres of trees cleared for the ROW. The RCL crosses 0.69 miles of wetland, including a wetland in the vicinity of County Ditch No. 14 which is approximately 2000 feet wide. Crossing a wetland of this width would require the placement of 3-4 structures within the wetland. The RCL also crosses the Estes Brook and the west branch of the Rum River.

No designated public, recreational or wildlife areas, or sites of historical significance are located within this segment.

Segment 9-10

This segment links Route B with the southern approach to Milaca which was proposed for Route A by UPA. The segment covers a distance of 2.06 miles, with the RCL aligned along the west 1/16th line of Sections 12 and 1 in Milo Township. The RCL as drawn requires two heavy angles, and is oriented diagonally for the final 0.23 miles of the segment.

The RCL crosses over one unpaved road and one gas pipeline. With no shared ROW, the proposed transmission line would require the full width of 120-130 feet.

No homes are within the ROW area in this segment; however, one home lies within 500 feet of the ROW.

The RCL crosses over 0.32 miles of cultivated fields and borders an additional 0.17 miles of cropland. 0.70 miles of pasture are crossed, and 0.48 miles of pasture are bordered. The diagonal crossing is located over a moderately wooded, marshy area. The landscape is typically undulating, occasionally marshy, with several small scattered stands of trees. Soils are typically light textured sandy loams which are fairly to moderately productive where drainage is adequate.

The RCL crosses a total of 0.69 miles of woodland, requiring a clearing of 5.02 acres of trees. The RCL falls within 0.07 miles actual wetland areas, although poor drainage and the presence of several intermittent streams increase the amount of wetland-type and low-lying land crossed by the RCL in this segment.

No rivers or designated recreational, wildlife or historically significant sites are located within this segment.

Segment 10-10A-11

See discussion for Route A.

route C

Segments 1-1A, 1A-2, and 2-3

A description of these segments is found in the discussions of Route A and Route B.

Segment 3-3A

The RCL in this segment parallels the east side of the existing UPA 230 kV line from Node 3 to Node 3A, requiring up to 70 feet of additional ROW width if the proposed HVTL is placed parallel to that line. The total segment length is 3.0 miles, with three light angles (3-30°) and one heavy angle (30-90°) required in the line. Over that distance, three unpaved roads and one two lane paved road are crossed by the RCL.

One home is located within the ROW of the RCL, and three additional homes are situated within 500 feet of the ROW.

Land use is predominantly agricultural throughout this section of the study area. The RCL crosses 0.68 miles of cultivated field, and borders fields for an additional 0.77 miles. 0.19 miles of pastureland are crossed by the line. Soils in this area are typically deep loam, with much of the landscape rolling, rocky and poorly drained. Numerous stands of trees spot the area within the 1.25 mile wide route segment, particularly along the path of the Elk River. The RCL crosses 1.17 miles of woodland, requiring the clearing of a total of 8.50 acres. No wetlands are crossed by the proposed ROW in this segment. The existing 230 kV line is on the same north-south alignment as the Elk River. The RCL drawn on the east side and parallel to of that line would necessitate crossing the river seven times. Approximately 1.14 miles of the proposed ROW would lie within floodplain or bottomlands of the Elk River.

There are no public recreational, wildlife or other designated lands within this segment. A privately owned game farm is located in the southeast quarter of Section 23 adjacent to the existing line.

Segment 3A-3B-12

UPA's RCL in this segment continues to parallel the existing 230 kV line for the total distance of 8.46 miles. If constructed alongside the existing line, the proposed HVTL would require up to 70 feet of additional ROW width. The intended ROW crosses eight unpaved roads and three paved two lane roads.

Impact on homes and farmsteads is minimal, with no dwelling structures within the ROW, and only three houses and three farmsteads within 500 feet of the ROW.

The RCL crosses 1.14 miles of cultivated land and 0.95 miles of pasture land; it borders 2.70 miles of cultivated fields, and 0.83 miles of pasture in this segment. Soils in this segment continue to be predominantly deep, well-to-poorly drained prairie loams. The landscape is characterized by undulating or rolling terrain with high spots interspersed with poorly drained or wetland hollows. The soil is frequently littered with glaciated stones, particularly along the southern half of this segment. The map of general soil productivity ratings correspondingly show alternating pattern between high and low scores moving from the south to north between nodes 3A and 3B.

The RCL crosses 1.23 miles of wetland (predominantly willow-low brush cover), and 1.40 miles of woodland. Clearing for a 70 foot additional ROW would remove 10.2 acres of trees. One small stream (Mayhew Creek) is crossed by the RCL.

Segment 12-12A

The distance between Node 12 and Node 12A is 6.36 miles. At Node 12, the RCL turns east away from the existing 230 kV line and parallels the north side of County Road 22, a paved two lane road. One 90° angle occurs in this segment, at Node 12. In addition, a UPA-owned 69 kV line is paralleled for the final 1.90 miles west of Node 12A. The RCL crosses five unpaved roads and three paved two lane roads.

In this segment, three houses and three farmsteads are within the RCL right of way. Additionally, 11 houses and 11 farmsteads are located within 500 feet of the ROW.

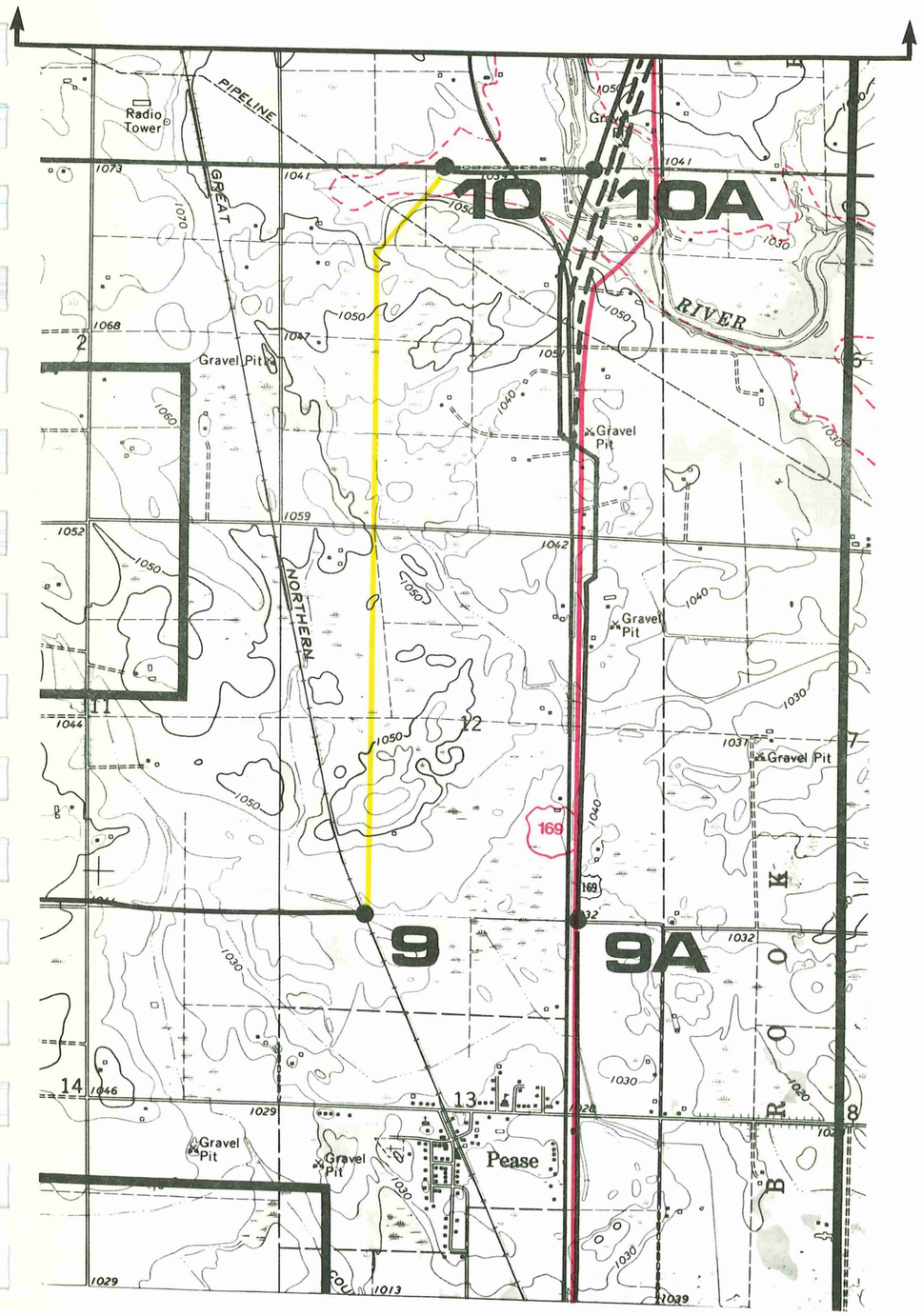
The RCL borders 3.65 miles of cultivated land and 0.38 miles of pasture. Soils in this sector are extremely varied, with well drained loams interspersed with boggy peat-like soils in low areas. The terrain is rolling and frequently littered with small glaciated stones. The generalized soil productivity map for the study area affirms this uneven and spotted pattern of soils.

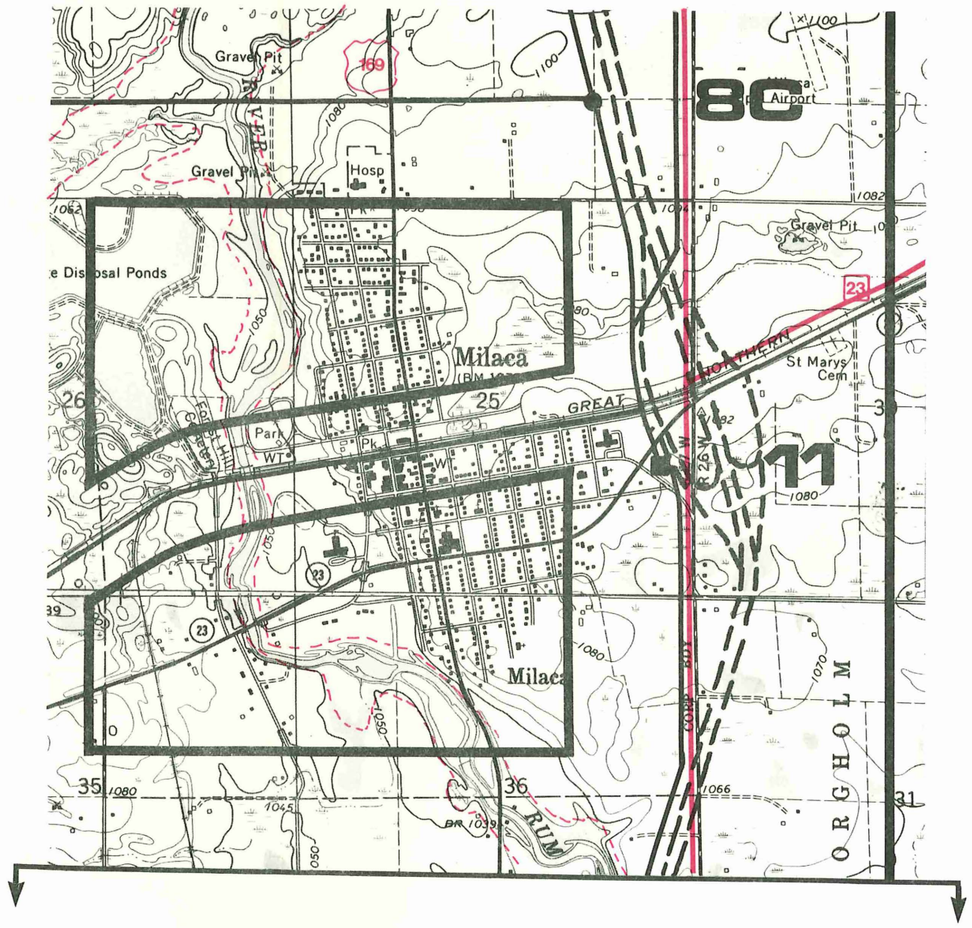
The RCL crosses 1.50 miles of wetland and 0.55 miles of wooded land (4.22 acres cleared for ROW).

Segment 12A-12B

This segment extends from the crossroads community of Brennyville (population 50) to the Benton County line, a total of 6.80 miles.

PROPOSED ROUTE SEGMENT 9·10





NORTH

0 1/2 MILE

ROUTE BOUNDARY

SEGMENT REFERENCE CENTERLINE

NODE

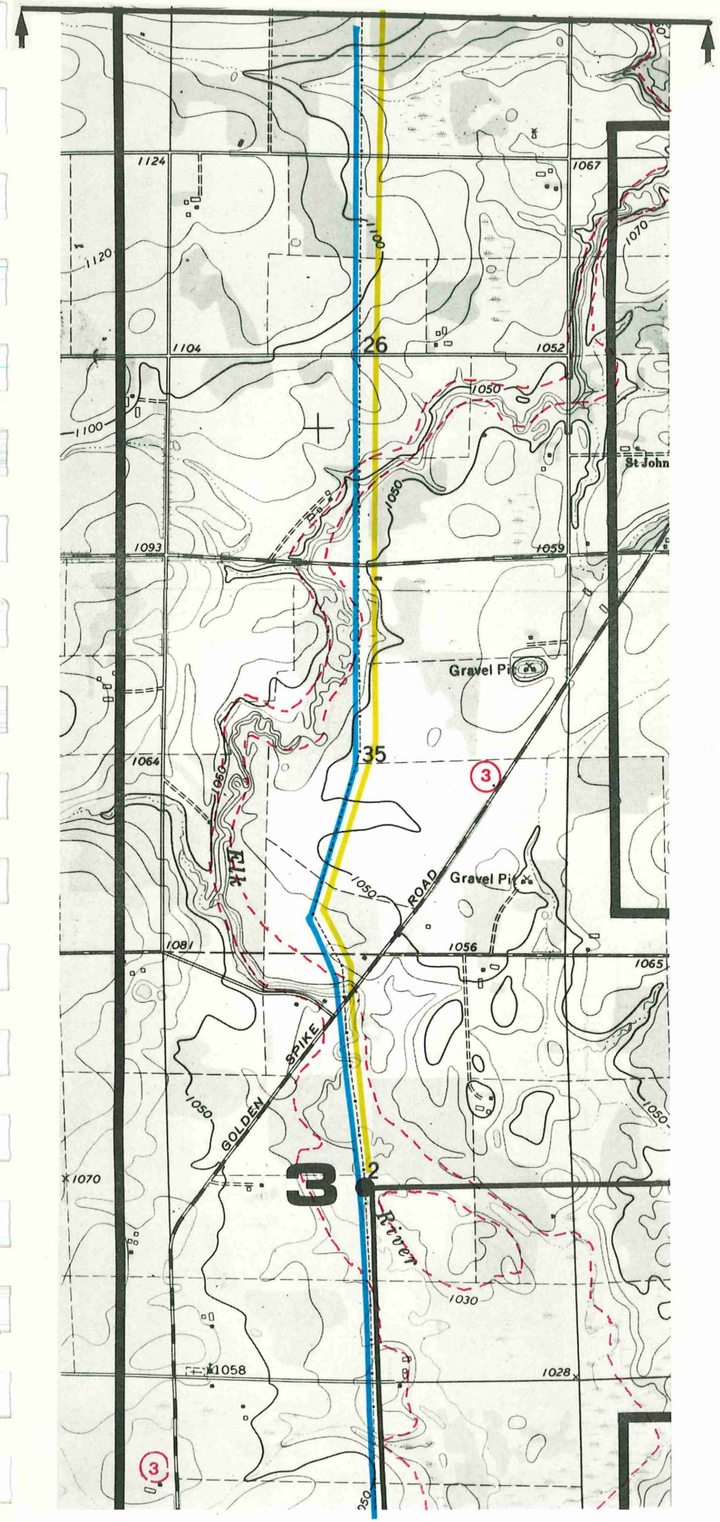
REFERENCE CENTERLINE

EXISTING 69 KV LINE

FLOOD HAZARD ZONE

PROPOSED ROUTE SEGMENT 9·10

PROPOSED
ROUTE
SEGMENT 3·3A·3B



ROUTE BOUNDARY
SEGMENT REFERENCE CENTERLINE
NODE
REFERENCE CENTERLINE
EXISTING 69 KV LINE
EXISTING 230 KV LINE
FLOOD HAZARD ZONE

NORTH

0 1/2 MILE

PROPOSED ROUTE SEGMENT 3·3A·3B

The RCL drawn by UPA continues to parallel County Road 22 and a 69 kV transmission line. The RCL is shown as bordering the north side of County Road 22 for 5.30 miles, then crossing (with the 69 kV line) to the south side of the road for the remaining 1.50 miles. By sharing ROW with the 69 kV line, approximately 60 feet of new ROW would be required for the proposed HVTL, depending on the design of the proposed line.

With the RCL on the north side of the county road, a number of houses (8) and farmsteads (8) lie within RCL ROW. 19 houses and 19 farmsteads are situated within 500 feet of the ROW. In the vicinity of Brennyville, the RCL crosses through 1.25 miles of land zoned or planned for residential development. A school at Granite Ledge is within 500 feet of the proposed ROW.

The landscape becomes increasingly wooded and rough from west to east between Nodes 12A and 12B. Accordingly, the greatest incidence of agricultural activity is in the western portion of this segment. Cultivated fields are bordered for 3.08 miles, and pasture land for 0.44 miles. Soils are predominantly upland sandy loams of the Mora-Ronneby association.

The RCL crosses or borders 2.55 miles of wooded land, and 0.27 miles of wetland. ROW clearing would remove 18.5 acres of trees. One stream, the west branch of the Rum River, is crossed by the RCL.

A small 4-H Club wayside park near the Rum River (just west of the road-river intersection) is adjacent to the RCL right of way. No other public designated lands or wildlife areas occur in this segment.

Segment 12B-13

This segment completes the east/west portion of Route C, and extends from the Mille Lacs County line to a township road east of Highway 169 where the RCL turns south. The total length of 5.87 miles parallels the existing 69 kV line; in addition, County Road 11 (County 22 in Benton County) is paralleled for 1.25 miles and Mille Lacs County Road 38 for one mile. Other local unpaved roads are parallel to the 69 kV line for 0.55 miles, leaving only a small portion of the segment (in the vicinity of the Rum River) which is not adjacent to a road. The 69 kV and the RCL cross from the south to the north side of County Road 11 once, requiring two heavy angles (30-90°) in the line. Two paved and two unpaved roads are crossed by the RCL.

As the RCL is drawn, three houses and three farmsteads lie within the ROW, and 26 farmsteads and houses are located within 500 feet of the ROW.

The RCL borders 3.29 miles of fields under cultivation; and 0.43 miles of pasture land. The terrain continues to be characterized by gently rolling hills, but gradually becomes more level between Stoney Brook and the Rum River ravine.

Soils are generally light textured loams, which are alternately well and poorly drained with numerous small wetlands spotting the area in this segment. Soil productivity is rated relatively high in this portion of the study area, with most 40 acre cells receiving scores of 38-56.

The RCL crosses 0.55 miles of wetland. Most of the wetland affected is willow-brush type wetland, generally small (500-800 feet across) in size. 1.53 miles of woodland is within the RCL ROW (a total of 11.1 acres would be cleared). The RCL crosses Stoney Brook about 1.50 miles east of Node 12B; in that area it is a minor intermittent stream only a few feet wide.

Approximately one mile east of Node 13, the RCL crosses the Rum River and its valley. The RCL is parallel to and north of the existing 69 kV line. The environmental setting of the crossing is a wooded valley approximately 1/2 mile wide, with steep banks (50-60 feet high) enclosing a relatively flat and marshy floodplain or bottomland. This area is approximately 1300 feet wide and is heavily wooded. The river itself is approximately 120 feet wide at the point of crossing. This section of the river has been designated as a protected scenic resource under the Wild and Scenic River Act. The management plan for this area indicates that scenic easements will be sought by the DNR for both banks of the river for the entire portion of the river within the 1.25 mile wide route. The visual impact of the proposed HVTL and its ROW may be magnified at the river crossing.

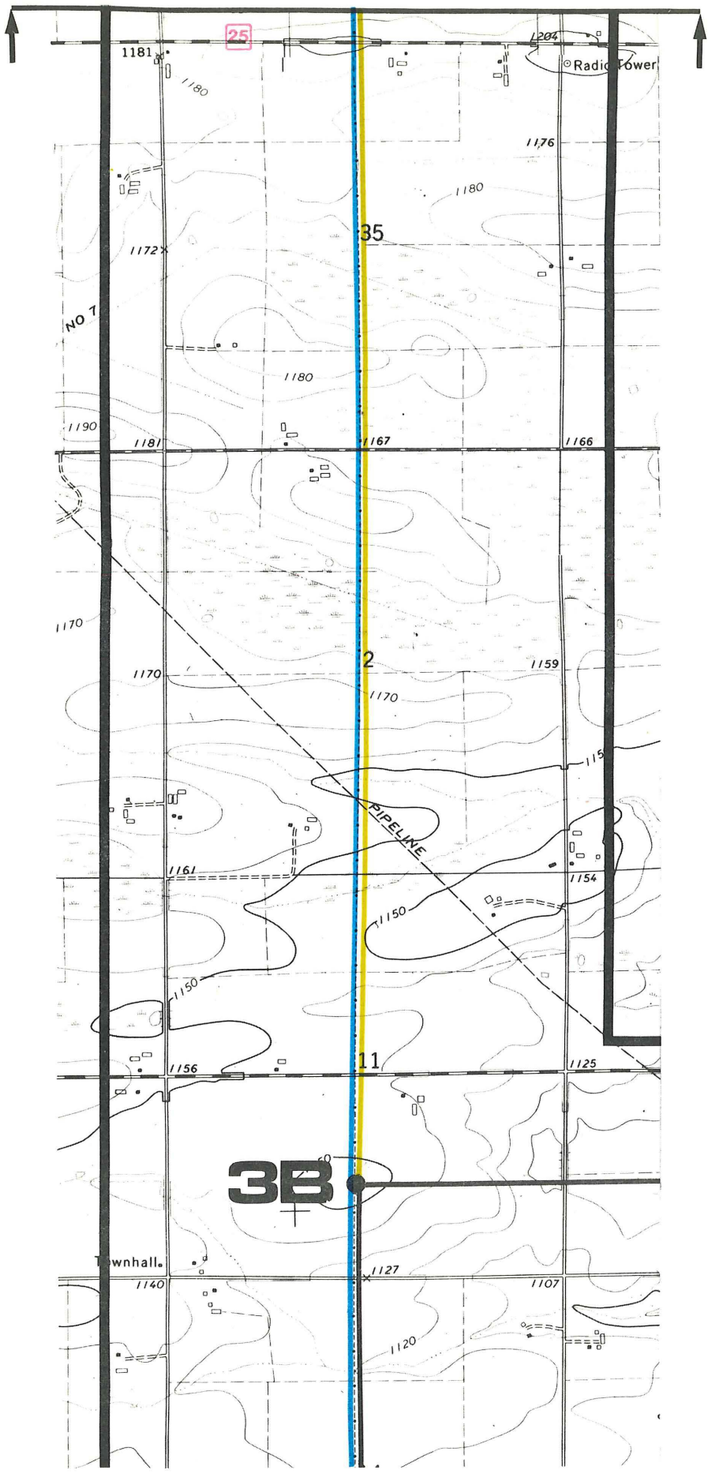
This increased impact is related to a variety of factors, including, the presence of the existing line and its cleared ROW, the steep valley walls, and because the proposed crossing is perpendicular (rather than diagonal) to the river. A 20-30 acre privately owned and managed wildlife area is also located in the vicinity of this crossing.

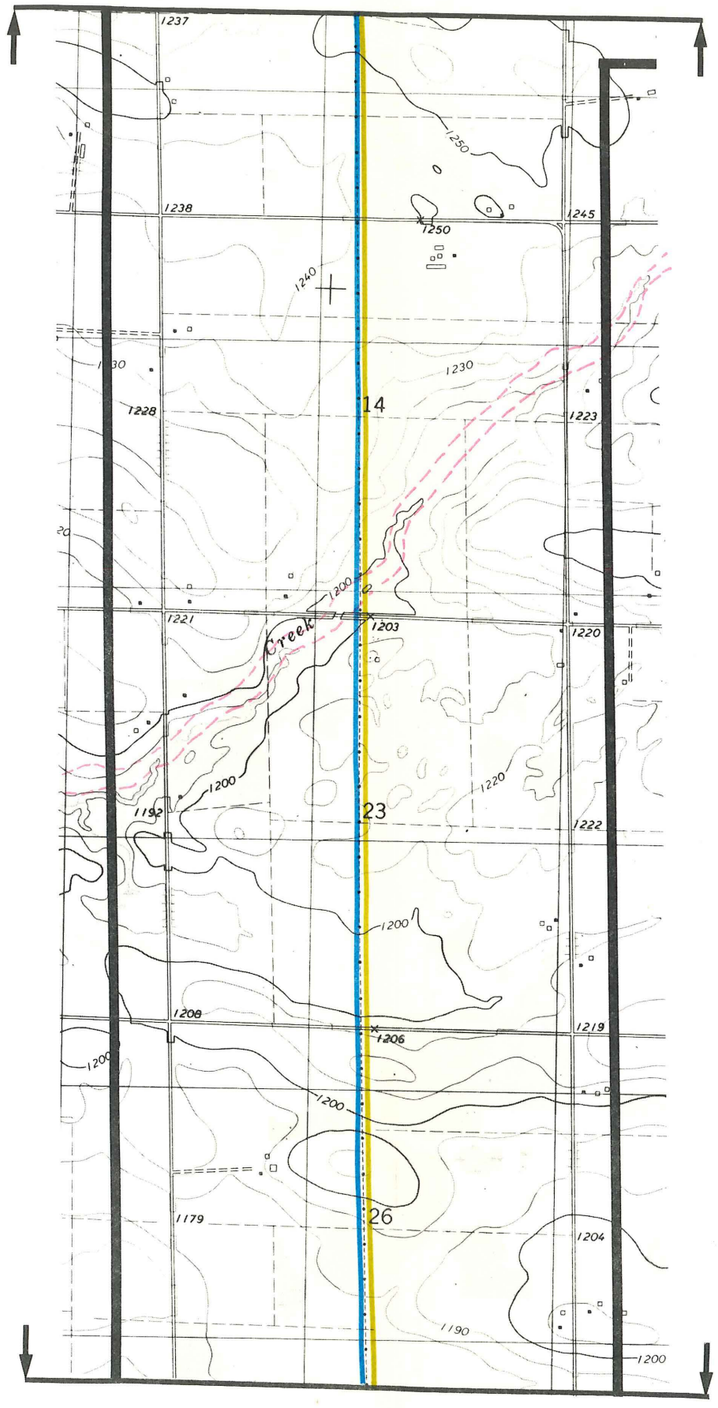
No other public lands are affected by the proposed project in this segment.

