# ALTERNATIVES REPORT

## PROPOSED BASELOAD POWER PLANT

**Prepared for the**

**Rural Utilities Service**

## Associated Electric Cooperative, Inc.

**August 2005**

Burns & McDonnell
SINCE 1898

# ALTERNATIVES REPORT

Prepared for:

**Rural Utilities Service**

**Prepared by:**

**Burns & McDonnell Engineering Company, Inc.**
**Kansas City, Missouri**

**38370**

**August 2005**

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# ACRONYM LIST

| | |
|---|---|
| AECI | Associated Electric Cooperative, Inc. |
| AFB | Air Force Base |
| AQCR | Air Quality Control Region |
| AQRV | air quality related values |
| ASM | Archaeological Survey of Missouri |
| AWEA | American Wind Energy Association |
| BACT | Best Achievable Control Technology |
| BNSF | Burlington-Northern Santa Fe Railroad |
| CA | Conservation Area |
| CAA | Clean Air Act |
| Central | Central Electric Power Cooperative |
| CFR | Code of Federal Regulations |
| cfs | cubic feet per second |
| CMSU | Central Missouri State University |
| CO | carbon monoxide |
| CSR | Code of State Regulations |
| DSM | demand side management |
| DOE | Department of Energy |
| EIS | environmental impact statement |
| EPA | Environmental Protection Agency |
| FAA | Federal Aviation Administration |
| FEMA | Federal Emergency Management Agency |
| FGD | flue gas desulfurization |
| FIRM | Flood Insurance Rate Map |
| FLM | Federal Land Managers |
| gpm | gallons per minute |
| G&Ts | Generation &Transmission Cooperatives |
| IGCC | integrated gasification combined-cycle |
| KCPL | Kansas City Power & Light |
| km | kilometer |
| kV | kilovolt |
| MDC | Missouri Department of Conservation |
| MDNR | Missouri Department of Natural Resources |
| MGD | million gallons per day |
| MINT | Missouri-Iowa-Nebraska Transmission 345 kV line project |
| MKT | Missouri-Kansas-Texas Railroad |
| MMBTU | million British thermal units |
| MW | megawatt |
| MWh | megawatt-hour |
| NAAQS | National Ambient Air Quality Standards |
| NEPA | National Environmental Policy Act |

| | |
|---|---|
| NESC | National Electric Safety Code |
| NOx | nitrogen oxide |
| $NO_2$ | nitrogen dioxide |
| NPDES | National Pollutant Discharge Elimination System |
| NPS | National Park Service |
| NREL | National Renewable Energy Laboratory |
| NRHP | National Register of Historic Places |
| NS | Norfolk Southern Railroad |
| NSR | New Source Review |
| NW | NW Electric Cooperative |
| NWI | National Wetlands Inventory |
| NWR | National Wildlife Refuge |
| $O_3$ | Ozone |
| Pb | lead |
| PM | particulate matter |
| PSD | Prevention of Significant Deterioration |
| RUS | Rural Utilities Service |
| SAC | Strategic Air Command |
| SCR | selective catalytic reduction |
| $SO_2$ | sulfur dioxide |
| TCP | Traditional Cultural Properties |
| tpy | tons per year |
| TVA | Tennessee Valley Authority |
| UP | Union Pacific Railroad |
| U.S.C. | United States Code |
| USCOE | U.S. Army Corps of Engineers |
| USDA | U.S. Department of Agriculture |
| USFS | U.S. Forest Service |
| USFWS | U.S. Fish and Wildlife Service |
| USGS | U.S. Geological Survey |
| VOR | Very High Frequency Omni-Directional Range |
| WA | Wildlife Area |
| 7Q10 | 7-day average, 10-year low flow |

# 1.0 EXECUTIVE SUMMARY

Associated Electric Cooperative Inc., (AECI) a generation and transmission cooperative headquartered in Springfield, Missouri, proposes to develop a new 660 megawatt (MW) baseload coal-based generation unit to be located in northwestern Missouri with an in-service date of 2011. AECI's load forecast studies indicate additional baseload capacity will be needed in this timeframe to meet its members growing energy demand.

AECI provides electric service to six regional generation and transmission (G&T) cooperatives. The G&T's serve 39 distribution cooperatives in Missouri, 3 in southeast Iowa, and 9 in northeast Oklahoma. These distribution cooperatives provide electrical service directly to more than 830,000 consumer members, including businesses, farms, and households.

The existing generation facilities AECI owns and operates include three coal-fired steam units totaling 1,153 megawatts (MW) at Thomas Hill and two coal-fired units totaling 1,200 MW at New Madrid. AECI's gas-fired generation includes two combined-cycle units totaling 522 MW at Chouteau, two combined-cycle units totaling 501 MW at St. Francis, two simple-cycle units totaling 182 MW at Nodaway and one simple-cycle unit totaling 107 MW at Essex. Additionally AECI has three simple-cycle units totaling 321 MW at Holden that are gas-fired with oil backup, and one oil-fired unit totaling 45 MW at Unionville.

In addition, AECI has established power purchase agreements with several neighboring utility power generation facilities including the City of New Madrid (New Madrid Unit 1 – 570 MW), Missouri; Central Electric Power Coop (Chamois Power Plant –68 MW); KAMO Power (Grand River Dam Authority's Unit 2 – 198 MW); Southwestern Power Administration (478 MW – hydro capacity); the City of West Plains, Missouri (36 MW – peaking capacity); and Duke Trading and Energy Marketing (St. Francis).

A review of alternative ways to meet the needs of AECI was conducted. Options evaluated included load management, renewable energy resources, distributed energy, fossil fuel generation, repowering or uprating existing units, participation in another company's generation project, purchase power, and adding new transmission capacity. It was concluded that a new coal-fired unit would be the most economical, particularly at larger unit sizes.

A site selection study was then done to determine the best location for the new unit. AECI conducted several siting activities between 1977 through 2001. This work was updated as part of a 2004 siting process. The 2004 study further defined sites in those areas identified in the previous studies as suitable for fossil fuel plants. The study resulted in eight candidate siting areas in Northwest and West Central Missouri. Much of the current siting effort centers on a re-examination and update of the findings of the previous studies. As discussed in the siting study, several sites in northwest Missouri were evaluated resulting in the Norborne and Forbes Sites being selected as the proposed and alternate sites. The siting section of this report thoroughly reviewed and confirmed the work done by AECI through 2004.

For power generated by the new power plant to reach the wholesale customers of AECI, new 345-kilovolt (kV) and 161 kV transmission facilities will be needed. In section 7.0, Transmission Macro Corridor Analysis, AECI evaluated the connections needed for the Norborne Site, and the Forbes site. In summary, 125-135 miles of new transmission would be required for either location (see Section 7.0 for further information).

The results of the analysis to date indicates that the best solution to meeting AECI's load growth is to construct a 660 MW unit at the Norborne site and build approximately 135 miles of new 345 kV transmission line. Interconnections will likely occur via two new lines from the Norborne plant to the Thomas Hill Power Plant, the Sedalia Substation, and /or the Mt. Hulda substations in Missouri. The transmission studies being conducted by AECI over the next few months will confirm the best locations for the new interconnections. This constitutes AECI's proposed action.

Construction of a coal-based generating plant at the Forbes site with about 125 miles of 345 and 161 kV transmission line is AECI's proposed alternative. We believe this to be an environmentally acceptable alternative, but not superior to the proposed action at Norborne.

Because AECI intends to finance the project through a guaranteed Federal Financing Bank loan, the project represents a major federal action that must be reviewed under the National Environmental Policy Act (NEPA). The agency with responsibility to carry out the NEPA review is the Rural Utilities Service (RUS), formerly known as the Rural Electrification Administration (REA).

RUS is required by its NEPA regulations to evaluate the environmental impacts of the project and prepare an environmental impact statement (EIS) and Record of Decision (ROD). This document is the first step in the NEPA process. It is intended to provide agencies and other interested parties enough background information on the project so that they can provide feedback to RUS and the applicants regarding issues that should be addressed in the EIS.

This document presents the purpose and need for the project and identifies the various options the utility considered to meet that need including load management, renewable energy sources, distributed generation, re-powering existing units, participation in other company's projects, purchased power, and new fossil-fueled generation alternatives (gas, oil, coal). In addition, it presents the results of a site selection study that reviews previous siting studies and evaluates two proposed sites. Finally, it includes a macro-corridor study which examines the constraints and opportunities for new transmission lines that will allow the new unit to be connected to the utility's distribution system.

# 2.0 INTRODUCTION

AECI proposes to develop a new baseload coal-fired generation unit. The new unit would be a 660 MW net generating unit to be in-service by 2011. The projected cost of the plant and associated transmission, rail interconnections, and water supply line is approximately $1 billion (including owner's costs and interest during construction).

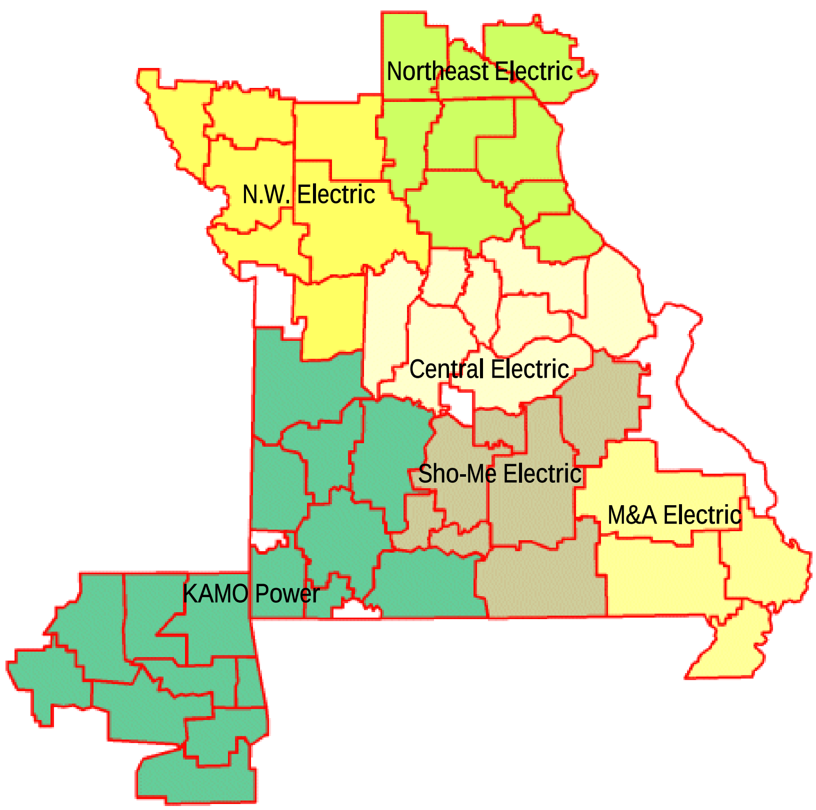
This document is actually a combination of three separate studies; an alternatives analysis, a siting study, and a macro-corridor study. The alternatives analysis is presented in Chapters 3, 4, and 5 and presents a profile of the applicant, an explanation of the purpose and need for the project, and a discussion of the capacity alternatives that were considered. These alternatives included power purchases, load management, energy conservation, and various alternative electric generation technologies. The alternatives review includes descriptions of each technology, and its general advantages and disadvantages.

The siting study is presented in Chapter 6. This chapter includes a review of previous siting studies completed by the utility, updated to include current information where appropriate. Chapter 7 is the macro-corridor study, which consists of a macro-level review of the alternative transmission corridors proposed for the project. Chapter 8 provides conclusions from the three studies (alternatives analysis, siting study and macro-corridor study), and Chapter 9 is a summary of the references used in compiling the report.

# 3.0 PROFILE OF AECI

Associated Electric Cooperative Inc. (AECI) is owned by, and is the major source of electric power supply for an extended system of six regional G&Ts. These G&Ts serve areas of Missouri, southern Iowa and northeast Oklahoma (See Figure 3-1). Through these electric utility systems, the G&Ts supply wholesale power to 51 distribution cooperatives. The G&T's serve 39 distribution cooperatives in Missouri, 3 in southeast Iowa, and 9 in northeast Oklahoma. These distribution cooperatives provide electrical service directly to more than 830,000 consumer members, including businesses, farms, and households. Table 3-1 lists the six regional G&Ts and their distribution cooperatives.

**Figure 3-1 Generation & Transmission Cooperatives Service Area**




Source: AECI, April 2005

The member G&Ts work on a regional level, and own and maintain all electrical systems from 69 kV up to 161 kV. The G&T's build and maintain the higher voltage lines, but they are planned and owned by AECI. The distribution cooperatives take on many different responsibilities including installation and maintenance of power lines (below 69 kV) from substations to consumer/members, planning for the future needs of their service area, working with communities to encourage economic development and helping their members learn to conserve energy.

AECI was founded in 1961 and given the responsibility for generation and power procurement. The transmission of the power remained the primary responsibility of the G&Ts. To help meet the objective of providing the lowest cost reliable energy, AECI is able to conduct power transactions with other utilities in and outside Missouri through its 96 interconnections, 19 interconnection agreements, and 79 interchange agreements.

The electrification of rural America enabled the rural economy to grow in many ways. In 1961, the year AECI was formed, a large majority of its electric consumers were involved in farming. Today, only 11 percent claim to receive their income from agriculture.

As the sole provider of power to its members, AECI serves a vital role in the regional rural economy. AECI is an active member of the Association of Missouri Electric Cooperatives, which assists rural electric cooperatives and promotes growth and development of Missouri's rural electric system. AECI’s success in keeping rates as low and as stable as possible, is an important attribute to communities seeking to attract and develop industry.

To provide for the system's ever-growing demand for wholesale electricity, AECI has acquired a flexible mix of resources, including thermal generation facilities, hydropower access, and power purchase agreements with neighboring utilities.

## Table 3-1 List of Generation & Transmission Cooperatives

| Northeast Electric Power Cooperatives | N.W. Electric Power Cooperatives | Central Electric Power Cooperatives | KAMO Power | | Sho-Me Electric Power Cooperatives | M & A Electric Power Cooperatives |
|---|---|---|---|---|---|---|
| Access Energy Cooperative | Atchison-Holt Electric Cooperative, Inc. | Boone Electric Cooperative | Barry Electric Cooperative | Northeast Oklahoma Electric Cooperative | Crawford Electric Cooperative, Inc. | Black River Electric Cooperative |
| Lewis County Rural Electric Cooperative | Farmers' Electric Cooperative, Inc. | Callaway Electric Cooperative | Barton County Electric Cooperative, Inc. | Osage Valley Electric Cooperative Association | Gascosage Electric Cooperative | Ozark Border Electric Cooperative |
| Macon Electric Cooperative | Grundy Electric Cooperative, Inc. | Central Missouri Electric Cooperative, Inc. | Central Rural Electric Cooperative | Ozark Electric Cooperative | Howell-Oregon Electric Cooperative | Pemiscot-Dunklin Electric Cooperative |
| Missouri Rural Electric Cooperative | North Central Missouri Electric Cooperative, Inc. | Co-Mo Electric Cooperative, Inc. | Cookson Hills Electric Cooperative | Ozarks Electric Cooperative Corp. | Intercounty Electric Cooperative | SEMO Electric Cooperative |
| Ralls County Electric Cooperative | Platte-Clay Electric Cooperative, Inc. | Consolidated Electric Cooperative | East Central Oklahoma Electric Cooperative | Sac Osage Electric Cooperative | Laclede Electric Cooperative | |
| Tri-County Electric Cooperative Electric Cooperative | United Electric Cooperative | Cuivre River Electric Cooperative, Inc. | Indian Electric Cooperative | Southwest Electric Cooperative | Se-Ma-No Electric Cooperative | |
| Southern Iowa Electric Cooperative | West Central Electric Cooperative, Inc. | Howard Electric Cooperative | Kiamichi Electric Cooperative | Verdigris Valley Electric Cooperative | Southwest Electric Cooperative | |
| Chariton Valley Electric Cooperative | | Three Rivers Electric Cooperative | Lake Region Electric Cooperative | White River Valley Electric Cooperative | Webster Electric Cooperative | |
| | | | New-Mac Electric Cooperative | | White River Valley Electric Cooperative | |

Source: AECI, April 2005.

# 4.0 PURPOSE AND NEED FOR THE PROJECT

AECI needs to add approximately 600 megawatts (MW) of reliable baseload generation to the current mix of generation resources by approximately 2011 to serve the growing loads within the service territories of the member cooperatives. The need is determined based on the projection of load growth (both peak loads and annual energy requirements), an evaluation of potential power supply options including purchase agreements and the potential to participate in other power development opportunities.

Separate from the proposed addition of baseload capacity, AECI has plans to add peaking capacity during this time period. AECI is purchasing the Dell Project from TECO Power Services (TPS), a subsidiary of TECO Energy (AECI, 2005). The partially constructed Dell Power Station is situated within the city limits of Dell, Arkansas, on approximately 100 acres. This project is a nominal 540 MW (599 MW, with duct firing) combined-cycle, natural gas-fired power plant. Construction of this facility was temporarily suspended in 2002 (TECO, 2005). AECI's plans call for completing construction and starting the Dell plant by May 2007. This plant, with strategic power purchases, will provide AECI's peaking and intermediate power needs through 2011.

## 4.1 DEMAND FORECAST

The most recent electrical energy demand analysis indicates that the peak capacity demand for AECI exceeded 3,650 MW during 2004. This peak capacity demand is projected to exceed 4,450 MW by 2011. The peak capacity is the amount of electrical generation capacity necessary to satisfy the peak system requirements (the point in time when the maximum energy requirement exists on the system). The capacity requirement varies during the day and by the seasons. Another tool to view the need for additional generation is the annual energy requirement which is a product of the capacity and the number of hours of operation at that capacity. The annual energy required to meet the load demands of the members in 2004, measured in megawatt hours (MWh), was 17,226,858 MWh. This annual energy usage is projected to exceed 21,244,000 MWh by 2011 and just over 30,000,000 MWh by 2025. Figure 4-1 depicts the peak capacity demand from 1980 to 2004, and projects the future demand to 2015. Figure 4-2 depicts the forecasted energy requirements from 1980 to 2025.

**Figure 4-1 AECI Peak Demand, 1980 - 2014**

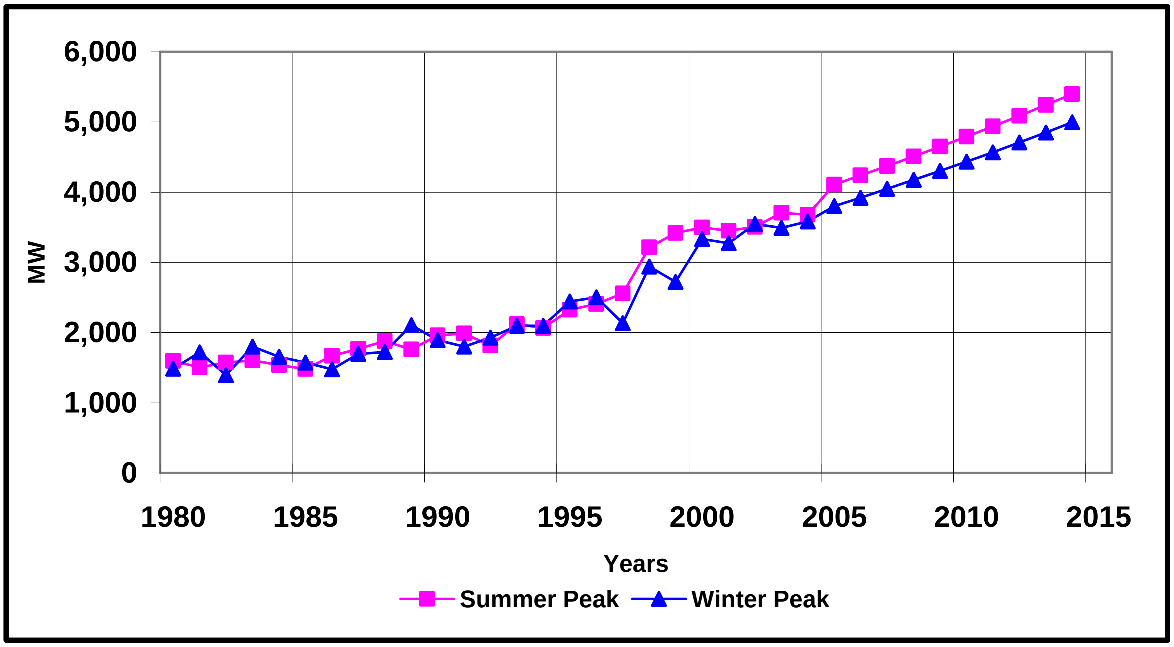



**Figure 4-2 AECI Forecasted Energy Requirements, 1980 - 2025**

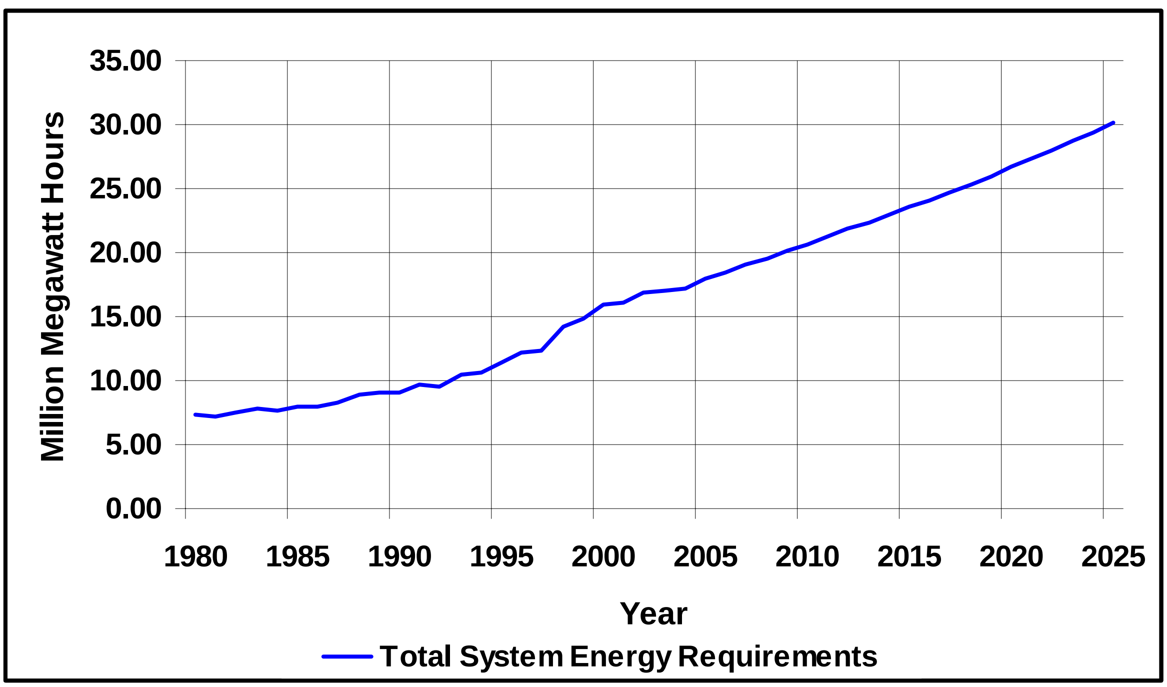


Table 4-1 presents the total peak demand for electrical energy on the AECI System. Historic information is presented for the period from 1980 to 2004 (AECI, 2005). The forecast information is shown from 2005 through 2014, and was obtained from the latest Power Requirements Study (AECI, 2001).

**Table 4-1 Peak Energy Demand**

| Year | Summer Peak (MW) (Jul-Aug) | Winter Peak (MW) (Dec-Feb) | Year | Summer Peak (MW) (Jul-Aug) | Winter Peak (MW) (Dec-Feb) |
|---|---|---|---|---|---|
| 1980 | 1,598 | 1,486 | 1998 | 3,214 | 2,943 |
| 1981 | 1,505 | 1,719 | 1999 | 3,421 | 2,720 |
| 1982 | 1,571 | 1,396 | 2000 | 3,499 | 3,333 |
| 1983 | 1,604 | 1,803 | 2001 | 3,453 | 3,273 |
| 1984 | 1,535 | 1,653 | 2002 | 3,507 | 3,546 |
| 1985 | 1,480 | 1,573 | 2003 | 3,708 | 3,494 |
| 1986 | 1,670 | 1,475 | 2004 | 3,678 | 3,584 |
| 1987 | 1,771 | 1,697 | 2005 | 4,108 | 3,802 |
| 1988 | 1,879 | 1,723 | 2006 | 4,239 | 3,923 |
| 1989 | 1,759 | 2,108 | 2007 | 4,374 | 4,048 |
| 1990 | 1,960 | 1,893 | 2008 | 4,510 | 4,175 |
| 1991 | 1,987 | 1,803 | 2009 | 4,649 | 4,303 |
| 1992 | 1,813 | 1,928 | 2010 | 4,790 | 4,434 |
| 1993 | 2,120 | 2,099 | 2011 | 4,937 | 4,569 |
| 1994 | 2,066 | 2,096 | 2012 | 5,086 | 4,708 |
| 1995 | 2,326 | 2,445 | 2013 | 5,241 | 4,851 |
| 1996 | 2,408 | 2,504 | 2014 | 5,397 | 4,996 |
| 1997 | 2,556 | 2,136 | | | |

Source: AECI, 2001

Table 4-2 presents the historical and forecasted system energy requirements for AECI. Historic information is presented from 1980 through 2004, and projected requirements are presented from 2005 through 2025. As noted in Table 4-3, the average growth rates over 5 year periods have varied from 3.0 to 7.2 percent over the last 15 years. The forecasted growth rates demonstrate a conservative expected average growth rate ranging from 2.9 to 2.5 percent per year for the future 5-year periods.

### Table 4-2 Historic and Forecast Energy Requirements

| Year | Total System Energy Requirements (MWhs) | Year | Total System Energy Requirements (MWhs) |
|---|---|---|---|
| 1980 | 7,357,657 | 2003 | 17,083,912 |
| 1981 | 7,141,742 | 2004 | 17,226,858 |
| 1982 | 7,459,015 | 2005 | 17,935,166 |
| 1983 | 7,824,591 | 2006 | 18,479,105 |
| 1984 | 7,636,288 | 2007 | 19,039,862 |
| 1985 | 8,038,413 | 2008 | 19,607,604 |
| 1986 | 7,992,479 | 2009 | 20,168,743 |
| 1987 | 8,266,284 | 2010 | 20,695,684 |
| 1988 | 8,939,124 | 2011 | 21,244,220 |
| 1989 | 9,092,002 | 2012 | 21,846,128 |
| 1990 | 9,120,387 | 2013 | 22,394,722 |
| 1991 | 9,633,354 | 2014 | 22,957,199 |
| 1992 | 9,533,823 | 2015 | 23,533,913 |
| 1993 | 10,441,175 | 2016 | 24,125,226 |
| 1994 | 10,567,434 | 2017 | 24,731,396 |
| 1995 | 11,451,925 | 2018 | 25,352,797 |
| 1996 | 12,160,988 | 2019 | 25,989,811 |
| 1997 | 12,384,522 | 2020 | 26,642,831 |
| 1998 | 14,203,937 | 2021 | 27,312,258 |
| 1999 | 14,875,250 | 2022 | 27,998,505 |
| 2000 | 15,861,891 | 2023 | 28,701,995 |
| 2001 | 16,153,567 | 2024 | 29,423,161 |
| 2002 | 16,898,527 | 2025 | 30,162,447 |

Source: AECI, 2001, Includes non-Act beneficiary sales, and system losses

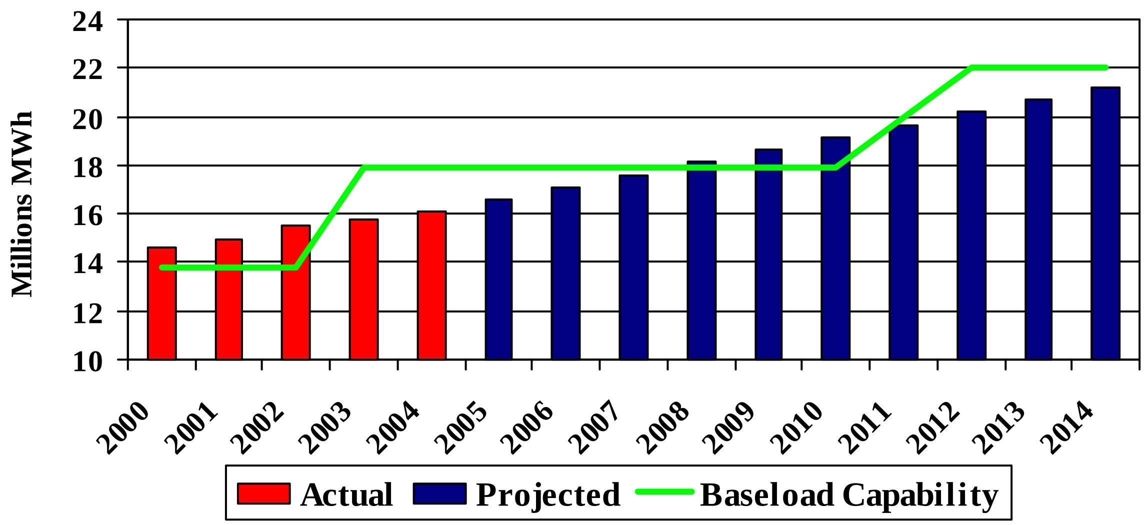
### Table 4-3 Historic and Projected Energy Demand Growth Rates

| Years | Average Growth Rate in Energy Requirements |
|---|---|
| 1989-1994 | 3.1% |
| 1994-1999 | 7.2% |
| 1999-2004 | 3.0% |
| 2005-2010 | 2.9% |
| 2010-2015 | 2.6% |
| 2015-2020 | 2.5% |

Source: AECI, 2001

The chart below compares the actual and projected member sales to Act beneficiaries, and indicates the energy that could be generated using existing baseload capacity to meet this demand. It illustrates that the baseload capability would not meet members demand by 2 million MWh in 2012.

**Figure 4-3 Comparison of Member Sales to Energy Available Through Existing Resources.**




Source: AECI. Member Sales does not include non-Act beneficiary sales or system losses. Baseload Capacity represents coal fired capacity on the AECI system.

## 4.2 PLANNING HISTORY

The 2000 Power Requirements Study (PRS) for AECI contains the most recent 15-year forecast. This study provides a class-specific energy sales forecast, as well as system energy requirements and a forecast of peak demand. This PRS includes historical data through 1999 with projections through 2014. Prior to the completion of the 2000 PRS, AECI's previous PRS was published in 1999, and included historical data through 1997. AECI is currently in the process of developing a new PRS. This study will be available as soon as it is completed (expected in late 2005).

## 4.3 EXISTING RESOURCES

AECI operates a wide variety of owned and leased electrical generation resources to serve the energy requirements of its members. In addition, AECI has established power purchase agreements with several neighboring utility power generation facilities to purchase available economical resources.

### 4.3.1 Existing Generation Resources

Currently, AECI operates two coal-based power plants: New Madrid Power Plant (1,200 megawatts) and Thomas Hill Energy Center Power Division (1,153 MW). AECI also dispatches KAMO Power's portion of Grand River Dam Authority's Unit 2 (198 MW) and Central Electric Power Cooperative's Chamois Power Plant (68 MW), both of which are coal-based. The Chamois plant also burns a percentage of biomass fuels, such as, used railroad ties, shelled corn, sawdust, and walnut shells. The walnut shells have proven to produce the greatest amount of heat value and are routinely burned at the facility. In the summer of 2005, there is a plan to burn fescue seed hulls made available from a seed plant near Kansas City.

AECI's natural gas-based generating plants include St. Francis Power Plant (501 MW), Essex Power Plant (107 MW), Nodaway Power Plant (182 MW), Chouteau Power Plant (522 MW) and Holden Power Plant (321 MW) which also has oil backing capability.

The cooperative also owns and operates the oil-based generators at Unionville (45 MW) and has a long-term contract with the Southwestern Power Administration for 478 MW of hydroelectric peaking power. Table 4-4 provides a list of AECI's resources and their respective capacity, fuel type, and type and percentage of ownership.

### 4.3.2 Existing Purchase Contracts

AECI has entered into power purchase agreements with its member generation and transmission cooperatives (Member G&T's) and with the City of New Madrid, Missouri, which provide that AECI will receive the electrical output of generation facilities owned by those entities, exclusive of power reserved for certain third parties and for station service.