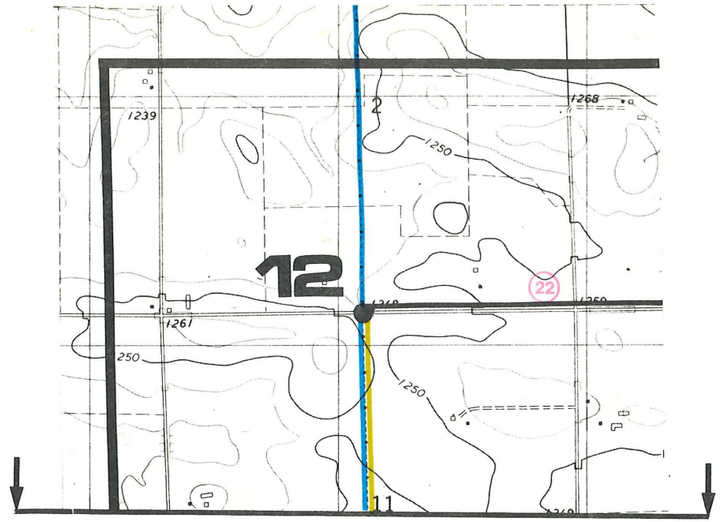
Segment 13-11

This segment links Node 13 with the Milaca substation at Node 11, and covers a distance of 3.54 miles. The first three

PROPOSED ROUTE SEGMENT 3B·12







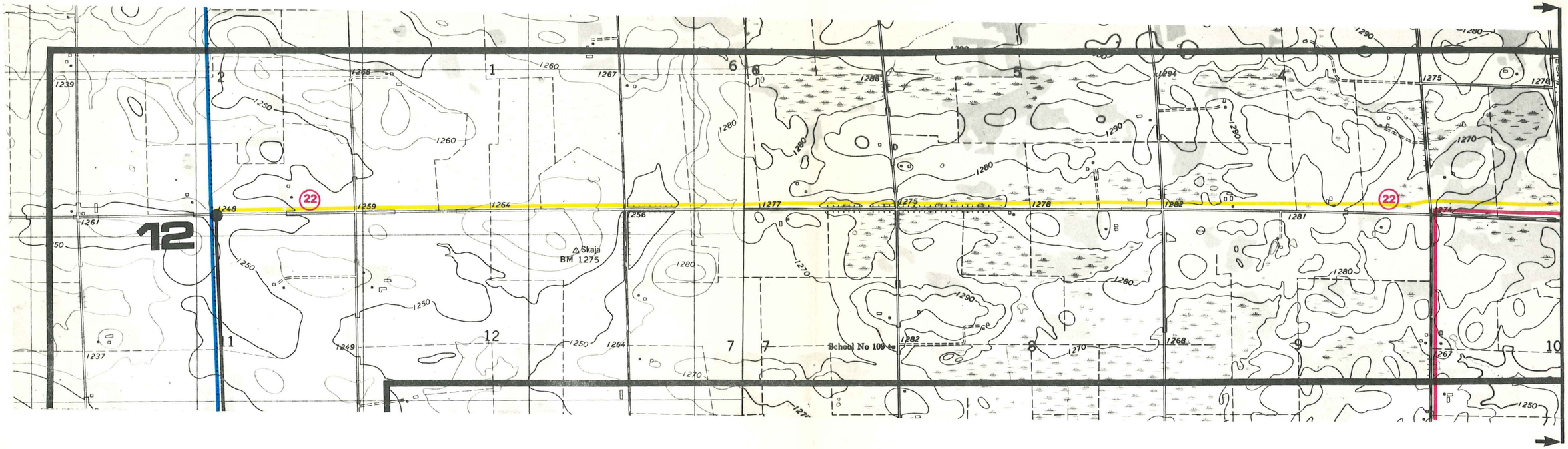
NORTH

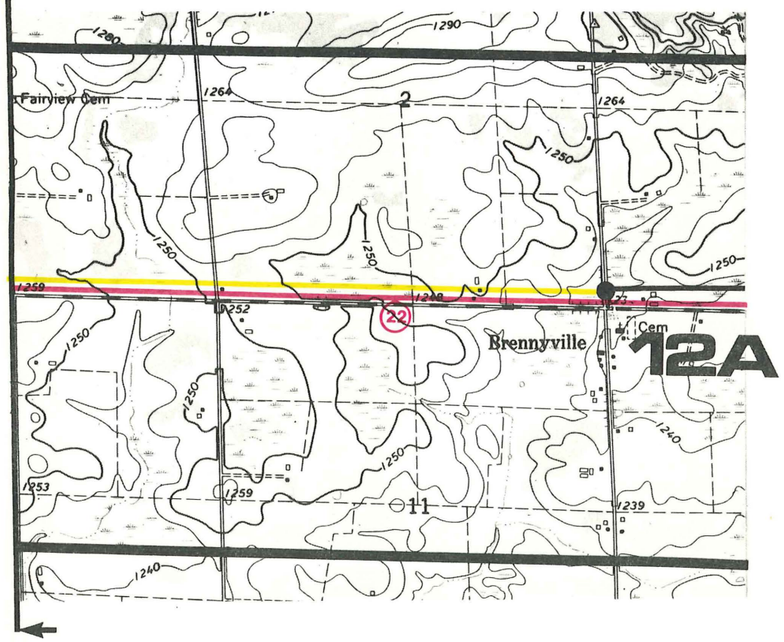
0 1/2 MILE

ROUTE BOUNDARY
SEGMENT REFERENCE CENTERLINE
NODE
REFERENCE CENTERLINE
EXISTING 69 KV LINE
EXISTING 230 KV LINE
FLOOD HAZARD ZONE

PROPOSED ROUTE SEGMENT 3B·12

PROPOSED
ROUTE
SEGMENT 12·12A





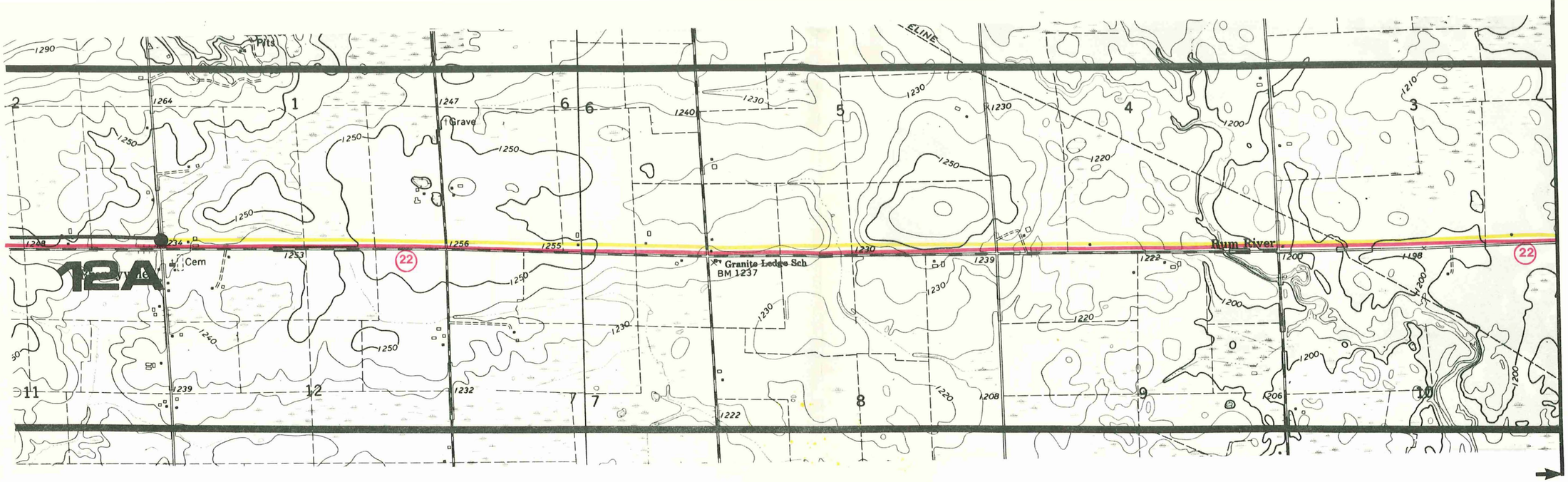
ROUTE BOUNDARY
SEGMENT REFERENCE CENTERLINE
NODE
REFERENCE CENTERLINE
EXISTING 69 KV LINE
EXISTING 230 KV LINE

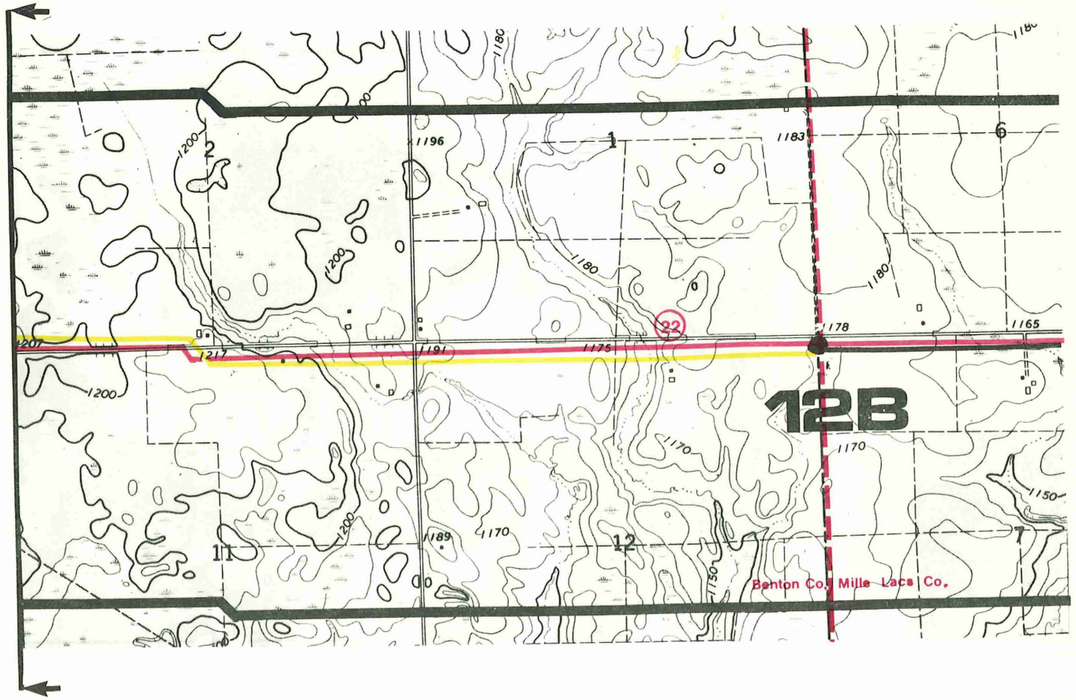
NORTH

0 1/2 MILE

PROPOSED ROUTE SEGMENT 12·12A

PROPOSED ROUTE SEGMENT 12A·12B





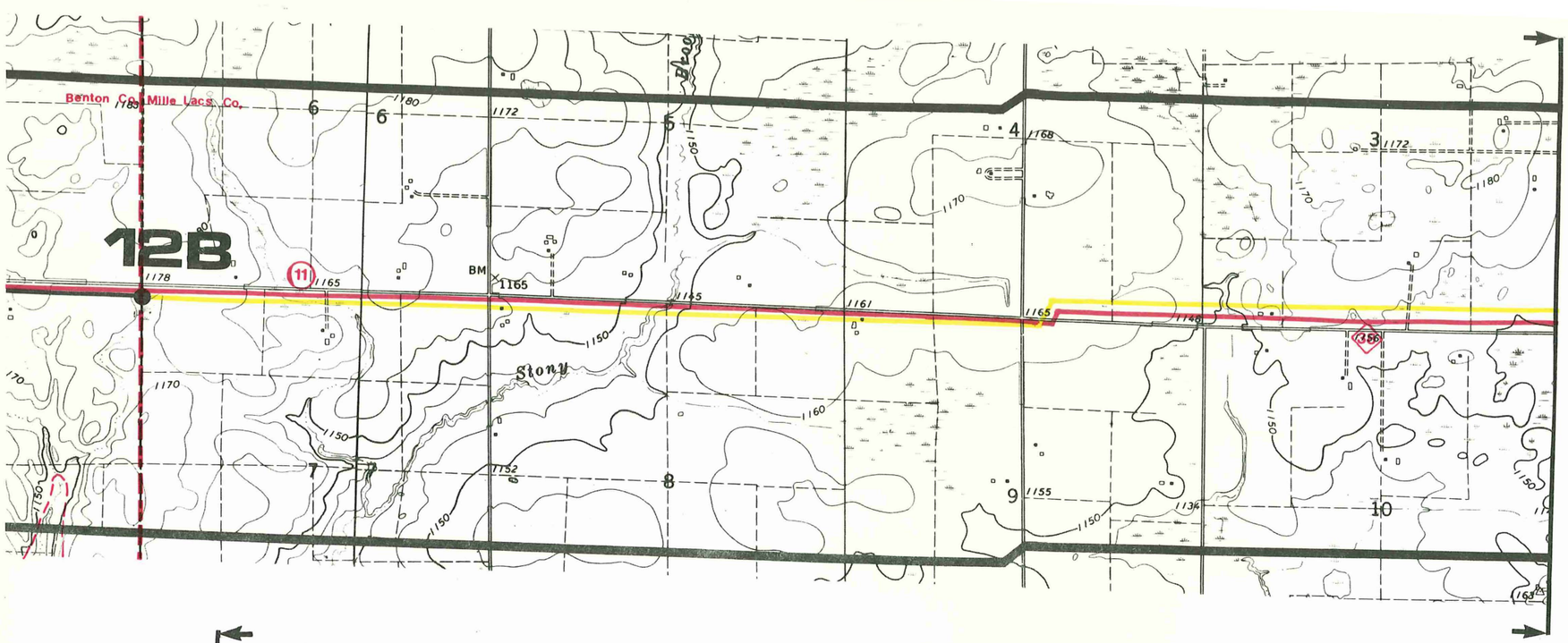
ROUTE BOUNDARY
SEGMENT REFERENCE CENTERLINE
NODE
REFERENCE CENTERLINE
EXISTING 69 KV LINE

NORTH

0 1/2 MILE

PROPOSED ROUTE SEGMENT 12A·12B

PROPOSED ROUTE SEGMENT 12B·13



ROUTE BOUNDARY
SEGMENT REFERENCE CENTERLINE
NODE
REFERENCE CENTERLINE
EXISTING 69 KV LINE
FLOOD HAZARD ZONE

NORTH

0 1/2 MILE

PROPOSED ROUTE SEGMENT 12B · 13

miles parallel the west side of an unpaved township road and the existing double circuited 69 kV line. Because of the planned construction of the Highway 169 by-pass, the RCL deviates to the southwest in order to cross the by-pass just north of a planned interchange at Highway 23. Skirting the west edge of the interchange ROW, the RCL proceeds south over Highway 23 to the substation. This alignment would require two light angles and two heavy angles. In addition to the crossing of the Highway 169 by-pass, the RCL crosses over two unpaved roads, and one paved two land road (Highway 23), and the Burlington Northern railroad tracks.

Two houses and two farmsteads lie within the ROW for the RCL; 12 houses and seven farmsteads are located within 500 feet of the ROW in this segment. The final 0.60 miles of the RCL are within the corporate city limits of Milaca. Zoning districts crossed by the RCL include I-1 industrial (approximately 0.13 miles), C-1/ conservation (0.20 miles) and R-2/suburban district (0.10 miles). (See Section 2.9.2 for a detailed description of these zoning classifications.)

The Milaca Municipal Airport is located to the east of the RCL in Section 19. Information from the Milaca Airport Zoning Board indicates that poles for the proposed transmission line would violate height restrictions imposed by the airport zoning ordinance for a distance of approximately 1500 feet, where the RCL crosses zones A and B (see Figure 2.18).

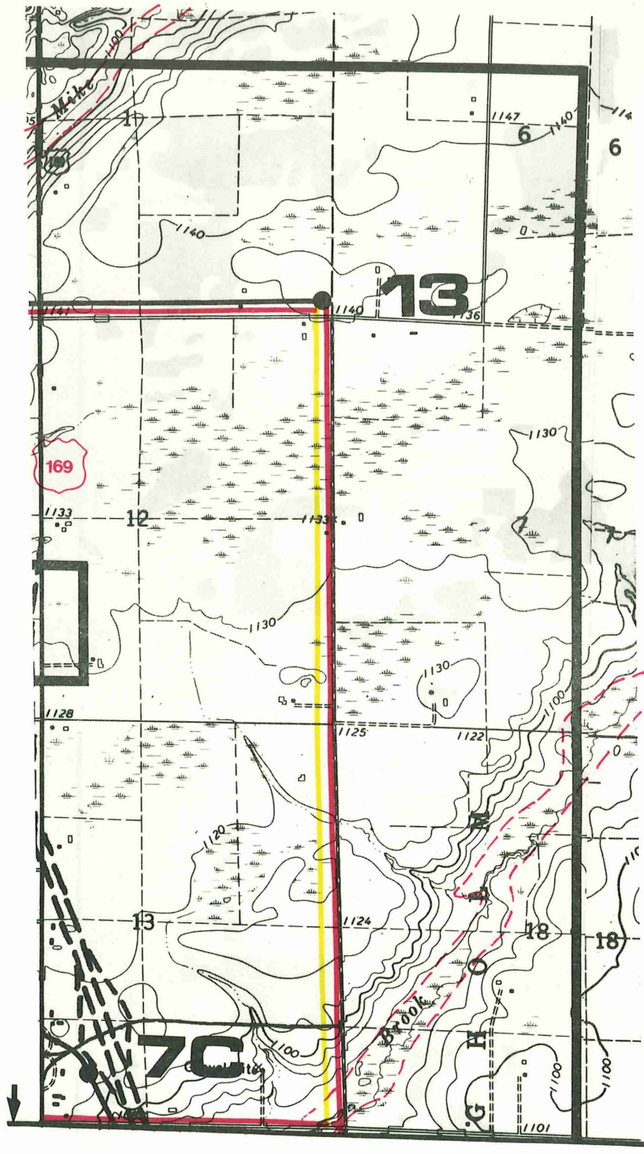
In addition to the interference with and the possible violation of airport safety zones, the RCL in this segment would be affected by construction of the planned four lane highway and interchange for Highway 169 (see map). The RCL as drawn would cross the northern end of the Milaca interchange (four lanes of freeway and one access ramp). Present laws and regulations do not permit placement of transmission line structures on controlled access highway ROW. This constraint would require this area to be spanned by the transmission line. Maintaining the required vertical clearance, and spanning the horizontal distance involved (350 feet) may require structures which are measurably higher than those used elsewhere for the line.

The impacts on farmland in this segment area generally are limited to the bordering of cultivated fields (1.32 miles) and pastures (0.29 miles). Generalized soil productivity ratings are relatively high (38-56) in this portion of the study area. However, farming activities tend to be somewhat limited in this part of the study area due to the hilly terrain, tree cover, frequent wetland or boggy areas, and rocky soils.

The RCL crosses 0.39 miles of wetland. One wetland crossed (in Section 12) is about 1000 feet wide, possibly requiring the placement of one pole in the wetland. 1.21 miles of woodland are crossed, requiring the clearing of approximately 8.80 acres of trees. The RCL crosses one minor stream, O'Neill Brook.

No public recreational or wildlife lands are affected and no historical sites are known to be affected by the RCL in this segment.

PROPOSED ROUTE SEGMENT 13 · 11



ROUTE BOUNDARY
SEGMENT REFERENCE CENTERLINE
NODE
REFERENCE CENTERLINE
EXISTING 69 KV LINE
FLOOD HAZARD ZONE

NORTH

0 1/2 MILE

PROPOSED ROUTE SEGMENT 13 · 11

route D

Segment 1-1A

See discussion for Route A.

Segment 1A-1B

The reference centerline (RCL) of the segment between Nodes 1A and 1B is 6.42 miles in length, and parallels Highway 95 for the entire distance. The RCL is on the north side of the highway in this section, with the edge of its right of way abutting that of the 150 foot wide highway right of way. One heavy (30-90°) angle structure (at Node 1A) would be required in this section.

The RCL between Nodes 1A and 1B crosses three unpaved roads and three paved two lane roads. Due to its location along a state highway, the RCL in segment 1A-1B parallels and could possibly share highway right of way for its entire length of 6.42 miles.

In this section, there are a total of 11 homes (4 of which include farmsteads) within the 120 foot wide right of way for the RCL. Additionally, there are 44 homes or farmsteads within 500 feet of the right of way. In the southeast quarter of Section 19, there is a concentration of homes (presently a total of 12) on the north side of the highway. All of these homes are outside of the RCL right of way.

Aside from the small subdivision of residential homes mentioned above, segment 1A-1B is characterized by extensive cultivation. The RCL borders 5.18 miles of cultivated fields, and 0.09 miles of pasture land. No cultivated fields or pastures are crossed by the RCL. No existing irrigation systems on the north side of Highway 95, would be affected by the RCL. There are several existing center pivot systems on the south side of the highway, however, and the RCL crosses approximately 3.50 miles of potentially irrigable land. According to the climate-modified soil productivity ratings (see Chapter 2), for the study area, land crossed by the RCL in this segment falls within the lower ranges of productivity scores. However, the potential irrigability of this land more than offsets any limitations based on soil characteristics. Placement of the line on the RCL would require removal of 1.91 miles of windrows. In addition, 1.89 acres of trees would be cleared for the RCL right of way in this segment.

Due to the extensive degree of cultivation in this section, few natural areas are affected by the RCL. A small stream (Stony Brook) is crossed once by the RCL, as well as two narrow meadow type wetland areas, both of which could be spanned by the line. In Section 19, the edge of a privately owned natural wooded area known as Stony Brook Wildlife Management Area would be crossed by the RCL for approximately two miles. This area, however, is also the location of a residential subdivision so the area adjacent to the RCL has already been subjected to some man-made impacts. Approximately 14.4 acres of the wildlife area are within the RCL's right of way.

Route Segment 1B-1C

At Node 1B the RCL begins joint use of a 69 transmission line ROW (see map). Both lines parallel Highway 95 for 6.21 miles to Node 1C. As drawn by UPA, the RCL is north of the 69 kV line at this point, and south of it on those portions of the 69 kV line which are south of the highway. Due to the possibility of sharing right of way with the 69 kV line, approximately 60 feet of additional right of way width would be required in this segment. Both lines cross Highway 95 twice, requiring the use of four heavy (30-90°) angle structures. In addition, the RCL crosses three paved county roads, and four unpaved local roads.

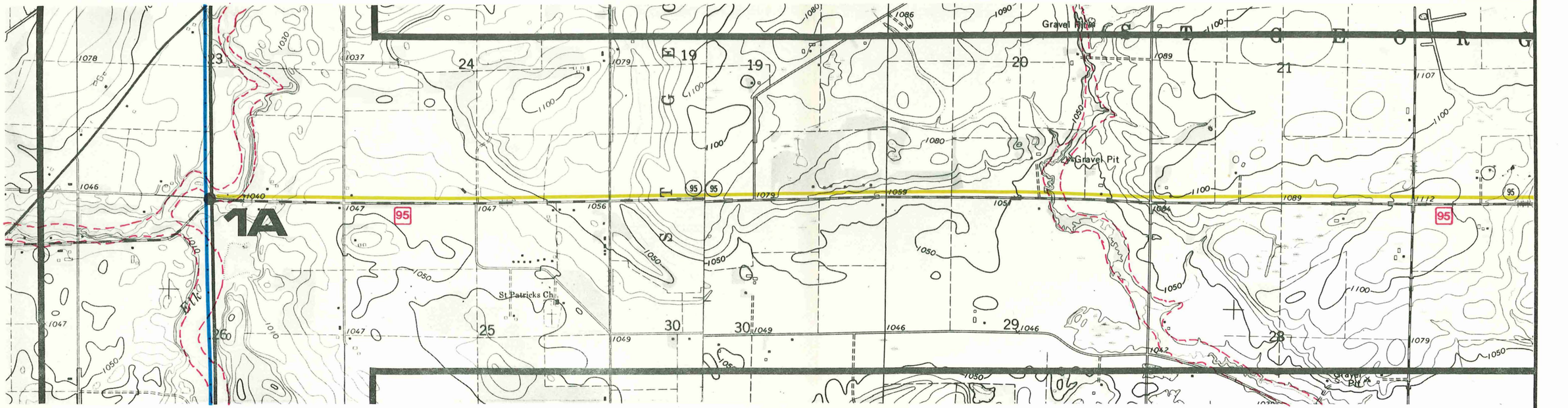
Six residences and six farmsteads are inside the required ROW for the RCL and an additional 42 homes and farmsteads are within 500 feet of the ROW. No communities or other features of human settlement are encountered in section 1B-1C.

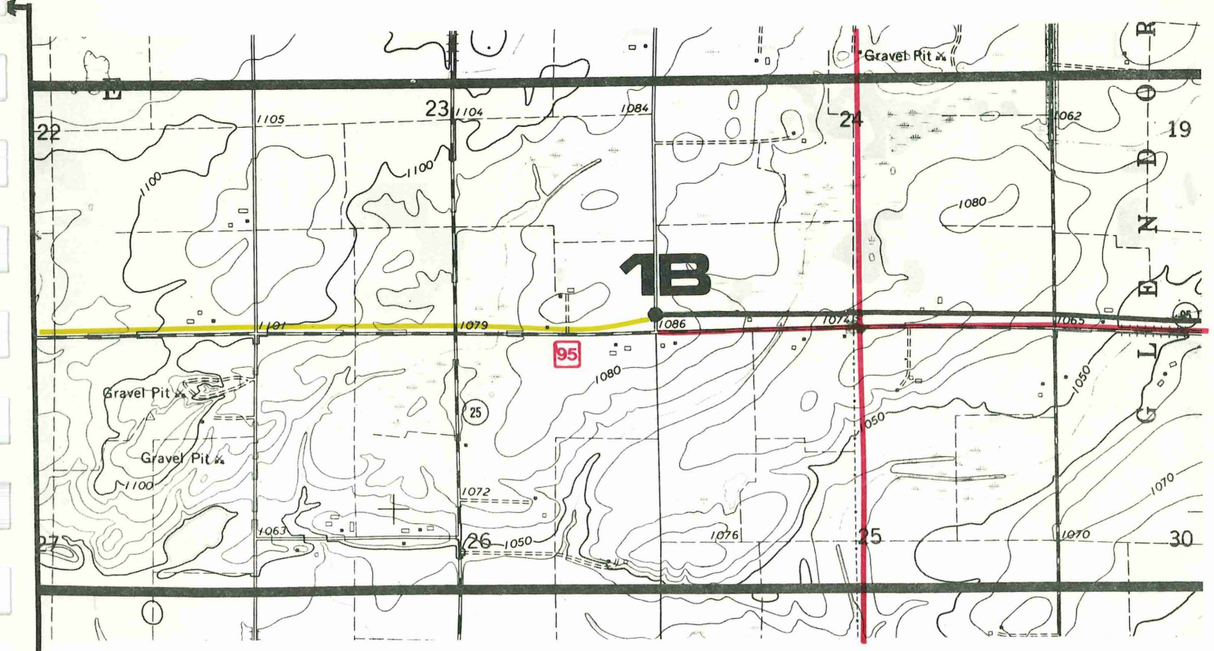
Soils crossed by section 1B-1C are generally light textured loams and loamy sands, with variable drainage.

Cropland productivity scores are moderately high throughout most of this segment (38-56). Between Nodes 1B and 1C, the RCL borders 5.18 miles of cultivated fields. The RCL passes through 0.38 miles of wooded land, requiring the clearing of approximately 2.75 acres of trees.

The RCL crosses one large stream, the St. Francis River. At the point of crossing, the river is approximately 30 feet wide, with the adjoining floodplain and wetland approximately 500 feet wide. Several small (100-200 foot wide) meadow and meadow/willow type wetlands are crossed by the RCL (a total of 0.33 miles within this segment). In addition, in Section 28 (Glendorado Township) the RCL crosses a 500 foot wide open water/wetland area. The size and amount of water in this area appears to vary considerably with the season of the year and precipitation levels.

PROPOSED ROUTE SEGMENT 1A·1B





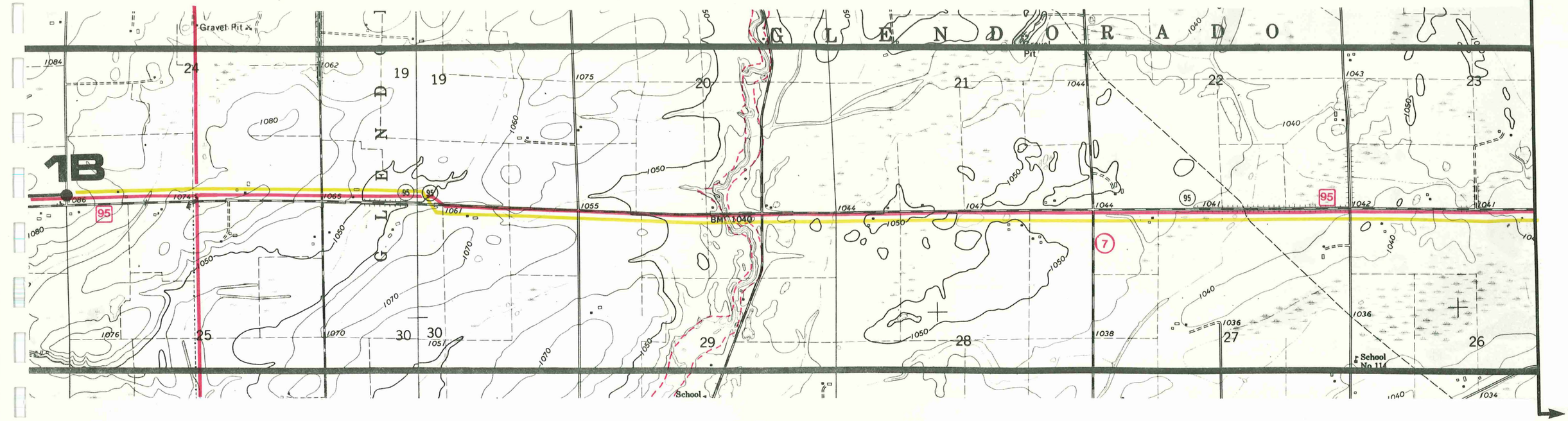
NORTH

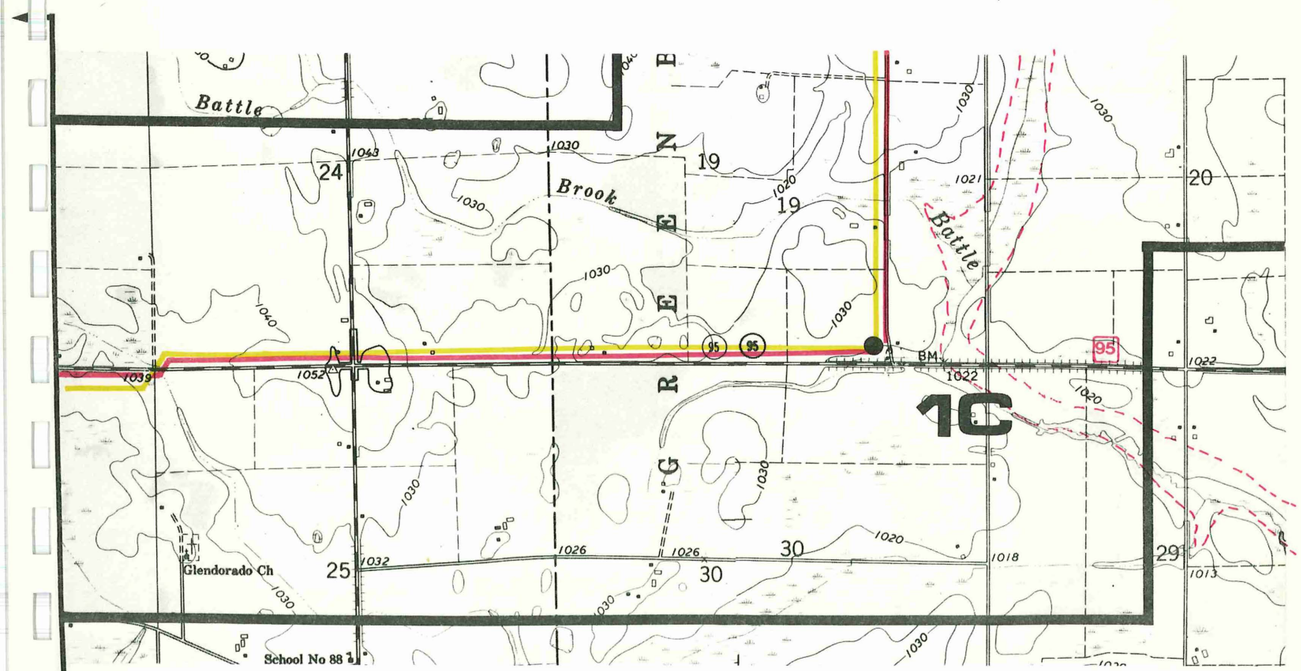
0 1/2 MILE

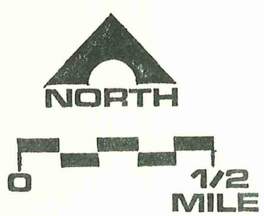
ROUTE BOUNDARY
SEGMENT REFERENCE CENTERLINE
NODE
REFERENCE CENTERLINE
EXISTING 69 KV LINE
EXISTING 230 KV LINE
FLOOD HAZARD ZONE

PROPOSED ROUTE SEGMENT 1A·1B

PROPOSED ROUTE SEGMENT 1B·1C







ROUTE BOUNDARY
SEGMENT REFERENCE CENTERLINE
NODE
REFERENCE CENTERLINE
EXISTING 69 KV LINE
FLOOD HAZARD ZONE

PROPOSED ROUTE SEGMENT 1B·1C

Segment 1C-1D

Segment 1C-1D is 7.33 miles long, and as drawn, contains four light angles (3-30°) and five heavy angles (30-90°). Two short diagonal orientations are made in Section 16, by both the RCL and the existing 69 kV line, Greenbush Township, to avoid a wetland area near the Prairie Brook. Although the RCL leaves Highway 95 at Node 1C, it continues to parallel UPA's 69 kV subtransmission line to Node 1D. Due to joint use of rights of way, new right of way requirements for the proposed HVTL would be reduced to approximately 60 feet. This segment terminates at the intersection of the RCL with Federal Highway 169 northwest of Princeton.

Segment 1C-1D parallels unpaved county and township roads for 6.56 miles of the total distance of 7.53 miles. The existing 69 kV line is paralleled for the entire distance. The RCL crosses nine unpaved and two paved local roads.

Seven residences and five farmsteads lie within the RCL right of way located, by UPA, with an additional 25 homes and 23 farmsteads within 500 feet of the RCL right of way. No other aspects of human settlement are crossed or adjacent to the RCL.

The agricultural landscape in segment 1C-1D shows a great deal of variation in soils, productivity ratings and vegetative cover. A greater frequency of wetlands and low-lying areas in the RCL path makes much of this segment less suitable for crop production than other parts of the study area, with a corresponding increase in pasture and woodlands through this area. The RCL in this segment borders approximately 4.88 miles of cultivated land. Soil types in segment 1C-1D tend to be in the Freer-Freeon-Adolph association, light textured and well to poorly drained loams.