**Table 4-4 Summary of Facilities Operated by AECI**

| Resource | Net Summer Capacity (MW) | Net Winter Capacity (MW) | Fuel-type | Type of Ownership | Ownership |
|---|---|---|---|---|---|
| Chouteau 11 | 165 | 165 | Natural Gas | Own | 100% |
| Chouteau 12 | 165 | 165 | Natural Gas | Own | 100% |
| Chouteau 10 | 165 | 170 | Combined Cycle - Steam | Own | 100% |
| Essex 1 | 107.4 | 112.5 | Natural Gas | Own | 100% |
| Holden 11 | 77.6 | 89.5 | Natural Gas/Fuel Oil | Own | 100% |
| Holden 12 | 77.6 | 89.5 | Natural Gas/Fuel Oil | Own | 100% |
| Holden 13 | 77.6 | 89.5 | Natural Gas/Fuel Oil | Own | 100% |
| New Madrid 1 | 580 | 580 | Coal | Lease | 0% |
| New Madrid 2 | 580 | 580 | Coal | Own | 100% |
| Nodaway 1 | 91.4 | 113.7 | Natural Gas | Own | 100% |
| Nodaway 2 | 91.4 | 113.7 | Natural Gas | Own | 100% |
| St Francis 1 | 225 | 242 | Natural Gas | Own | 100% |
| St Francis 2 | 248 | 272 | Natural Gas | Own | 100% |
| Thomas Hill 1 | 175 | 175 | Coal | Own | 100% |
| Thomas Hill 2 | 275 | 275 | Coal | Own | 100% |
| Thomas Hill 3 | 670 | 670 | Coal | Own | 100% |
| Unionville 1 | 22.5 | 22.5 | Fuel Oil | Own | 100% |
| Unionville 2 | 22.5 | 22.5 | Fuel Oil | Own | 100% |

Source AECI, 2005

Under the terms of the agreement with the City of New Madrid, Missouri, AECI operates the City's New Madrid Unit 1. AECI also receives all capacity and energy from New Madrid Unit 1 in excess of the demand and energy reservations for the City of New Madrid, Missouri. New Madrid Unit 1 has a net generating capacity of 570 megawatts and an annual energy production of approximately 4,000,000 megawatt-hours (MWh). The agreement is in effect until bonds issued to cover the construction of the power plant by the City of New Madrid are paid, or other arrangements are made for their retirement, or 50 years has passed since the date of initial commercial operation (October 1, 1972), whichever is later.

Under the terms of the agreement with Central Electric Power Coop, AECI receives the electrical output of Central's Chamois Power Plant. The combined capacity of Chamois

Units 1 and 2 is 68 MW, and annual energy production is approximately 450,000 MWh. The agreement with Central Electric Power Coop terminates on May 31, 2040.

Under the terms of the agreement with KAMO Power, AECI receives power and energy from the 38 percent KAMO Power portion of the second unit of the Grand River Dam Authority (GRDA) power plant. The net capacity received from this unit is 197.6 MW. The energy delivered from this plant is limited to the load factor of KAMO Power's Oklahoma load. When not needed by GRDA, AECI has the ability to purchase additional energy from the power plant. The agreement with KAMO Power terminates on May 31, 2040.

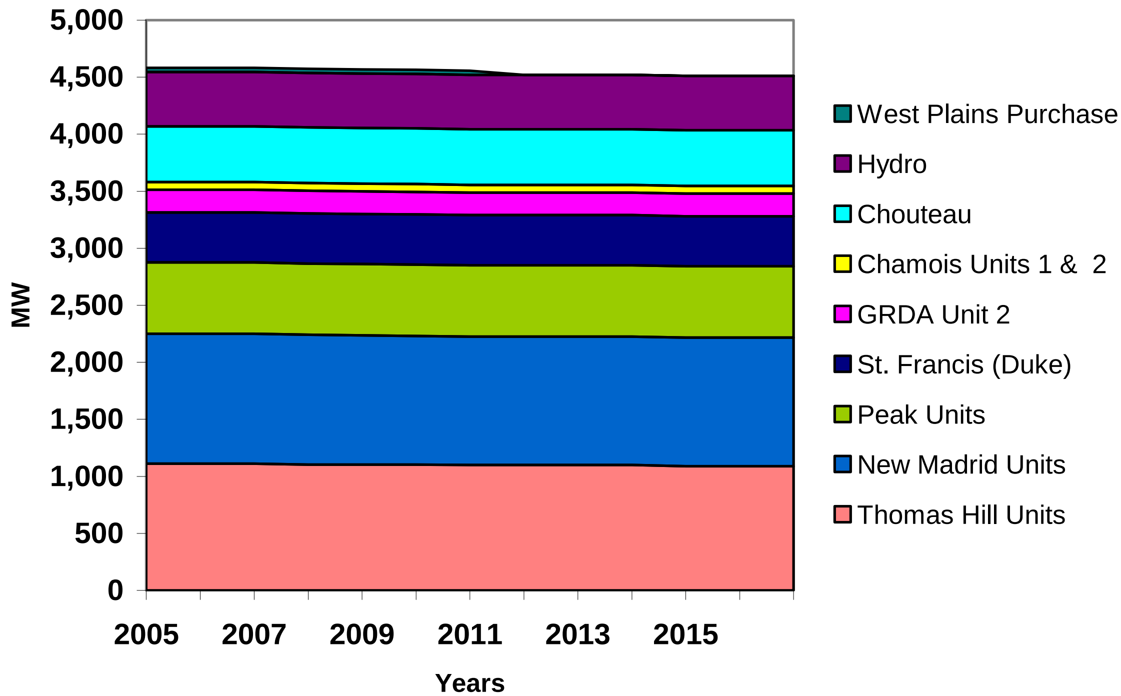
AECI has additional agreements for purchase of power and energy with Southwestern Power Administration; the City of West Plains, Missouri; and Duke Trading and Energy Marketing (Duke).

Under the terms of the agreement with Southwestern Power Administration, AECI receives a firm 478 MW hydro capacity and a commitment for this much capacity to be available for an equivalent of 1,200 hours per year (573,600 MWh of energy). In addition, AECI has the right to purchase additional supplemental energy which may be available each year. Annual supplemental energy purchases typically average 573,600 MWh. The agreement with Southwestern Power Administration terminates on February 28, 2016.

Under the terms of the agreement with the City of West Plains, Missouri AECI receives peaking capacity in excess of the load and reserve requirements of the City. The excess capacity available is approximately 36 MW. This agreement terminates on October 1, 2009.

Under the terms of the agreement with Duke, AECI has ownership in the St. Francis Power Plant Units 1 and 2. Duke has rights and obligations to half the output resulting from Units 1 and 2. AECI also has the right to purchase the capacity and energy rights from the Duke portion of both units, making a total 440-MW capacity available to AECI from the St. Francis Power Plant. The term of the agreement allows Duke the option to terminate its rights and obligations in 2009 for Unit 1, and 2011 for Unit 2; however, the figure below depicts this capacity as continuing to be available to AECI through 2016. Figure 4-4 depicts the total capacity available from the exiting resources on the AECI system.

**Figure 4-4 AECI System Capacity**




### 4.3.3 Existing Demand Side Management Resources

It is first important to note that AECI has only six G&T customers. They in turn have 51 distribution customers who supply the ultimate consumer. AECI and the six G&T's are contractually obligated to supply the power and energy demands of those consumers. Demand side management (DSM) initiatives are determined solely by the distribution cooperatives. AECI's ability to influence DSM is limited to sending appropriate price signals to the members.

In the year 2000, AECI modified its rate structure to have both a peak and base demand billing component. With the recent revisions, the demand charges are now generally determined using averages of the member's maximum monthly system demands (referred to as self-coincident peak demand) over multiple historical monthly or seasonal periods. This kind of demand billing structure encourages distribution cooperatives, through their G&T

supplier, to implement cost-effective actions to lower their peak demand especially during the period coincident with AECI's summer and winter peak.

The most common types of DSM activity among AECI members are direct load control programs. Most direct load control programs are conducted at the distribution cooperative level. Some of AECI's members are active in installing electric water heaters and ground-source heat pumps. Additionally, most of AECI's members make literature available to their consumers regarding conservation and energy efficiency. Details of the particular DSM activities of each distribution cooperative member of AECI are documented in the respective 2000 PRS report for each cooperative.

### 4.3.4 Incremental Upgrades

Incremental upgrades include projects to increase the output from existing facilities. There were no incremental capacity upgrades considered that would meet the need of additional baseload capacity. Under the Environmental Protection Agency's (EPA's) current regulatory interpretations, incremental upgrades can be subject to New Source Review. This reduces the potential advantages associated with improving existing facilities.

### 4.3.5 Power Pool Member Resources

Because lack of reliability has a huge potential cost, AECI belongs to a regional organization of utilities dedicated to preserving reliability -- the Southeastern Reliability Council (SERC), headquartered in Birmingham, AL. SERC is one of the ten (10) regional reliability councils constituting the North American Electric Reliability Council (NERC). SERC is responsible for promoting, coordinating and ensuring the reliability and adequacy of the bulk power supply systems in the area served by the Member Systems. SERC membership is comprised of investor-owned, municipal, cooperative, state and federal systems, independent power producers, and power marketers.

Because of the geographic size of the region and the diversity among its parts, the region is divided into sub-regions for data reporting purposes. These are the Virginia - Carolinas Reliability sub-region (VACAR), the Tennessee Valley Authority (TVA) sub-region (Tennessee and adjacent portions of Alabama, Georgia, Kentucky and Mississippi) the

Southern sub-region (Georgia, Alabama, part of Mississippi, and panhandle of Florida), and, effective January 1, 1998, the Operating Companies of Entergy, Associated Electric Cooperative and CAJUN Electric Power Cooperative became official members of SERC, adding a fourth sub-region to SERC.

### 4.3.6 Transmission System Constraints

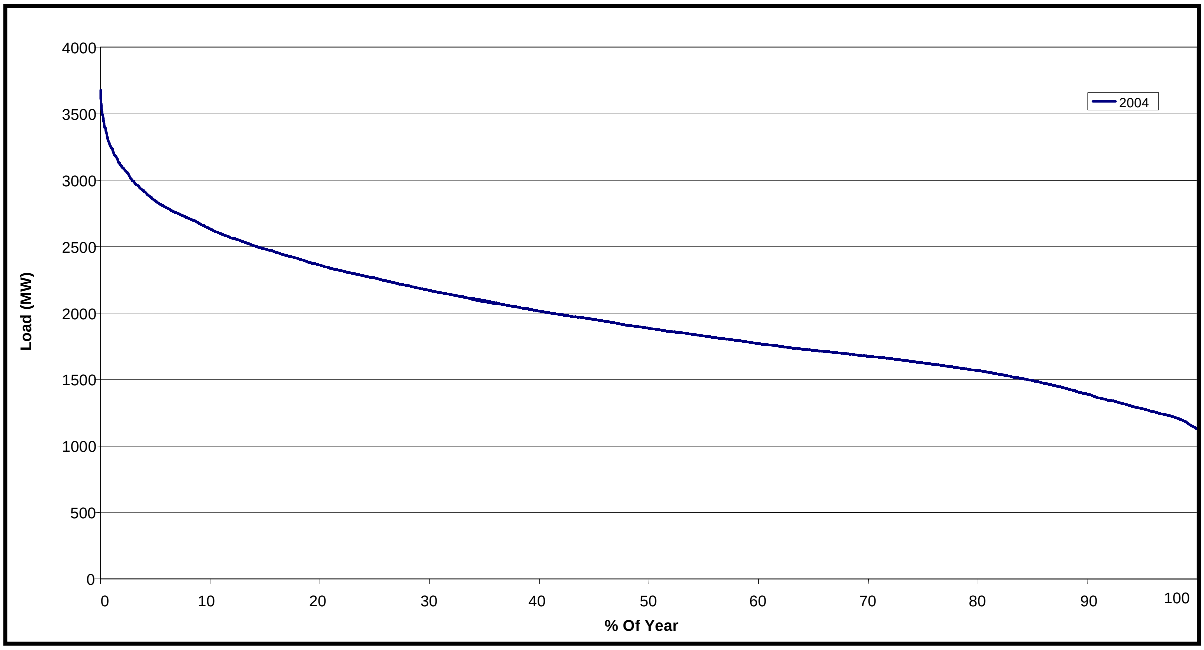
AECI and its member G&Ts currently has over 9,000 miles of high voltage transmission lines with 96 interconnection points and 79 interchange agreements with Missouri and regional power suppliers. Although there are some transmission constraints, AECI is a very strong system that provides adequate interconnection to neighboring systems. The lack of available low cost energy reserves serves as a larger constraint to the purchase of power.

### 4.3.7 Characteristics of Energy Needs

AECI's needs are for firm, baseload generation to meet their demand and energy requirements. As shown by the curve below in Figure 4-5, the energy requirements on AECI's system in 2004 were always greater than approximately 1,150 MW. This, plus the required reserve capacity, represents baseload capacity requirements. As discussed above, the energy demand is projected to increase in the future. The relationship between the baseload and peak load (i.e. the shape of the load duration curve) is expected to remain fairly constant. The total load exceeded 1,150 MW for essentially all of the year and for more than 50 percent of the time the demand requirements were greater than 1,850 MW. This represents intermediate load. The power requirements above this amount (i.e. needed less than 50 percent of the year represent peak loads. The total loads exceed 2,700 MW approximately 10 percent of the year. This load duration curve reflects the diversified loads on the system, and the efforts to manage peak loads.

The total number of consumers on AECI's system is projected to increase from 731,418 in 2000 to 982,741 by 2014. This equates to an expected average annual increase of 2.1 percent. Excluding the impact of the Oklahoma cooperatives' consumers, the average historical growth of the total consumers was 2.4 percent annually from 1985 to 1999.

**Figure 4-5 AECI Energy Requirements, Load Duration Curve**




Source: AECI, 2005

### 4.3.7.1 Residential

The residential class is, by far, the largest consumer class on AECI's system, accounting for approximately 92 percent of the total number of consumers in 1999. The aggregate forecast of the number of residential consumers served by AECI's members is expected to increase from 669,997 in 2000 to 897,454 by 2014. This equates to an average annual increase of 2.1 percent, slightly lower than the historical average annual rate of growth of 2.2 percent experienced from 1985 to 1999. This excludes the impact of the addition of the Oklahoma members of KAMO Power to the AECI system in 1998.

Sales to the residential class made up approximately 69 percent of AECI's total sales in 1999. Energy sales to the residential sector grew at an average annual rate of 3.7 percent during the period 1994 to 1999, excluding the impact of the addition of the Oklahoma members of KAMO Power to the AECI system. This compares to the national average residential sales growth of 2.5 percent per year over the same period. The total energy sales to the residential class is projected to grow at an average annual rate of 3.2 percent from 2000 to 2014, increasing from 8,945,388 MWh in 2000 to 13,918,587 MWh in 2014. This projected rate of growth is slightly less than the historical rate of growth in total residential energy sales from

1985 to 1999 of 3.7 percent, excluding the impact of sales to the Oklahoma cooperatives' consumers.

#### 4.3.7.2 Small Commercial

The small commercial class (defined as commercial accounts with less than 1,000 kVA transformer capacity), accounts for slightly more than 7 percent of the total number of consumers. Typical consumers in this class include office buildings, service stations, restaurants, and other retail establishments. The number of small commercial consumers is expected to increase from 52,175 in 2000 to 73,317 by the end of the forecast period. This commercial class of consumers is forecast to increase at an average annual rate of 2.5 percent. The average annual growth rate from 1985 to 1999 was 4.5 percent without considering the impact of the addition of the Oklahoma cooperatives' consumers.

Small commercial energy sales by AECI's members, which accounted for 15 percent of the total sales in 1999, have historically grown at a faster rate than residential sales. The average annual growth rate was 5.0 percent from 1985 to 1999, excluding the impact of the Oklahoma cooperatives sales (compared to 3.7 percent for the residential class). Total small commercial sales are projected to increase from the 2000 level of 1,917,460 MWh to 2,964,478 MWh by 2014. This represents an average annual growth rate of 3.2 percent.

#### 4.3.7.3 Large Commercial

The large commercial class includes commercial accounts with greater than 1,000 kVA transformer capacity. In 1999, the large commercial class accounted for about 9 percent of the total sales to consumers by AECI's member cooperatives. The sum of the G&Ts' forecasts indicates large commercial sales are projected to increase from 1,154,368 MWh to 1,766,992 MWh, or 3.1 percent, from 2000 through 2014. This average annual growth is considerably lower than the 9.8 percent average annual growth experienced from 1985 to 1999 and the 12.6 percent average annual growth that occurred from 1994 through 1999, excluding the addition of the Oklahoma portion of the KAMO Power system.

#### 4.3.7.4 Other

Other classifications of consumers served by the distribution cooperatives of AECI's member G&Ts include irrigation, public street and highway lighting, other sales to public authorities, and sales for resale. The combined total energy sales to these other classes represented less than 7 percent of the total retail sales on AECI's system. The largest portion of these other sales (approximately 78 percent in 1999) represent direct sales by Sho-Me Power Electric Cooperative (Sho-Me Power) to municipal consumers. Total energy sales to these other classes of consumers is projected to grow at an average annual growth rate of 2.6 percent from 2000 to 2014, increasing from 833,261 MWh in 2000 to 1,188,268 MWh in 2014. This compares to historical average annual growth of 1.8 percent from 1985 through 1999, excluding the impact of the addition of the Oklahoma cooperatives.

Table 4-5 shows the total capacity requirements of AECI's member cooperatives, which represents the sum of the consumer class forecasts described above. Total capacity requirements are projected to increase at an average annual growth rate of 3.2 percent. This compares to average annual growth of 4.1 percent for the period 1985 to 1999 and 4.4 percent from 1994 through 1999, excluding the impact of the addition of the consumers of the Oklahoma cooperatives to the AECI system.