The RCL in segment 1C-1D crosses 0.58 miles of wetland, which is typically vegetated with willow/brush and grass, interspersed with stands of trees. The largest wetland area affected by the RCL occurs in Section 16, Greenbush Township, adjacent to Prairie Brook. This extensive wetland (approximately one mile wide) contains a large stand of mature trees (maple, basswood, elm and cottonwood) and a variety of brush species (largely willow and alder). The existing 69 kV and the RCL make a jog to the north for a distance of 0.33 miles in this location, minimizing direct contact with this wetland area. Several additional lowland areas are crossed by the RCL in Sections 14 and 13. The terrain in this portion of the study area tends to be flat and the soils are often poorly drained. No lakes occur in

this segment. The RCL crosses one stream, the west branch of the Rum River. Approximately 1.12 miles of the RCL passes through wooded areas, requiring a total clearing of 8.82 acres of trees. No wildlife areas occur within the route boundaries in segment 1C-1D, although there are several of these protected areas to the south and northwest of this portion of the route.

No designated public recreational lands, natural or historic areas are crossed by the RCL in this segment.

Segment 1D-9A

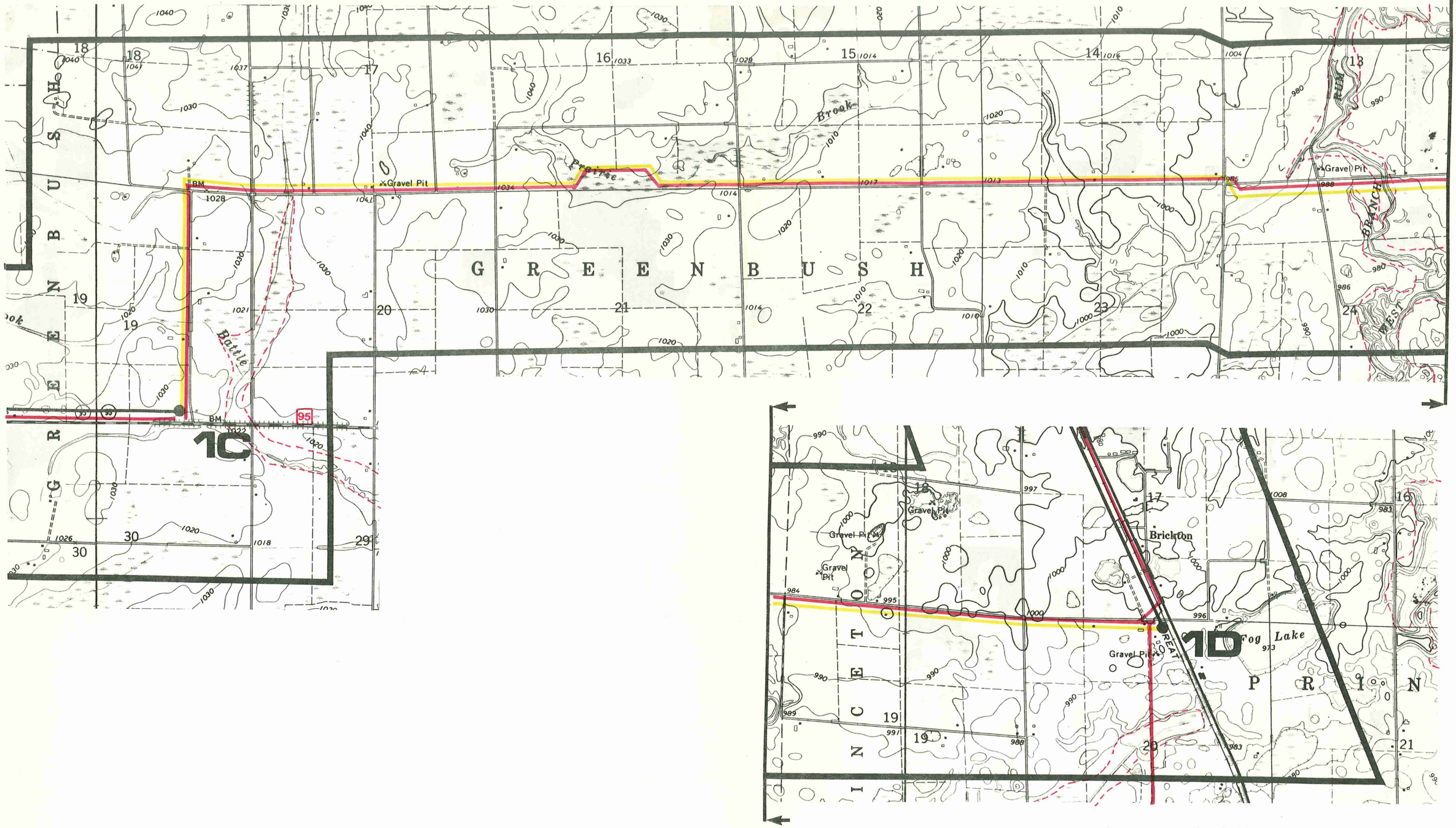
The proposed ROW along the RCL in this segment is 7.33 miles long, and would parallel the west side of Highway 169 to the community of Long Siding. The RCL also parallels an abandoned Great Northern railroad route, the ROW of which has been added to Highway 169 ROW. The Minnesota Department of Transportation indicates that part of this excessive highway ROW may be available for joint use with the proposed HVTL. Just north of Long Siding, the RCL crosses to the east side of Highway 169, continues to follow an existing 69 kV line to Node 9A. Two paved roads (including Highway 169) and five unpaved local roads are crossed by the RCL in this segment.

One home and one farmstead lie within the ROW area, and an additional 27 homes or farmsteads are located within 500 feet of the ROW. Some industrial and commercial development has taken place along Highway 169 and such development can be expected to continue along this major highway corridor.

Land use adjacent to the RCL is predominantly agricultural. Cultivated fields are bordered for a total of 5.33 miles in this segment, and pasture land is bordered for 0.92 miles. In the southern half of this segment, soils are predominantly in the Brickton-Daldo-Peat association, are heavy textured and moderately to poorly drained. Ratings for climate-modified soil productivity tend to be moderately low (0-37) in this portion of the study area.

Intermittent wetlands are common in Sections 6 (Princeton Township), and 30 and 31 (Bogus Brook Township). The RCL (as drawn) crosses a total of 0.41 miles of wetland, most of which are small enough to be spanned. The RCL passes through 0.29 miles of wooded land, requiring the clearing of 2.15 acres.

PROPOSED ROUTE SEGMENT 1C · 1D



ROUTE BOUNDARY

SEGMENT REFERENCE CENTERLINE

NODE

REFERENCE CENTERLINE

EXISTING 69 KV LINE

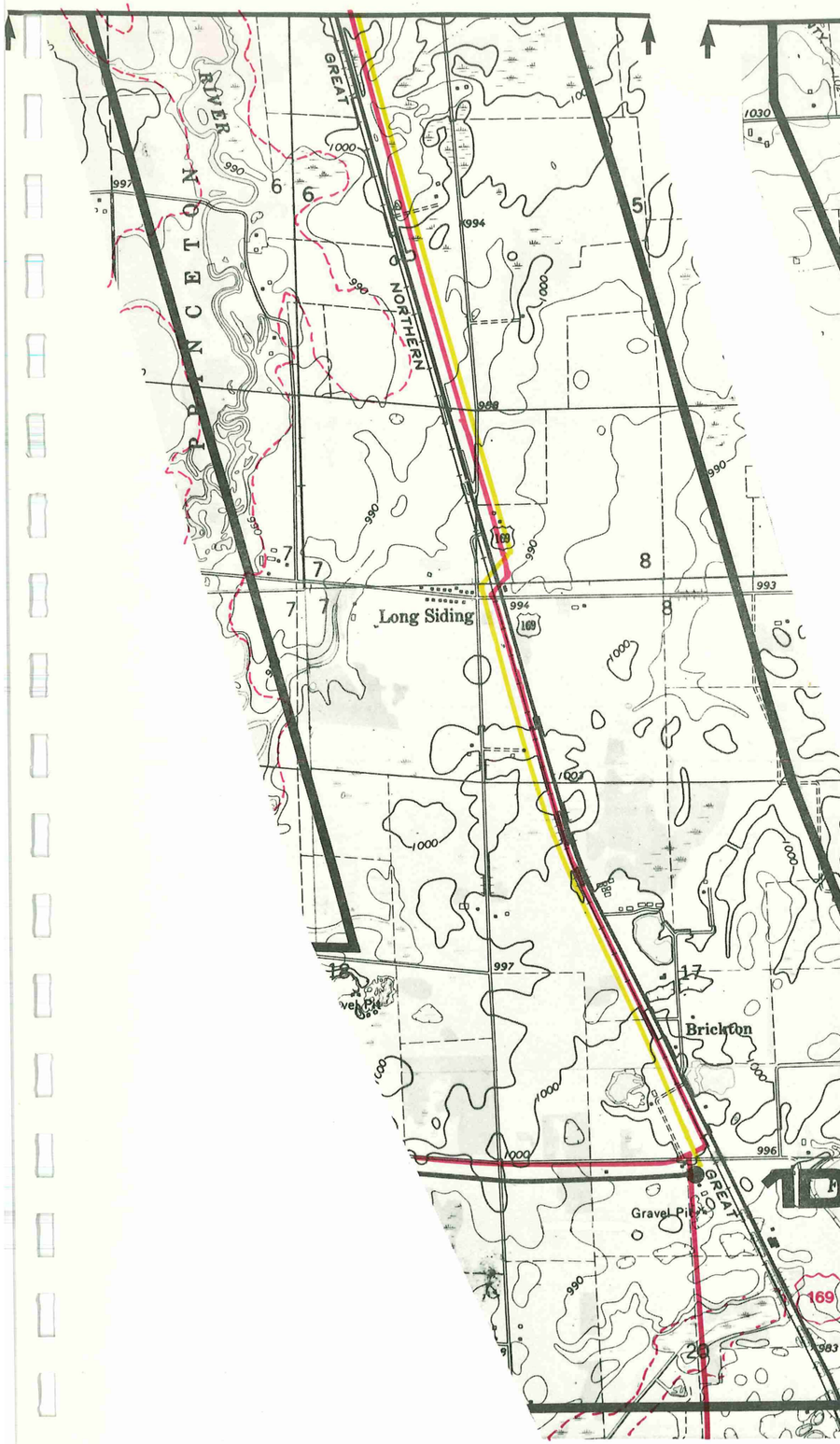
FLOOD HAZARD ZONE

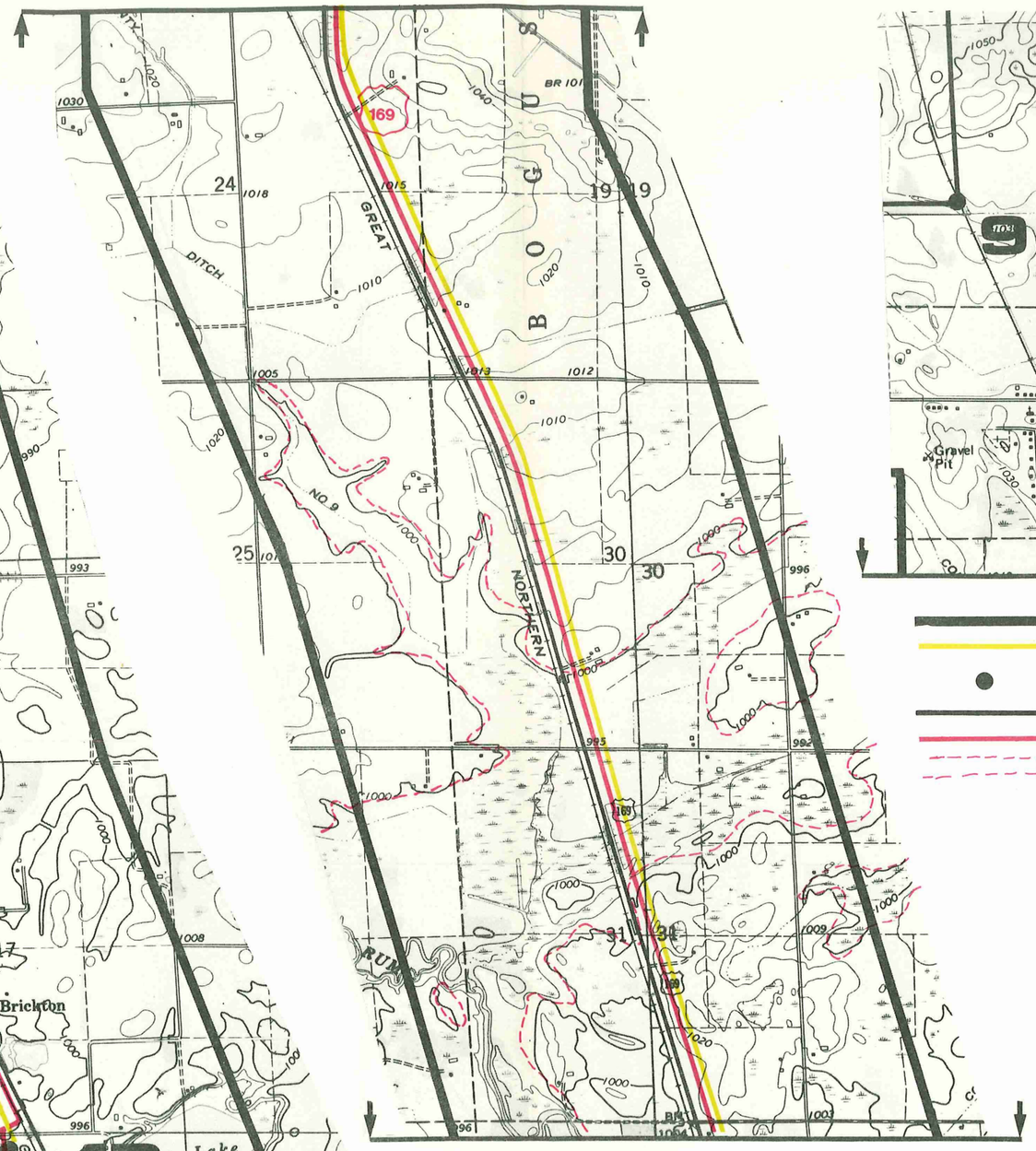
NORTH

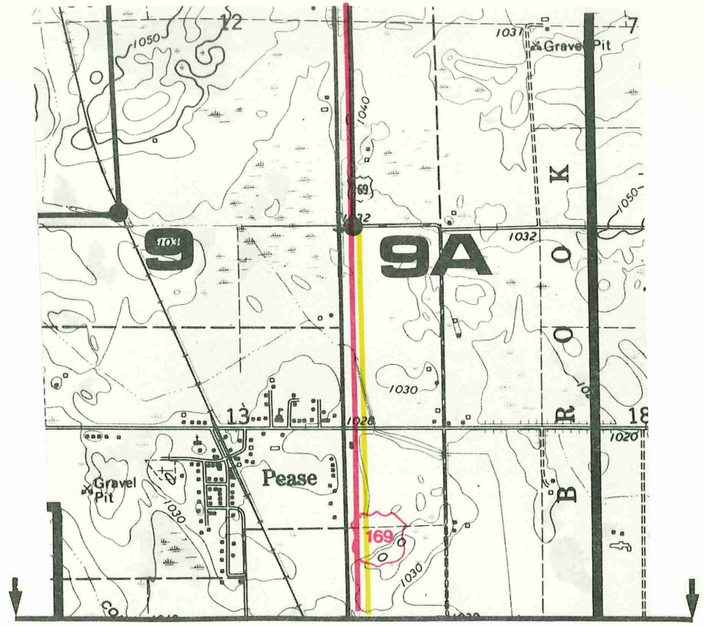
0 1/2 MILE

PROPOSED ROUTE SEGMENT 1C·1D

PROPOSED ROUTE SEGMENT 1D·9A







ROUTE BOUNDARY
SEGMENT REFERENCE CENTERLINE
NODE
REFERENCE CENTERLINE
EXISTING 69 KV LINE
FLOOD HAZARD ZONE

NORTH

0 1/2 MILE

PROPOSED ROUTE SEGMENT 1D·9A

There are no designated public recreational or wildlife areas crossed by the RCL in this segment. Just north of Node 1D, the RCL passes near the site of the former town of Brickton, which is marked by an historical marker.

Segment 9A-10A

North of node 9A, the RCL continues to parallel the existing 69 kV line on the east side of Highway 169 for a distance of 1.17 miles. At that point, the planned interchange on Highway 169 requires the line to veer east slightly, cross the highway to the west side of old Highway 169, then cross back to the west edge of the by-pass (see map). This design would require the use of one light angle structure and three heavy (30-60°) angle structures. Construction of the interchange and associated highway improvements is expected to be completed by 1982. As this construction may require the relocation of up to 1 1/2 miles of existing 69 kV line, UPA may consider a double circuiting of this line with the proposed HVTL if this segment is part of the final route designated by the MEQB. The total length of this segment is 2.02 miles. Additional right of way width varies considerably in this segment due to the range in design options.

Two homes are in the RCL right of way and an additional 13 farmsteads and homes are within 500 feet of the ROW. Several of these homes could also be affected by the highway redesign and construction required for the planned by-pass.

The RCL in this segment borders 1.10 miles of cultivated fields and 0.37 miles of pasture. The landscape is generally flat in this portion of the route, with most of the soil productivity ratings in the top two categories found in for the study area (38-56 and 57-75).

The RCL crosses over 0.11 miles of wooded area, requiring a total clearing of 0.77 acres in this segment. No wetland is crossed by the RCL as drawn.

The RCL crosses the Rum River at a point just south of Node 10A. The river is a state-designated recreational river in this location, and the Department of Natural Resources (DNR) is currently in the process of acquiring scenic easements along both banks. Permission from the Commissioner of DNR to cross the easements would be required if this segment is a part of the designated route. The flood plain of the Rum River is approximately 2000 feet wide at this point. On the east side of the river, the RCL continues to parallel the Highway 169 bypass.

There are no designated wildlife areas, historic or archeological sites or public recreational lands (other than the Rum River) in this segment.

Segment 10A-11

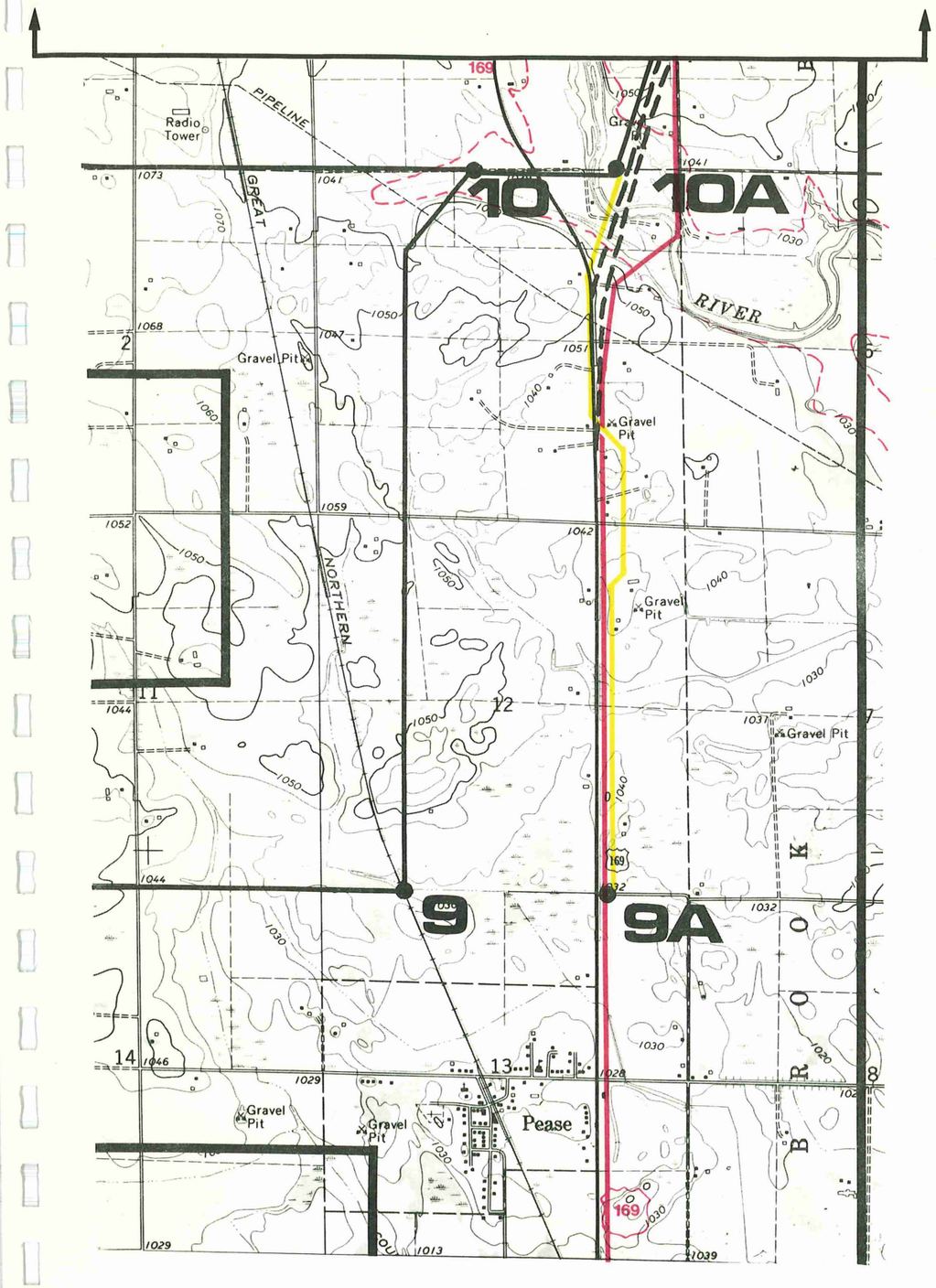
The RCL in this segment is 1.39 miles long and and follows the west side of the planned Highway 169 by-pass for approximately 0.50 miles to the junction with a township road. From that point, the RCL for the proposed line parallels the township road (west side) directly north to its termination at the Milaca sub-station, a distance of 0.89 miles. This alignment also parallels UPA's existing 69 kV line from Princeton, and a double circuiting with this line would be considered if this route segment is used. Depending on the final design, 60-80 feet of additional ROW width would be needed. Two 3-30° angles are required by this alignment, and one unimproved township road is crossed.

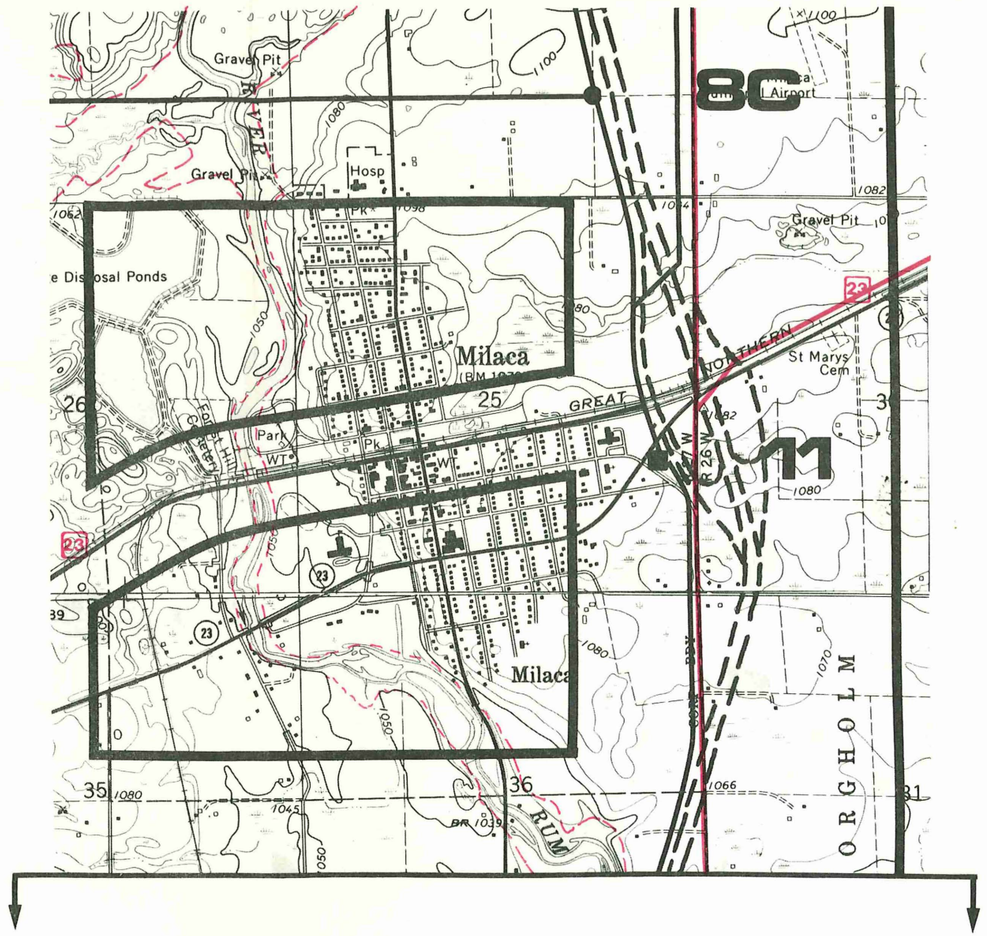
No homes or farmsteads are within the RCL ROW in this segment, although seven residences and five farmsteads are within 500 feet of the ROW. The final 0.89 miles of the RCL is within the corporate limits of Milaca. At the present time, most of this part of the city is undeveloped and presently used for agricultural purposes. This area is zoned for residential development but little change in its present use is anticipated for the near future.

Agricultural land bordering the RCL is partially under cultivation (0.45 miles) with the remainder in pasture (0.41 miles) or woodlot (0.36 miles). Rights of way clearing would remove 2.62 acres of trees. No wetland is crossed by the RCL in this segment.

No designated public recreational areas, wildlife areas, or historic or archeological sites are crossed by, or adjacent to the RCL in this segment.

PROPOSED ROUTE SEGMENT 9A·10A





NORTH

0 1/2 MILE

ROUTE BOUNDARY

SEGMENT REFERENCE CENTERLINE

NODE

REFERENCE CENTERLINE

EXISTING 69 KV LINE

FLOOD HAZARD ZONE

PROPOSED ROUTE SEGMENT 9A · 10A

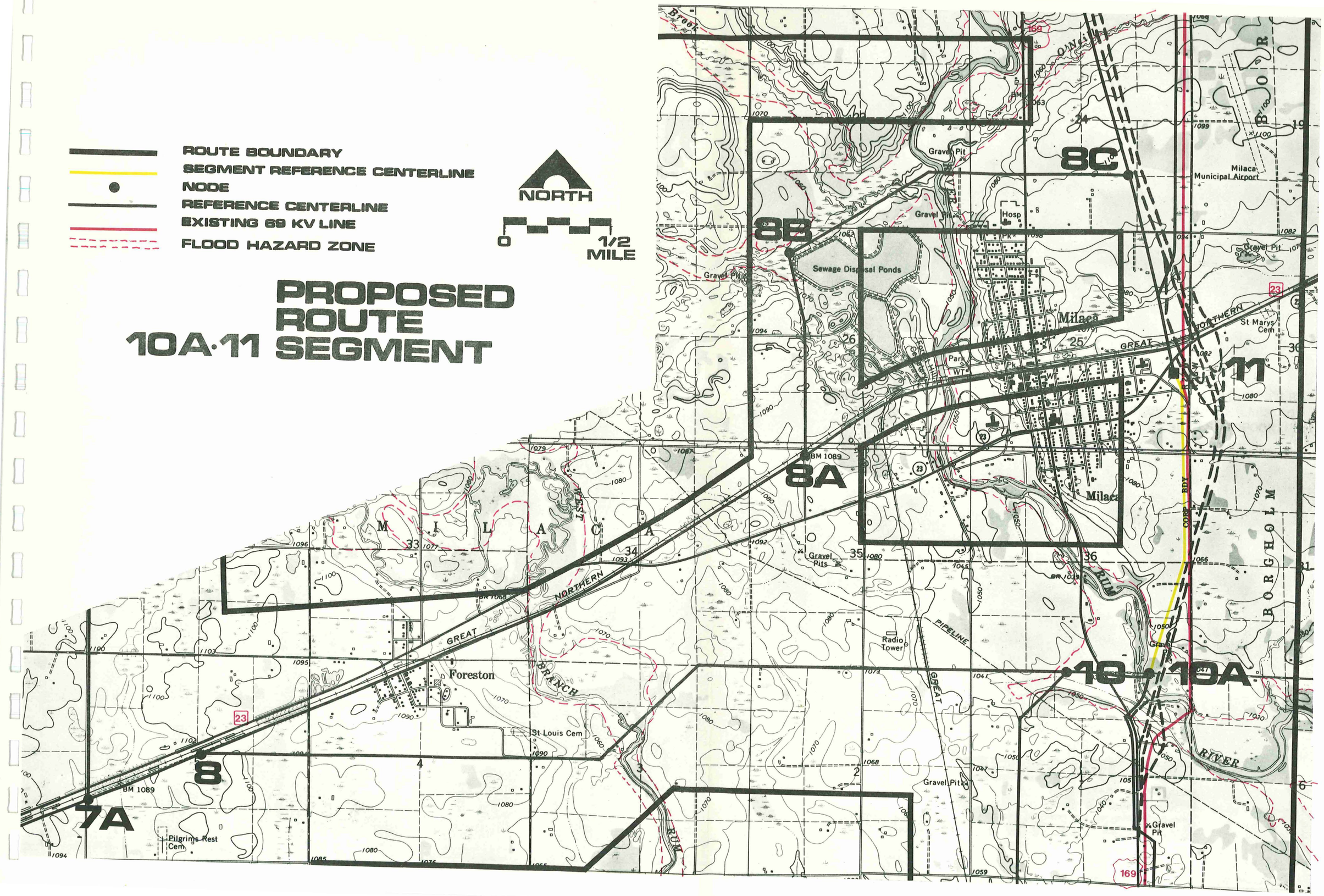
PROPOSED ROUTE SEGMENT 10A·11

ROUTE BOUNDARY
SEGMENT REFERENCE CENTERLINE
NODE
REFERENCE CENTERLINE
EXISTING 69 KV LINE
FLOOD HAZARD ZONE

NORTH

0 1/2 MILE

PROPOSED ROUTE 10A-11 SEGMENT



MISCELLANEOUS ROUTE SEGMENTS

Segments 3B-6 and 3A-4A

These segments provide alternatives to Segments 3-4-4A-6 on Route B. Both segments were proposed in order to increase the paralleling of the UPA 230 kV line north of Highway 23, and to avoid the cross-country diagonal and step-like segments from Nodes 3 to Node 6 which were proposed by UPA.