**Table 4-5 Total Capacity Requirements**

| Contract Year | Coop Load (MW) | Other Loads (MW) | Required Reserve (MW) | Total Capacity Requirements (MW) |
|---|---|---|---|---|
| 2004 | 3,797 | 2 | 608 | 4,407 |
| 2005 | 3,896 | 3 | 608 | 4,507 |
| 2006 | 3,996 | 2 | 608 | 4,606 |
| 2007 | 4,095 | 3 | 608 | 4,706 |
| 2008 | 4,195 | 3 | 608 | 4,806 |
| 2009 | 4,295 | 3 | 608 | 4,906 |
| 2010 | 4,394 | 3 | 608 | 5,005 |
| 2011 | 4,494 | 3 | 608 | 5,105 |
| 2012 | 4,594 | 3 | 608 | 5,205 |
| 2013 | 4,693 | 4 | 608 | 5,305 |
| 2014 | 4,793 | 3 | 608 | 5,404 |
| 2015 | 4,893 | 3 | 608 | 5,504 |
| 2016 | 4,992 | 4 | 608 | 5,604 |

Source: AECI, 2005

## 4.4 NEED SUMMARY

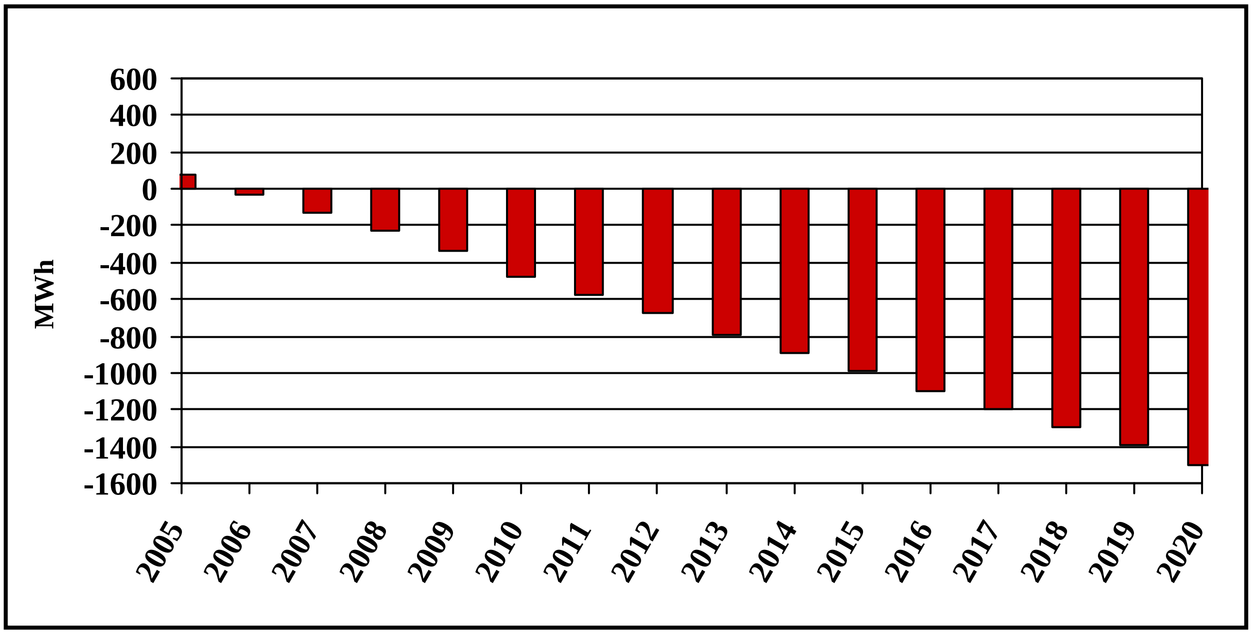
The results of the PRS, indicates a need to add approximately 660 to 700 MW of baseload generation in the 2010 – 2013 timeframe. A baseload addition in this time frame will help to provide protection against rising and volatile fuel prices. Table 4-6 indicates the system surpluses (i.e. when system resources exceed the capacity requirements), and the periods of deficits (i.e. when system resources do not satisfy the projected capacity requirements). Figure 4-6 illustrates this information in graphic form. Figure 4-7 illustrates how the addition of the Dell project reduces or eliminates the deficit for several years and Figure 4-8 illustrates how the addition of the planned coal fired generation will eliminate the deficit until approximately 2017.

**Table 4-6 System Capacity and the Forecast Deficit Capacity**

| Year | Megawatts |
|---|---|
| 2004 | 299 |
| 2005 | 75 |
| 2006 | -25 |
| 2007 | -133 |
| 2008 | -238 |
| 2009 | -341 |
| 2010 | -449 |
| 2011 | -584 |
| 2012 | -684 |
| 2013 | -784 |
| 2014 | -893 |
| 2015 | -992 |
| 2016 | -1,091 |

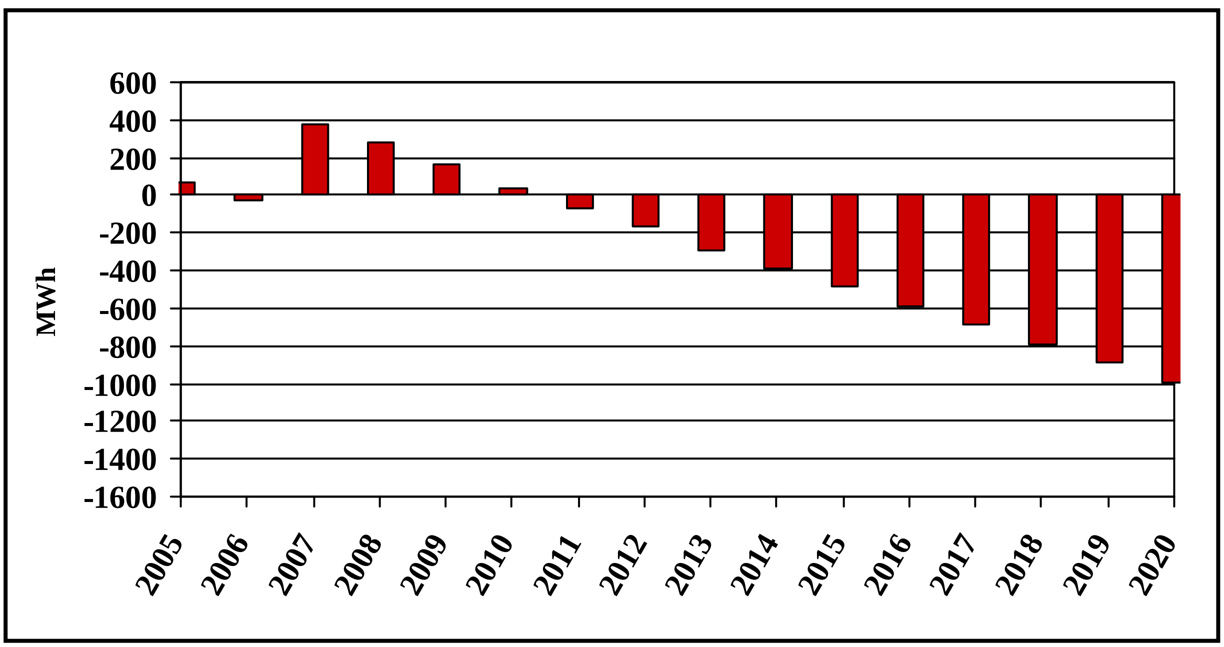
Source: AECI, 2005

**Figure 4-6 AECI Projected Surplus and Deficit Capacity Without Additional Generation**



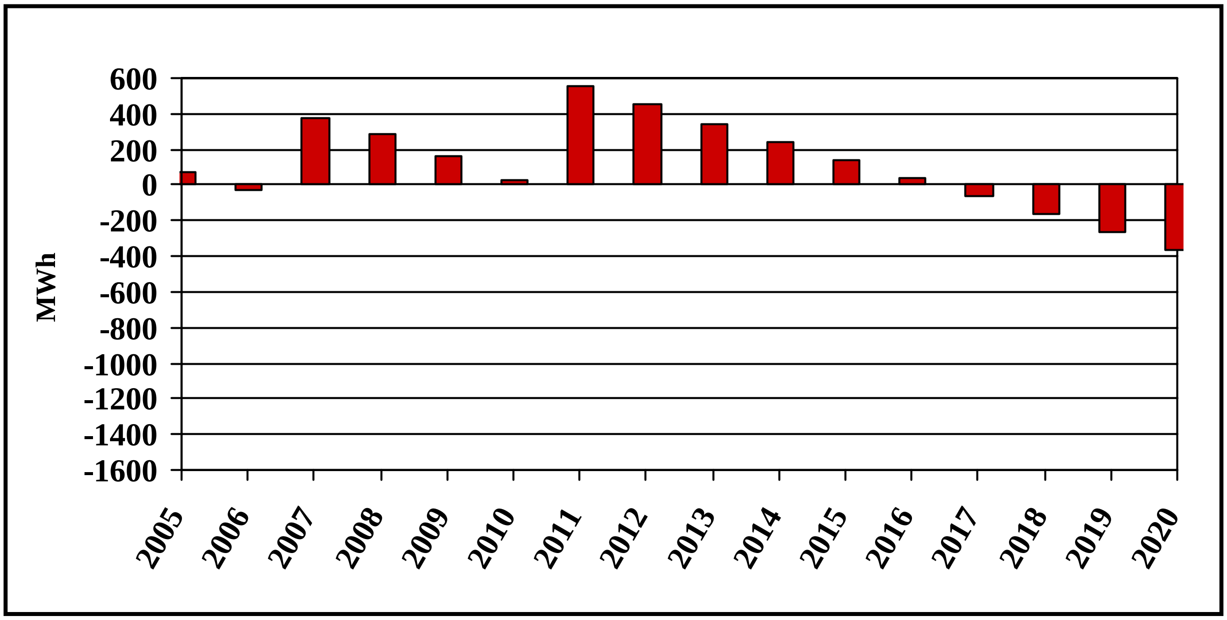

Source: AECI, 2005

**Figure 4-7 AECI Projected Surplus and Deficit Capacity With Dell Addition**




Source: AECI, 2005

## Figure 4-8 AECI Projected Surplus and Deficit Capacity With Coal Plant Addition




Source: AECI, 2005

# 5.0 CAPACITY ALTERNATIVES

Several alternatives to the construction of new capacity were considered. The other options to provide energy or reduce the need include: load management, renewable energy utilization, distributed generation, central station generation, repowering of existing units, participation in other units, or purchase power options. The internet Web site for Associated Electric Cooperative, Inc. (http://www.aeci.org/index.html), presents information concerning their plans to build new generation, including consideration of conservation and renewable energy resources. This information is highlighted under the topic of "Building for Tomorrows Energy Needs."

## 5.1 LOAD MANAGEMENT

As a cooperative, AECI's primary purpose is to provide low cost energy to meet the needs of its members. Consumer/members serve on the management team for the distribution cooperatives, the G&Ts, and on the Board for AECI. In the year 2000, AECI modified its rate structure to have both a peak and base demand billing component. This kind of demand billing structure sends appropriate price signals to and encourages the G&T members to take any cost-effective action possible to lower their peak demand at the time of AECI's summer and winter peak. As discussed in Section 4, implementation of DSM or other load management policies is the responsibility of individual distribution cooperatives. Beyond providing information and sending appropriate price signals in its rates, there is little else AECI can do that would have a significant effect on the projected load growth in their system.

As noted earlier, the major load growth is associated with residential growth, and this category has already experienced some conservation measures and efficiency improvements. Although additional improvements to efficiency and improved load management are anticipated, these are already incorporated in the load forecast.

## 5.2 RENEWABLE ENERGY SOURCES

AECI is in a similar situation with respect to renewable resources as it is with load management. AECI exists for the sole purpose of providing all the energy demanded by its member owners reliably and at the lowest cost possible. Therefore, absent specific requirements from our members, renewable resources can only be incorporated into AECI's generation mix when they are the lowest cost alternative. Every quarter AECI provides its members the opportunity to purchase energy from renewable resources. To date, this demand has been very limited and AECI has been able to supply it through its own renewable generation resource.

In general, renewable technologies hold promise for certain applications, and in certain locations, but the available renewable energy sources are not compatible with the need for this project. For the projected baseload energy needs of AECI, renewable energy technologies, while often innovative and in some aspects environmentally preferable, do not yet provide a reliable generation source for meeting baseload requirements. This is due in large part to their dependence on uncontrollable factors (i.e. the wind and sun) and the relatively large land requirement per MW of capacity of these technologies. As the technologies mature, and the development costs become more competitive with conventional generation alternatives, the use of renewable energy sources will increase.

### 5.2.1 Wind Energy

Wind energy has developed rapidly during the past decade due in part to Federal supporting grants. Fuel costs are non-existent and the only costs are the capital costs associated with the initial installation of the equipment, including the transmission lines, and maintenance costs.

The 1.5-Megawatt series turbines are the largest wind turbines manufactured in the United States and are among the most widely utilized worldwide with more than 1,000 in operation today. The turbine rotor diameter is about 230 feet (10 percent longer than the wingspan of a Boeing 747), and the rotor height, at its tallest point, is about 330 feet. Each machine requires space for the 230-foot blades to spin freely, and optimal spacing is required to assure minimal interference between turbines. According to a publication from the American Wind Energy Association (AWEA) entitled "The Most Frequently Asked Questions About Wind

Energy," in open flat terrain, the land area required is approximately 50 acres per MW (AWEA, 2005). Therefore, to produce 660 MW of power would require approximately 433 of the 1.5 MW turbines, or over 21,000 acres of land. Also, due to the intermittent nature of wind, capacity factors, even in high wind resource areas, are no more than about 30 percent. To be comparable to a 660 MW baseload plant, over 2,000 MW of widely dispersed wind generation would be required.

Some larger turbine systems are under development, including a 3.6 MW system, which is the industry's highest capacity operating prototype to date. The continuing development of larger and more efficient wind power systems is expected to make the technology an even more cost-competitive power generation option in the years ahead. As mentioned above, it is important to note that since the wind does not blow all of the time, it cannot be the only power source for that many households without some form of power storage system or grid backup.

As a renewable resource, wind is classified according to wind power classes, which are based on typical wind speeds. These classes range from class 1 (the lowest) to class 7 (the highest) Wind resources in Missouri are classified by the National Renewable Energy Laboratory (NREL) as Class 2 and Class 3 (Elliott, et al., 1986). Wind power classes and their respective power and speeds are provided in Table 5-1. According to the Missouri Department of Natural Resources (MDNR):

> "Generally speaking, utility-scale wind power projects using large turbines that service the electrical grid require an average wind speed of at least 7 meters per second (15.7 miles per hour) or average power of at least 400 Watts per square meter (NREL class 4). Small-scale turbines such as those used by farmers and homeowners are designed to operate at lower wind speeds, and may be useful at average speeds as low as 5-6 meters per second (11.2 to 13.4 miles per hour, NREL class 2 to 3)." (MDNR, 2005)

MDNR is working with several utilities to study winds at high elevations to determine whether large commercial wind farms are possible in the state. Kansas City-based Aquila Inc. and St. Louis-based AmerenUE are funding a yearlong study through the University of

**Table 5-1 Classes of Wind Power**

| Wind Power Class | Wind Power | Speed, m/s (mph)[a] |
|---|---|---|
| 1 | 1<200 | 5.6 (12.5) |
| 2 | 200-300 | 5.6-6.4 (12.5-14.3) |
| 3 | 300-400 | 6.4-7.0 (14.3-15.7) |
| 4 | 400-500 | 7.0-7.5 (15.7-16.8) |
| 5 | 500-600 | 7.5-8.0 (16.8-17.9) |
| 6 | 600-800 | 8.0-8.8 (17.9-19.7) |
| 7 | >800 | >8.8 (19.7) |

[a] Mean wind speed is based on the Rayleigh speed distribution of equivalent wind power density. Wind speed is for standard sea-level conditions. To maintain the same power density, speed increases 3%/1000 m (5%/5000 ft) of elevation. (from the Battelle Wind Energy Resource Atlas)
Source: AWEA, 1998.

Missouri-Columbia to look at six locations. The NREL has recently provided new maps of the state's wind speeds indicating the windiest part of the state is in extreme northwest Missouri, rather than in the southwest as previously shown on a 1980's map (Kansas City Star, 2005). Statewide wind resource maps are available online at http://www.eere.energy.gov/windandhydro/windpoweringamerica/wind_maps.asp.

Based on this information, the wind resources in Missouri may be adequate for small scale applications, but would not offer the average wind power required for utility scale wind power projects.

In addition, very good wind generation resources generally achieve a capacity factor of about 25 to 35 percent. In other words, although the wind speed may be within the range required to produce power approximately 65 to 80 percent of the time, it will only be able to achieve between 25 to 35 percent of maximum capacity on an annual average (AWEA, 2004). This is not compatible with a baseload requirement, and would need to be supplemented with energy resources that can be scheduled to provide "firm" energy. There are some wind generation facilities that have included natural gas fired combustion turbines to supplement the wind powered generation and therefore can offer "firm" energy. In this type of installation, the high costs of the natural gas fuel are offset somewhat by the low costs of the wind generation. The total cost however, including the capital costs for both, plus the operation and maintenance is not as cost effective as other options for firm baseload generation capacity even with wind's current production tax credit.