Segment 3A-4A parallels an existing 69 kV line which intersects the 230 kV line approximately three miles north of Node 3. This alternative is 3.90 miles long, and parallels the 69 kV line for its entire distance. This alignment would result in two homes and farmsteads lying within the ROW area, and six homes and farmsteads within 500 feet of the ROW.

While no fields are crossed, 2.41 miles of cultivated fields and 0.63 miles of pasture land are bordered. The RCL crosses 0.39 miles of wooded land, requiring a total clearing of 2.84 acres of trees. The RCL also crosses the Elk River once, and traverses 0.19 miles of wetland.

Segment 3B-6 similarly connects the RCL paralleling the 230 kV line with Route B, at a point approximately 4 3/4 miles north of Node 3. The RCL in Segment 3B-6 is 3.37 miles long, and is aligned along 1/16th section lines, which are used for the RCL alignment of Route B east of Node 6. No existing ROW is paralleled or shared.

Two homes and farmsteads lie within 500 feet of the RCL ROW; no dwellings are located within ROW area. The RCL crosses 0.97 miles of cultivated land, and borders cropland for an additional 1.31 miles. 1.47 miles of pasture is crossed or bordered by the RCL. Wooded land crossed or bordered by the RCL totals 0.19 miles, requiring 1.38 acres to be cleared; no wetlands are affected by the RCL in this segment.

There are no designated public recreational lands, wildlife areas or historical sites in either of these segments.

Segments 5A-5B-5C

Route segments 5A-5B and 5B-5C together provide a means of by-passing the City of Foley completely. This alternative route branches off the railroad route at node 5A about a mile southwest of Foley and proceeds eastward for 2.77 miles along County Road 51 and the township line between St. George and Gilmanton Townships to Node 5B. At Node 5B, this route intersects and parallels the existing 69 kV transmission line northward across open fields for 1.45 miles to Node 5C east of Foley.

Heavy angle structures will be necessary at each node. Double circuiting with the existing 69 kV line along 5B-5C may be possible.

Segment 5A-5B is adjacent to cultivated land for 1.90 miles. Soils in this part of the study area typically poorly drained upland loams. Productivity ratings for this area are correspondingly in the lower ranges for the study area (0-18).

Two houses and one farmstead are within the right of way and 12 houses and seven farmsteads are within 500 feet of the right of way.

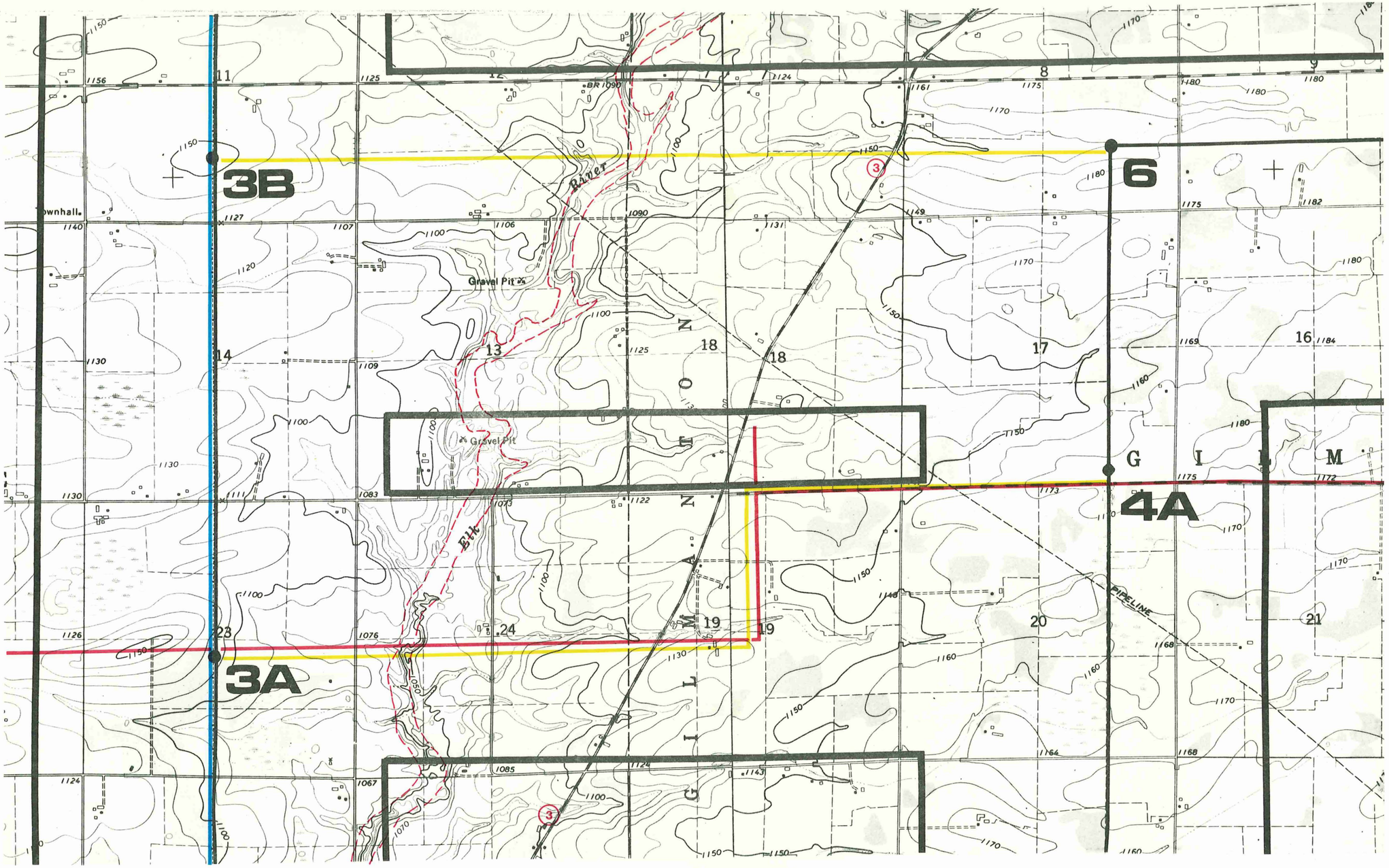
In addition, 0.4 miles of woodland is crossed and 2.89 acres of trees would be cleared for ROW. One stream (Stony Brook) and 0.15 miles of wetland are crossed by the RCL in Segment 5A-5B.

Between nodes 5B and 5C, 0.69 miles of cultivated land are crossed and another 0.38 miles are bordered. Two wooded acres are bordered and 1.31 acres of woods would be cleared.

Two houses and two farmsteads are within 500 feet of this proposed right of way.

No designated public recreational or wildlife areas occur within this segment.

PROPOSED
ROUTE
SEGMENT 3A·4A, 3B·6



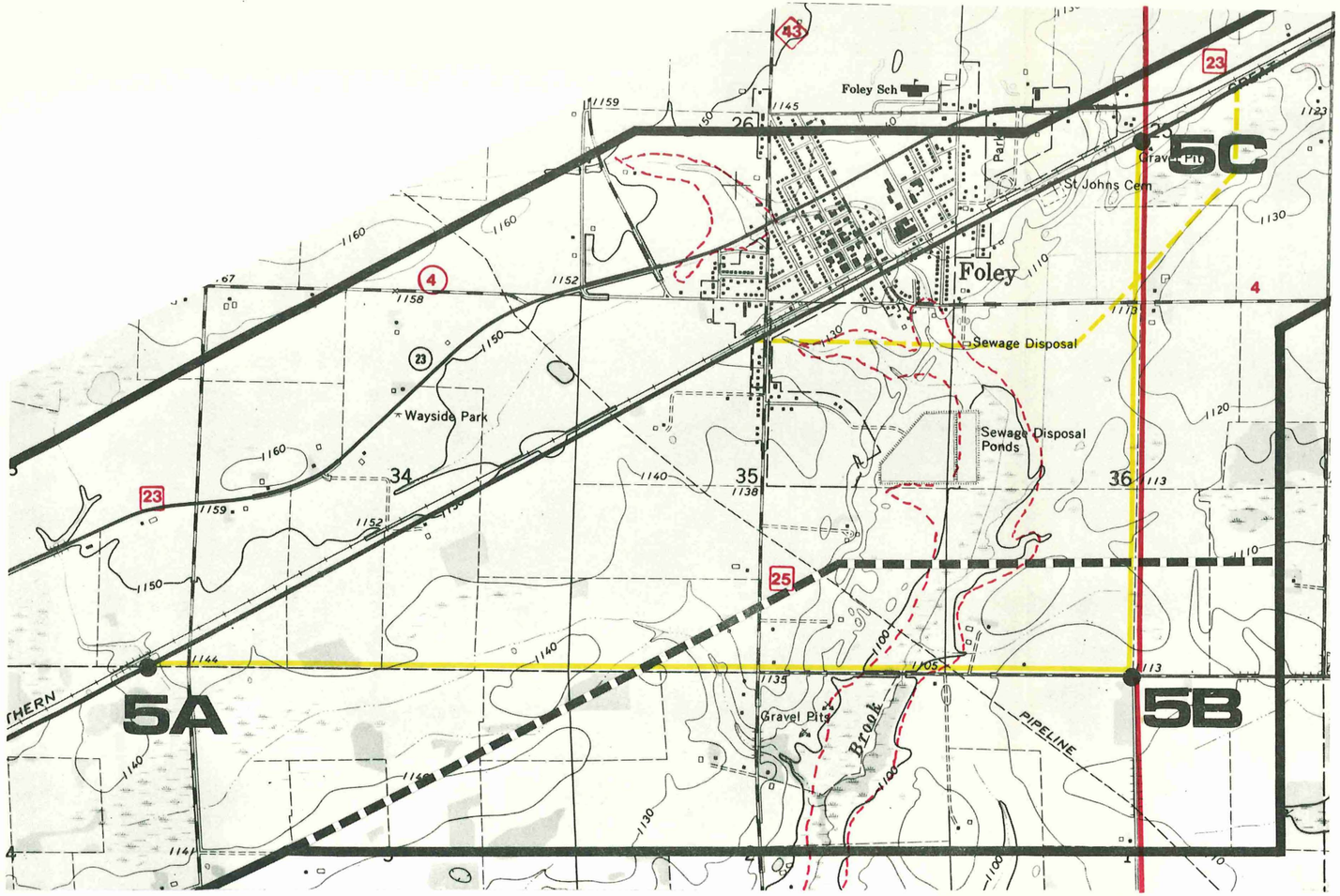
ROUTE BOUNDARY
SEGMENT REFERENCE CENTERLINE
NODE
REFERENCE CENTERLINE
EXISTING 69 KV LINE
EXISTING 230 KV LINE
FLOOD HAZARD ZONE

NORTH

0 1/2 MILE

PROPOSED ROUTE 3A·4A SEGMENT 3B·6

PROPOSED
ROUTE
SEGMENT 5A·5B·5C



ROUTE BOUNDARY
SEGMENT REFERENCE CENTERLINE
NODE
REFERENCE CENTERLINE
EXISTING 69 KV LINE
FLOOD HAZARD ZONE

NORTH

0 1/2 MILE

PROPOSED ROUTE SEGMENT 5A·5B·5C

Land use in the developed portion of Foreston adjacent to the proposed RCL is presently mixed residential and commercial (generally uses associated with or dependent on rail transportation). BNRR right of way is approximately 250 feet wide in this area, and contains an 1800 foot-long siding. A paved road (Old Highway 23) is immediately adjacent to the BNRR ROW for a distance of 1.61 miles. The presence of this road would require the right of way for the HVTL to be entirely within BNRR ROW unless a centerline south of the road is used.

One home is located within the ROW, and an additional 12 homes are within 500 feet of the ROW.

Agricultural lands affected by the RCL in this section include 1.91 miles of cultivated fields and 0.67 miles of pasture bordered by the RCL. In addition, 0.48 miles of windrow would be cleared for the ROW.

The RCL crosses 0.21 miles of wetland, and crosses or borders 0.15 miles of wooded land (required clearing would remove 1.10 acres of trees).

The RCL crosses the west branch of the Rum River just east of the Foreston City limits. The river is approximately 40 feet wide in this location, with heavily wooded banks. The railroad tracks to the north of the RCL are constructed on an elevated roadbed and bridge which is approximately 20 feet above grade. The RCL presumably is located on the side of this grade. Supplemental foundation support and taller poles to provide adequate vertical and horizontal clearance would likely be required if this RCL were to be used for an actual centerline.

The RCL in Segment 7A-8A is located within 500 feet of the Northwestern Bell buried toll cable for the entire distance of 3.65 miles. One telephone repeater hut is also located in this segment. Northwestern Bell has indicated that a total relocation of this portion of this cable would be necessary to adequately protect it (see chapter 4).

Route Segment 7A-8A affects no designated public recreation lands, wildlife areas, or historic sites.

Segment 7A-7B-7C-8C

This segment is one of several variations of the approach to the Milaca substation from the north side of the city. The RCL in this segment leaves Route A at Node 7A, travels north along County Road 19 for approximately 2 1/2 miles, turns northward to cross the West Branch of the Rum River, and then north 1/2 mile

to Node 7B. From that point, the RCL travels northeast and east along the 1/16th line of sections 17, 16, 15 and 14, Milaca Township, to Node 7C. The link between Nodes 7C and 8C runs in a south-southeasterly direction just west of the planned HIghway 169 Milaca by-pass. (See map.)

The total length of Segment 7A-7B-7C-8C is 8.72 miles, including a diagonal distance of 0.91 miles. As drawn the RCL uses one light angle and six heavy angles. The RCL is drawn parallel to existing county road ROW for a total of 3.55 miles.

There is one house located within ROW in this approach, and an additional 12 houses and farmsteads lie within 500 feet of the ROW. The Chase Brook Cemetary on County Road 18 lies within 500 feet of the RCL between Node 7B and 7C.

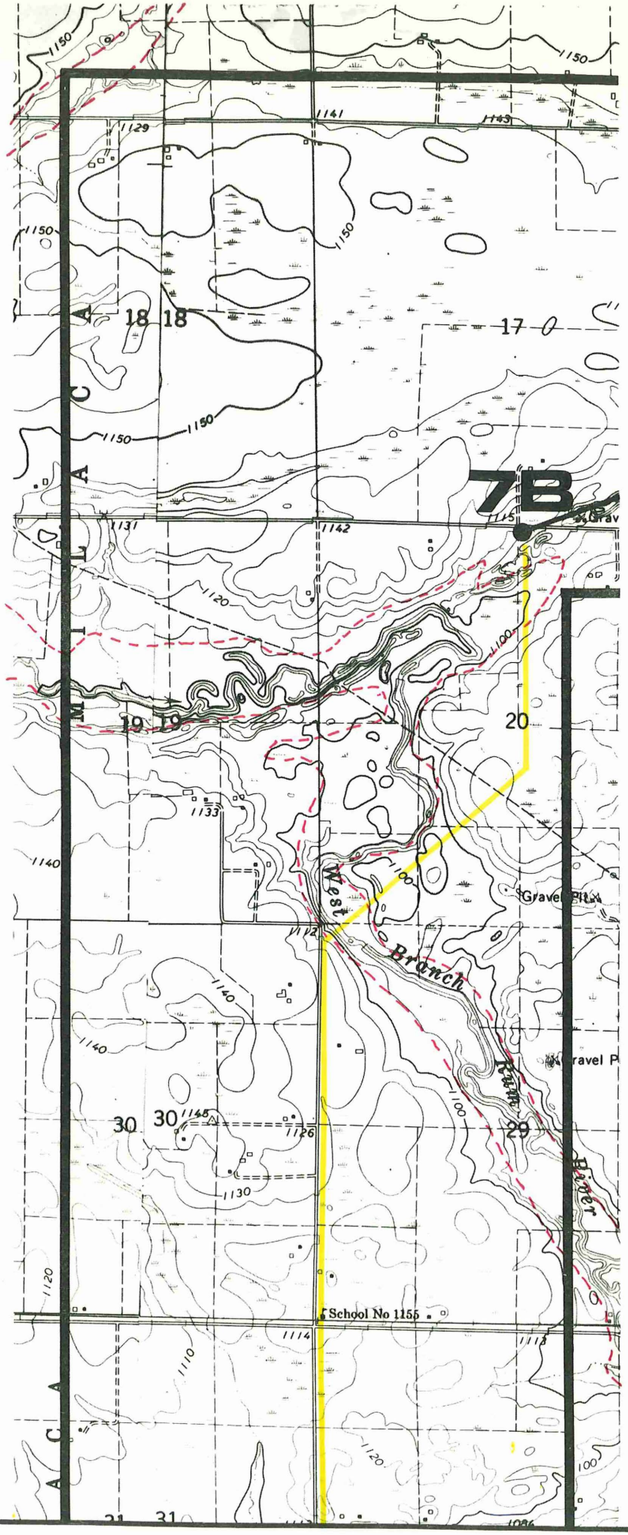
While there are numerous gravel pits in the vicinity of the RCL drawn by UPA, only one (adjacent to Node 7B) has a potential of being affected by the proposed project.

Terrain is preponderantly hilly and uneven throughout the total segment; with numerous wetlands distributed over much of the route area. Soils in this part of the study area are typically deep, light colored loams, with a relatively high potential productivity. Terrain and drainage conditions tend to be limiting factors for row crop production, particularly between Nodes 7B and 7C. However, better agricultural conditions generally prevail in the southern part of this first leg of this segment. As drawn, the RCL crosses 0.37 miles of cultivated fields, and borders an additional 5.88 miles. A total of 0.88 miles of pasture is bordered. 1.01 miles of field windrows lie within the right of way area for the RCL in this segment, and would require removal.

The RCL crosses or borders woodland for a total of 2.37 miles. ROW clearing would result in the removal of 19.7 acres of trees. A total of 0.97 miles of wetland are crossed by the RCL.

As is the case for all of the approaches into Milaca, both the west branch of the Rum River and the Rum River are crossed by the RCL. The crossing of the Rum River near Node 7C occurs in a section of the river which presently is designated as a scenic resource. The Rum River Valley at this point is approximately 0.75 miles wide, and is characterized by steep escarpments on both the east and the west (50-60 foot drops), and a flat, valley floor. Land on both sides of the river bank is under cultivation in the vicinity of the crossing.

PROPOSED ROUTE SEGMENT 7A·7B



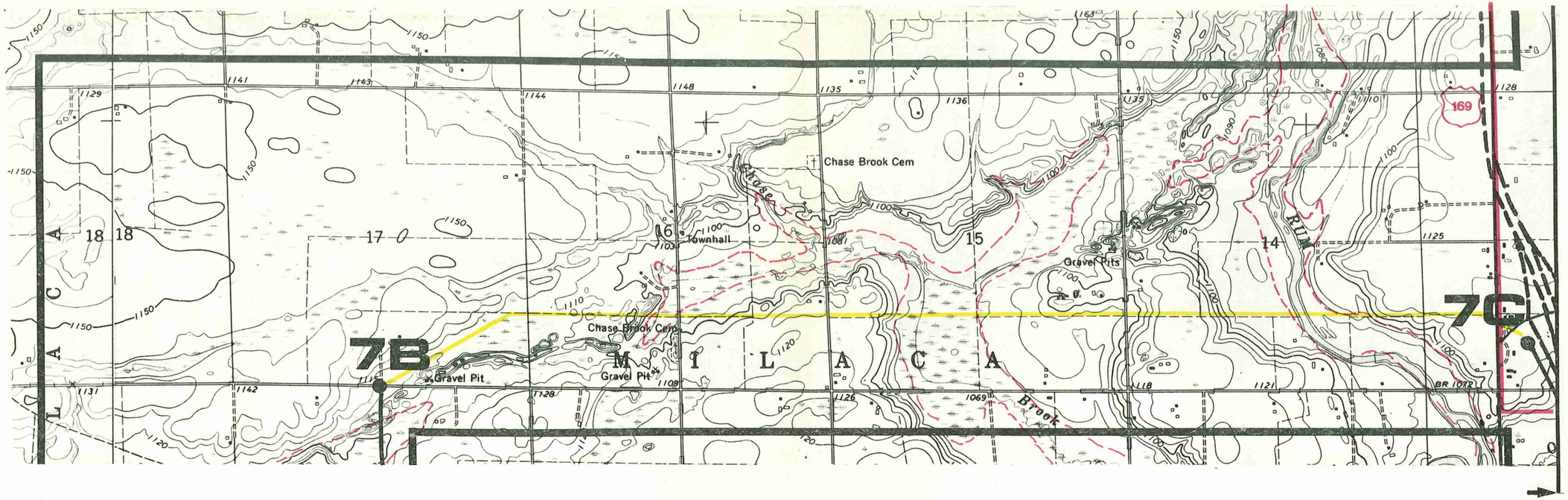
ROUTE BOUNDARY
SEGMENT REFERENCE CENTERLINE
NODE
REFERENCE CENTERLINE
FLOOD HAZARD ZONE

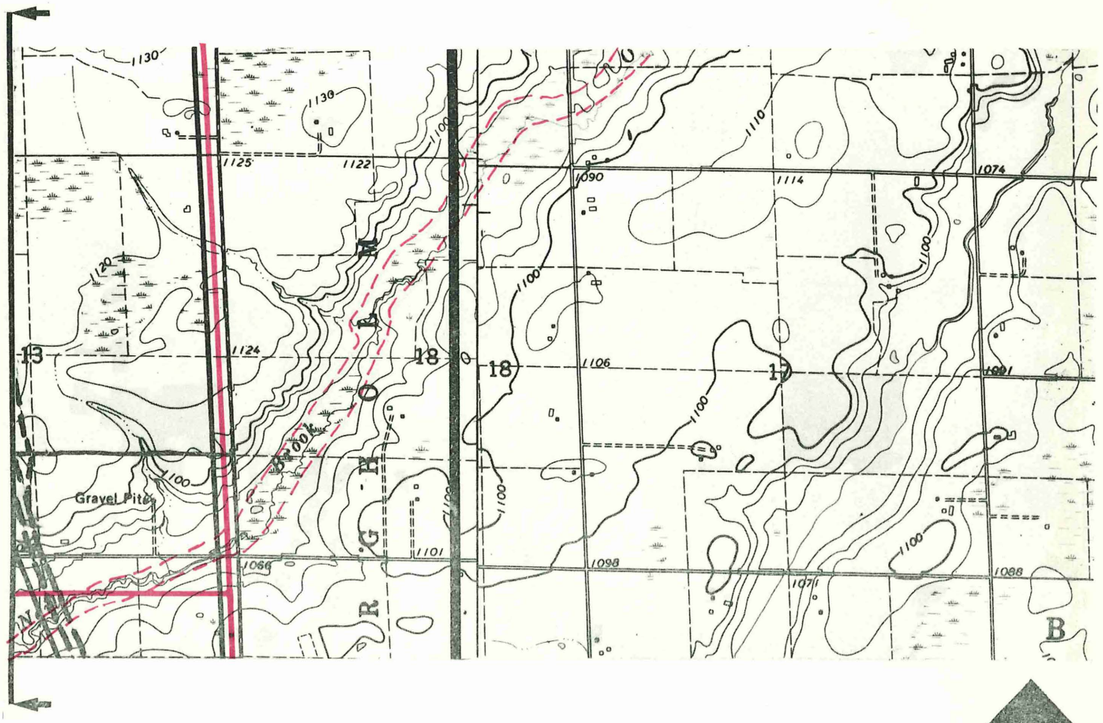
NORTH

0 1/2 MILE

PROPOSED ROUTE SEGMENT 7A · 7B

PROPOSED ROUTE SEGMENT 7B·7C





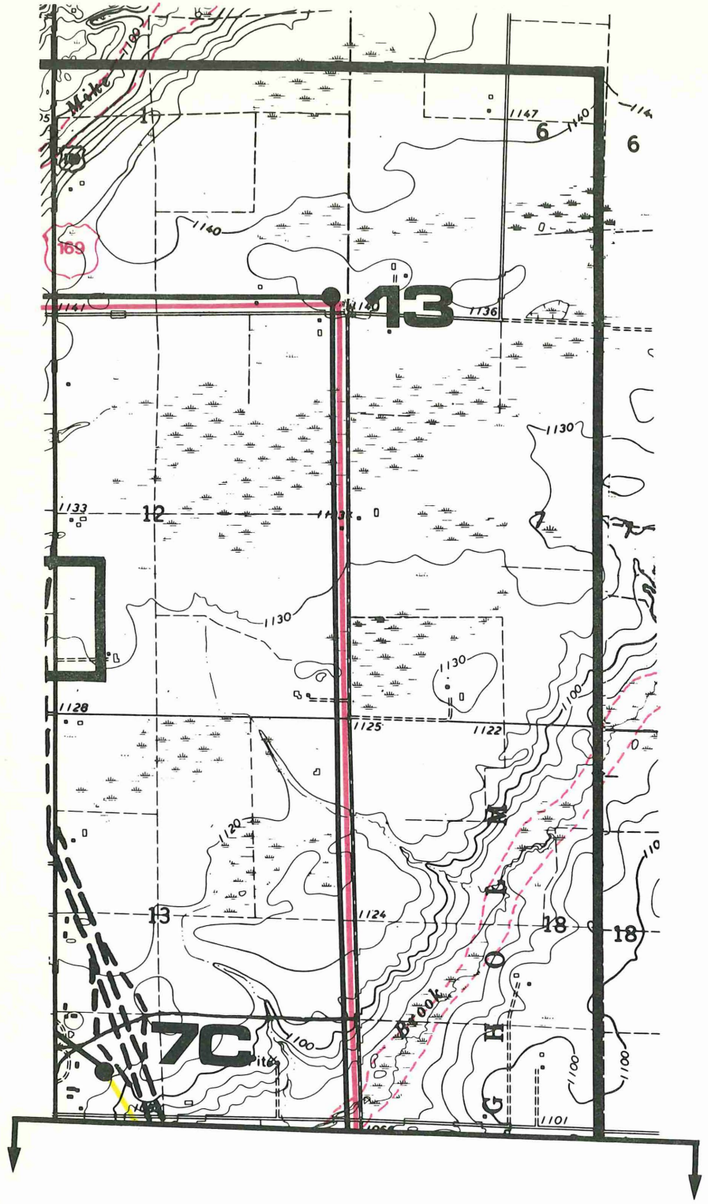
NORTH

0 1/2 MILE

ROUTE BOUNDARY
SEGMENT REFERENCE CENTERLINE
NODE
REFERENCE CENTERLINE
EXISTING 69 KV LINE
FLOOD HAZARD ZONE

PROPOSED ROUTE SEGMENT 7B·7C

PROPOSED ROUTE SEGMENT 7C·8C



ROUTE BOUNDARY

SEGMENT REFERENCE CENTERLINE

NODE

REFERENCE CENTERLINE

EXISTING 69 KV LINE

FLOOD HAZARD ZONE

NORTH

0 1/2 MILE

PROPOSED ROUTE SEGMENT 7C·8C

No designated public recreational lands, wildlife area or historic sites occur within this segment.

Segments 8A-8B, 8B-8C and 8C-11

An additional route option exists at Node 8A along Highway 23 and the railroad tracks east of Foreston. At this point, the transmission line could avoid the center of Milaca by travelling northward around the city. Segment 8A-8B extends northward 0.86 miles to a point immediately west of the Milaca sewage disposal ponds. Route segment 8B-8C continues northeastward for 1.51 miles across the Rum River and Highway 169 to a point immediately west of the new Highway 169 alignment. Segment 8C-11, which is common to the northern route alternatives, continues southward along the new Highway 169 alignment for 1.82 miles to the Milaca Substation.

Segment 8A-8B crosses 0.36 miles of cultivated land, 0.12 miles of wetland, and 0.37 miles of woodlands, requiring the clearing of 1.81 acres of trees. No houses are located within the RCL ROW or within 500 feet of its edge on this route segment.

The first portion of Segment 8B-8C goes northeastward from the west end of the sewage ponds to an angle immediately north of the confluence of Chase Brook and the Rum River. The RCL in this segment crosses the Rum River at that point, then passes through 0.25 miles of planned residential development, across an area proposed for expansion of the local golf course and over the existing commercial strip along old Highway 169. In addition, 0.60 miles of wetlands are crossed and 0.62 miles of cultivated land are bordered by the RCL. The removal of 0.12 miles of windrow would be required.

Segment 8C-11 travels southward along the eastern outskirts of Milaca to the Milaca Substation. New Highway 169 would be paralleled for 0.67 miles and the existing 69 kV transmission line would be paralleled for 0.30 miles. Although the entire area is zoned for future residential use, only one house and one farmstead are presently within 500 feet of the reference centerline. Cultivated land would be bordered by this route for 0.72 miles. Near the substation, the railroad tracks would be crossed for a final time.

At the point of crossing, the Rum River has a designation as a recreational resource. The riverbanks at this point are moderately wooded, with from 100 to 300 feet of floodplain on either side.

With the exception of the Rum River, no designated public recreational or wildlife lands, or culturally significant sites are affected on these segments.

Segment 8A-11

Segment 8A-11 connects Route A (from Node 8A) to the Milaca substation along a route which continues to parallel the BNRR tracks east of Foreston, as they cross to the north side of Highway 23, and pass through the center of Milaca. The RCL in this segment is 1.82 miles in length, and as drawn by UPA, remains on the south side of the BNRR ROW up to the point where it makes a 90° turn to re-cross Highway 23 and enter the substation. Over that distance, the RCL crosses paved two lane roads three times. No existing transmission lines are paralleled in this segment. One heavy angle and three light-to-moderate angles (less than 30°) would be required with this alignment of the RCL.

No homes or farmsteads lie within the ROW. However, as this segment passes through the center of Milaca, at least 70 houses and 60 mobile homes are located within 500 feet of the ROW. In general, however, the proposed HVTL would be in full view of only those houses and trailer homes which are actually adjacent to the BNRR tracks (or separated from the tracks by local streets), due to intervening trees, buildings or terrain. 1.10 miles of the total length of the RCL in Segment 8A-11 lie within the corporate limits of Milaca. Although existing land uses along this segment vary considerably, most of the land crossed by the RCL which is within the city is zoned for residential use (a total of 1.48 miles). The RCL is adjacent to the central business district of Milaca for 0.2 miles. If right of way along the RCL were to be used, however, no existing commercial buildings would be affected by the proposed HVLT. Although the available ROW is narrow, UPA engineers feel that adequate horizontal and vertical clearances could be maintained thorugh the use of special line and pole design, and through careful placement of the poles.

West of Highway 169, the RCL passes within 200 feet of an LP gas storage area, and within 100 feet of a lumber yard. On the east side of the BNRR - Highway 169 intersection, the RCL right of way passes over two fuel storage facilities. Relocation of these facilities may be required to meet the requirements of the utility's safety standards. The remainder of the RCL ROW adjacent to the BNRR tracks through Milaca is relatively unencumbered at the present time. A few structures (including a small BNRR depot building, and a hamburger stand) would be within or immediately outside the right of way identified by the RLC. It is not likely, however, that placement of the line in this right of way would necessitate their removal.