In addition, numerous environmental issues have been raised concerning wind turbine installation including: potential impacts to migrating waterfowl, raptors, and bats; visual impacts; and noise. Small wind energy systems are a feasible component of load management, and can be used to reduce energy usage requirements within residential, commercial, and agricultural categories. The consumers/members of AECI can, and do, implement small wind energy projects as determined individually to be appropriate.

In summary, wind is an improving generation technology that can contribute to a systems energy supply. However, until significant advances in storage technology are realized, wind will continue to need substantial subsidy, such as the federal production tax credit, to be economically viable. At this time it has been estimated that two-thirds of the economic value of wind projects comes from tax benefits (Feo, 2004). Therefore, unless and until this changes or AECI's members begin to demand a renewable resource, wind is not a viable alternative to the proposed project.

### 5.2.2 Solar

The solar powered systems for potential power generation include both direct conversion, using photovoltaic (PV) cells, and indirect conversion using concentrated solar power (CSP) system to create steam. There are two primary obstacles to solar energy development for AECI's need for central power generation; the space required and the energy storage requirement.

According to the NREL, Missouri has a good useful resource throughout the state for flat-plate collectors using PV cells. In one of the state's better locations, a PV array with a collector area equal to the size of a football field (1.3 acres) can produce around 957,000 kWh per year. This is enough to power 96.1 average homes (NREL, 2005). Using the example above, approximately 7,900 acres or 12 square miles would be needed for this technology to produce the 660 MW projected for this project.

The Department of Energy (DOE) has established a partnership between Sandia National Laboratory and the NREL to investigate and encourage the development of solar energy (DOE, April 2005). Within this program the DOE researches and develops various CSP systems including: trough systems, dish/engine systems, and power towers. These technologies are used in CSP plants that use different kinds of mirror configurations to convert the sun's energy into high-temperature heat. The heat energy is then used to generate electricity in a steam generator.

CSP demonstration projects have shown the ability to deliver power during periods of peak demand by using thermal storage systems. Land requirements for CSP plants vary with generating capacity and technology. Generally four to five acres are required for each megawatt of installed capacity. To serve the planned 660 MW for AECI, this would require at least 2,600 acres.

According to the NREL, for concentrating collectors, Missouri could pursue some type of technologies, but large scale thermal electricity systems are not effective with these resources. In the state's best areas, a current PV solar concentrator system with a collector area of 200,000 square meters, a system covering roughly 200 acres, could produce about 35,011,000 kWh per year—enough to power 3,513.4 homes. This correlates to approximately 32,500 acres or 50 square miles that would be needed to produce the 660 MW projected form this project.

Most of these studies and solar energy demonstration plants have been accomplished in the southwest United States where conditions are ideal for solar power. The NREL has developed maps of solar resources for the United States and many other regions, to allow precise assessment of potential sites. No solar sites have been identified in AECI’s service area that would be suitable for the large scale generation required to satisfy their loads. Nonetheless AECI continues to follow commercial advances in solar photovoltaic technology.

Solar heating and photovoltaic energy systems are a feasible component of load management, and can be used to reduce energy usage requirements within residential, commercial, and agricultural categories. The consumers/members of AECI can, and do, implement solar technologies as determined individually to be appropriate.

Solar is a resource similar to wind in that it is intermittent, and requires large land areas, and advanced storage technologies to provide a baseload resource. However, the solar technology is not as advanced and costs are higher than wind. Solar is not a viable alternative for this project.

### 5.2.3 Hydroelectric

Hydroelectric resources can be more dependable, but are commonly used to supplement baseload generation when water is available, and there is a peak demand. There are several hydroelectric generating sources in the region. None of these existing facilities or planned hydroelectric generation resources would be able to meet the baseload need of 660 MW. In addition, both the construction of a new dam and the operation of a hydroelectric facility can result in unacceptable environmental impacts. In fact, it is questionable whether another hydroelectric facility will ever be permitted in the U.S.

### 5.2.4 Biomass

Biomass is the renewable resource of highest potential in the AECI service area. Conventional steam electric generation is capable of using biomass fuels to provide some or all of the energy requirements. Due to the fact that the biomass fuels usually contain less heat per pound and more water per pound than coal, using biomass fuels can require substantially greater material handling. In some cases, treating the fuels (crushing, drying, pelletizing, etc.) is beneficial to the combustion process, but adds to the fuel preparation costs. AECI operates the Chamois plant and uses biomass fuels for a portion of that plant's heat input. AECI does not intend to design the proposed new AECI baseload plant to utilize biomass fuels for a portion of the heating requirements for the following reasons:

- Capacity is available at the Chamois plant to burn additional biomass fuels.
- Other existing units in the AECI system are better suited to biomass co-firing than the proposed unit.
- Availability of biomass fuels in large quantities are seasonal and subject to frequent interruptions and variability in both quality and quantity.

- The use of biomass fuels is best suited to combustion processes such as circulating fluidized bed or stoker firing. These combustion processes are not typically available above a single unit size of 250 MW, and have a lower efficiency than some other combustion processes.
- The proposed unit will be a pulverized coal unit which does not lend itself to biomass co-firing.
- Biomass fuels can reduce the potential for recycle (sales) of ash.

## 5.3 DISTRIBUTED GENERATION

Fuel cells, micro-turbines, internal combustion engines and battery energy storage systems were briefly considered to meet AECI's needs. Fuel cells are not currently economical on a commercial electric generation basis. Micro-turbines, while increasingly becoming an element of resource planning strategy, are not cost effective as a primary source of meeting overall customer requirements. Micro-turbines will continue to provide an option for niche power requirements where lack of transmission access, footprint limitations, and low load factor situations exist. Internal combustion engines (i.e. diesels) are used throughout the country for smaller generation needs. A large engine could produce approximately 15 MW of power, which means that over 40 such engines would need to be distributed throughout the service territory to replace the planned centralized generation of 660 MW. This source would have the disadvantage of higher fuel prices and greater emissions of some pollutants. For the reasons above, none of the distributed generation alternatives are appropriate for AECI's proposed baseload plant.

## 5.4 CENTRAL STATION GENERATION

The following sections apply to central station projects as opposed to distributed generation. Fossil fuels are the most cost effective fuel source for the centralized energy demand. The only alternative to fossil fuels that has been successfully demonstrated to provide the capacity and firm power required for large dependable and continuously operated centralized generation is nuclear.

### 5.4.1 Nuclear

The Nuclear Energy Institute provides a substantial amount of information on its website (http://www.nei.org/) related to the re-emergence of nuclear technology. Prominent among this information is the recent bill referred to as the Climate Stewardship and Innovation Act of 2005 (*Introduction of S. 1151 on May 26; Congressional Record, page S6046*). This bill, introduced by Senators McCain and Lieberman, strongly supports additional development of nuclear technology to help respond to the global climate change issues.

As evidence of the growing recognition of the need to reconsider the potential for nuclear energy, three industry consortia applied in 2004 to the DOE to test the new combined construction and operating license (COL) for new nuclear power plants. The consortia include NuStart Energy Development LLC, a partnership of 11 leading energy companies, a group led by Dominion, and another led by the TVA. The three consortia will partner with DOE to test the Nuclear Regulatory Commission's new COL process and DOE will provide funding to the groups to assist in the development of advanced technology reactors.

Nuclear energy is currently our nation's largest source of emission-free electricity and our second largest source of power overall. The 103 U.S. nuclear units supply about 20 percent of the electricity produced in the United States. A total of 441 nuclear power plants are operating around the world in 31 countries, and supply approximately 16 percent of the world's electrical energy. Currently 25 new nuclear plants are under construction worldwide. Although there are some problems, including the long term disposal of nuclear waste material that need to be resolved, it is likely that nuclear energy will have a significant role in the energy future of the United States and the world.

Further information concerning nuclear energy can be found through the DOE, the Nuclear Regulatory Commission (NRC), the Nuclear Energy Institute (NEI), the American Nuclear Society (ANS), the World Nuclear Association, the Nuclear Energy Agency (NEA) and the International Atomic Energy Agency (IAEA).

AECI believes nuclear power will be a critical component of the U.S.'s energy future. However, the risks and costs associated with the next generation of nuclear plants will be large. As noted above, even large utilities are forming consortia to deal with these potential risks and costs. While AECI believes nuclear power may be an option for its future generating needs, it is simply far too small for nuclear power to be a viable option for this project.

### 5.4.2 Natural Gas

Natural gas-fired generation was evaluated and determined to not be a preferred option to meet the baseload energy requirements due to the higher fuel costs and volatility of natural gas prices. Natural gas-fired generation can be developed using internal combustion, typically either simple-cycle or combined-cycle combustion turbine technology, or using external combustion such as direct firing in a boiler.

Direct firing in a boiler was rejected due to the current and projected cost of natural gas and this technology does not offer a higher efficiency than other fuels using the same type of process.

Combined-cycle plants do provide a higher level of efficiency. The basic principle of the combined-cycle plant is to utilize the natural gas to produce power in a gas turbine - which can be converted to electric power by a coupled generator—and then use the hot exhaust gases from the gas turbine to produce steam in a Heat Recovery Steam Generator (HRSG). This steam is then used to create electric power with a coupled steam turbine and generator. The use of both gas and steam turbine cycles in a single plant to produce electricity results in high conversion efficiencies and low emissions. The gas turbine (Brayton) cycle is one of the most efficient cycles for the conversion of gas fuels to mechanical power or electricity. Modern combined-cycle plants utilizing the steam produced by the HRSG increases the efficiencies up to and in some cases exceeding 58 percent. Gas turbine manufacturers are continuing to develop high temperature materials and improved cooling to raise the firing temperature of the turbines and further increase the efficiency. This combined-cycle system offers high efficiency, but because of the high fuel costs, this type of system is best suited to supply intermediate electrical demands, rather than baseload capacity. AECI currently owns, or is acquiring, over 1,500 MW of combined-cycle generation, adequate to meet its intermediate capacity needs.

Simple-cycle combustion turbine technology offers an even lower capital cost, but also has the fuel cost disadvantages associated with natural gas and lower overall efficiency. This technology is primarily used to meet peak electrical demands.

The price and volatility of natural gas is problematic in using this fuel for baseload generation. Natural gas prices for electrical generation have recently increased from a low of $2.86 per thousand cubic feet in February of 2002 to a high of $6.85 per thousand cubic feet in December of 2004 with short term spikes of over $12 (EIA, May 2005). Both simple-cycle and combined-cycle options were considered for this project. However, they are not well-suited for baseload capacity and, with the relatively high and volatile cost of fuel, these options did not compare favorably with the solid fuel options for the proposed project.

### 5.4.3 Oil

Similarly, oil could theoretically be used in the simple-cycle and combined-cycle facilities described above under natural gas, and as boiler fuel. According to a report by the DOE's Electric Power Monthly for May of 2005, the average price of fuel oil in January of 2005 was $5.63 per million British Thermal Units (BTU) compared to $1.44 for Coal and $6.64 for Natural Gas (EIA, May 2005). Although the cost of energy from fuel oil is slightly less than natural gas, the cost for environmental controls for burning fuel oil would be higher that the controls required for natural gas. While generally cleaner burning that coal, oil can result in significantly greater emissions of some pollutants than natural gas. Oil-fired generation was not considered as a viable option, based on the high cost of the fuel, combined with concerns related to availability, energy independence, and environmental controls

### 5.4.4 Coal

Coal is the most abundant fuel resource in the United States. The DOE has identified coal reserves underground in this country to provide energy for the next 200 to 300 years. There are three primary technologies identified for generating electrical energy from coal: fluidized bed (FB), integrated gasification combined-cycle (IGCC) and pulverized coal (PC). As part of the alternatives evaluation, all three technologies (FB, IGCC, and PC) were evaluated. A PC unit was found to have the lowest installed cost, the lowest fixed operations and maintenance costs and is the most proven technology of the three options, and was selected as the preferred coal technology.

#### 5.4.4.1 Fluidized Bed

The combustion process within a fluidized bed boiler occurs in a suspended bed of solid particles in the lower section of the boiler. The bed is fluidized by air drawn through the bed from underneath. Some incombustible material is placed in the bed to help control the combustion process. Using limestone and flyash re-injection for this incombustible material helps to reduce the emissions of acid gases. A refinement to this design collects and returns material to the bed. This is referred to as a circulating fluidized bed (CFB) system. Generally, combustion within the bed occurs at a slower rate and lower temperature than a pulverized coal boiler. The result is that a fluidized bed boiler can burn a lower quality fuel and remove 90 percent or more of the sulfur products and produce less nitrogen pollutants.

Fluidized bed boilers can also burn just about anything that is combustible — wood, ground-up railroad ties, seeds, hulls and other waste materials. This technology is well suited to burn fuels with large variability in constituents. Within a reasonable range, deviations in fuel type, size or Btu content have minimal effects on the furnace performance characteristics.

Currently, fluidized bed units are limited to a maximum size of approximately 250 MW. Although a multi-unit facility could be built, this would not be able to benefit from the economies of scale associated with a 660 MW project. Also, because of the lower operating temperature of the CFB system, it doesn't achieve the higher efficiency levels achieved by pulverized coal boilers, especially supercritical boilers.

A new type of fluidized bed boiler is being proposed to improve on the basic system. It encases the entire boiler inside a large pressure vessel. Burning coal in a pressurized fluidized bed boiler (PFBC) results in a high-pressure stream of combustion gases that can spin a gas turbine to make electricity, then boil water for a steam turbine. The PFBC technology offers higher thermal efficiency. It is estimated that boilers using this system will be able to generate 50 percent more electricity from coal than a regular power plant from the same amount of coal. Because it uses less fuel to produce the same amount of power, this technology would result in less carbon dioxide (a greenhouse gas) being produced per MW generated. This technology is currently in the demonstration phase and is not feasible for the proposed project.

#### 5.4.4.2 Integrated Gasification Combined-cycle (IGCC)

Integrated Gasification Combined Cycle (IGCC) is emerging as one of the most promising technologies in power generation. AECI thoroughly evaluated this technology and considers it very promising. The primary concern is its stage of development. There is not yet an IGCC unit in the 600 MW range operating commercially; much less with an extended operating history. AECI is simply too small to accept the risk of a first-of-a-kind technology that an IGCC unit would constitute at this time.

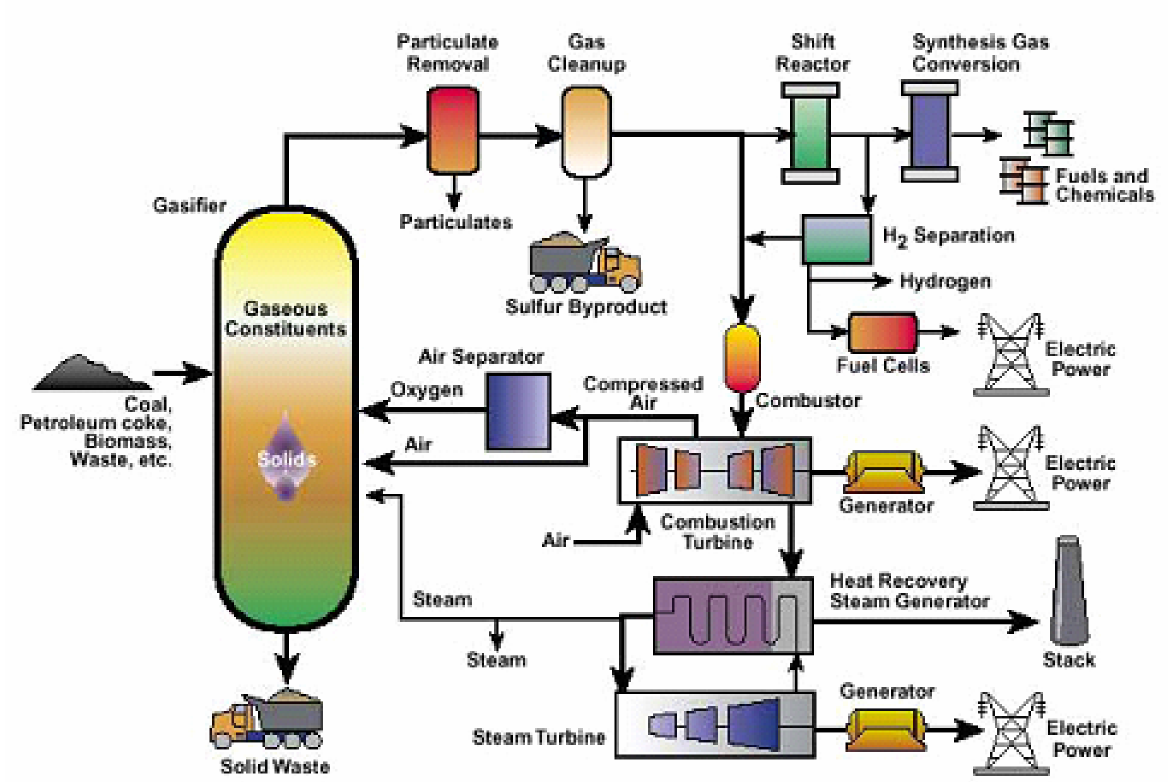
This technology can utilize low-quality solid and liquid fuels, and is able to meet stringent emissions requirements. Rather than burning coal directly, gasification breaks down coal or virtually any carbon-based feedstock into its basic chemical constituents. In a modern gasifier, coal is typically exposed to hot steam and carefully controlled amounts of air or oxygen under high temperatures and pressures. Under these conditions, carbon molecules in coal break apart, typically producing a mixture of carbon monoxide, hydrogen and other gaseous compounds.

Currently demonstration projects in Tampa, Florida, and West Terre Haute, Indiana, are generating electricity by gasifying coal, rather than burning it. At a plant in Kingsport, Tennessee, the Eastman Chemical Company has been using coal gas to make methanol and plastics.

In the simplest of terms, an IGCC power plant consists of a “gasification island” and a combustion turbine combined-cycle power block. IGCC involves the integration of the following technologies: cryogenic oxygen production, gasification (coal conversion to raw syngas), heat recovery, syngas scrubbing and desulfurization processes, sulfur recovery, and a syngas-fired combined-cycle power block.

The gasification island includes the entire coal receiving, handling, preparation, gasification, heat recovery, and syngas cleanup facility—up to delivery of the syngas to the power block. Figure 5-1 provides a schematic of a generic IGCC process.

**Figure 5-1 IGCC Schematic**




Source: National Energy Technology Laboratory (NETL), December 2002

Only oxygen-blown gasification has been successfully demonstrated for IGCC. Oxygen-blown gasification avoids the large gas (nitrogen) flows and very large downstream equipment sizes and costs that air-blown gasification (discussed below) would otherwise impose. However, the trade-off is that an expensive cryogenic oxygen plant (with a large auxiliary power demand) is required. Pressurized oxygen-blown gasification reduces equipment sizes and enables the delivery of syngas at the fuel pressure required by combustion turbines.

Saturated steam is routed to the HRSG of the combined cycle, where it is superheated and used to augment steam turbine power generation. The steam required for gasification is also supplied from the steam circuit.

The environmental benefits of coal gasification stem from the ability to clean as much as 99 percent of the pollutant-forming impurities from coal-derived gases. Sulfur in coal, for example, emerges as hydrogen sulfide, and can be captured and, in some cases, extracted in a form that can be sold commercially. Likewise, nitrogen typically forms ammonia and can be scrubbed from the coal gas. Again, in some cases the scrubber can yield by-products that can be used to produce fertilizers or other ammonia-based chemicals.

Generally cyclones and/or ceramic, sintered metal hot filters, and water scrubbing are employed for particulate removal. Water scrubbing removes ammonia ($NH_3$), hydrogen cyanide (HCN), and hydrochloric acid (HCl) from the syngas. Following cooling and particulate removal, a chemical process like Rectisol or Claus is used to remove most of the sulfur constituents from the syngas.

As part of the Air Quality Construction Permit process, a few states have elected to review IGCC as a viable process alternative for electrical generation. In response to a request from the IEPA, Prairie State prepared an analysis of the development status, performance (thermal, environmental, operational), and economics of IGCC. As part of the analysis, the carbon dioxide ($CO_2$) emission rates for the pulverized-coal (PC) option and the two potential IGCC technologies were normalized to the same equivalent net power output (1,599 MW). The results of this study indicated that the $CO_2$ output of a 1,599 MW (equivalent) IGCC plant may be lower or higher than that of the 1,559 MW Prairie State proposed PC design, depending on which gasification process is selected for comparison and the ultimate optimization of those IGCCs (Prairie States 2003).

**Table 5-2 Comparison of Estimated $CO_2$ Emissions from the Prairie State PC and IGCCs**

| 1,559 MW | PC Plant | ChevronTexaco-Q | Global E-Gas-HR |
|---|---|---|---|
| Coal required, tons/day | 20,287 | 22,532 | 20,178 |
| Estimated Heat Rate, Btu/kWh | 9,521 | 10,576 | 9,451 |
| Estimated carbon conversion, % | 99.9 | 97.0 | 99.0 |
| $CO_2$ output, tons/day | 36,019 | 38,844 | 35,503 |
| tons/year | 11.83 MM | 12.76 MM | 11.66 MM |
| tons/MWh | 0.963 | 1.038 | 0.949 |

Coal carbon content = 48.5% as received
90% capacity factor IGCC plants (Normalized to 1,559 MW equivalent)
Source: Prairie States 2003.

IGCC technology does offer an increased opportunity for $CO_2$ removal. A study prepared by DOE/ National Energy Technology Laboratory (NETL)-EPRI reported that $CO_2$ scrubbing could capture about 90 percent of the uncontrolled $CO_2$ for any combustion technology. Since any coal-based technology will produce approximately twice as much $CO_2$ as natural gas technology, scrubbing coal-fired plants results in capturing about twice as much $CO_2$ as from natural gas-fired power plants (DOE 2002). This can be beneficial if there is a use for the captured $CO_2$. Currently, there are few practical ideas for carbon sequestration, and it is possible that captured $CO_2$ may eventually be released back into the environment. For example, $CO_2$ that is used by plants through photosynthesis to create biomass can sequester $CO_2$, but the $CO_2$ can eventually be released back into the environment should the biomass be burned.

The same DOE study of $CO_2$ capture indicated the addition of technology to remove up to 90 percent of the $CO_2$ would result in a capital cost increase of approximately 30 percent for the IGCC technology, while the additional cost to a PC system would be approximately 73 percent. In addition to lower capital cost, because IGCC produces a more concentrated $CO_2$ stream at higher pressure that other technologies, the energy consumption associated with the $CO_2$ scrubbing is lower. Even though scrubbing of $CO_2$ emissions from IGCC can reduce the amount released to the atmosphere, the emissions would still be about twice that of a gas-fired combined-cycle plant (DOE 2002).

There are less costly options envisioned, but they typically achieve less removal. An engineering study, performed for ChevronTexaco by Jacob's Engineering in cooperation with General Electric, evaluated the design concept of incorporating the option of approximately 75 percent $CO_2$ capture into a new IGCC facility. Their evaluation was based on the logic that IGCC units built today may not have a commercial need to capture $CO_2$, unless there was the potential for using enhanced oil recovery (EOR) through $CO_2$ injection or a future regulatory requirement for sequestration in a suitable repository (e.g., an aquifer). The engineering study developed a process flow scheme that used ChevronTexaco Quench gasifers followed by syngas shift reactors, physical absorption acid gas removal (e.g. Selexol), a sulfur recovery system, and a combined cycle unit consisting of two gas turbines, a HRSG and a single steam turbine. The unit design they evaluated would be capable of capturing 75 percent of the feed carbon as $CO_2$ (DOE 2002).

The IGCC emission information in Table 5-3 is based on a Final Report Prepared for the Gasification Technologies Program, National Energy Technology Laboratory, entitled "Major Environmental Aspects of Gasification-Based Power Generation Technologies." (DOE, 2002)

### Table 5-3 Comparison of IGCC Technology Criteria Pollutant Emission Levels

| Criteria Pollutant | Projected IGCC Emission Levels[a] | Recent BACT Permit Limits for Conventional Coal Combustion | Polk IGCC Operating Permit Limit[b] | Wabash River IGCC Operating Permit Limit[c] |
|---|---|---|---|---|
| Sulfur dioxide ($SO_2$) | 0.08 lb/$10^6$ Btu<br>0.7 lb/MWh | 0.1 lb/$10^6$ Btu, 30-Day average,<br>0.09 lb/$10^6$ Btu annual average | 0.166 lb/$10^6$ Btu<br>1.43 lb/MWh | 0.145 lb/$10^6$ Btu<br>1.25 lb/MWh[e] |
| Nitrogen oxides ($NO_x$) (as $NO_2$) | 0.09 lb/$10^6$ Btu<br>0.77 lb/MWh | 0.07 lb/$10^6$ Btu, 30 day, normal operation<br>NOx - 0.06 lb/$10^6$ Btu, annual | 0.06 lb/$10^6$ Btu<br>0.53 lb/MWh | 0.157 lb/$10^6$ Btu<br>1.35 lb/MWh |
| Particulate ($PM_{10}$) and Sulfuric Acid ($H_2SO_4$) Mist | 0.011 lb/$10^6$ Btu<br>0.10 lb/MWh | PM10 - 0.018, 3-hour (Method 202 or alternative) | 0.033 lb/$10^6$ Btu<br>0.288 lb/MWh[d] | 0.029 lb/$10^6$ Btu<br>0.25 lb/MWh[f] |
| Carbon monoxide (CO) | 0.033 lb/$10^6$ Btu<br>0.29 lb/MWh | 0.15 lb/$10^6$ Btu, 24-hour average | 0.045 lb/$10^6$ Btu<br>0.392 lb/MWh | 0.256 lb/$10^6$ Btu<br>2.2 lb/MWh[g] |

[a] Basis: Heat rate equals 8,600 Btu/kWh. $SO_2$ emissions are based on 2.5 percent sulfur, 12,000 Btu/lb coal, and 98 percent reduction. $NO_x$ emissions are based on a turbine combustor that emits 15 ppm $NO_x$ (15 percent $O_2$, dry). CO, $PM_{10}$, and $H_2SO_4$ emissions are based on 1998 Wabash River plant experience.
[b] Values provided by TECO Energy
[c] Basis: permit limits specified in final technical report for Wabash River Coal Gasification Repowering Project.
[d] Basis: 0.068 lb/MWh for particulate-only (17 lb/hr, excluding $H_2SO_4$ mist) and 0.22 lb/MWh (55 lb/hr $H_2SO_4$)
[e] Basis: 252 MWe @ 6,000 hrs/year, 1,512,000 MWh/year
[f] Basis: limits specified for combustion turbine (20 percent max opacity, 0.01 lb/$10^6$Btu $H_2SO_4$) and tail gas incinerator (6.8 tons/yr)
[g] Based on limits specified for flare, combustion turbine, and tail gas incinerator.

The emission rates in Table 5-3 represent permitted emissions during normal operation, and do not include emissions during start-up and shutdown of the system and upset conditions. The IGCC demonstrations (all partly supported by government and/or R&D consortia funding) have been largely successful and have shown that coal gasification is technically feasible and the systems are capable of meeting current emissions regulations for new coal-fired plants.

Efficiency gains are another potential benefit of coal gasification. In a typical coal combustion plant (supercritical plant), approximately 40 percent of the energy value of coal is actually converted into electricity, the rest is lost as waste heat.

A coal gasification power plant, however, typically gets dual duty from the gases it produces. First, the coal gases, after being cleaned to remove sulfur, particulate and nitrogen pollutants, (and possibly carbon dioxide), are fired in a gas turbine - much like natural gas - to generate electricity. The hot exhaust of the gas turbine is then used to generate steam to power a conventional steam turbine-generator. Similar to the natural gas combined cycle, this system converts much more of coal's inherent energy value into useable electricity. The thermal efficiency of a coal gasification power plant can be boosted to 40 percent or more.

Future concepts are being investigated that may incorporate a fuel cell or fuel cell-gas turbine hybrid that could achieve even higher efficiencies, perhaps in the 60 percent range, or nearly 50 percent above today's typical coal combustion plants. Higher efficiencies can translate into more economical electric power and potential savings for ratepayers. A more efficient plant also uses less fuel to generate power, meaning that less carbon dioxide is produced.

However, in its present state of development and demonstration, IGCC is still encumbered by lower reliabilities, and higher capital and electricity production costs than modern PC boiler power plants with state-of-the art emissions controls.

"Availability" is the measure commonly used to represent the reliability of a power plant and component sections of or equipment in the plant. Availability is a measure of the percentage of the time in a period during which the plant was actually running, operable at full capacity, and—if not operating—was fully available to be operated. Annual availabilities (12 month periods) are commonly reported, since short-term availabilities are not very meaningful. The IGCC availability data generally show a pattern of gradual improvements in most of the demonstrations. Despite the success of the demonstration projects, significant design issues have limited coal gasification units from achieving acceptable availability levels. Some of the design issues include fouling within the syngas cooler, design of the pressurized coal feeding system, molten slag removal from the pressurized gasifier, durability of gas clean-up equipment and solid particulate carryover resulting in erosion within the combustion turbine. The complexity of the combined-cycle unit in conjunction with the reliability of numerous systems including the gasifier, $O_2$ generator, air separation unit and multiple scrubbers tends towards reduced plant availability. The current generation of IGCC plants has demonstrated operational availability of around 75 percent compared to typical availability of greater than 90 percent for conventional pulverized coal units.

While conceptual "optimized" designs are now emerging, none have been built. One approach to ensuring high availability is the use of a spare gasifier. Having a spare gasifier enables higher availability, since the operation and maintenance of the units can be alternated. For example, Eastman Chemical Company has been operating a ChevronTexaco coal gasification system at its chemical plant in Kingsport, Tennessee since 1983. Operations are alternated between two 1,250 ton/day (bituminous coal) 1,000 psig gasifiers. The reported on-stream factor for September 2000 - September 2002 was 97 percent. However, this has an unfavorable impact to the capital cost. Another approach, which supports high power block availability, is to fire natural gas in the combustion turbines to replace the loss of syngas when gasifier capacity is reduced or lost. Unfortunately, the economics of this approach are subject to the volatility of natural gas prices—and possibly also to gas supply interruptions or unavailability.

Continuing efforts of the existing demonstration plant owners/operators and most of the gasification technology vendors have led to improvements in operations, maintenance, and design concepts. However, presently, gasification process reliability issues remain. IGCC plant availabilities are not yet comparable to the 90+ percent availabilities expected and required by modern electric power generating companies for competitive operation in the United States power market. Although the availabilities to date of the various IGCC demonstration projects reflect progress, long-term availabilities over 90 percent for single-train systems have not yet been achieved and remain to be demonstrated.

It is potentially feasible that multiple train IGCC plants could be constructed to produce approximately 660 MW—and some economies of scale should be realized with a large plant. However, such multi-train plants have not been demonstrated and, at this stage of the development and evolution of IGCC technology, the financial risks of building an IGCC plant have thus far prevented the project from proceeding beyond the planning stages. The addition of spare gasifiers to allow the IGCC to operate with 90+ percent availability and approach the standard of 90 percent annual capacity factor results in estimated capital costs and costs of producing electricity of about 30-35 percent higher than those estimated for PC plants.

Because of the availability and reliability concerns, and the fact that no coal-based IGCCs larger than the single-train 250-265 MW demonstration plants have been built in the United States, some financial institutions have been unwilling to finance IGCC projects. Recently, the Public Service Commission of Wisconsin ruled against a proposed IGCC plant (Wisconsin Energy Corporation, Elm Road) as being too expensive and unreliable to impose on the rate payers.

The ability to finance a project, and to obtain commercial performance and cost guarantees from the system providers has been a major hurdle. Over the past 2-3 years, the major gasification process vendors, and at least a few engineering/plant construction companies have been collaborating with the objective of developing improved IGCC designs, which address the above availability and cost issues. No gasification process vendors or IGCC suppliers have yet offered written guarantees regarding availability, however discussions are underway about how to structure a commercial IGCC package bid with the necessary guarantees/warranties. The complexity of IGCC makes this challenge very formidable.

Some in the utility industry, anticipate that a 2-year record (at least) of 92+ percent availabilities (plus demonstrated economics comparable to PC power plants) will be required to convince financial institutions that the risk in financing IGCC projects is comparable to that of PC projects.

A recently published review of DOE's Vision 21 Research and Development Program (Phase I) by the National Research Council (NRC—of the National Academies) came to a very similar conclusion about IGCC (DOE, May 2005). Specifically, the NRC concluded that "even if the projected cost of these plants reach the required levels, investors need confidence that these plants will run as designed, with availability levels in excess of 90 percent. The only way to achieve this is to build additional plants incorporating the necessary lower cost improvements and to allow extended periods for start up so the improved technologies can mature sufficiently to meet their goals. The pace of development and demonstration appears to be too slow to meet the goal of having coal gasification technology qualified for the placement of commercial orders by 2015" (NRC, 2003).

In its review, the NRC noted recent DOE/ NETL surveys of the market for gasification technologies which indicate that plant owners will require 90 percent availability for power production plants and 97 percent availability for chemical production plants. The DOE/NETL survey referred to reliability as gasification's "Achilles' Heel" (NRC, 2003).

Coal-fueled IGCC technology offers some potential advantages relative to environmental impacts and energy efficiency, and has a potential to be part of the long-term future for clean-coal generation within the United States. For this project, these perceived benefits do not offset the disadvantages of this technology associated with the reduced availability combined with the increased cost, increased financing difficulty, and the risks associated with initial application of a new technology.