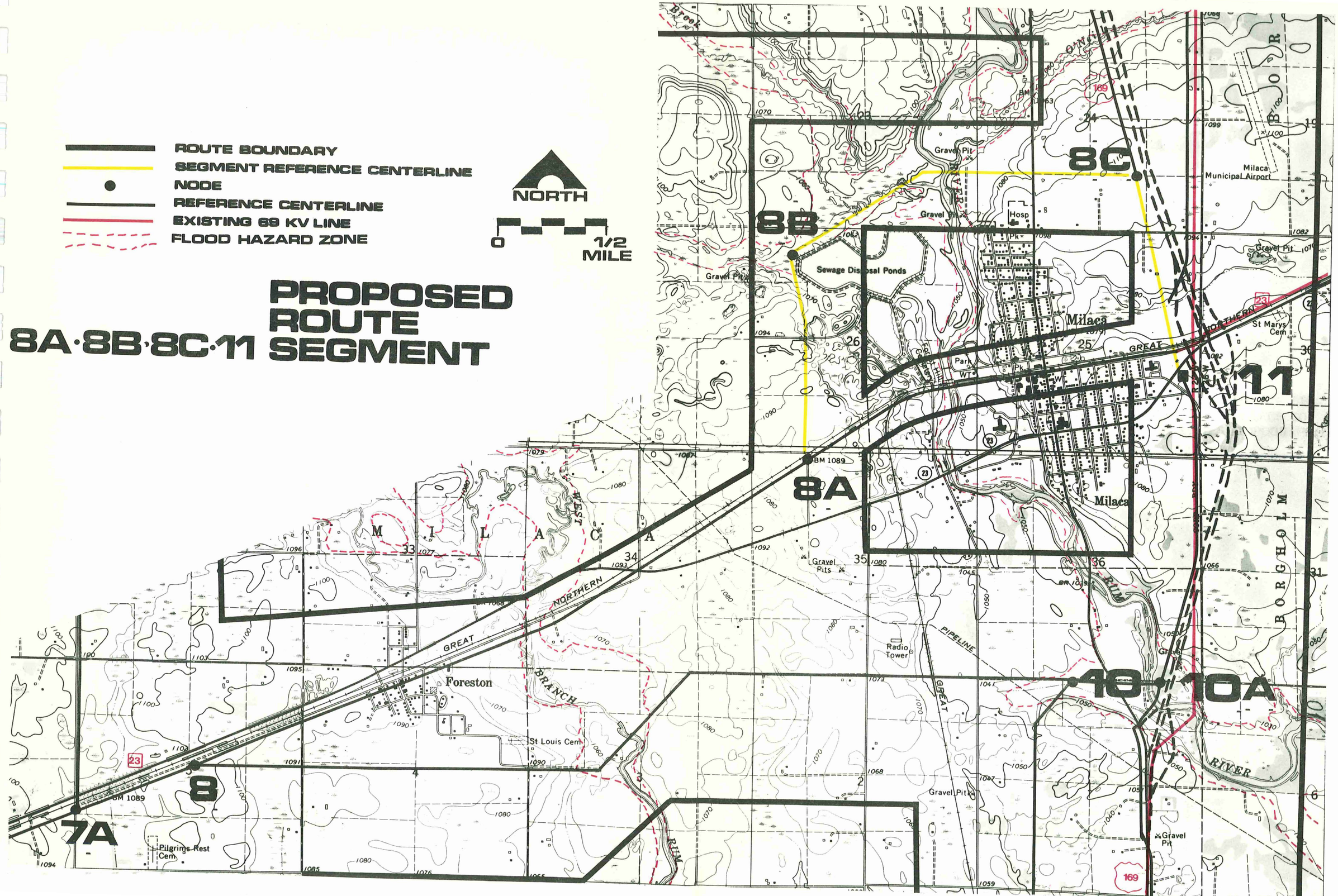
PROPOSED
ROUTE
SEGMENT 8A·8B·8C·11

ROUTE BOUNDARY
SEGMENT REFERENCE CENTERLINE
NODE
REFERENCE CENTERLINE
EXISTING 69 KV LINE
FLOOD HAZARD ZONE

NORTH

0 1/2 MILE

PROPOSED ROUTE 8A·8B·8C·11 SEGMENT



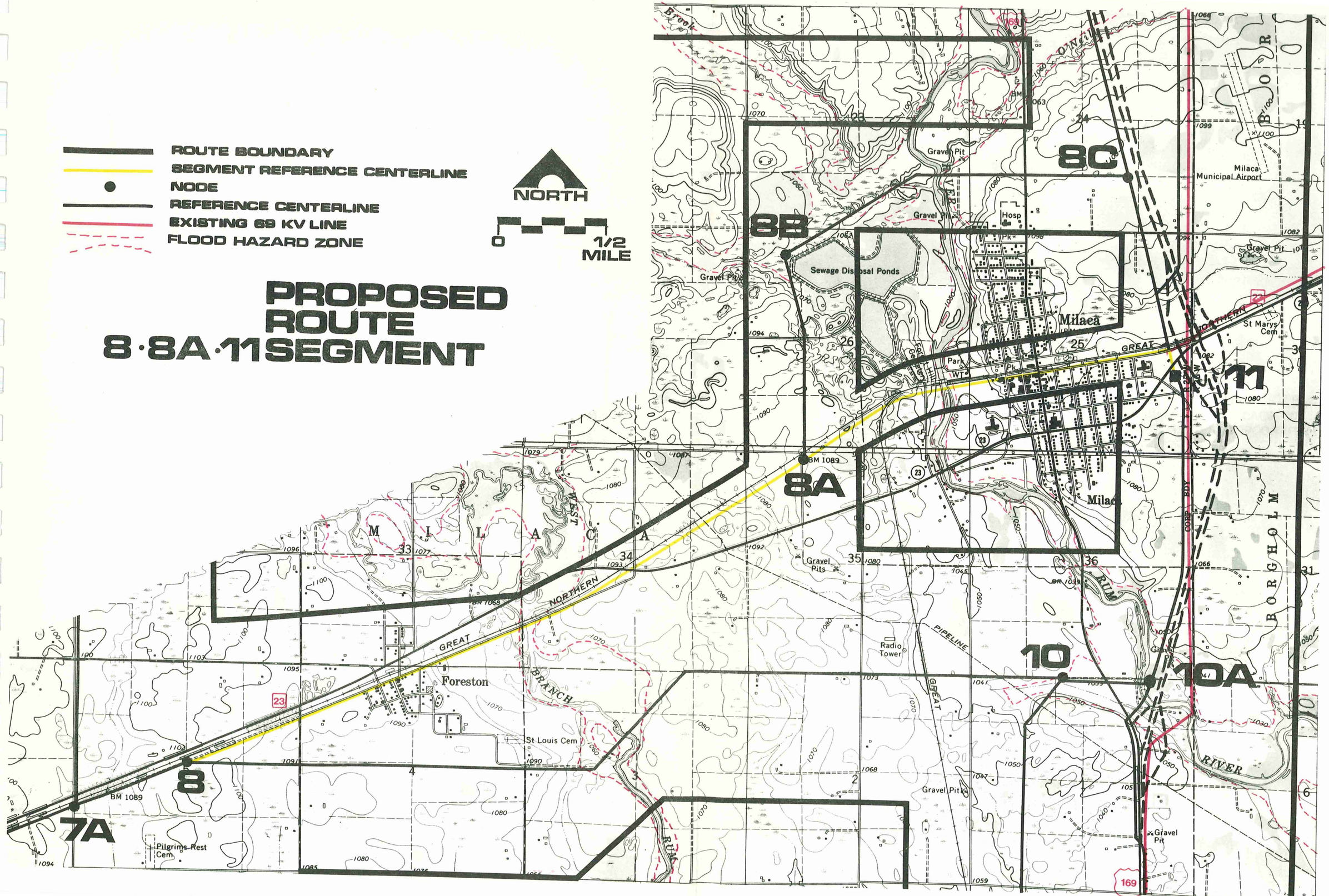
PROPOSED
ROUTE
SEGMENT 8·8A·11

ROUTE BOUNDARY
SEGMENT REFERENCE CENTERLINE
NODE
REFERENCE CENTERLINE
EXISTING 69 KV LINE
FLOOD HAZARD ZONE

NORTH

0 1/2 MILE

PROPOSED ROUTE 8·8A·11 SEGMENT



Just east of the Rum River, the RCL is adjacent to the Milaca High School property for a distance of approximately 1000 feet. Several athletic fields are lcoated on this property, although there is approximately 300 feet between the perimeter of the closest field and the edge of the RCL ROW.

Immediately north of the BNRR tracks and the RCL in this same location, there is a 20+ acre city park (Riverside Recreational Park). Federal Land and Water Conservation Fund monies were used in the development of this park, restricting the use of any parkland for the proposed project. However, the RCL and accompanying right of way do not cross any park property, and the elevated BNRR track road bed at this point would partially screen the proposed transmission line so that users of the park would not have a full view of the poles supporting the line.

A second small (1.3 acre) park (owned by Burlington Northern) is immediately north of the BNRR tracks and the RCL in the vicinity of 3rd Avenue S.W.

At the point of crossing of the Rum River, the RCL is immediately adjacent to a railroad bridge, a large metal structure which is approximately 25 feet high. Although the Rum River has been designated as a recreational resource at this point (pursuant to the State Wild and Scenic Rivers Act), the bridge and railroad grade present an existing visual impact.

The RCL does not cross or border any cultivated land in this segment; 0.17 miles of pasture land are bordered.

In segment 8A-11, the RCL passes through 0.48 miles of woodland. Right of way clearing would result in the removal of 3.5 acres of trees. No wetland is encountered by the RCL in this route segment. No designated wildlife areas occur within this segment.

Segment 7A-8A

This segment represents an alternative approach into Milaca for Route A from a point on Highway 23, west of Foreston. While the UPA Route A proposal for the Milaca approach consists of a deviation away from the BNRR tracks eastward, and then north to the substation (Nodes 8-10-11), this approach would extend the paralleling of the railroad tracks and highway to the western corporate boundary of Milaca. The length of this segment is 3.65 miles. The RCL selected by UPA continues to adjoin the south side of the BNRR ROW. This alignment required two light angles. For approximately a mile on either side of Foreston, the RCL also parallels a two lane paved road (formerly part of Highway 23).

In following the railroad tracks, the RCL passes through the north side of Foreston and lies within the corporate limits of the City for 1.10 miles. Zoning in the area crossed by the RCL is residential.

5.3 Summary of Route Impacts

In the following section, the potential impacts on human settlement, economic operations and the natural environment are summarized for the five main routes. Route segments which can be substituted for sections of the main routes are not included in this comparison. These segments are: 3A-4A, 3B-6, 5A-5B-5C, 7A-7B-7C and 8A-8B-8C. Substitution of any of these links for main route segments may slightly change certain impacts in a portion of the route, but it is unlikely that the overall route impacts would be significantly altered.

Table 5-2 summarizes a number of the important data items presented in Table 5-1 for the five main routes (A, A', B, C and D).

5.3.1 Impact on Existing and Projected Human Settlement

Routes A and A', which follow Highway 23 and the Burlington Northern Railroad tracks, pass through five areas of concentrated human settlement (a total of 2.19 miles for Route A, and 3.49 miles for Route A'). These routes clearly would have the highest level of indirect impact on urbanized or urbanizing lands, existing homes near the proposed ROW, and on other aspects of the man-made environment, such as transportation systems. However, Routes A and A' have the fewest direct impacts on homes (those situations in which homes lie within proposed ROW and would possibly require relocation) of the five routes under consideration. Along Route A and A', only two houses lie within proposed ROW as shown by UPA's reference centerlines. Route D, along Highway 95, would likely have the greatest impact on individual homes (22 in ROW), although Route C would require the relocation of a similar number of homes (18) if the actual route centerline were to coincide with the RCL.

Within a 500 foot path on either side of the RCL, the visual impacts (and other effects associated with proximity to transmission lines) would affect the least number of homes and farms on Routes B (23) and C (64). Although the number of homes similarly affected is much higher for Routes A and A', the transmission line's location adjacent to the railroad tracks would serve to moderate the intrusive effect. Within the urbanized areas, the railroad corridor is typically characterized by mixed industrial and commercial land uses and it is unlikely that the presence of a transmission line would be incompatible with those uses. Along the rural portion of the route, there often are existing trees and other vegetation along the railroad ROW which could serve to screen the structures and conductors of the proposed HVTL from adjacent dwellings.

TABLE 5-2

Summary Comparison of Key Factors

UPA-TR-1

Benton-Milaca 230 kV Transmission
Line Route Proposals

Route	A (Railroad)	A'	B	C	D
Length (Miles)	25.4	24.2	38.7	32.2	38.7
Diagonal length (Miles)	0.6	0.0	1.8	0	0.2
Angles: 3°-30°	14	17	5	7	7
Angles: 30°-90°	5	0	11	7	19
Length adjacent prop. lines (Miles)	12	10.4	25.0	29.3	27.9
# Homes in ROW	2	2	5	18	22
# Homes within 500'	145+	209+	28	64	115
Length in conc. settlement (Miles)	2.2	3.5	0.9	0.6	0.8
Length cultivated field crossing (Miles)	0.5	0.0	2.6	2.2	0.0
Length cultivated field bordered (Miles)	14.0	12.2	15.4	16.7	22.7
Acres woodlot cleared	28.5	28.0	66.7	68.4	24.5
Length 230 kV paralleled (Miles)	2.3	2.3	4.7	16.1	1.3
Length 69 kV paralleled (Miles)	0.9	0.0	0.9	18.1	23.1
Length RR paralleled (Miles)	16.5	21.9	0.0	0.0	0.0

Table 5-2 Continued

Route	A (Railroad)	A'	B	C	D
Length joint use of ROW (Miles)	21.5	24.2	12.2	38.7	32.2
% Joint use of ROW	85%	100%	38%	100%	100%
Wetland	0.8	1.0	2.3	1.5	1.3
Irrigable Land (Existing or potential)	1.5	1.5	1.5	1.5	4.8
Wildlife Areas crossed	1	1	0	0	0
Streams Crossed	12	12	16	24	8

NOTES:

(1) All lengths are in miles.

(2) All information based on evaluations of individual segments of the four routes, shown in Table 5.2.

(3) Evaluations are based primarily on examination of aerial photographs (scale 1 inch = 400 feet).

(4) Route A figures are based on the UPA reference centerline through Foley.

Population projections for the study area indicate gradual but steady increases for both Benton and Mille Lacs Counties to the year 2000. Past population growth has centered primarily in and around the major towns in the study area (Foley, Milaca, Foreston, Oak Park and Pease). If this trend continues, Routes B and C would have the least effect on future populations. Routes A and A', which pass through all of the above towns except Pease, could potentially have the greatest impact on future population and urban growth patterns. However, in paralleling Highway 23 and the BNRR tracks, Routes A and A' follow well established linear features within the study area, and it is unlikely that the addition of HVTL on these routes would in itself bring about changes in the existing patterns for land development or land use.

The predominant land use along all proposed routes is agriculture. On Routes B, C and D, construction of the proposed HVTL is not likely to alter this dominant land use pattern. Within Routes A and A', those segments which are outside areas of concentrated settlement should be similarly unaffected. However, the proposed HVTL could have some impact on land use in developed and developing parts of towns such as Foley, Oak Park and Milaca. Figure 5-1 contains aerial photographs of these communities with the RCL indicated by a dashed line.

In Foley, new residential development is occuring on all but the eastern perimeters of the city, where wetland and an active gravel mining operation act as constraints. According to City Officials, little residential development is likely in the vicinity of the BNRR tracks or on city-owned land crossed by the CREC proposed centerline alignment.

Within the unincorporated settlement of Oak Park, most residential development has taken place south and southeast of the BNRR tracks. Therefore, the likely effects on that community would be restricted to temporary construction-related impacts, and possible proximity impacts on the several commercial structures which are located within the proposed ROW. However, these impacts could be diminished by the use of special tower structures to assure adequate ground-to-conductor clearances, or by the relocation of the centerline to the north side of the BNRR tracks for the 1/2 mile distance through the town.

In the town of Foreston, most existing development is similarly south of the BNRR tracks, and north of Highway 23. There should be adequate clearance adjacent to BNRR ROW to accomodate the proposed HVTL.

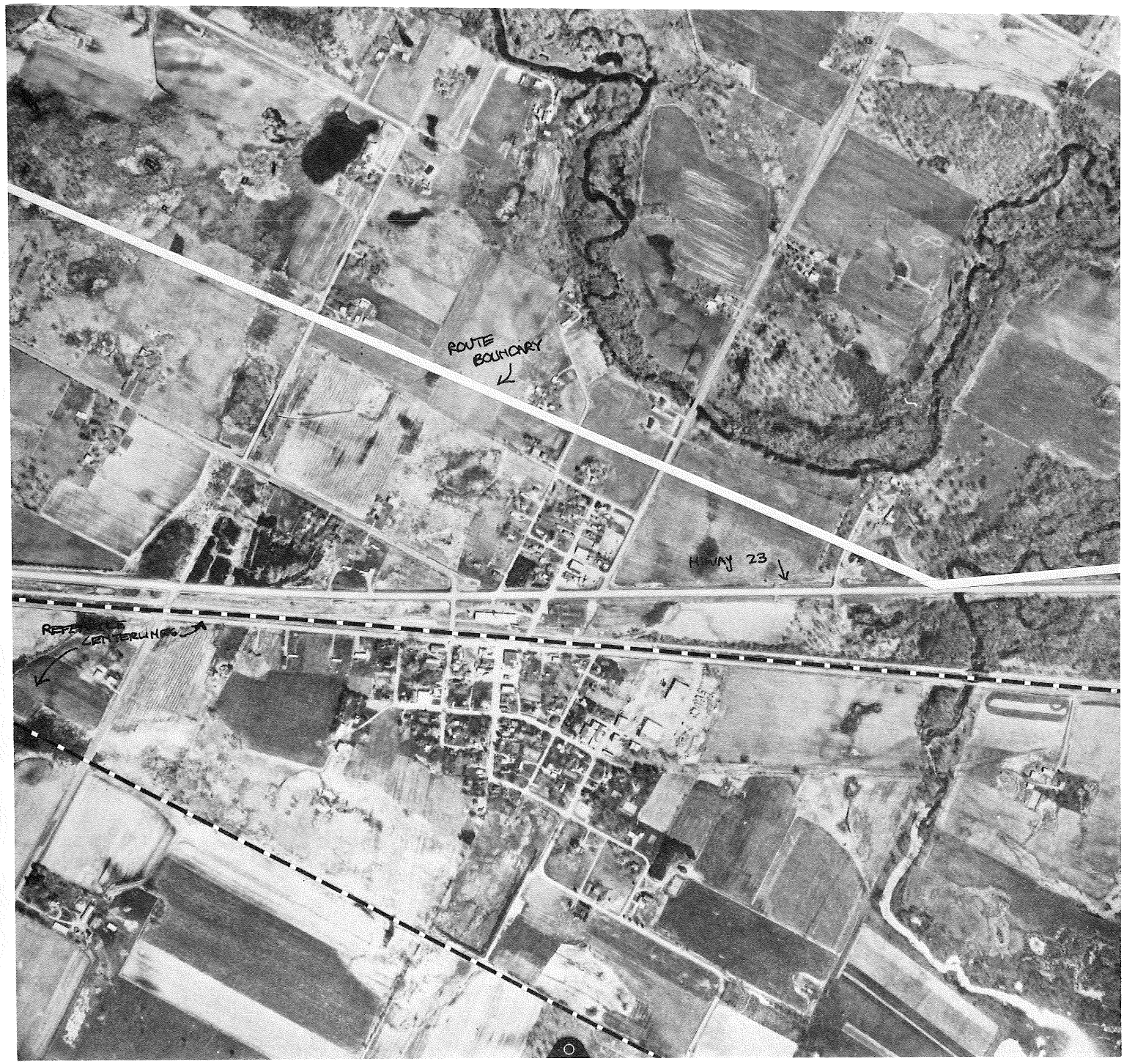
MILACA

NORTH

FIGURE 5.1

FOLEY

FIGURE 5.1



FORESTON

NORTH

FIGURE 5.1

NORTH

OAK PARK

FIGURE 5.1

A significant amount of new residential and industrial development has occurred in Milaca in recent times. Several of the proposed approaches could affect these areas and their future development. A new subdivision (Ridgewood North) is being constructed east of the Rum River in the vicinity of Segment 8B-8C. The RCL for that segment is located very close to the northernmost lots in that subdivision, and could also intrude on land planned for future expansion of the golf course owned by the Milaca Golf Club. South of the city's sewage lagoon, Segment 8A-8B on the same approach also crosses southwest of the city. Segment 8-10 crosses land which may be slated for residential development, and Segment 10A-11 borders land in the southeast portion of the Milaca which is presently farmed, but which is zoned residential. The southern portions of Route Segments 8C-11 and 13-11 cross land within the city's industrial park. Because of its proximity to the access roads for the planned Highway 169 by-pass, this undeveloped land is likely to be considered prime land for commercial or light industrial uses.

All of the proposed routes could have a slight impact on the transportation network in the study area, since various route segments parallel Highway 95, Highway 23, Highway 169, and miscellaneous county roads for considerable portions of the proposed routes. In most instances, however, the RCL's drawn by UPA show ROW's which do not infringe upon highway right of way, but merely parallel it. Where the highways in question are also the location of 69 kV sub-transmission lines, UPA has drawn the RCL parallel to, and on the outer edges of existing 69 kV ROW, rather than between those ROW's and the highway. A transmission line placed on any of the RCL's as drawn would therefore be 130-175 feet away from the highway centerline. Unless substantial improvements or relocations of existing highways take place, the proposed project should have only a minimal effect on these roads. Although the RCL's as drawn cross highways and local roads numerous times on all of the proposed routes, these crossings are regulated by federal and state law (in the case of Trunk Highways 23, 25, 95 and Federal Highway 169), and by NESC standards (other roads). These regulations and standards will assure that adequate vertical clearances will be maintained at the crossing points.

During the construction phase, certain temporary impacts such as traffic delays, noise, dust, and the presence of large construction equipment are likely to occur as well.

In the vicinity of the Milaca substation, several of the proposed route segments could have a considerable adverse impact on transportation. The map accompanying the discussion for Segments 10-10A-11, 8A-8B-8C-11, 8A-11, and 13-11 shows the alignment of the planned Highway 169 Milaca by-pass. The Minnesota Department of Transportation's Office of Environmental Affairs, District 3, Utilities Section and Aeronautics Division personnel have reviewed the proposed routes. Their comments are as follows:

"The major concern with all the routes (excepting [Segment 8A-11]) is how they will impact the planned freeway construction and the airport in the immediate Milaca sub-station area.

The power plant and substations are located on both sides of T.H. 23 at the eastern corporate limits of Milaca. There are presently three 69 kV circuits and four distribution circuits radiating from the substation to the south, east and north. These present lines will be affected by the interchange construction and will require relocation (more than likely westerly of the freeway) to such points where they can be accommodated at reasonable crossings. It appears that it would be extremely difficult to bring in a new line from the north or east. Present laws do not permit any line placement on the freeway right of way.

In addition, proposed routes entering the Milaca substation from the north (i.e., Segments 8C-11 and 13-11) will impact the Milaca Municipal Airport. Construction of the line on 85± foot high poles will constitute an obstruction to air navigation and will severely restrict future planned airport development. These proposed routes would also be in violation of the airport zoning ordinance adopted August 6, 1975 by the Milaca Municipal Joint Airport Zoning Board. The in-place 69 kV line was placed prior to the adoption of the ordinance and will constitute an obstruction to air navigation when runway expansion plans are implemented."

Segments 13-11, and 9A-10A, which each cross interchanges of the planned by-pass, would have the greatest direct impact on the by-pass. Other route segments parallel the by-pass to the west, and could be designed so as to minimize any interference with the by-pass or its access roads.

All of the route segments which approach the Milaca Sub-station from the north would result in some degree of conflict between the proposed project and airport zoning regulations. (See Section 2-12.3 for a discussion of the regulated zones adjacent to the airport). Segment 13-11 presents the greatest conflict, as a transmission line constructed on the RCL would not be permitted under present regulations. While a ROW alignment further west (outside of zones A and B) would eliminate that particular problem, the structures required for the proposed project may still be a safety hazard to planes at any location within the 1.25 mile wide route.

Mitigating Measures

Careful construction practices, planning and scheduling during the construction phase can help to mitigate the temporary impacts on human settlement and transportation such as noise, dust and traffic. In particular, the utility should seek to minimize the disruption caused by construction in areas of concentrated population and traffic such as Foley and Milaca.

During the final design and engineering phases of project planning, and in negotiating easements, the utility should seek to minimize the potential adverse effects of the HVTL on existing and projected land use. Where land use or zoning plans exist, the utility should consult with local planning bodies to develop a ROW alignment which is compatible with local development plans. UPA should take other local concerns into consideration as well.

Minnesota Department of Transportation permits will be required for all crossings of trunk highways (T.H.'s 23, 25, 95 and 169). Review of utility plans during the permit processing period should help to insure that the long and short term impacts on the highway network along the designated route are kept to the minimum.

5.3.2 Impact on Economic Operations

5.3.2.1 Agricultural Impacts

As the economic base for the study area is predominantly agriculture, impacts of the proposed HVTL on agriculture are of considerable concern. However, by utilizing existing rights of way, field boundaries and natural survey lines to the greatest extent possible, impacts on agricultural operations can be minimized.

Because agriculture is the prevailing land use in the study area, it would be impossible to route the proposed HVTL without some agriculture-related impacts. Table 5-2 indicates that interference with agricultural operations (in terms of cultivated fields crossed) is highest on Route B (2.56 miles), followed by Route C (2.19 miles), and Route A (0.53 miles). Route D and Route A' contain no segments which cross cultivated land. A significant amount of cultivated land is bordered by all of the five main proposed routes. Route D, which borders 22.7 miles of cultivated land, would have the highest amount of any associated impacts; Route A' (12.2 miles bordered) shows the least.

Generalizations of soil productivity have been made for the main routes based upon the climate-modified soil productivity ratings obtained from the MLMIS computer study. The MLMIS study is the basis of the State Planning Agency report entitled "Minnesota's Cropland Resources (1979)." An assessment based on the USDA Soil Conservation Service's (SCS) definition of "prime agricultural land" is also presented for Benton and Mille Lacs Counties. Both systems of evaluation have been discussed in Section 2.10.2.

UPA measured the amount of "prime agricultural land," as defined by the SCS, for the RCLs along the five main routes at the request of REA. The "prime agricultural land" within the study area is mapped in Figure 2.10a. This evaluation of UPA showed that Routes A and A' cross the least amount of "prime agricultural land" i.e. 11.7 miles, or 46% of the route's length. Route C crosses the greatest amount; i.e. 23.6 miles, or 62% of its total length. Route B and D respectively cross 15.5 or 49% and 19.8 or 58% miles of "prime agricultural land."

The MLMIS soil productivity ratings evaluate a number of factors as discussed in Section 2.10.2.1. The resulting computer map, using these data generalized within 40 acre units, is shown as Figure 2-10. In general, this map shows that there is a considerable amount of variation in relative soil productivity within the study area. These soil productivity ratings tend to increase from the southwest to the northeast portion of the study area, and, therefore, gradually increase for all of the routes except Route D. However, this change may be due in part to the inconsistency between soil data for Benton and Mille Lacs Counties. The most highly rated soils in the study area generally coincide with the locations of the major streams while bottom lands may be more fertile than upland soils, terrain, forest cover and susceptibility to flooding could be offsetting factors for soil productivity in these locations.

Only a small amount of potentially irrigable soils (based on University of Minnesota Agricultural Experiment Station, DISC Report 138-1976) is affected by any of the proposed routes. Route D, which crosses 4.77 miles of potentially irrigible land, shows the highest possible conflict. All of the other routes cross an equal amount of irrigable soil (1.52 miles), as this feature is present in Segment 1-1A-2 (common to Routes A, A', B and C).

Mitigative Measures

Most of the impacts discussed in Section 4.3.1 could occur on any of the proposed routes; the magnitude of impacts would correspond to the amount of agricultural lands affected by each route, as well as such variables as the presence of irrigation,

type of crops grown, type of soils, etc. Possible mitigative measures include careful planning of the final location of the ROW and poles; attempts to minimize construction impacts through careful scheduling, strict adherence to construction practices which minimize damage to soils, crops or livestock, and monitoring of contractors throughout the construction and clean-up phases; the selection and placement of poles and related materials (e.g. guys) which minimize intrusion into cultivated fields; and the use of appropriate right of way management techniques to reduce problems such as weed growth around the base of the poles.

5.3.2.2 Telephone System Impacts

According to information from the telephone companies, telephone equipment may be interferred with in two ways that could require mitigative measures: 1) ground potential rise around the Milaca Substation during a fault; and 2) exposure of the Pine City to St. Cloud long distance cable to very high voltages and currents during a fault.

Ground Potential Rise

Under some fault (short-circuit) conditions, the voltage of the soils around the Milaca substation and in an area immediately surrounding it will rise above "zero." The major difficulty this causes (other than for utility employees working within the substation) is the possible damage to nearby telephone cables and equipment during faults.

Continental Telephone of Minnesota, Inc. has both local service cables and a long distance cable in the area that could be affected. According to Continental Telephone, the total cost of the corrective measures will range from approximately $875 to $3,280. The lower cost figure assumes a soil resistance of 0.05 ohms at the substation. The higher figure assumes a 1.0 ohm ground resistance. The final soil resistance is a design feature of the substation. A lower ground resistivity costs the electric utility more to achieve than a higher value. The effect on telephone cables near the Milaca Substation is independent of the route selected for the proposed transmission line.

The problem of ground potential rise is common at major substations. The corrective measures are usually the joint responsibility of the owners of the affected facilities and the substation.

Exposure of Long Distance Cable

The Northwestern Bell Telephone long distance (toll) cable from Pine City to St. Cloud will be affected only if the proposed transmission line is along any of the following proposed route

segments: 2-5, 5-5A, 5A-5C, 5C-7, 7-7A, 7A-8, 8-8A. (Figure 5-2 shows the toll cable location and the repeater segments of the toll cable.) A fault on the proposed 230 kV transmission line of 15,000 amps could produce an induced current on the toll cable. Even if the cable is well grounded, induced voltages of between 4,600 and 28,700 volts are likely to occur on the individual cable wires that form the cable bundle. This could cause electronic interference or damage to electronic telephone equipment and consequent disruptions of long distance telephone service for periods from a few moments to a day or so.

As a result, Northwestern Bell Telephone feels compelled to modify and/or relocate its cable if the transmission line is constructed in any of these proposed route segments. Depending on the relative location to the power line, steel and aluminum shielding would be added to existing cables, or new shielded cable and new repeater huts would be installed in a different location.

Tentative alterations were outlined (by repeater sections) by Northwestern Bell for the purposes of illustration. Cable in Section 1 (near the Benton County Substation) would require shielding, but could remain in its present location. New cable with shielding would be required in Section 2. The cable must be moved about 1500 feet to the northwest in Section 3 and 1200 feet in the same direction in Section 4. No relocation would be necessary within Section 5 if UPA's recommended approach to the Milaca Substation is used (Route Segments 8-10, 10-10A, 10A-11). If Segment 8-8A (using one of the other proposed approaches into Milaca) is in the route designated by the MEQB, the cable again would need to be replaced and relocated to assure adequate distance between the proposed HVTL and the toll cable. The number and location of new repeater huts, which are needed approximately every five miles, depend upon the length of the cable route.