IGCC offers some potential advantages relative to environmental impacts and energy efficiency. At the current stage of development however, the systems do not offer adequate reliability and are too costly on the basis of total cost ($/MWh) to meet AECI's needs.

#### 5.4.4.3 Pulverized Coal (PC)

Conventional PC technology is a reliable energy producer around the world and can be characterized by the maximum operating pressure of the cycle. Coal is supplied to the unit through coal bunkers, then to the feeders and into the pulverizers where the coal is crushed into fine particles. The primary air system transfers the coal from the pulverizers to the steam generator burners for combustion. Flue gas is transferred from the steam generator, through a selective catalytic reducer (SCR) for nitrogen oxides ($NO_x$) reduction and into an air heater. From the air heater the flue gas flows to a sulfur dioxide ($SO_2$) scrubber system and a particulate removal system.

The operating pressure of conventional coal-fired power plants can be classified as subcritical and supercritical. Subcritical and supercritical technology refers to the state of the water and steam that is used in the steam generation process. Subcritical power plants utilize pressures below the critical point of water in which there is a distinct difference in the state of the liquid. The majority of the steam generators built in the United States utilize subcritical technology. These units utilize a steam drum and internal separators to separate the steam from the water. In general, the steam cycle consists of one steam generator and one steam turbine generator. The balance of plant equipment consists of a condenser, condensate pumps, low-pressure feedwater heaters, deaerating feedwater heater, boiler feedwater pumps and high-pressure feedwater heaters.

The critical point of water is 3,208.2 pounds per square inch (psi) and 705.47 degrees Fahrenheit (°F). At this critical point, there is no difference in the density of water and steam. At pressures above 3,208.2 psi, heat addition no longer results in the typical boiling process in which there is an exact division between steam and water. The fluid becomes a composite mixture throughout the heating process. Supercritical units, which are slightly more expensive, are somewhat more efficient than subcritical units. AECI currently is proposing a supercritical boiler for this project.

The steam turbine exhausts to a condenser where the steam is condensed. The heat load of the condenser is typically transferred to a wet cooling tower system. The condensed steam is then returned to the steam generator through the condensate pumps, low-pressure feedwater heaters, deaerating heater, boiler feed pumps and high-pressure feedwater heaters. Some operating units utilize a closed feedwater system in lieu of a deaerating feedwater heater with a deaerating condenser included in the system.

## 5.5 REPOWERING/UPRATING OF EXISTING GENERATING UNITS

Repowering and uprating of existing generation units owned or operated by AECI is not practical or feasible. Each operating unit has been reviewed, and there is not a potential to uprate an existing plant or to repower an existing facility that would result in the required additional capacity. In addition, under EPA's current regulatory interpretations, repowering or up-rating a unit would potentially subject the facility to review in accordance with the New Source Review requirements. This reduces the potential economic advantages associated with improving existing facilities.

There are no repowering or up-rating opportunities on the AECI system that have the potential to satisfy the need for an additional 660 MW of capacity.

## 5.6 PARTICIPATION IN ANOTHER COMPANY'S GENERATION PROJECT

AECI considered participation in other units including one proposed by Kansas City Power and Light (KCP&L, a subsidiary of Great Plains Energy) referred to as Iatan 2, and Peabody Coal's Prairie State plant in Illinois. Participation in these units was thoroughly evaluated by AECI and considered by their Board of Directors. However, based on their determination that the "self build" option provided significant advantages regarding future dispatch requirements, compliance with future environmental regulations, and also offered better security for future energy prices and availability, the AECI Board rejected participation in these projects. No other projects were known to AECI where participation was an option and adequate generating capacity was available.

## 5.7 PURCHASED POWER

AECI continuously evaluates the power market for cost effective opportunities to meet the power supply obligations to its members. Historically, AECI did rely on long-term power purchase contracts as part of its resource mix. However, as wholesale electricity markets have become more deregulated, transmission constraints have increased and prices have become more volatile, purchase power has become increasingly less viable.

As noted, AECI's mission is to provide the lowest cost reliable power supply, with as much stability as possible, to its member owners. AECI has experienced situations where power supplied under long term contracts has not been reliable. Furthermore, "long term" in this market is less than 10 years and costs are high.

Additionally, as part of its planning process to meet its growing loads, AECI issued a Request for Proposal (RFP) to supply its needed capacity and energy. Only a few responses were received and none of them were as cost effective as the proposed project.

AECI has and continues to evaluate power markets for opportunities to supplement its generation portfolio. However, long term power supply agreements are too costly and too unreliable to be a viable alternative to the proposed project.

## 5.8 NEW TRANSMISSION CAPACITY

AECI has an excellent transmission system with a large number of interconnections with regional power suppliers. There are now new transmission capacity additions that in and of themselves would provide the needed power and energy. Furthermore, new transmission capacity was evaluated as part of the RFP mentioned in the previous section, which resulted in offers that were not competitive with the proposed project.

## 5.9 CAPACITY ALTERNATIVES SUMMARY

As part of its planning to meet the increasing capacity and energy demand on its system, AECI evaluated numerous supply alternatives. As a member-owned cooperative with contractual obligations to meet its member's requirements, certain options have very limited applicability. Of the potential capacity supply options, AECI considers IGCC and nuclear very promising but with far too much risk for a company of its size at this time. Renewable options are currently too costly, are not available in the AECI service territory, and are not viable for the needed capacity. Other options, such as purchased power and transmission capacity additions, are too costly and unreliable. The best alternative at this time for AECI to meet its growing loads is a 660 MW supercritical pulverized coal generating unit.

# 6.0 SITING ALTERNATIVES

This section describes the site selection process that Associated Electric Cooperative, Inc. (AECI) conducted in determining their proposed site for a proposed new 660 megawatt (MW) coal-based electric generating facility in Missouri.

The primary purpose of the site selection study is to identify the potential site for locating the new unit. Ultimately, the proposed site will be one that can accommodate a new 660 MW coal-based unit and also best meets the following general criteria:

- Satisfies the requirements and guidelines of the Rural Utilities Service (RUS)
- Minimizes adverse environmental and social impacts
- Possesses the necessary physical attributes such as size and topography
- Provides access to adequate fuel and water supplies, and transmission facilities
- Allows for economical construction and operation of the proposed generating station

For the proposed 660 MW unit, there are several critical elements that need to be considered in the siting process. These elements include:

- Land Area. The land area required for this type of facility requires a minimum of between 1,200-1,500 acres, depending on the topography, with a level site that is outside of a floodplain being the best choice. The proposed facility will include the power generating equipment, an on-site ash disposal facility, rail spur with a coal off loading area, a coal storage area, plus ancillary buildings and equipment.
- Water Source. The proposed coal-based generating unit will require water for steam condensation and other plant uses. An adequate, reliable water supply is essential for plant operation. For this proposed facility, rivers or lakes that can provide an annual average daily supply of 8 million gallons per day (mgd) [5,600 gallons per minute (gpm)] will be required. In Missouri, the primary water resources that can satisfy this need are the Missouri River and the Mississippi River.
- Rail Access. This proposed facility will burn coal coming from the Powder River Basin in Wyoming and delivered by train. Therefore, nearby rail access to interstate rail lines that can deliver coal in unit trains will be required, with the location of two nearby rail lines being optimal to maintain competitive fuel delivery costs.

- Class I Areas. Under the Prevention of Significant Deterioration (PSD) regulations promulgated in the Clean Air Act Amendments of 1977, maximum pollutant concentration increases (increments) were established for each criteria pollutant. These allowable increments are smallest for areas designated as Class I areas. In addition, there are restrictions with regard to visual impacts at a Class I area. As a general rule, visibility issues related to emission sources that are over 200 kilometers from a Class I area are not significant.
- Nonattainment Areas. Nonattainment locations are regions where ambient ground-level concentrations are higher than the National Ambient Air Quality Standards (NAAQS). Major metropolitan areas are the primary nonattainment areas. In Missouri, the St. Louis air quality control region is a nonattainment area. The Kansas City air quality control region is currently in attainment but it has had recent episodes of ozone levels that are close to nonattainment conditions. Therefore, it is best to locate the proposed facility and its emissions away from any nonattainment areas.

The identification and assessment of potential generation site areas for the project were based on the following four steps.

- Step 1 – Identify the scope of the project
- Step 2- Identify potential siting opportunities (alternatives) within the scope of the project
- Step 3 – Conduct field reconnaissance at the alternative areas to obtain and confirm information and identify potential individual sites with those areas
- Step 4 – Evaluate each potential site to assess its relative advantages and disadvantages
- Step 5 – Select the best site for the new unit

The following sections describe the previously completed siting studies, recent field reconnaissance of proposed sites, and evaluation of the final alternative sites.

## 6.1 PREVIOUS SITE SELECTION STUDIES

AECI continually evaluates its service area and the current and future demand for electricity to meets the needs of its cooperatives and their customers. As part of their evaluation of the current power production facilities and areas requiring increased capacity, AECI periodically identifies locations that are best suited for development of a generation resource. In 1981, AECI completed a site selection study to identify greenfield sites within Missouri for a new coal-based (1,200 MW) generating station. The study identified 18 potential sites which were evaluated using primary criteria such as water resources and fuel supply delivery as part of the initial screening to locate regions and then sites within those regions.

The full site selection process involved several phases of investigation and evaluation. Within each phase progressively more stringent criteria were applied, first to the siting regions and then to potential sites.

The site selection process followed the following four-step systematic approach. The studies:

1) Establish minimum evaluation criteria
2) Apply the criteria by using a series of overlays to designate favorable power plant siting regions within Missouri
3) Delineate potential generalized site locations within the siting regions
4) Use field reconnaissance information and available literature to evaluate the generalized site locations and designate candidate sites

Extensive map studies and research were conducted to identify potential site areas within the siting regions. The map studies included the application of evaluation criteria that included favorable air quality, available water resources, proximity to rail for fuel transport, and compatible land use in the siting regions. The results of this level of investigation identified three suitable regions in Missouri: the Southeast region, the West Central Region and the Northwest Region (Figure 6-1).

Field reconnaissance of the regions was then undertaken to obtain first-hand knowledge of present land use, recent changes that were not apparent on published topographic maps, residential density, agricultural use, access, drainage, ecological and geological observable conditions, and characteristics of the source rivers. This analysis resulted in the identification of seven siting areas within the three regions including:

- Southeast Region (Lusk and Wyatt areas)

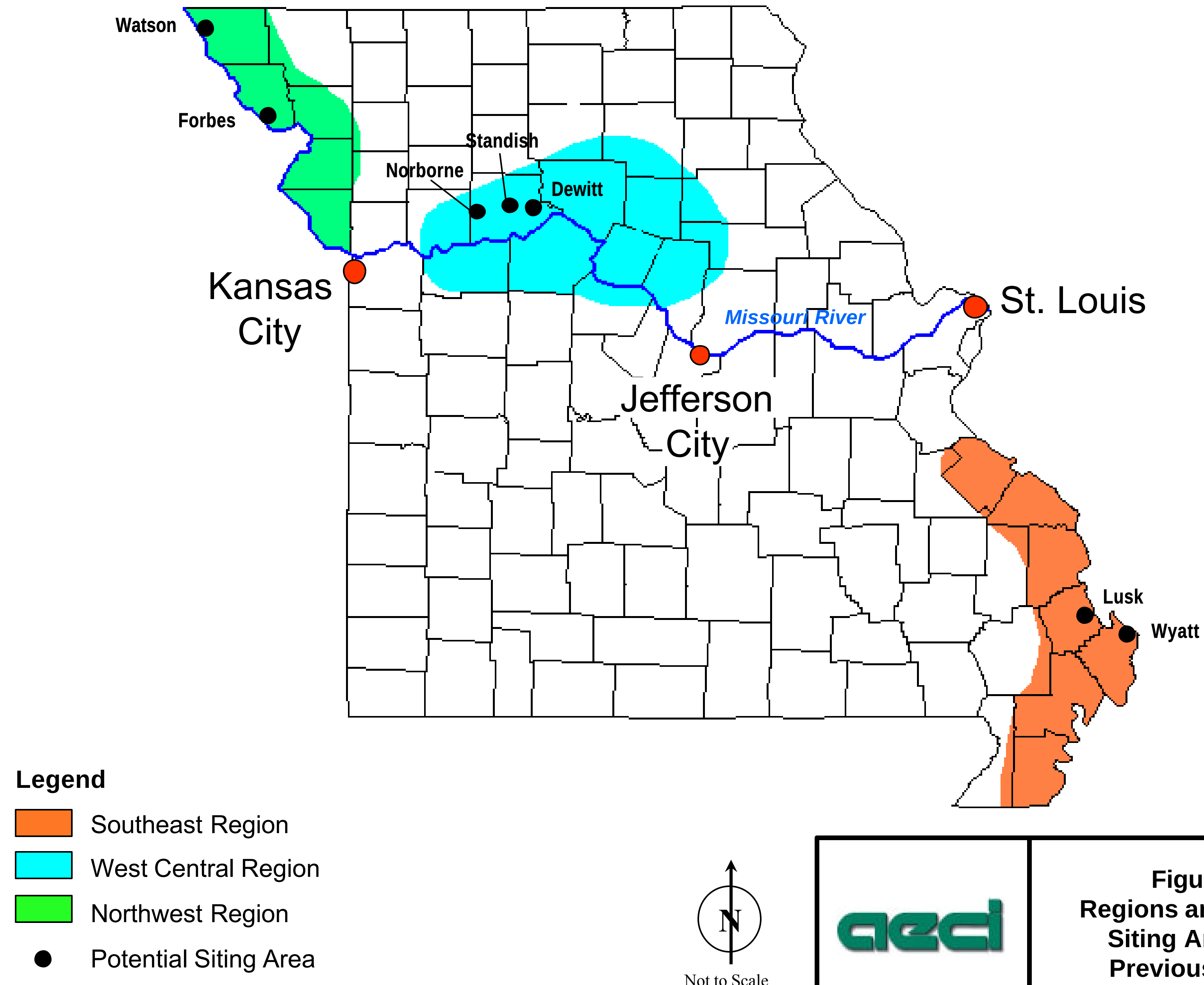



**Figure 6-1**
**Regions and Potential Siting Areas from Previous Studies**

- West Central Region (Dewitt, Norborne and Standish areas)
- Northwest Region (Forbes and Watson areas)

By early 2001, AECI had concluded that the additional generation its system would eventually need should be located in Northwest or West Central Missouri, along the Missouri River. This was based on projected loads, transportation of fuel, water availability and environmental considerations. The siting areas in Southeast Missouri (Lusk and Wyatt) were not considered further because they were located at a considerable distance from AECI's needed delivery points.

AECI also considered expansion of the existing Thomas Hill Power Plant, located in West Central Missouri in Randolph County, as a potential site. The possibility of adding a fourth unit at Thomas Hill was evaluated. AECI recognized the benefits of meeting its resource need by adding a fourth unit at the existing Thomas Hill Plant. However, three problems with the Thomas Hill site were identified. First, a detailed water supply study conducted by AECI's Engineer concluded that the current Thomas Hill Reservoir is inadequate to meet the water supply needs of an additional 660 MW power plant. Alternatives for additional water included raising the reservoir level and supplemental supplies from other regional water supplies. All the options considered were determined to be costly, not viable and/or result in substantial environmental impacts. Transmission and fuel transportation costs were also much higher for Thomas Hill.

The water supply constraints and higher transmission and fuel transportation costs were greater than the benefits of developing this project at an existing site. Therefore, Thomas Hill was eliminated from further consideration.

Having potential sites located in Northwest Missouri and in West Central Missouri provides AECI with the flexibility it needs for cost effective interconnections with its electrical transmission system in two general areas, maintaining separate geographic areas that positions AECI to receive competitive site costs, and provides for alternative areas to locate the proposed power plant if environmental constraints would limit development in one geographical area. From the West Central area sites going further west would be unacceptable because of the proximity to the Kansas City metropolitan area. Similarly from the Northwest area sites to the south would be unacceptable because of the proximity to Kansas City metropolitan area. Obtaining site permits for a power plant in or near Kansas City could be difficult if the metropolitan area air quality status changes to nonattainment for ozone or other parameters. As a result, AECI decided to investigate siting areas in the Northwest and West Central areas of Missouri.

As a first step in determining potential sites, eight siting areas were analyzed during 2004 (Figure 6-2). All of the sites were located in the Missouri River floodplain because of the increased costs associated with site development in the hilly terrain adjacent to the floodplain, obtaining water from the Missouri River or adjacent alluvial wells is cost beneficial to the plant operations because of the quantity and minimal costs associated with getting water to the plant, and a greater intrusion into the visual landscape if a power plant would be constructed in the upland areas rather than in the floodplain.

Of the eight sites, two are in the Northwest area and six in the West Central area. The eight sites were evaluated using criteria that included site topography, access, fuel transportation to the site, water supply, land use on site and adjacent, nearby sensitive resources or land uses, air quality, wetlands, and threatened/endangered species. Table 6-1 lists the sites and primary constraints for each of the sites.