Relocation of telephone cables is estimated by Northwestern Bell Telephone to cost $16,300 per mile with an additional $350,000 for associated repeater facilities required (assuming the use of public road rights of way). The total replacement cost could be on the order of $850,000-900,000. However, since the existing cables are about 10 years old, about half their projected life, and since new and better cables would be installed, the actual cost charged to the HVTL project may be somewhat less.

5.3.2.3 Impacts on Railroad Operations

Two of the five proposed routes (A and A') adjoin the Burlington Northern Railroad tracks for a considerable distance. If the ROW is located along the alignment indicated by the RCL for

these routes, the proposed HVTL would abut or share right of way with the railroad for 16.5 (Route A) to 21.9 (Route A') miles.

While railroad track ROW is often shared or paralleled by high voltage transmission lines, Burlington Northern has indicated that the length of parallel contemplated with either Route A or Route A' would be considered excessive and undesirable. In general, the railroad has two concerns. The first is related to safety of operating conditions for trains using this portion of track, and to possible interference with ROW maintenance equipment and procedures, as a result of the presence of the transmission lines and poles on or adjacent to BNRR right of way. While the probabilities are relatively low that a derailed car could strike a transmission line pole, such an event could cause a hazardous situation for railroad personnel, as well as extensively damage the HVTL. The likelihood of such an accident occurring is directly related to the distance over which the HVTL and railroad tracks are in close proximity.

Periodic maintenance of the roadbed and tracks could also be made more difficult and hazardous due to the presence of a HVTL immediately adjacent to BNRR ROW. The use of boomed equipment for maintaining the grade of the roadbed, cranes, and other large machines requires that adequate horizontal and vertical clearance be maintained between the conductors and poles of the HVTL and BNRR ROW. In several stretches of both Route A and A', the tracks are located on steeply graded, elevated roadbeds (15-25 feet above surrounding terrain). It may be difficult to insure adequate clearances between the HVTL and the track if the line is constructed immediately adjacent to the railroad ROW. A greater separation between the two rights of way may be necessary in these locations.

The presence of the HVTL immediately adjacent to railroad ROW could also make railroad expansion (e.g. for additional sidings) difficult and costly.

The second major concern that BNRR has with regard to Routes A and A' is the possibility of interference or damage to railroad communication systems and road crossing signals from the electrical field present around the HVTL. This problem has been discussed previously in Chapters 3 and 4.

Mitigating Measures

Interference with electronic and communciation equipment can be minimized by measures taken to shield and ground that equipment (see Chapter 3 and 4). Potential dangers to track operations and maintenance can be minimized through careful ROW design, provision of adequate horizontal and vertical clearances, and mutual cooperation between the railroad and the utility during

construction of the HVTL and the subsequent operation of both facilities.

5.3.3 Impacts on the Natural Environment and Public Lands

5.3.3.1 Impacts on Natural Areas

None of the proposed routes affect designated natural wildlife areas located in the study area. Routes A and A' cross the Maywood Game Refuge near Ronneby; however as noted in the discussion for Segment 5C-7, this statutory game refuge is not maintained as a true wildlife area, and is largely under cultivation. Its protected status is under review and the Minnesota Department of Natural Resources indicates that it is likely to be withdrawn.

5.3.3.2 Impacts on Wildlife Habitat

Due to the extent of farming activity in the study area, relatively few areas remain in a natural state. Those that do remain are in the form of small scattered stands of hardwood trees, wooded river bottomland and wetlands. These small woodlands and wetlands are scattered more or less uniformly throughout the study area, but gradually increase in frequency from west to east. The relative value of these areas as wildlife habitat varies with the size of the area, its use (e.g., as pasture land) and the degree to which it has been already altered by man's activities.

Routes B and C would have the greatest impact on woodland, respectively requiring the removal of 66.7 and 68.4 acres of trees. The other routes have much lower tree clearing requirements (24-28 acres).

Route B crosses the greatest amount of wetland (2.31 miles) and Routes A and A' cross the least (0.79 and 1.0 miles respectively). Most of the wetlands encountered by all of the routes are small (less than 500' across) and can be spanned by the proposed HVTL without the placement of poles within the wetland itself. Stream bottomland is most severely affected on Routes B and C, which are adjacent to the Elk River for considerable distances. The floodplain and bottomland areas of other major rivers in the study area, including the West Branch of the Rum River and the Rum River, are both crossed by all of the proposed routes, and similar impacts could be expected on all of the routes.

5.3.3.3 Impacts on Recreation Areas

The study area has relatively few public recreational areas. The most important sites are located along the Rum River north of Milaca (see Chapter 2), where the river has been designated as a scenic and recreation resource. Route C crosses the Rum River

in the portion which is designated as a scenic resource; however the crossing is shown at a location where a 69 kV transmission line crossing has already affected the scenic value of the river. Routes A, A', B and C cross portions of the river designated as a recreational resource. All of these crossings could have some limited visual impact. The crossing point of Route A', however, is immediately adjacent to the BNRR bridge across the Rum River, and screened by the steep railroad grade from a park and campground to the north. Routes A and B share a common crossing which (as indicated by the RCL) would pass over the river in a wooded area, so that poles may not be visible from the river. The crossing point of Route D is more open; however it is parallel and adjacent to the planned Highway 169 bypass bridge over the Rum River. Figure 5-3 shows the proposed crossing locations for all proposed routes.

5.3.4 Impacts on Historically or Culturally Significant Features.

While there are several features which are historically or culturally significant within the 1.25 mile wide route boundaries on all proposed routes, none of these sites are within areas likely to be used for ROW. Where sites are within 1000 feet of the RCL, intervening trees, buildings and terrain generally serve to minimize any visual impacts of the HVTL on those sites.

Mitigating Measures

Mitigation of the potential impacts on natural areas, wildlife habitat, floodplains and wetlands, recreational lands, and historically/culturally significant sites can be achieved through careful design, engineering and construction of the proposed HVLT. Specific practices to minimize impacts will be required under the conditions of the construction permit, and individual sites may also be singled out in the permit for special treatment.

5.3.5 Impact on Public Safety

For 230 kV transmission lines, physical contact and magnetically induced currents during faults are the primary public safety concerns. Electrostatic induction is normally not a problem.[1]

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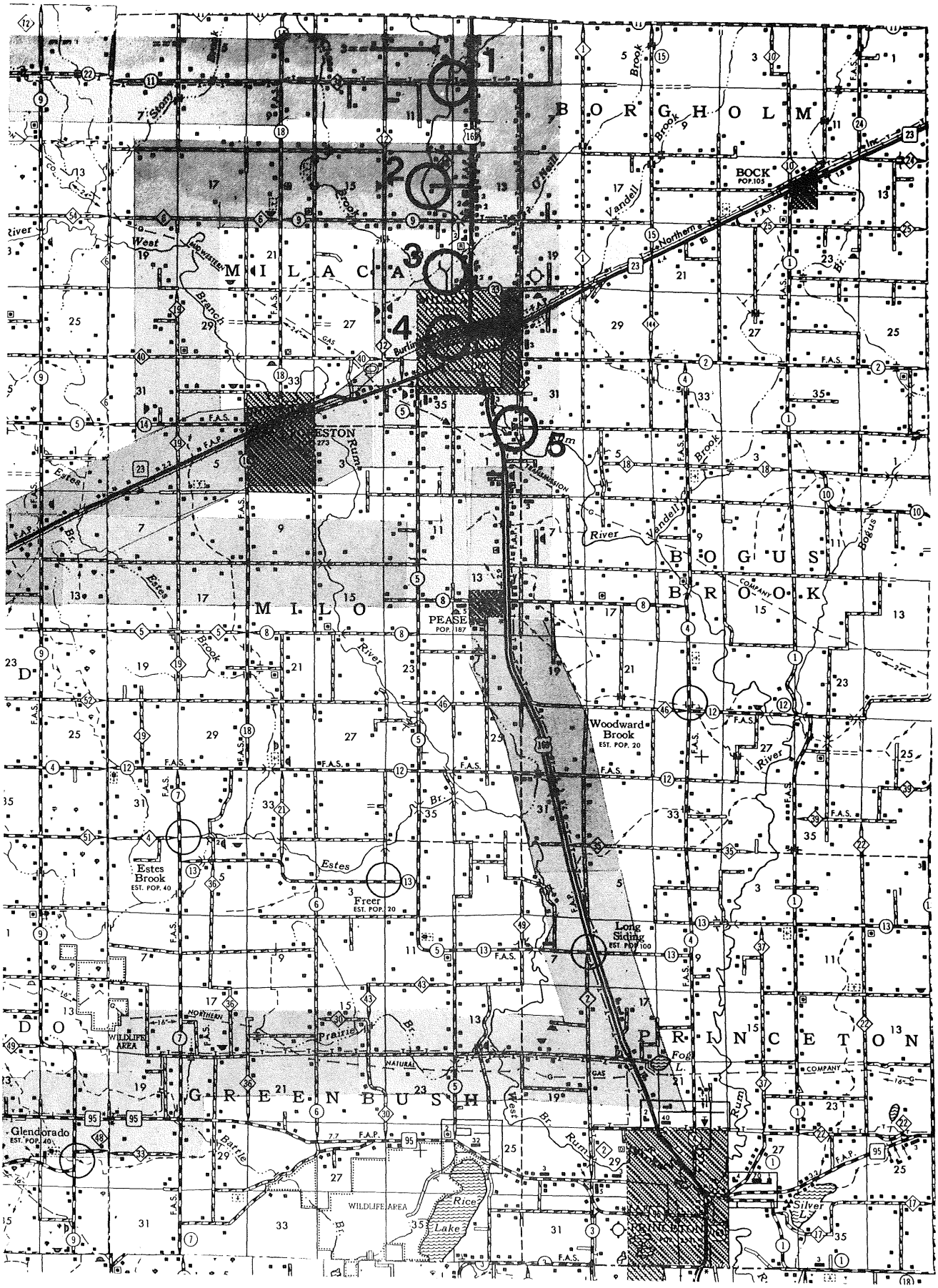
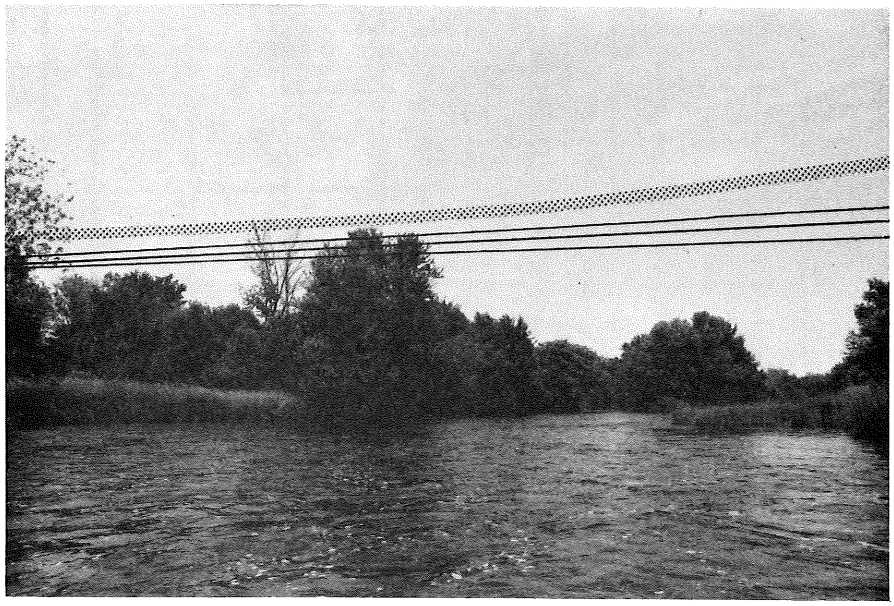
[1] REA bulletin 62-4, Electrostatic and Electromagnetic Effects of Overhead Transmission Lines, 1976, page 2.

REFERENCE CENTERLINES
RUM RIVER CROSSING POINTS

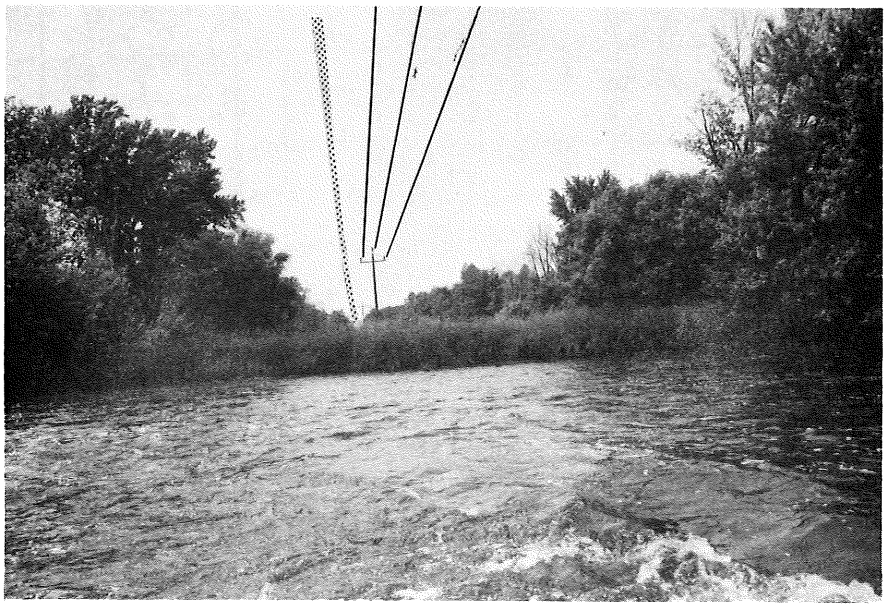
FIGURE 5.3



ROUTE C CROSSING 1 12B - 13



VIEW LOOKING EAST



VIEW LOOKING NORTH

FIGURE 5.3a

VIEW LOOKING EAST

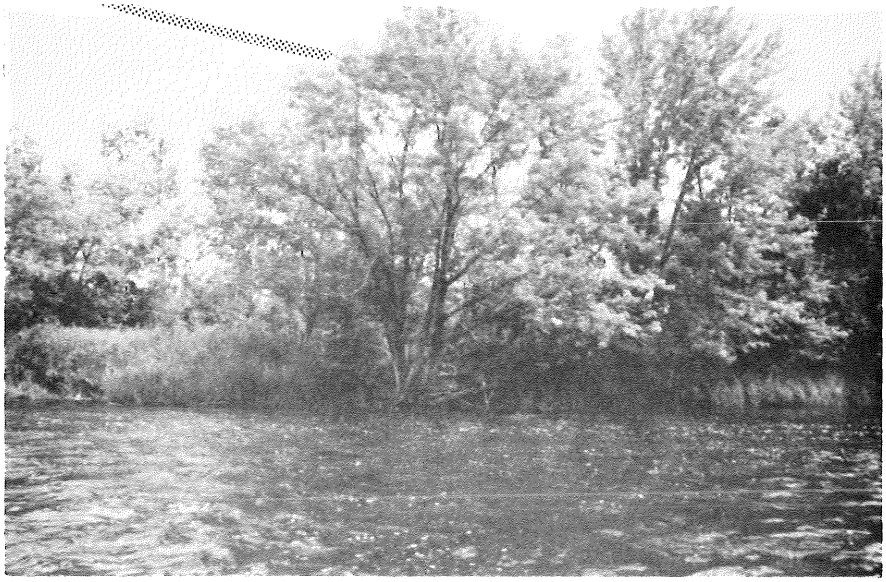
VIEW LOOKING NORTH

VIEW LOOKING WEST

CROSSING **2**

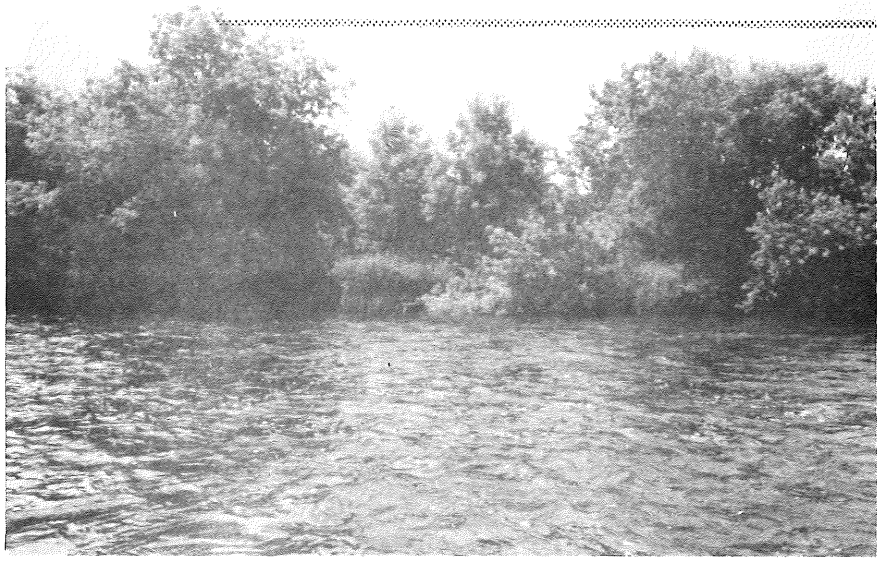
7B - 7C

FIGURE 5.3b



VIEW LOOKING EAST

VIEW LOOKING NORTH



VIEW LOOKING WEST

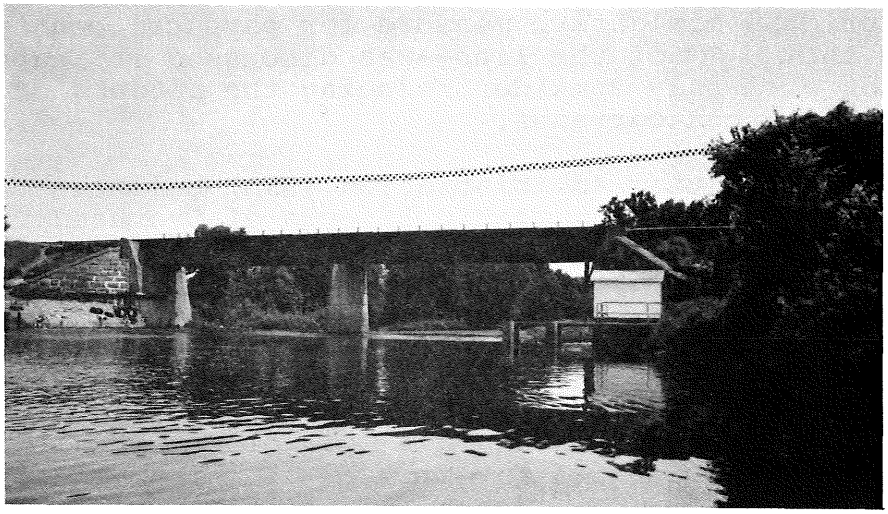
CROSSING **3**

8B - 8C

FIGURE 5.3c

CROSSING **4**

8A - 11



VIEW LOOKING SOUTH

VIEW LOOKING EAST

CROSSING **5**

10 - 10A

FIGURE 5.3d

VIEW LOOKING SOUTH

Since the primary mitigative measure for physical contact--increasing the height of the line--was discussed in Chapter Four, this section will only consider reducing the effects of magnetically induced currents.

A Rural Electrification Administration (REA) bulletin titled Electrostatic and Electromagnetic Effects of Overhead Transmission Lines[2] suggests the following measures for minimizing magnetic induction hazards:

> "If conductive objects such as fences in the vicinity of transmission lines 230 kV and below are completely insulated from ground, a single point-of-contact such as a body touch will present no problems since a complete circuit will not exist. Therefore, one solution to minimize electromagnetic effects on conductive objects is to eliminate all possible paths to ground on the conductive object in question. However, if conditions exist in which object grounding can be considered inadequate for the specific case involved, a potentially undesirable situation could exist. In practice, inadequate grounding could be the result of an insufficient number of actual physical grounds, patches of tall grass, bushes, branches, or even multiple instantaneous body contacts.
>
> Consideration should therefore be given to all conductive objects in the vicinity of transmission lines and a decision made to determine which approach will be followed to assure that all conductive objects are either adequately grounded or completely insulated.
>
> In those cases where a determination is made that inadequate grounding exists and the object must be adequately grounded, recommended grounding intervals (Gf) versus fault currents (If) for single line-to-ground faults are specified in Table 5.3 for fences parallel to transmission lines 230 kV and below.* For fences that cross the transmission line right of way (ROW) at right or oblique angles, it is recommended that the fence be grounded at the edges of the ROW." [3]

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2 Ibid.

* "For balanced three phase faults, the induced voltage on an object is minimal since the vector relationships of the symmetrical phase fault currents cancel the net E/M effect."[4]

3 Ibid.

4 Ibid.

TABLE 5.3

FENCE GROUNDING INTERVALS (G_f)
FOR LINE VOLTAGES 230 kV AND BELOW (E/M CASE)

Fault Current, I_f (AMPERES)	69 kV G_f (FEET)	115 kV to 230 kV G_f (FEET)
1,000	5,000	7,000
5,000	1,000	1,400
10,000	500	700
20,000	250	350
30,000	170	235
40,000	125	175
50,000	100	140

G_f = FENCE GROUNDING INTERVAL FOR A SINGLE LINE-TO-GROUND FAULT

According to UPA, the calculated fault current for their line is 5000 amps. This level of fault current would require parallel fences to be grounded every 1,400 feet.

Indirect currents are not a problem for vehicles at the voltage of the proposed transmission line. Therefore, no mitigative measures for this problem are necessary.

5.4 Reliability, Cost and Accessibility

The three factors of reliability, cost and accessibility must be considered in response to the requirements of the "Rules" governing the siting of high voltage transmission lines in Minnesota. These considerations are related to the primary criteria needed by the MEQB in evaluating the acceptibility of any proposed high voltage transmission line route. These criteria are: Minimize adverse human and environmental impact, maximize the efficient use of resources and ensure continuing electric power system reliability. Reliability is important in the provision of uninterrupted electrical service. Interruption of service can cause economic losses and can disrupt functions of important services. The cost of constructing and maintaining the subject HVTL is important in order to help maintain a reasonable cost of electricity to the consumer. Costs increase in direct proportion to the length of the line, and the number and severity of angle structures required by the ROW design. The type of poles used also affects total costs of the project.

Accessibility directly affects the ease by which the line may be constructed, adequately maintained and repaired. In inaccessible areas, access roads may need to be built to the right of way for construction, maintenance and repairs.

Reliability of service for the proposed HVTL becomes a factor when there is a possibility that it may be located adjacent to other lines in UPA's system which serve a similar purpose or which are designed to supplement or support the HVTL. The physical proximity which results from double circuiting, paralleling or use of common right of way exposes all of transmission lines in a common location to the conditions producing outages or faults which may otherwise occur only on one line.

Information from UPA indicates that paralleling existing 69 kV lines with the proposed 230 kV line (especially Routes C and D) may in certain cases affect system reliability. The primary flow of power in the UPA system is from south to north. Therefore, those 69 kV lines oriented north-south (rather than east-west) are much more likely to experience reliability problems as a result of being paralleled or double circuited by the proposed line. In particular, locating the 230 kV line adjacent

to the 69 kV line from Princeton - Milaca along Highway 169 creates a potential for a double outage which could cause sagging voltages in the Milaca area (particularly if the outage occurred during the winter). In Segments 1-1A-2-3-3A-3B-12 (where the RCL parallels the existing 230 kV Monticello-Riverton (MR) line), UPA states that the proposed Benton County - Milaca 230 kV line and the existing MR line serve unrelated load areas. Hence, an outage of both of these lines will not seriously affect the performance of the electric system. Consequently, system reliability would not be a problem, with either the paralleling or double circuiting of these two lines.

The cost of the transmission line is proportional to its length, the number and severity of required angle structures, and the type of towers used. Table 5-2 shows a comparison of the five main routes for the first two factors. Although the utility stated a preference for wooden H-frame towers in the Application for a Construction Permit, the use of other types of towers have been discussed during the CREC route proposal and recommendation process, and all feasible tower structures will be considered by the MEQB. Variations in costs (and other specifications) of the types of poles under consideration are given in Table 3-3, in Chapter 3. The utility estimates per mile costs to range between $140,000 and $216,000, depending on the type of poles designated. These figures include costs for design, engineering, materials, ROW clearing and construction; costs for ROW easements and environmental requirements would be additional.

Accessibility would not be considered a problem on Routes A, A', C or D due to the access network provided by existing roads and transmission lines adjacent to proposed ROW. Accessibility would be more difficult on Route B between Nodes 3-4-4A-6-7, as the RCL in these segments tends to be located on field boundaries, section lines, or 1/16 section lines rather than along existing roads.

5.5 Methods of Minimizing Impacts

5.5.1 Existing Land Use or Management Plans, and Established Methods of Resource Management

Existing city and county management plans make no specific reference to transmission lines other than recognizing them as essential services. The project and routes have been discussed with local authorities concerned with land use and their comments have been considered in the route selection and evaluation process.

5.5.2 Use of Existing Right of Way

All of the five main routes make use of existing ROW to varying degrees. Table 5-2 summarizes the amount and type of ROW which is paralleled by the RCL for each route. As shown, Routes A', C and D could parallel and jointly use ROW for 100% of the distance between the Benton County and Milaca Substations.

Route B, which parallels in part the existing 230 kV line, various county roads and an existing 69 kV line, has the least opportunity to jointly use existing ROW (38% of its length).

The routes do offer some variation in terms of the type of ROW which could be paralled. With Routes A and A', the contemplated joint use is with existing transmission lines and the Burlington Northern Railroad track. Existing 69 kV lines and federal and state highways, and county or township roads are the basis for shared ROW use with the other routes.

Some significant differences in potential impacts could be associated with these various paralleling possibilities. In general, the rights of way for 69 kV lines are less than 100 feet in width, and in a rural area such as is found in the study area, they usually are located immediately adjacent to county roads which themselves have a minimal right of way (typically 66 feet). As a result of rural settlement patterns in the portions of Benton and Mille Lacs counties which fall within the study area, the county roads which are paralleled by 69 kV lines are generally lined with numerous houses and farmsteads; the structures often are no more than a few feet outside existing transmission line ROW. Therefore, while the 69 kV lines and county or township roads do offer some opportunity for possible joint or parallel use of existing ROW for a HVTL, in many cases such use would be accompanied by excessive impacts on houses and other buildings.

A second disadvantage associated with the paralleling of 69 kV transmission lines by the proposed HVTL, is the problem of reliability. As noted above, UPA does foresee potential reliability problems arising with the routing of the proposed 230 kV line parallel to certain of the in-place 69 kV lines (particularly those 69 kV lines oriented north-south).

5.5.3 Natural Division Lines

Within all of the proposed route segments, it would be possible to route the transmission line right of way along government survey or natural division lines. Where the reference centerlines used to approximate the location of the ROW do not parallel

existing ROW, they are in most cases located along field lines, or section, half section, quarter section or 1/16 section lines. Portions of the RCL which do not follow these natural lines are relatively short (less than 2 miles), and are generally aligned to alleviate potential impacts (eg., crossing through an extensive wetland area).

5.5.4 Potential for Expansion to Accomodate Future High High Voltage Transmission Lines

At the westerly end of all of the routes (Segments 1-1A, 1-1A-2, 1-1A-2-3, and 1-1A-2-3-12), and additionally, on all segments in which the RCL parallels existing 69 kV lines, there is an opportunity for double circuiting with existing facilities. As noted above, however, reliability problems could occur in some of these segments as a result of double circuiting. It would also be possible to install structures capable of expansion in Segments 10-11 to accommodate the possible future extension of the 230 kV system to the Rush City area.

Information contained in the 1978 Advance Forecast to the Minnesota Environmental Quality Baord submitted by the Minnesota/Wisconsin Power Suppliers indicates that the utilities anticipate building a 500 kV transmission line from the Benton County Substation to Riverton, Minnesota, to be in service in 1984. With the same origination and end point as the existing 230 kV line north of Benton County Substation, it would seem likely that any portion of the 500 kV line within the study area would be parallel or adjacent to the existing 230 kV line ROW. The use of structures for the proposed project which are capable of accommodating either the planned 500 kV or the existing 230 kV line would reduce line congestion around the substation and significantly reduce the total ROW width which would be required for the three lines north of the substation. UPA indicates that problems of reliability would be minimal with a double circuiting of the proposed HVTL with either of these lines. This is due to the fact that the Benton County Substation to Riverton lines serves load areas which are not related to the load area to be served by the proposed 230 kV line.

No other HVTL's are anticipated in the study area by the forecast.

5.5.5 Alternative Structures

In its Application for a Construction Permit, UPA has indicated a preference for wooden H-frame poles for this project. This preference was based both on the relative cost of wood poles as compared to other structure types, and the lower level of impacts felt to be associated with wooden H-frame poles. Other structure

types under consideration are steel or concrete single shaft poles, which are generally preferred by the CREC, the communities located along routes and members of the public who have attended committee and information meetings. In addition, the use of lattice steel tower structures will also be considered.

Table 3-4 compares these structure types for: number required per mile, foundation requirements, height, land area at base, required guying and costs per mile. Advantages associated with one structure type for one or several of the above features, may be offset by other undesirable characteristics. For example, lattice towers are relatively low in cost, can accommodate longer spans than some other types, and do not require guying. However, they impose a much higher land requirement per tower at base (900-1000 square feet versus 10-50 feet for single shaft poles). These advantages and disadvantages must be weighed in order to choose the optmium tower structure type.

5.5.6 Alternative Technologies

Currently, the only practical way of transmitting electric power is by transmission lines. Other methods that have been proposed (e.g. transmission of power by lasers or by microwave) are very inefficient and currently are not technically feasible. Therefore, the only alternative to be considered here will be underground cables.

5.5.6.1 Underground Alternatives

There are a number of possible underground cable systems. Three types that will not be considered as alternatives are superconducting, cryogenic, and compressed gas. Both superconducting and cryogenic (supercold) cables are still in the research and development phase and are not yet available for utility use. Compressed gas insulated cables are now only practical for short cable sections in special circumstances. Other systems (solid insulation, high pressure oil-filled pipe-type cable, and low pressure self-contained cables) will be considered in this section.

Solid Insulation. Cables with solid plastic insulation ("solid dielectric cable") are commonly used for underground power transmission. They are simple, reliable, and have a relatively low cost when compared to other underground cable systems. They are currently available for voltages up to about 138 kV. At this level voltage, it would take about four solid dielectric cables to have the same energy transfer capability as one 230 kV cable. This type of transmission system is considerably more costly than overhead configurations, and would require construction practices which could have significant environmental impacts.

High Pressure Oil-Filled Pipe-Type Cable. High pressure oil-filled pipe-type cable (HPOPT) is the cable system most often used for underground transmission lines of 230 kV or larger in the United States. This system has a long history of use and is very reliable. It is also very expensive (five to ten times as expensive as overhead lines).[5]

HPOPT cable is constructed by welding rigid steel pipe sections together in a trench, backfilling the trench, pulling cables insulated with a special paper tape through the pipe, and filling the pipe with a special oil under high pressure. To maintain the high pressure, pumping stations are provided along the cable. To increase the power transfer capability of the cable, a cooling system can be provided to cool the oil at the pumping stations.

Low Pressure Oil-Filled Self-Contained Cable. Low pressure oil-filled self-contained cable (LPOF) is used extensively for voltages above 200 kV in Europe and Japan and to some extent in the United States. While being simpler in design and less costly than HPOPT cable, LPOF cable is more susceptible to damage since it lacks the steel pipe.

LPOF cable is made with an outer oil-tight flexible sheath, oil soaked insulating paper, and a hollow conductor. Oil fills the hollow conductor and, through holes in the conductor, keeps the paper insulation saturated with oil. Oil reservoirs are provided along the cable route to maintain the low pressure on the cable.

This type of cable costs about four to eight times the cost of an overhead system of the same voltage and capacity.[6]

5.5.6.2 Evaluation of Alternatives

The use of underground high voltage cable is usually possible. The main question is whether it is practical to do so. Because of the costs involved, underground construction is normally considered only in areas of special concern such as highly scenic locations or densely populated areas.

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5 Philadephia Electric Company. Evaluation of the Economical and Technological Viability of Various Underground Transmission Systems for Long Feeds to Urban Load Centers, December 1977, for U.S. Department of Energy, Division of Electric Energy Systems.

6 Ibid.

Other potential problems associated with undergrounding high voltage transmission lines are:

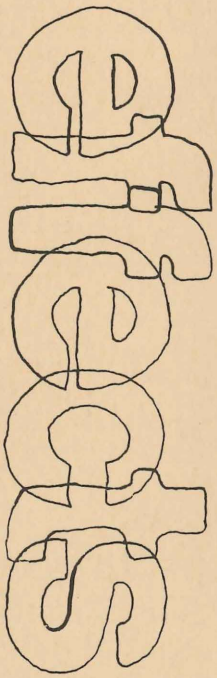
1. Engineering - While an underground system would be less susceptible to weather-related outages, it is sensitive to damage by digging equipment. When damage does occur, it takes much longer to repair than overhead cable.

2. Potential adverse environmental effects - The soil would be disturbed by the trenching and special backfill requirements. Vegetation on the right of way would be limited to small, shallow rooted species, potentially limiting the ability to restore the ROW to or near its natural state in those instances where the ROW crosses natural areas.

   In the case of line failure, the use of heavy construction equipment on the ROW would be required. Negative impacts on vegetation could also occur because the heating effects of the cable would cause the soil to dry faster than other soil in the area.

3. Agricultural effects - The trenching and backfilling required with underground cable construction constitute a disturbance of the soil which may have negative impacts on soil productivity. Even with careful construction techniques, some soil mixing may be inavoidable. Depending on the type of subsoil and the degree of mixing which occurs, the trenching could potentially affect the fertility and other qualities, e.g., drainage of the disturbed soil. In addition, soil moisture in land above the cable may be depleted as a result of heat dissipation on the cable. This effect could also reduce productivity.

UNAVOIDABLE EFFECTS ON THE ENVIRONMENT, ECONOMY, EMPLOYMENT AND ENERGY SUPPLY



CHAPTER 6
DIRECT AND INDIRECT EFFECTS WHICH CANNOT BE AVOIDED

6.1 Adverse Effects of the Proposed Transmission Line

Construction and operation of the proposed 230 kV transmission line will have unavoidable adverse effects on the environment. As discussed previously, the three major areas of concern are agriculture, human settlements, and the natural environment.

Due to the predominance of agricultural land use within the project study area, adverse effects on farmland and to farm operations will be unavoidable. In general, the following effects can be anticipated:

a. Crop damage will occur within the right of way where construction equipment crosses fields.

b. Compaction of soils occurs when the land is traversed by the heavy equipment used for construction.

c. Normal water flow in subsurface drainage systems can be disrupted by construction activities.

d. Erosion and siltation may result where soil disturbance occurs or where windrows have been cleared.

e. In those instances where cultivated fields must be crossed, some modification of crop patterns may be necessary during construction.

f. Following construction, tower structures which are located in cultivated fields will remain as permanent obstructions to farming. This may require some changes in equipment handling and alterations in crop patterns.

g. Aerial spraying, dusting or seeding may be more difficult, more costly, and more dangerous.

h. Placement of the HVTL along field edges and property boundaries may influence future plans for consolidation or subdivision of the land for either agricultural or residential uses.

The direct and indirect effects upon human habitation within the study area may include the following.

a. Dwellings and other structures may be removed from the right of way. The presence of the transmission line will prevent future construction of buildings within its immediate vicinity.

b. In general, the presence of the transmission line creates linear constraints upon future development and consequent land use opportunities are altered or lost.

c. The sale of an easement for a right of way will change and may decrease the real estate value of the property.

d. The operation of the high voltage transmission line may create a variety of public health and safety problems which may be minimized, but not entirely elmiinated.

e. Historical and archaeological sites may be damaged, especially during the construction period, unless special care is taken during the siting process. Salvage archaeology may be necessary.

f. Electrical effects from a HVTL may impair the operation of telephone, radio, television and other electronic equipment.

g. A high voltage transmission line creates an unavoidable adverse impact on the visual landscape.

The direct and indirect effects upon the natural environment include the following impacts.

a. Trees and shrubs in the right of way will be cleared. Tall growing plants will be permanently suppressed.

b. Right of way clearing will alter natural habitats and, in some cases, provide easier access for hunters and other outdoor recreationists.

c. Both plants and animals in the vicinity of the right of way may be affected by the long term use of herbicides.

d. Wetlands, stream banks and other natural features will be altered during the construction period.

e. Construction activities may encourage soil erosion and cause mixing of top soils with subsoils.

f. Birds, especially migrating waterfowl and raptors, may collide with the new tower structures.

Although proper design and planning can reduce their impact, these effects, are unavoidable. Although significant for the entire project, they are a series of relatively small disturbances along the entire length of the right of way. Proper and efficient engineering, construction and maintenance in conjunction with sound routing procedures will limit the overall environmental impact.

6.2 Mitigative Measures

The following description of mitigative measures is based upon specifications supplied by the Applicant:

6.2.1 Design

a. The alignment will parallel existing rights of way, section lines, quarter-section lines, and property lines to the greatest extent possible.

b. Structures will be spotted near field boundaries, along roadways, and in corners when possible to reduce interference with large field equipment.

c. Long tunnel views of the transmission lines will be avoided where possible by preserving or improving existing screening vegetation, by employing changes in line alignment at strategic points, or by judiciously applying landscape siting techniques.

d. Existing bridges will be used for crossings during construction. Construction near streams will not be performed during high stream flows when possible. Disturbed stream banks will be restored and seeded immediately after construction. When crossing pothole and swamp areas, structures will be placed on well-drained areas, and machinery movements kept to a minimum. Staging and storage sites will be located away from water bodies when practicable to avoid adversely affecting water quality.

e. Selective clearing will be practiced along stream banks. Undergrowth will be left in order to protect the soils and reduce erosion.

6.2.2 Construction

a. Trees, shrubs and grass not cleared will not be damaged when practicable during construction.

b. Special sites such as staging areas, tower sites and roadways will be combined to the maximum extent practicable.

c. Timber will be disposed of in accordance with landowners wishes as outlined in the applicant's right of way management policy. Special precautions will be taken in handling and disposing of elm and oak wood particularly where they are affected by Dutch elm disease or oak wilt, respectively.

d. Cross country equipment travel will be avoided whenever possible.

e. The smallest equipment that will perform the job practically will be used.

f. A thorough and complete cleanup will be conducted.

g. Construction will be planned to minimize the adverse effects of soil compaction on agricultural land.

6.2.3 Maintenance

a. Vegetative management will be performed safely and with minimum impact on the environment. Herbicides will be used only in compliance with government approved regulations and with landowners' knowledge and consent.

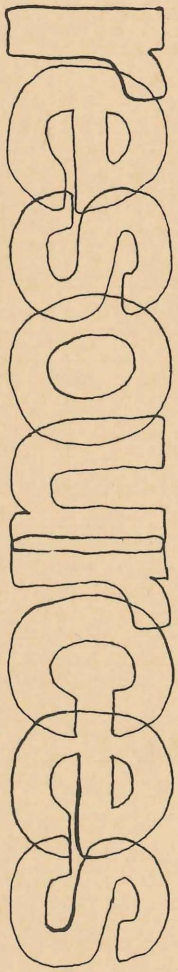
b. Low growth native vegetation will be promoted. Any grasses and shrubs introduced will be compatible with existing plant communities and usable by wildlife and/or livestock.

c. Environmental damage or inadequate restoration will be inspected by UPA and rectified.

d. Maintenance will be performed with minimal impact on crops, fields and agricultural operations.

e. Elm trees affected by Dutch elm disease may be encountered on the right of way selected. All elm wood, whether diseased or not, will be removed in accordance with Minnesota Department of Agriculture Plant Quarantine #78-1.

IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

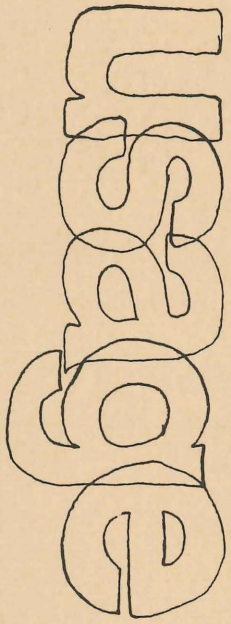


CHAPTER 7
IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

The construction of a high voltage transmission line requires a substantial amount of natural and human resources. These resources, by the nature of such a project, are irreversibly and irretrievably committed on a comparatively permanent basis. Examples include: (1) the irreversible socio-economic commitment of labor, financial resources, and technical expertise for the construction and maintenance of the project; (2) the irretrievable use of raw materials, both renewable and non-renewable; (3) the comparatively permanent commitment of natural resources by the clearing of forested rights of way; and (4) the loss of present and future alternative land use opportunities caused by the need to modify agricultural practices or by the loss of scenic values.

The Applicant indicates that the abandonment of the right of way does not seem likely in the foreseeable future. However, if the line is abandoned in the future, all structures would be removed and reasonable restoration of the right of way, consistent with the existing land uses and circumstances, would be attempted.

SHORT AND LONG TERM USE OF THE ENVIRONMENT



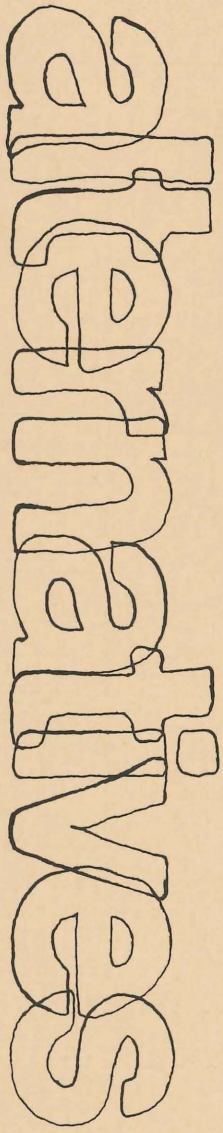
CHAPTER 8
SHORT AND LONG TERM USE OF THE ENVIRONMENT AS IT RELATES TO PRODUCTIVITY

The project's short term consequences include the disruption of land use and land cover during the construction process and the adjustment period for the natural landscape, e.g., shifts in wildlife habitats immediately after the construction of the line. Other disruptions include land cleared of vegetation for the line, the existence and maintenance of access roads, the maintenance of rights of way, cutting of trees, brush burning, and the general nuisances of construction activities such as dust, noise and fumes. While short lived, these activities may disturb nearby residents and wildlife.

The expected average useful life of 230 kV transmission line facilities is between 40 and 50 years. Experience indicates that, in most cases, transmission rights of way and corridors are the areas most likely to be upgraded to higher capacities in response to energy demands and technological advancements. Since the locations of generating facilities and load centers are not expected to shift significantly, the 230 kV right of way will continue to be the best available route for transmitting electricity in the area. Therefore, the 230 kV right of way represents a long term use of the environment.

The most significant long term impact on the environment and productivity of this 230 kV transmission line and associated facilities is its general contribution to the Applicant's electrical power distribution system and its ability to provide an adequate and reliable power supply. This will contribute to the overall economic well-being and stability of the study area which will increase the likelihood for the general improvement of the standard of living and for increased economic and population along with their consequent impacts upon the environment.

ALTERNATIVES TO THE PROPOSED ACTION



CHAPTER 9
ALTERNATIVES TO THE PROPOSED ACTION

9.1 Additional Routes

The routes and route segments covered in this analysis include all of the prudent and feasible routing alternatives in the study area. While it is conceivable that other routes could be developed, it is not likely that any additional routes would have characteristics or advantages which would be significantly different from those routes presently under consideration.

9.2 Certificate of Need

Prior to the siting and construction of large energy generating and transmission facilities in Minnesota, Minn. Statutes, Chapter 116H requires that the Director of the Minnesota Energy Agency review and approve the need for such facilities. With regard to transmission lines, Minn. Stat. § 116H.02, subd. 5(b) (1978), defines a large energy facility as:

> Any high voltage transmission line with a capacity of 200 kilovolts or more and with more than 50 miles of its length in Minnesota; or any high voltage transmission line with a capacity of 300 kilovolts or more with more than 25 miles of its length in Minnesota . . .

Since the Benton County - Milaca 230 kV line is less than 50 miles long, this project by itself does not require a Certificate of Need from the Director of the Minnesota Energy Agency.

However, the Director of the Minnesota Energy Agency conducted an inquiry on April 30, 1979 in order to determine whether the close relationship between the Benton County - Milace 230 kV line and the proposed Sherco - Benton County 345 kV line justified their being considered one line for the purpose of Certificate of Need requirements. The question arose because these two lines have the following similar features:

a. both lines are the products of coordination and planning amongst NSP, CPA and UPA;

b. both lines are scheduled to be completed in 1981;

c. both lines tie into the Benton County Substation and require expansion of this facility;

d. UPA, which would own the Benton County - Milaca line, also would share ownership of the Sherco-Benton County line with NSP, and CPA; and

e. the Benton County - Milaca line will use power delivered to the Benton County Substation in part by the Sherco - Benton County transmission line.

After reviewing hearing testimony and other materials submitted by the utilities, the Director of the Minnesota Energy Agency declared on June 1, 1979 that a Certificate of Need was not required. Despite the similarity of carrying capacities, common of ownership and in-service dates, the major function of the 345 kV line is to serve as an interconnection between the metropolitan systems and the northern Minnesota and to serve NSP and CPA needs in the St. Cloud area. In contrast, the Benton County - Milaca 230 line will meet local demands within UPA's service area. In addition, the 345 kV line will be built without regard to whether the 230 kV line is built. If the 345 kV line were not built, then 230 kV line would still be constructed. however, it would have been routed from Sherco to Milaca or from some other suitable point of origin other than the Benton County substation.

9.3 System Alternatives

The Minnesota Energy Agency and the MEQB both lack the legislative authority to study and, subsequently, to require the use of a particular system alternative other than the one proposed by a utility in its application for a Construction Permit. Nevertheless, a discussion of potential alternatives to the UPA proposed project is included in order to present a more complete overview of the environmental implication of the proposed project.

9.3.1 Sherco to Milaca Transmission Line

A transmission line of at least 230 kV from NSP's Sherco Generating Station to Milaca was evaluated by the applicant and would be an acceptable alternative if the proposed 345 kV transmission line from Sherco Substation to the Benton County Substation is not built by NSP (see Chapter 12). The proposed Benton County to Milaca transmission line is the preferred option primarily because it would be about one half the length of a UPA-constructed Sherco to Milaca transmission line. In addition, according to the applicant, the proposed transmission line better fits into the long range plans of all the utilities serving the area. The Benton County Substation is to be a regional substation facility.

9.3.2 Direct Current Transmission

According to UPA, direct current (dc) transmission has a number of limitations which make it an undesirable alternative to the proposed project. Although dc transmission lines are less expensive to build than comparable alternating current (ac) lines, they must be quite long (usually over 100 miles) in order for construction cost savings to offset the expense of the terminal equipment needed to make them compatible with ac systems. With the relatively short length of the proposed HVTL, no such offsetting economy would occur.

In its Application for a Construction Permit, UPA rejected dc transmission as a viable alternative to ac transmission, citing as a reason the relatively short length of the proposed HVLT, and their desire to make it compatible with UPA's existing 230 kV ac high voltage transmission grid.

9.3.3 Power Generation

An alternative to the transmission of electricity to Milaca via a HVTL is the installation of generating facilities there to produce power equivalent of that supplied by the proposed transmission line project. In order to estimate the cost and reliability of service associated with a 230 kV transmission system, UPA asserts that such a facility would have to be a base load plant rather than a mid-range or peaking unit.

In its Application for a Construction Permit, UPA indicates that such a plant would be impractical and uneconomic to build and operate. In addition, generation may produce adverse air and water quality impacts, solid waste disposal requirements and other environmental impacts which may be greater than those associated with transmission lines.

9.3.4 Upgrade the Existing Lines

There are two ways by which the power transfer capacity of the existing 69 kV transmission system could be increased: by increasing the current carrying capacity of the existing transmission line or by increasing the voltage of the existing transmission lines.

Increasing the current carrying capacity of the existing system would require the addition of larger or more conductors. Because of the greater weight of these conductors, many of the existing poles would have to be replaced. UPA states this alternative is economically impractical.

Increasing the voltage of the existing 69 kV lines would require new poles, insulators and transformers. UPA also contends that this option is uneconomical.

With the proposed project, the existing 69 kV system can remain in use both during construction and as a distribution system after completion of the proposed line.

9.4 Project Need/No Action

A final alternative to the proposed action is "no action", or a decision that the HVTL as proposed by UPA is not warranted at this time. Although this alternative is discussed in this chapter, it is not within the statutory authority of the MEQB to deny a construction permit to UPA on the basis of such a determination. State Environmental Impact Statements for high voltage transmission line routes are specifically exempted from considering the need of a project (6 MCAR § 3.025 G.2.(3)). However, under Federal regulations, REA does have the option of determining that the project as submitted by UPA for a loan guarantee is not warranted on the basis of potential environmental impacts, need or other criteria. The discussion of project need which follows, therefore, is directed toward the requirements for Federal Environmental Impact Statements under the National Environmental Policy Act and its implementing regulations.

According to the Application to the MEQB by United Power Association, the proposed transmission line and the associated facilities are required to:

1. maintain reliability and adequate voltage levels on the existing 69 kV transmission system,

2. assure adequate capacity for projected load growth, and

3. conserve resources and promote economic savings . . ."

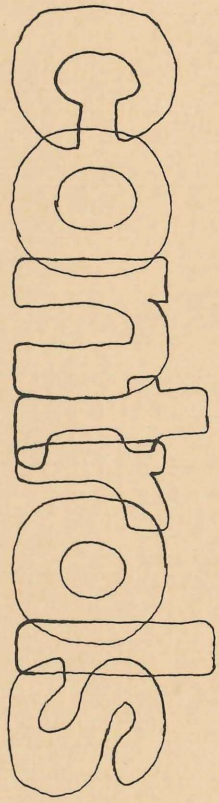
The need for this transmission line was thoroughly discussed in Section 3.1. This section will only summarize that discussion.

Reliability The 69 kV system supplying electricity to parts or all of the service areas of the East Central Electric Association (ECEA) and several neighboring cooperatives currently receives power primarily from the Elk River and Rush City substations. This means that the western half of this area -- most of Benton and Mille Lacs Counties -- has to rely on the existing 69 kV system to provide all of its power. This places a heavy load on the 69 kV circuits. If one of these heavily loaded circuits fails, or if one of the supply substations fails, large areas of the ECEA service area (and portions of the service area of other UPA member cooperatives) would suffer from a low voltage condition. This condition could dim lights, overhead or burnout electric motors and shrink television pictures. The proposed transmission line will provide support to the western half of the ECEA service area and will allow continued service even with one of the other service substations or lines out of service.

Capacity According to UPA, while it has made every effort to prolong the usefulness of the existing transmission system, projected load growth will require additional bulk power capacity in the area by the winter of 1981. The proposed facilities will provide that capacity.

Conservation The proposed line will conserve resources and promote economic savings by reducing the power losses to the heavily loaded 69 kV subtransmission system by reducing the oil based generationg needed to supply these losses during peak load periods, and by allowing the transmission of surplus generation, at off peak times, to municipal utilities which will reduce their need for oil based generation.

IMPACT OF FEDERAL CONTROLS ON STATE GOVERNMENT



CHAPTER 10
IMPACT OF FEDERAL CONTROLS ON STATE GOVERNMENT

The proposed 230 kV transmission line is subject to a number of federal laws and regulations, in addition to those enforced by the State of Minnesota. Failure to comply with any of these laws and regulations could result in the delay, modification or ultimate cancellation of the project.

United Power Association, an REA cooperative, has applied to the REA for a loan guarantee for the construction of this 230 kV transmission line. Subsequently, REA was designated the lead federal agency for the purpose of coordinating compliance with NEPA and other relevant federal laws and regulations applicable to this project.

The United States Army Corps of Engineers requires permits under Section 404 of the Federal Water Pollution Control Act of 1974 whenever wetlands are filled. In addition, the Corps of Engineers may require a permit under Section 10 of the River and Harbor Act of 1899 for the crossing of the Rum River.

Under Section 7 of the Endangered Species Act, the United States Fish and Wildlife Service requires that an examination of critical natural habitats within the study area be carried out in order to determine whether or not any species protected under the Endangered Species Act of 1973 would be harmed. This is discussed in Section 2.6.3. In addition, the FWS will review the proposed project with regard to any potential adverse impacts on other wildlife in the area.

The transmission line must meet height limitations for structures near airports established by the Federal Aviation Administration and the Minnesota Department of Transportation. In addition, safety markers may be required on the conductors which are in the vicinity of the Milaca airport.

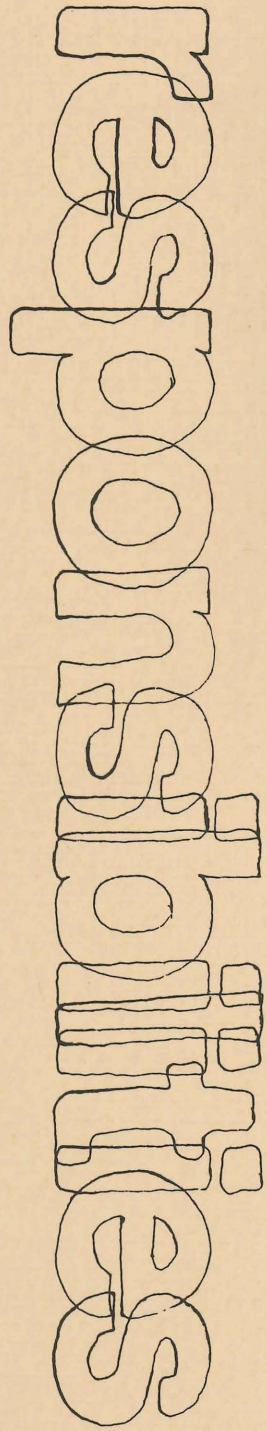
Federal regulations (Title 23, part 645.206 (e)) presently prohibits transmission lines on or overhanging freeway rights of way. Transmission lines may cross freeways but towers generally are not allowed within the right of way of controlled access roads.

Federal legislation was enacted in 1978 (the Surface Transportation Act of 1978) which included a provision which permits the use of Federal Aid highway right of way by utilities to reduce adverse impacts on abutting agricultural land. However, the Act also states that such usage could only take place when the location of utility facilities would not affect highway user safety. To date, this provision has been interpreted to mean that the state and federal governments would be legally liable for any accidents involving any

utility facilities located on the highway's right of way.

At the time of this analysis, a technical amendment to the Act is being being proposed which w more clearly define the "safety" language of the 1978 Act. The Federal and state governments are presently involved in the development of regulations which will guide the implementation of the 1978 Act. These regulations should be completed in the latter part of 1980; the existing regulations guiding the use of Federal Aid highway right of way will remain in effect until the new regulations are adopted. The routing process for the proposed Benton County to Milaca 230 kV transmission line will have been completed prior to the implementation of the new federal regulations which will modify the present restrictions.

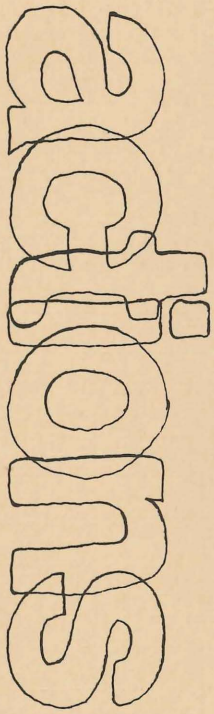
MULTI-STATE RESPONSIBILITIES



CHAPTER 11
MULTI-STATE RESPONSIBILITIES

This proposed 230 kV transmission line will not cross any state or international boundaries. In addition, although United Power Association's transmission line system does cross state boundaries, the electricity transmitted on this line will be used entirely within the Applicant's service area in Minnesota.

RELATED ACTIONS



CHAPTER 12
RELATED ACTIONS

The proposed 230 kV transmission line between the Benton County Substation and the Milaca Substation is part of United Power Association's overall transmission line network, which consists of the 69 kV and 230 kV grid in east central Minnesota described in Chapter 2 and elsewhere. In turn, this grid is but one component of the Mid-continental Area Power Pool System. Within this context, this 230 kV transmission line is interrelated with a variety of existing and future transmission lines and is a product of joint utility planning and forecasting. Most immediately, the proposed Benton County - Milaca line is related to planned developments at the Benton County and Milaca substations.

Further plans for the Benton County Substation envision four new transmissoin lines:

1. UPA's 230 kV transmission line to Milaca to be completed in 1981;

2. A 345 kV line to West St. Cloud owned and operated by NSP, CPA and UPA to be completed in 1984;

3. A 345 kV line from Sherco owned and operated by NSP, CPA and UPA to be completed in 1981; and

4. A 500 kV line to Riverton owned and operated by NSP, MP&L and other utilities to be completed in the late 1980's.

These plans indicate that there will be seven transmission lines converging on the Benton County Substation in the near future.

Since three of these transmission lines go northward from the Benton County Substation--the existing 230 kV line to Riverton, the proposed 500 kV line to Riverton and the Milaca line itself--these plans have immediate implications for the routing of the Milaca line. The routing of the Milaca 230 kV line must take into consideration the possibility that the existing 230 kV line, the Milaca 230 kV line, and the proposed 500 kV line will be parallel to each other. Consequently, double circuiting of the two 230 kV lines should be considered along the initial portion of these lines.

While there are no transmission lines carrying voltages larger than 69 kV at the Milaca Substation presently, UPA's long range forecasts indicate that the proposed Benton County - Milaca 230 kV line will be extended to Braham and Rush City by 1988.

Extensive coordination and sharing of information between the utilities occurs during the planning of transmission line facilities. This coordination results in overlapping facilities both in terms of future power grid management and the physical co-existence of transmission lines. In this regard, the construction of the proposed 345 kV Sherco - Benton County transmission line concurrent with the Benton County - Milaca line is especially significant. Both lines are planned to be in service by 1981 and are the product of coordinated planning among NSP, CPA and UPA. The Sherburne County - Benton County 345 kV line will supply power for the Benton County - Milaca 230 kV line and serve NSP and CPA needs to the west and north of the substation. Without the 345 kV line, the 230 kV line would have had a different point of origin (probably Becker or Elk River). See Section 9.2 for a discussion of various system alternatives.

The purposes and construction schedules for the Benton County - Milaca 230 kV line and the Sherco - Benton County 230 kV line are quite similar. This similarity caused the Director of the Minnesota Energy Agency to order a hearing which was held on April 30, 1979 to determine whether NSP, CPA and UPA would be required to apply for a Certificate of Need for these two lines as a single project. The record of this hearing further outlines the interrelationship between these two transmission lines.

After reviewing the record of April 30th hearing, the Director of the Minnesota Energy Agency decided on June 1, 1979 that these two HVTLs were sufficiently independent of each other so as to be exempt from the MEA Certificate of Need process. See Section 9.3 for details.

appendix

APPENDIX

APPENDIX A

INDIVIDUALS AND AGENCIES CONTACTED

United States Army Corps of Engineers
Ethan Rubin

United States Congress
Representative Richard Nolan

United States Agriculture Stabilization and Conservation

Andrew Smelter	Foley
George Valo	Milaca

United States Department of Interior

David Jarvis	Chicago

United States Fish and Wildlife Service

Don Gregg	St. Paul
Nancy Walters	St. Paul

United States Soil Conservation Service

Kevin Adelman	Foley
Wes Cashman	Milaca
Bill Harju	Elk River

State Legislators

Senator Robert Dunn	Princeton
Senator Myrton Wegener	Bertha
Representative Stephen Wenzel	Little Falls
Representative Richard Welch	Cambridge

Minnesota Department of Agriculture

Jane Meyer	St. Paul
Randall Young	St. Paul

Minnesota Department of Health

Charlene Kannianen	Minneapolis

Minnesota Department of Natural Resources

Richard Carlson	St. Paul
Joe Geis	St. Paul
Alex Gurtin	Brainerd
Vonny Hagen	St. Paul
Bob Hance	St. Paul
Paul Hanson	St. Paul
Dale Homuth	Brainerd
Oliver Jarvenpa	St. Paul
Jerry Jensen	St. Paul

Gary Johnson	Little Falls
John Poate	St. Paul
Dan Retka	Grand Rapids
Paul Swensen	St. Paul
Dick Tuszynski	Cambridge
Al Wald	St. Paul
Ken Wald	St. Paul

Minnesota Department of Transportation

Bill Bunde	St. Paul
Randy Halverson	St. Paul
Elsa Larson	St. Paul
Ron Lloyd	St. Paul
Harry Lyon	St. Paul
Larry Myking	St. Paul
Joe Osendorf	St. Paul
Corrine Sando	St. Paul
Jerry Sivertson	Brainerd
Dave Smilovich	Brainerd
Mark Woell	St. Cloud

Minnesota Energy Agency

Karen Cole	St. Paul
David Jacobson	St. Paul

Minnesota Historical Society

Russell Fridley	
Susan Queripel	St. Paul

Minnesota Pollution Control Agency

Clarence Johannes

Regional Development Commission

Philip Del Vecchio	Mora
Robert Pulford	Mora
Robert Bixby	St. Cloud
Patty Reeker	St. Cloud
Otto Schmid	St. Cloud

County Officials

Robert Berglund	Milaca
Mahlon Dahl	Milaca
A.C. Barthelemy	Foley
Dave Buck	Foley
August Machula	Foley
Burton Olson	Foley
Don Welsch	Foley

Municipal Officials

Joe Atherton	Milaca
Karl Berlin	Foley
Dr. Dwayne Fogel	Milaca Municipal Airport Board
La Jean Jorgensen	Milaca
Mel Labins	Milaca
Richard Zimmer	Foley

Private Individuals

Jim Alders	Northern State Power, Minneapolis
George Baldy	Burlington Northern RR, St. Paul
Jeff Barnard	Nature Conservancy, Minneapolis
W.S. Byrne	Burlington Northern RR, Superior
Norm Ecklund	Northern State Power, St. Cloud
Robert Foster	Stoney Brook Wildlife Association, Duelm
Mark Heitlenger	Nature Conservancy, Minneapolis
Charles Jones	Mille Lacs County Historical Society, Princeton
Bill Kiffmeyer	East Central Minnesota Irrigation Association, Clear Lake
Jerry Masters	Burlington Northern RR, Minneapolis
Bernard Miller	Mille Lacs County Historical Society, Princeton
John Monson	Northwestern Bell Telephone, Minneapolis
Timothy Nolan	Benton County Historical Society, Sauk Rapids
Norm Peterson	Continental Telephone, Milaca
Karen Reineke	Milaca Civic Club Museum
Charles Riesenburg	Sovik, Mathre, Sathrum & Quanbeck Architects and Planners, Northfield
Ed St. Onge	Burlington Northern RR, St. Paul
Dr. Max Partch	St. Cloud State University
R.H. Shober	Burlington Northern RR, Minneapolis
John Sivenson	Sherburne County Rural Telephone Company, Big Lake
Caroline Westrum	Benton County Historical Society, Sauk Rapids
Keith Wietecki	Northern State Power, Minneapolis

APPENDIX B

CITIZENS' ROUTE EVALUATION COMMITTEE PROCESS

Authority

The Power Plant Siting Act, Minnesota Statutes §116C.51 et seq. (1978) requires that, upon acceptance of an Application for a Construction Permit for a high voltage transmission line, the MEQB shall appoint a Citizens' Route Evaluation Committee (CREC) consistant with the Act. Such a committee may be comprised of as many persons as may be designated by the MEQB, but must include at least one representative from each of the following: regional development commissions, counties and municipal corporations and one town board member for each county in which a route is proposed to be located. No officer, agent or employee of a utility shall serve on this committee.

Committee Activities

A committee consisting of 26 persons, most of whom reside in the study area, was appointed by the chairman of the MEQB in September, 1978. A list of the committee members appears below. The UPA-TR-1 CREC held its first meeting on October 18, 1978 in Foley, Minnesota. Subsequent meetings were held on a weekly basis (a total of nine meetings), to review the Application, the routes proposed by UPA, and to recommend alternative routes. On January 3, 1979, the committee voted to recommend consideration of the following routes:

Nodes 1-1A-2-3-3A-12-12A-12B-13-11 (Route C)
Nodes 1-1A-1B-1C-1D-9A-10A-11 (Route D)

They also recommended consideration of the following route segments:

3A-4A
3B-6
5A-5B-5C
7A-7B-7C
7A-8A-8B-8C-11
8A-11

These additional routes and route segments were reviewed by the MEQB and on February 21, 1979, were approved by the Board for consideration at public hearings.

Between January and April, 1979, the CREC held seven additional meetings to discuss the merits of all of the routes under consideration (including UPA's proposed routes). Specific issues and problems, such as those related to the Northwestern Bell Telephone Company long distance phone cable, and the use or sharing of railroad right of way were also examined.

Recommendation

On April 5, 1979, the Committee voted on a route to be recommended to the MEQB. The recommended route connects the following nodes: Node 1-1A-2-5-5A-5C-7-7A-8A-11. The voting record shows that the recommended route was favored by a margin of 16 votes in favor to one opposed. The Committee indicated that this route, which parallels the BNRR tracks from Node 2 to the Milaca Substation, seemed to represent the fewest adverse impacts to human settlement, agricultural and other economic operations, the natural environment, and to public lands and waters. Based on information and costs reported by UPA, this route was also felt to meet other criteria such as cost, accessibility, reliability and the maximized use of existing rights of way.

The attendance of Committee members at the various meetings ranged between 6 and 19; on the average at least 12 members attended most meetings. At the meeting on April 5, 1979, a total of 17 CREC members were present, and all were eligible to vote, by virtue of having attended at least 60% of the meetings.

Participation of the general public also varied somewhat, from a high of approximately 75 people to a low of five. From the outset, the public was encouraged to attend the meetings which were held at local schools in both Foley and Milaca, and which were announced in the local newspapers and by local radio stations.

A committee report which reviews the Committee's activities and elaborates on its recommendation is being prepared and will be available at the public hearings.

VOTING MEMBERS

Robert Atherton, St. Cloud
Jim Belt, Mora
Karl Berlin, Foley
John Cronn, Sauk Rapids
Ben Gratzek, Sauk Rapids
Devon Hackett, Sauk Rapids
Jeff Hennes, St. Cloud
Albert Herbrand, Foley
Robert Kaeter, Sauk Rapids
*William Kaschmitter, Sauk Rapids
Edwin Kilgard, Foley
Carol Meredith, Rice
Roger Olson, Milaca
Donald Patnode, Milaca
Lester Roehl, Oak Park
Mark Sederquist, Milaca
Art Studenski, Sauk Rapids

NON-VOTING MEMBERS

Woody Anderson, Rice
Phyllis Christianson, Foreston
Gunnard Forschen, Foley
John Godeka, Pease
Leonard Johnson, Milaca
Tom Keating, Foley
Margaret Kline, St. Cloud
Eric Larson, Milaca
Donald Pluimer, Milaca

*Chairman

APPENDIX C

RIGHT OF WAY CLEARING SPECIFICATIONS

This appendix contains excerpts from the standard REA right of way clearing contract CREA form 203; Rev. 3-72) which will be entered into by UPA and its contractor(s). The information contained in this appendix is provided by the applicant. Inclusion of this information is for reference purposes only and does not constitute approval of its contents by the Minnesota Environmental Quality Board.

Environmental Protection - The Bidder shall perform work in such a manner as to maximize preservation of beauty, conservation of natural resources, and minimize marring and scarring of the landscape and silting of streams. There should be no deposition of trash in streams or waterways. Herbicides, other chemicals or their containers should not be deposited in or near streams, waterways or pastures. The Bidder will be required to follow, under the general direction of the engineer, the criteria relating to environmental protection as specified herein by the engineer.

Protection to Persons and Property - The Bidder shall at all times take all reasonable precautions for the safety of employees on the work and of the public, and shall comply with all applicable provisions of federal, state, and municipal safety laws and building and construction codes, as well as the safety rules and regulations of the Owner. All machinery and equipment and other physical hazards shall be guarded in accordance with the "Manual of Accident Prevention in Construction" of the Associated General Contractors of America unless such instructions are incompatible with federal, state, or municipal laws or regulations.

The following provisions shall not limit the generality of the above requirements:

- The Bidder shall so conduct the construction of the Project as to cause the least possible obstruction of Public highways.

- The Bidder shall provide and maintain all such guard lights and other protection for the public as may be required by applicable statutes, ordinances and regulations or by local conditions.

- Where the right of way of the Project traverses cultivated lands, the Bidder shall limit the movement of its crews and equipment so as to cause as little damage as possible to crops, orchards or property and shall endeavor to avoid marring the lands. All fences which are necessarily opened or moved during the construction of the Project shall be replaced in as good condition as they were found and precautions shall be taken to prevent the escape of livestock. The Bidder shall not be responsible for loss of or damage to crops, orchards or property (other than livestock) on the right of way necessarily incident to the construction of the Project and not caused by negligence or inefficient operation of the Bidder.[1]

The Bidder shall be responsible for all other loss of or damage to crops, orchards, or property, whether on or off the right of way, and for all loss of or damage to livestock caused by the construction of the Project.

- Any and all excess earth, rock, debris, underbrush and other useless material shall be removed by the Bidder from the site of the Project as rapidly as practicable as the work progresses. There should be no disposition of trash in streams or waterways. Herbicides, other chemicals or their containers should not be deposited in or near streams, waterways or pastures.

- The Bidder shall not proceed with the cutting of trees or clearing of right of way without written notification from the Owner that proper authorization has been received from the owner of the property, and the Bidder shall promptly notify the Owner whenever any landowner objects to the trimming or felling of any trees or the performance of any other work on its land in connection with the Project and shall obtain the consent in writing of the Owner before proceeding in any such case.

Compliance with Statutes and Regulations - The Bidder shall comply with all applicable statutes, ordinances, rules, and regulations pertaining to the work. The Bidder acknowledges that it si familiar with the Rural Electrication Act of 1936, as amended, the so-called "Kick-Back" Statute (48 Stat. 948), and regulations issued pursuant thereto, and 18 U.S.C. Sections 286, 287 and 1001 as amended. The Bidder understands that the obligations of the parties hereunder are subject to the applicable regulations and orders of Governmental Agencies having jurisdiction in the premises.

Specifications - In preparing the right of way, trees shall be removed, underbrush cleared, and trees trimmed so that the right of way shall be clear from the ground up as specified in the Proposal. Trees fronting each side of the right of way shall be trimmed symmetrically unless otherwise directed by the Engineer. Dead trees beyond the right of way which would strike the line in falling shall be removed.[2] Leaning trees beyond the right of way which would strike the line in falling and which would require topping if not removed may be removed or topped at the direction of the Engineer.[2]

[1]Although the Bidder is not responsible for these losses or damages, UPA (the Owner) does assume these responsibilities.

[2]Any clearing activity beyond the right of way is done only upon obtaining permission of the owner of that property.

APPENDIX D

UPA's RIGHT OF WAY MANAGEMENT POLICY

This appendix contains a description of UPA's right of way management policy as provided by the Applicant. Inclusion of this information is for reference purposes only and does not constitute approval of its contents by the Minnesota Environmental Quality Board.

UNITED POWER ASSOCIATION

Electrical Operations

Operating Policy

Subject	Effective Date	Issued by	Memo No.
Right-of-Way Management Policy	6-1-78	Dan McConnon	5-3

It is the policy of UPA to establish and maintain transmission line rights-of-way in order to provide reliable and safe transmission of electrical energy to meet the needs of its member cooperatives. It is the long-term objective of UPA to achieve an optimum mix of the following parameters in the process of selecting, clearing and maintaining its rights-of-way:

- Constructability
- Accessibility/Maintainability
- Environmental acceptability
- Economic acceptability
- Agricultural compatibility
- Service reliability

Establishment of relatively stable stands of desirable vegetation and the lengthened retreatment period are important goals of right-of-way maintenance which will contribute to the ultimate objectives listed above.

GENERAL:

This policy is to be used in specific situations where vegetation type, land use, land ownership, terrain, population density and other variable factors will be taken into consideration. It is recognized that these variable factors must be considered in the context of each specific situation.

Many factors affect where a transmission line is built and how the right-of-way is cleared and maintained. This policy provides a non-site specific framework within which United Power Association (UPA) operates in creating new right-of-way and managing the vegetation in existing rights-of-way.

APPROVALS		MMG	
General Manager	Assistant General Manager, Electrical Operations	DCK	
		PAS	
Date July 20, 1978	Date: July 19, 1978	PAL	

(GENERAL) The process of choosing routes for transmission facilities is described in Memo No. 5-4 of the Electrical Operations Operating Policy Handbook.

Certain fundamental premises guide UPA in its clearing and maintenance activities:

- Adequate construction, operation and maintenance of a transmission facility may impinge upon certain environmental amenities (e.g., visual/aesthetic effects).

- Construction, operation and maintenance activities may also be performed in a manner which will enhance certain aspects of the environment (e.g., wildlife habitat).

- Some vegetation types, as well as herbicidal, mechanical, and other means of vegetation control, are of value and can be employed to the advantage of the right-of-way.

- Different maintenance techniques may be required on different portions of any lengthy segment of right-of-way.

- Any reasonable and accepted techniques may be employed in clearing and maintenance provided they are compatible with local authority and interests such as those of the local member distribution cooperative, local government, affected landowners and managers of impacted public lands.

- Clearing plans and procedures are recognized as a very important first phase in the process of providing electrical transmission since these initial activities generally have long-term effects on right-of-way vegetation and therefore on the selection of the management techniques which are subsequently required.

- Vegetation is recognized as heterogeneous, continually changing material which may be manipulated and managed in order to minimize the growth and percentage of undesirable species and individuals on a right-of-way.

United Power Association's service area constitutes approximately 1/3 of the area of Minnesota including the east-central and northeastern area of the state and a small portion of northwestern Wisconsin. The general north to south continuum of vegetation is conifers, aspen-birch

(GENERAL)

and conifers, hardwoods, oak openings and barrens, and grassland prairie beginnings. Agriculture, forest products, tourism/outdoor recreation and mining are the principal industries.

The following definitions are provided to give greater meaning to this operating policy:

Desirable Vegetation - Any plants, generally excluding trees, which will tend to exclude undesirable vegetation, provide a reasonably natural appearance and prevent erosion.

Low Growing Woody Vegetation - Plants which have not and likely will not reach a height of 10 to 20 feet; non-trees, shrubs, "brush." This vegetation is regarded as desirable on much of a typical right-of-way.

Undesirable Vegetation - Any plants which interfere with line construction (exclusive of clearing), which inhibit maintenance activities, and which may interfere with towers or conductors. Any living or standing tree in any position on a right-of-way, regardless of its size, is undesirable.

Tree - A plant which characteristically exceeds a height of 20 feet in the area in question.

Danger Tree - A tree located outside of the right-of-way designated by UPA and meeting any of the following criteria:

- The tree could strike any of the conductors if it were to fall.
- The tree has a definite lean toward the transmission line.
- The tree is diseased or otherwise unsound.
- The tree has a high potential for becoming tall enough to strike the conductors in falling.

Stump Sprouting Plant - A woody plant, generally including certain hardwood tree species, which is likely to produce new sprouts at the stump when cut. Cutting the tree does not allow the roots to die. These include ash, maple, oak, basswood, hackberry, birch, hickory, alder.

(GENERAL)

Root Sprouting (Suckering) Plant - A woody plant (aspen is the most important example) which will produce new sprouts from its roots, particularly when the tree or its roots are cut. These include aspen, cottonwood, sumac, alder.

PROCEDURE:

The Environmental Protection and Right-of-Way Division (EP&ROW) has the responsibility for obtaining easements for all transmission line rights-of-way and for noting any restrictions on clearing and maintenance activities. Any special restrictions must be noted but should not compromise the intent of this policy. The Transmission Construction and Maintenance Division (TC&M) is responsible for the execution of this policy in maintaining the right-of-way and in assuring that construction activity such as clearing is in conformance with the policy. The EP&ROW Division supports the TC&M Division by furnishing environmental guidelines and approvals for the use of chemicals.

1. Right-of-Way Width

UPA's rights-of-way are established at certain minimum widths depending largely upon the line voltage and design, and also upon the terrain and vegetation to be encountered. Minimum acceptable widths are as follows:

69 kV	100 foot
115 kV	100 foot
230 kV	130 foot
345 kV	160 foot
400 kV dc	160 foot

A right-of-way width of 70 feet may be acceptable for a 69 kV line located in the southern portion of the UPA service area if the terrain is generally regular, largely open and does not tend to suppport tall trees of the species which often cause outages.

(PROCEDURE)

2. Initial Clearing

Depending upon the existence and extent of desirable vegetation, the terrain, and the accessibility of the proposed right-of-way, clearing will be accomplished such that construction, operation and maintenance of the line is feasible and so that desirable vegetation may be preserved. Initial clearing is generally accomplished by mechanical means and limited to those portions of right-of-way which are or will become unacceptably inhabited by undesirable species. It is recognized that the preservation of stands predominated by desirable vegetation (shrubs particularly) will tend to minimize and continually reduce invasion by undesirable species.

3. Soil Disturbances

In clearing, construction and maintenance activities, soil disturbance will be minimized in order to reduce invasion by undesirable plants. Reproduction of such plants may occur from exposed and disturbed roots and by reseeding from trees off the right-of-way.

4. Key Area of Right-of-Way

A portion of right-of-way, generally that within the vicinity of the transmission facility itself, will be established and maintained as open as is reasonably possible. Terrain and other limitations permitting, the opening would generally permit access by truck and other equipment normally required for maintenance. As conditions require and as vegetation permits, this portion of right-of-way will range between approximately 15 and 50 feet in width and will be located near the center of the right-of-way to the extent possible.

5. Access and Assembly Areas

Open access to the right-of-way and construction assembly areas are created where feasible and necessary for construction activity. Right-of-way access which did not exist prior to creation of the right-of-way will be blocked if so requested by the landowner or land manager, in order to effectively prevent unauthorized entry to the right-of-way. Permission will be obtained from the landowner prior to creation of such access and assembly areas when they are to be established beyond the limits of the transmission line easement.

(PROCEDURE)

6. Balance of Right-of-Way Area
Following the establishment of the right-of-way and construction of the line itself, much of a right-of-way is generally not traveled upon for purposes of transmission facility maintenance and inspection nor occupied by structures and anchors. These areas, generally beyond the more intensively maintained area mentioned in #4 above, will be accordingly maintained to exclude undesirable vegetation. Any desirable vegetation, including herbaceous plants and low-growing woody species will be undisturbed or encouraged so as to exclude the invasion by undesirable types.

7. Land Adjacent to the Right-of-Way
It may be necessary to enter upon the land adjoining a right-of-way in order to eliminate danger trees or, as mentioned previously, for construction assembly and access. Large trees outside of the right-of-way limits are to be examined and any unsound individuals removed if they present a danger to the transmission line in the context of the definition of danger trees.

8. Stump-Sprouting Trees
Stumps of stump-sprouting species such as maple, ash, oak and basswood are to be treated within 72 hours of cutting with a suitable herbicide to prevent resprouting. The treatment of stumps which have already sprouted is to be accomplished by the generally accepted procedure described in #9 below.

9. Rootsprouting Trees
Root-sprouting trees produce shoots from any portion of horizontal roots. Aspen is by far the most significant species with this behavior. Treatment of cut stumps of these species is likely to give less than desirable results. The generally accepted procedure is to (a.) spray before cutting or (b.) cut first, let sprouts develop, then basal spray on stem foliage (in small, less dense areas) or broadcast spray (for larger, more densely suckering areas).

(PROCEDURE)

10. Disposal of Cleared Vegetation
Significant amounts of woody vegetation generated in clearing operations and not appropriately disposed of by on-site chipping will be burned or piled on the edge of the right-of-way as specified by the owner or manager of the land. Burning will be conducted only in accordance with Minnesota Pollution Control Agency regulations on Open Burning (APC-8). Other burning restrictions may prevail in other states. Particular attention must be given to state and local rules, regulations and practices for the handling and disposal of diseased or potentially diseased elm and oak trees.

11. Contractors' Activities
In activities for which UPA has contracted, it is the contractors' responsibility to assure that all activity, including the use of herbicides, is conducted in compliance with applicable federal, state and local laws and regulations and with the directives and policies of UPA. UPA shall maintain close liaison with clearing and maintenance contractors to insure that this responsibility is carried out.

12. Road, Trail and Stream Crossings
In situations where rights-of-way intersect roadways, recreational trails and streams, a screen of suitable native vegetation will be encouraged. Such a screen will serve to minimize visual exposure to passers-by and, in the case of streams, to minimize stream bank exposure which could result in erosion.

13. Preparation of Specific Management Plans
UPA's rights-of-way are inventoried periodically. This inventory is then used as the basis for preparation of management plans for specific lines. These plans are designed to conform with the objectives and procedures of this Operating Policy. Special right-of-way clearing plans may also be required for specific projects. The Transmission Construction and Maintenance Division is responsible for preparing specific management and clearing plans in conformance with the Right-of-Way Management Policy. The Environmental Protection and Right-of-Way Division shall review the management and clearing plans for environmental compatibility.

(PROCEDURE)

14. Periodic Review

Right-of-way vegetation problems, the Management Policy and its implementation are to be periodically reviewed and evaluated so that new techniques and changed circumstances may be taken into consideration.

SUMMARY OF CLEARING AND MAINTENANCE TECHNIQUES
(generally listed in order of increasing selectivity)

1. Broadcast application - aerial or ground.
   - generally a foliage spray.
   - non-selective.

2. Mowing, dozing, chopping, etc.

3. Discing.

4. Stem-foliage spray - lengthened treatment season.
   - good root kill.
   - recommended for rootsprouters.

5. Dormant cane spray - broadcast or selective.
   - good root kill
   - lengthened treatment season.
   - oil carrier for bark penetration.

6. Pellets - good root kill.
   - ideal for spot treatment to root areas.
   - likely to kill adjacent (desirable) vegetation.
   - not for use on sloping terrain.

7. Basal spray - practical only at lower densities.
   - best for aspen (in summertime).

8. Stump spray - important in initial clearing.
   - poor on root sprouters (aspen, etc.).

9. Manual cutting - chain saws.
   - brush hooks.
   - etc.

APPENDIX E
A LIST OF FLORA AND FAUNA

The following is a list of flora and fauna for the study area based upon library research. Since field observations and inventories are more abundant for the Rum River than for the western and non-riverine portions of the study, some species associated exclusively with the prairie and oak complex in western Benton Cuunty may have been inadvertently omitted.

Common Name	Scientific Name
Aquatic Plants	
Common cattail	Typha latifolia
Cane grass	Phragmites communis
Reed canary grass	Phalaris arundinacea
Cutgrass	Leersia oryzoides
Sedge	Carex spp.
Blue Flag	Iris versicolor
Arrowhead	Sagittaria spp.
Giant burreed	Sparganium eurycarpum
Floatingleaf burreed	Sparganium fluctuans
Rush	Juncus balticus
Needlerush	Eleocharis acicularis
Softstem bulrush	Scirpus validus
Water plantain	Alisma trivale
Water arum	Calla palustris
Horsetail	Equisteum spp.
Claspingleaf pondweed	Potamogeton Richardsonii
Floatingleaf pondweed	Potamogeton natans
Narrowleaf pondweed	Potamogetan spp.
River pondweed	Potamogetan nodosus
Yellow waterlily	Nuphar variegatum
White watterlily	Nymphaea tuberosa
White water butterchps	Ranunculus spp.
Coontail	Ceratophyllum demersum
Water milfoil	Myriophyllum exalbescens
Canada waterweed	Eledea canadensis
Wild Celery	Vallisneria americana
Duckweed	Lemna spp.

Common Name	Scientific Name
Terrestrial Plants	
Yellow Birch	Betula Aleghaniensis Britton
Eastern white pine	Pinus strobus
Red pine	Pinus resinosa
Jack pine	Pinus banksiana
Tamarack	Larix laricina
Black spruce	Picea mariana
Balsam fir	Abies balsamea
Eastern cottonwood	Populus deltoides
Quaking aspen	Populus tremuloides
Paper birch	Betula papyrifera
White oak	Quercus alba
Bur oak	Quercus macrocarpa
Northern red oak	Quercus rubra
Northern pin oak	Quercus ellipsoidaldis
American elm	Ulmus americana
Sugar maple	Acer saccharum
Red maple	Acer rubrum
Silver maple	Acer saccharinum
Boxelder	Acer negundo
American basswood	Tilia americana
Ash	Fraxinus spp.
Hackberry	Celtis occidentalis
Butternut	Juglans cinerea
Red cedar	Juniperus virginiana
Willow	Salix spp.
Gooseberry	Ribies spp.
Dogwood	Cornus spp.
Alder	Alnus spp.
Hazelnut	Corylus spp.
Northern White cedar	Thuja occidentalis
Balsam fir	Ables balsamea
Black cherry	Prunis serotina ehrch.

Common Name	Scientific Name
Terrestrial Plants	
Wild rose	Rosa spp.
Sumac	Rhus spp.
Poison ivy	Rhus radicans
Raspberry	Rubus spp.
Wild grape	Vitis spp.
Common prickly ash	Zanthoxylum americannum
Ostrich fern	Pteretis pensylvanica
Jack-in-the-pulpit	Arisaema stewardsonii
Sparagus	Aspargus officinalis
Solomons seal	Polygonatum spp.
Trilium	Trillium spp.
Stinging nettle	Urtica dioica
Wood nette	Laporea canadensis
Wild ginger	Asarum canadense
White campion	Lychnis alba
Deptford ping	Dianthus Ameria
Marsh marigold	Clatha palustris
Canada anemone	Anemone canadensis
Wild strawberry	Fragaria spp.
Bloodroot	Sanguinaria canadensis
Wormseed mustard	Erysimum cheiranthoides
Yellow sweet clover	Melilotus officinalis
Red clover	Trifolium pratense
Purple vetch	Vicia americana
Wild geranium	Geranium maculatum
Violet	Viola spp.
Milkweed	Asclepias spp.
Morning glory	Convolvulus sepium
Phlox	Phlox spp.
Virginia water-leaf	Hydrophyllum virginianum
Hoary puccoon	Lithospesmum canescens
Scullcap	Scutellaria spp.
Butter and eggs	Linaria vulgaris
Harebell	Campanula rotundifolia
Sow thistle	Sonchus spp.
prickly lettuce	Lactuca Scariola
Ragweed	Ambrosia spp.
Black eyed sun	Rudbeckia hirta
Canada thistle	Cirsium arvense
Queen Anne's lace	Daucus Carota

Common Name	Scientific Name
Birds	
Common loon	Gavia immer
Great blue heron	Ardea herodias
Green heron	Butorides virescens
American bittern	Botaurus lentiginosus
Canada goose	Branta canadensis
Mallard	Anas platyrhynichos
Blue-winged teal	Anas discors
Wood duck	Aix sponsa
Ring-necked duck	Aythya collaris
Turkey vulture	Cathartes aura
Red-tailed hawk	Buteo jamaicensis
Broad-winged hawk	Buteo platypterus
Marsh hawk	Circus cyaneus
American kestrel	Falco sparverius
Ruffed grouse	Bonasa umbellus
Ring-necked pheasant	Phasianus colchicus
Killdeer	Charadrius vociferus
American woodcock	Philohela minor
Common snipe	Capella gallinago
Spotted sandpiper	Actitis macularia
Herring gull	Larus argentatus
Common tern	Sterna hirundo
Black tern	Chlidonias niger
Band-tailed pigeon	Columba fasciata
Mourning dove	Zenaida macroura
Great horned owl	Bubo virginianus
Chimny swift	Chaetura pelagica
Ruby-throated hummingbird	Archilochus colubris
Belted kingfisher	Megaceryle alcyon
Common flicker	Colaptes auratus
Pileated woodpecker	Dryocopus pileatus
Red-headed woodpecker	Malanerpes erythrocephalus
Yellow-bellied sapsucker	Sphyrapicus varius
Kingbird	Tyrannus spp.
Great crested flycatcher	Myiarchus crinitus
Eastern phoebe	Sayornis phoebe
Eastern wood pewee	Contopus virens
Tree swallow	Iridoprocne bicolor
Bank swallow	Riparia riparia
Rough-winged swallow	Stelgidopteryx ruficollis
Barn swallow	Hirundo rustica
Cliff swallow	Petrochelidon pyrrhonota
Blue jay	Cyanocitta cristata
Common crow	Corvus brachyrhynchos
Black-capped chickadee	Parus atricapillus
White-breasted nuthatch	Sitta carolinensis
House wren	Troglodytes aedon

Common Name	Scientific Name
Birds	
Gray catbird	Dumettella carolinensis
Brown thrasher	Toxostoma rufum
American robin	Turdus migratorius
Eastern bluebird	Sialia sialis
Cedar waxwing	Bombycilla cedrorum
Starling	Sturnus vulgaris
Red-eyed vireo	Vireo olivaceus
Yellow warbler	Dendroica petechia
Common yellowthroat	Geothlypis trichas
American redstart	Setophaga ruticilla
House sparrow	Passer domesticus
Meadowlark	Sturnella spp.
Yellow-headed blackbird	Xanthocephalus xanthocephalus
Red-winged blackbird	Agelaius phoeniceus
Northern oriole	Icterus galbula
Common grackle	Quiscalus quiscula
Brown-headed cowbird	Molothrus ater
Scarlet tanager	Piranga olivacea
Cardinal	Cardinalis cardinalis
Rose-breasted grosbeak	Pheucticus ludovicianus
American goldfinch	Spinus tristis
Song sparrow	Melospiza melodia

Common Name	Scientific Name
Mammals	
Cottontail rabbit	Sylvilagus floridanus
Woodchuck	Marmota monax
Striped ground squirrel	Citella tridecemlineatus
Eastern chipmunk	Tamias striatus
Red squirrel	Tamiascuirus hudsonicus
Gray squirrel	Sciurus carolinesis
Fox squirrel	Scirus niger
Beaver	Castor canadensis
Muskrat	Ondatra zibethica
Racoon	Procyon lotor
White-tailed deer	Odocoileus virginianus
Amphibians and Reptiles	
Common tree frog	Hyla versicslor
Leopard frog	Rana pipiens
Wood frog	Rana sylvatica
Snapping turtle	Chelydra serpentina
Painted turtle	Chrysemys picta
Spiny softshell turtle	Trionyx spiniferus
Map turtle	Graptemys geographica
Garter snake	Thamnophis spp.
Aquatic Organisms	
Freshwater clams	Plecypoda
Snales	Gastropoda
Stoneflies	Pleocoptera
Mayflies	Ephemeroptera (Heptageniidae, Baetidae)
Dragonflies	Odonata
Aquatic bugs	Hemiptera (Gerridae, Pleidae)
Caddisflies	Trichoptera (Limnephilidae, Hydropschidae)
Aquatic beetles	Coleoptera (Gyrinidae)
Aquatic flies & midges	Diptera (Simulidae, Tabanidae, Culicidae, Dolichopodidae)
Freshwater Oligochaetes	Oligochaeta

Common Name	Scientific Name
Fish	
Bowfin	Amia calva
White sucker	Catostomus commersoni
Silver redhorse	Moxostoma anisurum
Northern redhorsse	Moxostoma macrolepidotum
Carp	Cyprinus carpio
Black bullhead	Ictalurus melas
Brown bullhead	Ictalurus nebulosus
Yellow bullhead	Ictalurus natalis
Northern pike	Esox lucius
Yellow perch	Perca flavescens
Walleye	Stizostedion vitreum
Smallmouth bass	Micropterus dolomieui
Largemouth bass	Micropterus salmoides
Pumpkinseed	Lepomis gibbosus
Bluegill	Lepomis macrochirus
Rock bass	Amblopites repestris
White crappie	Pomoxis annularis
Black crappie	Pomoxis nigromaculata
Burbot	Lota lota
Hornyhead chub	Hybopsis biguttata
Creek chub	Semotilus atromoculatus
Bigmouth shiner	Notropis dorsalis
Spottail shiner	Notropis hudsonius
Spotfin shiner	Notropis spilopterus
Common shiner	Notropis cornutus
Blacknose shiner	Notropis heterolepis
Mimic shiner	Notropis volucellus
Golden shiner	Notegimonus crysoleucas
Longnose dace	Rhinicthys cataractae
Brassy minnow	Hybognoathus hankinsoni
Bluntnose minnow	Pimephales notatus
Fathead minnow	Pimephales promelas
Tadpole madtom	Noturus gyrinus
Central mudminnow	Umbra limi
Troutperch	Percopsis omiscomageus
Johnny darter	Ethoestoma nigrum
Iowa darter	Etheostoma exile
Log perch	Percina caprodes
Mottled sculpin	Cottus bairdi