## 6.2 IDENTIFICATION OF PROPOSED SITES

As noted in Table 6-1, all eight sites have a variety of constraints to proposed development of a power plant. None of the eight siting areas resulted in a location that was clearly above and beyond the other sites. Based on this analysis, AECI focused on the next step in the site selection process and focused on specific tracts of land that that could be assembled in the vicinity of the siting areas. This investigation resulted in the two sites, one near the Forbes siting areas and one near the Norborne siting areas (Figure 6-3). These two sites both are located in the floodplain and have good proximity to water supply from the Missouri River. The proposed Forbes site has good road access, nearby primary railroad and relatively isolated. The proposed Norborne site has good road access and has good proximity to primary and secondary rail access. Because of the better rail access, Norborne was identified as AECI's proposed site and Forbes as the alternate site.

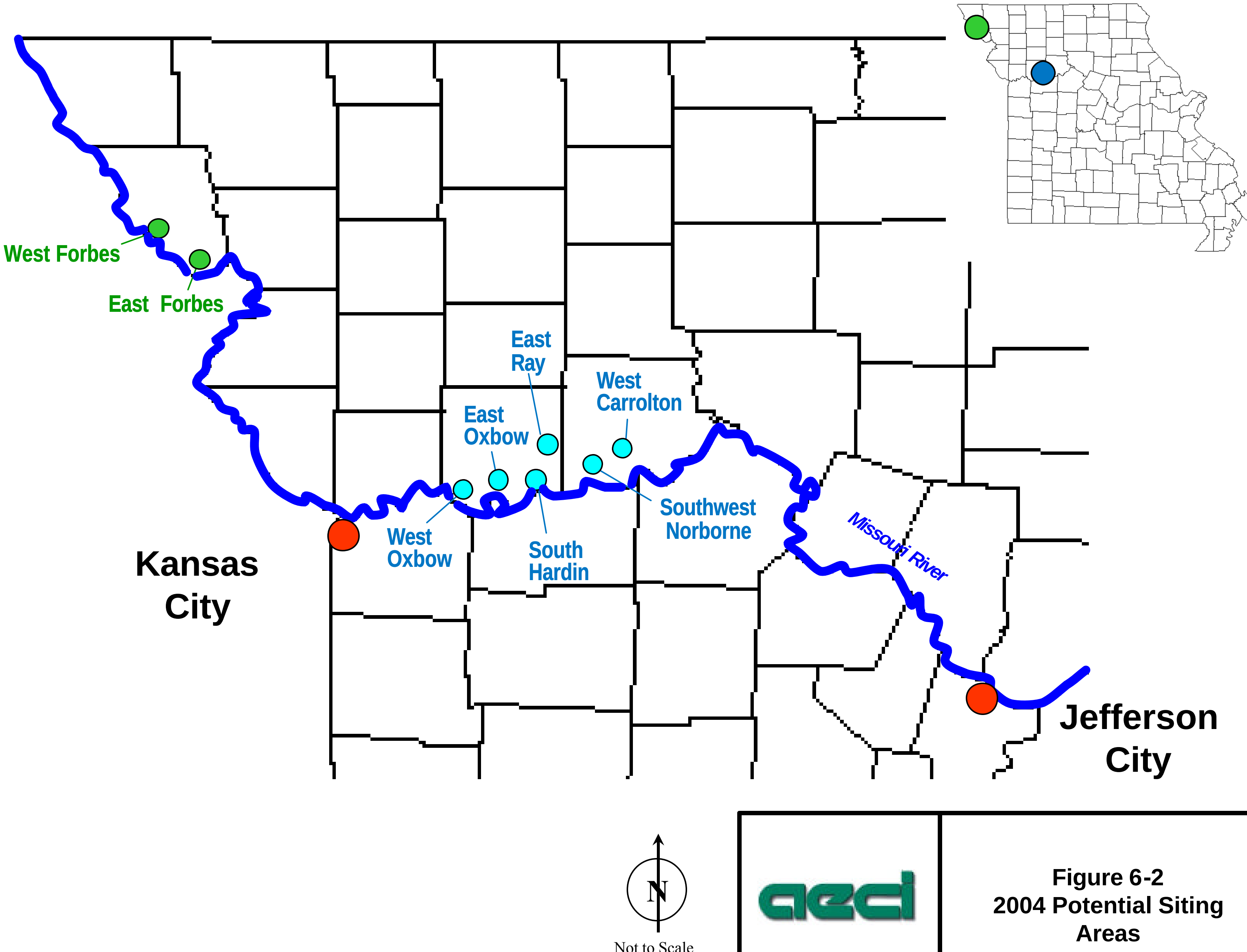
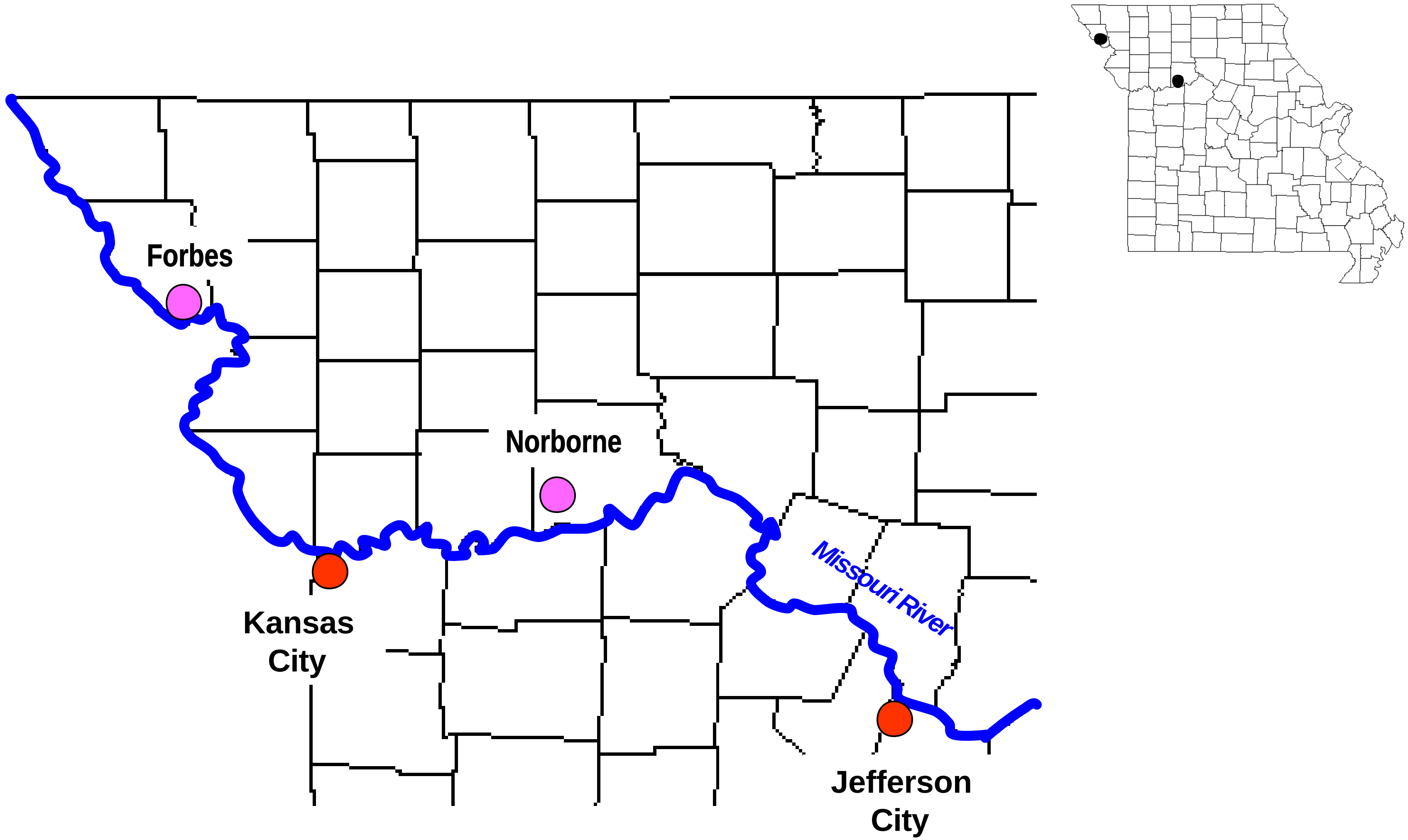



**Figure 6-2**
**2004 Potential Siting Areas**

## Table 6-1 2004 Site Analysis

| Site Constraints | East Forbes | West Forbes | West Carrolton | Southwest Norborne | East Ray | South Hardin | West Oxbow | East Oxbow |
|---|---|---|---|---|---|---|---|---|
| Floodplains | Site would have to be raised 16 feet with fill material | Site would have to be raised 11 feet with fill material | Siting area is in the floodplain but not behind a federal levee | Siting area is in the floodplain but not behind a levee and would have to be raised 13 feet with fill material | Siting area is in the floodplain but not behind a levee | Siting area is in the floodplain but not behind a levee and would have to be raised 16 feet with fill material | Siting area is in the floodplain but not behind a levee | Siting area is in the floodplain but not behind a levee |
| Railroads | Alternate rail access over 9 miles away and across the Missouri River | Alternate rail access over 12 miles away and across the Missouri River | Alternate Rail connection is 28 miles away | Alternate rail access over 23 miles away | Alternate rail connection is 16 miles away | Alternate rail is 13 miles away | -- | -- |
| Air | -- | -- | -- | -- | -- | Siting area is less than 17 miles from Jackson County (KC metro area) | Siting area is 3 miles from Jackson Co. (KC Metro area) | Siting area is 5 miles from Jackson Co. (KC Metro area) |
| Conservation Area | Siting area was less than 2 miles from a Missouri Conservation Area | Siting area was less than 0.8 miles from a Missouri Conservation Area | -- | -- | -- | -- | -- | -- |
| Wetlands | -- | -- | Potential to impact 15 acres of wetlands | Potential to impact 7 acres of wetlands | -- | -- | Potential to impact 20 acres of wetlands | Potential to impact 20 acres of wetlands |
| Towns | Siting area was less than 1 mile from the town of Forbes | -- | -- | Siting area is 1.5 miles from town of Norborne | Siting area is 2.4 miles from Hardin | Siting area is 3 miles from Lexington state historical site and 2.2 miles from the town of Hardin | Siting area is less than 1.6 miles to town of Fleming | Siting area is less than 0.6 miles to town of Camden |



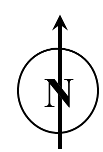




**Figure 6-3**
**Alternative Site Areas**

## 6.3 EVALUATION OF FINAL ALTERNATIVE SITES

### 6.3.1 Site Reconnaissance

Visits to the two sites were conducted in February and March of 2005. The purpose of this field reconnaissance was to obtain first-hand information about each site and its surrounding area. The field reconnaissance consisted of an automobile survey along public roads in the vicinity of each site. To the extent possible, each site area was assessed to:

- Confirm environmental information regarding presence or proximity to wetlands, floodplains, and topographic features
- Evaluate the site from constructability, access to transportation, and visibility standpoints
- Identify its proximity to existing development and sensitive noise receptors
- Confirm potential water supply sources
- Assess the likelihood of environmental impacts to historic structures, habitat suitable for threatened or endangered species, and receiving waterbodies water discharge
- Review potential routing for rail, transmission, and water infrastructure facilities

### 6.3.2 Evaluations

The two areas, Forbes and Norborne, were evaluated against a list of criteria designed to minimize adverse impacts to the environment, surrounding areas, and overall project viability. As the site areas were evaluated against the criteria, they were scored based on specific attributes. The attributes represented by the criteria are those that can help differentiate one site from another; attributes considered roughly equivalent for both sites were not included as evaluation criteria although they may be important considerations.

In total, 15 different criteria were used to evaluate the site areas. These criteria were organized into six major categories; three categories were further organized into 11 sub categories, and were allocated weights that totaled 100 percent. The evaluation categories, category weights, criteria, and composite weights were determined based on the professional judgment of an interdisciplinary team of engineers, biologists, and environmental scientists, and are summarized in Table 6-2. A detailed discussion of each of these criteria, which includes the rationale used to assign the ratings for each criterion and the resulting scores for each of the site areas, follows this table.

**Table 6-2 Site Evaluation Criteria**

| Major Category | Category Weight | Criterion | Composite Weight |
|---|---|---|---|
| Air Quality Impacts | 10% | Non-attainment areas | 10% |
| Fuel Supply | 20% | Rail Line Proximity<br>Competitive Rail Access<br>Railroad Considerations | 10%<br>6%<br>4% |
| Transmission | 20% | Proximity to Interconnection Point | 20% |
| Water Supply | 20% | Proximity to Source | 20% |
| Environmental | 20% | Land Use Compatibility<br>Protected Species Impacts<br>Noise Impacts<br>Wetlands Impacts<br>Floodplains Impacts<br>Cultural Resources Impacts | 2%<br>3%<br>6%<br>3%<br>3%<br>3% |
| Other | 10% | Site Accessibility<br>Land Availability<br>Constructability | 2%<br>4%<br>4% |

#### 6.3.2.1 Air Quality Impacts

The air impacts category was assigned a total weight of 10 percent. Ideally, the proposed generating facilities should be located on a site where air quality conditions are favorable. Favorable air quality conditions at a given potential site area are those where a construction permit and operation permit for air emissions from the proposed generating units can be obtained in a timely manner without significant permit conditions or other restrictions. The relative attractiveness of the sites with regard to air quality are generally based on the assessment of air quality attainment status or its location relative to a Class I area, and the potential impacts the proposed facility may have on nearby Class I areas.

The Clean Air Act Amendments of 1977 resulted in establishment of the Prevention of Significant Deterioration (PSD) regulations. Under these regulations, maximum pollutant concentration increases (increments) were established for each criteria pollutant. These allowable increments are most restrictive (lowest) for Class I areas. Congress designated all National parks and monuments over 6,000 acres in size a Class I area. Over time, wilderness areas and similar areas meeting the specified criteria have been designated Class I. These include areas managed by the National Park Service (NPS), U.S. Forest Service (USFS), and the U.S. Fish and Wildlife Service (USFWS), plus some Native American land. Typically, the distance that air modeling must consider impacts is 200 kilometers (km). There are no Class I areas located within 200 km of either site. However, two Class I areas are present in the state of Missouri. These are the Hercules-Glades Wilderness Area and the Mingo National Wildlife Refuge (NWR). Hercules-Glades is located in Taney County in southwestern Missouri near Arkansas state line. Mingo NWR is located on the border of Wayne and Stoddard counties in southeastern Missouri.

Under the CAA, Federal Land Managers (FLM) were given the responsibility to protect the natural and cultural resources of Class I areas from the adverse impacts of air pollution. FLM responsibilities include the review of air quality permit applications from proposed new or modified major pollution sources near Class I areas. If, in their review, an FLM demonstrates that emissions from a proposed source will cause or contribute to adverse impacts on the air quality related values (AQRV) of a Class I area, the permitting authority, typically the State, can deny the permit.

The FLMs' AQRV Work Group (FLAG) was established to develop a more consistent approach for the FLM to evaluate air pollution effects on their resources. Specifically, a more consistent approach in the review of the New Source Review (NSR) program, especially in the review of PSD regulations of air quality permit applications. The goal of FLAG is to provide consistent policies and processes for identifying AQRVs and for evaluating the effects of air pollution on AQRVs, primarily those in Class I areas. FLAG members include representatives from the three FLMs that administer the Class I areas; the USFS, the NPS, and the USFWS. The primary areas of concern are visibility impairment, ozone effects on vegetation, and effects of pollutant deposition on soils and surface waters.

Section 165 of the CAA requires the EPA or State permitting authority, to notify the FLM if emissions from a proposed project may impact a Class I area. Generally, the permitting authority should notify the FLM of all new or modified major facilities proposing to be located within 100 km of a Class I area or, additionally, "very large sources" with the potential to affect Class I areas located at greater distances than 100 km. The process of FLM permit review would include a pre-application meeting with the permitting authority and the applicants to discuss air quality concerns for the specific Class I area potentially impacted, share preliminary information, and advise the applicant of analyses needed to assess the potential impacts on these resources. Upon conducting all of the necessary air quality impact analyses, a completeness determination would be completed by the permitting authority, and notification provided to the FLM. The process will then include a public comment period. Following the review process, the FLM will make one of the four following determinations:

- No Class I Increment Violated and No Adverse Impacts
- No Class I Increment Violated but AQRV Impact Uncertainty
- Class I Increment Violated but No Adverse AQRV Impacts
- Adverse Impact Determination

Nonattainment areas occur where ambient ground-level concentrations of one or more criteria pollutants are higher than the National Ambient Air Quality Standards (NAAQS). The criteria pollutants are ozone ($O_3$), carbon monoxide (CO), nitrogen dioxide ($NO_2$), $SO_2$, particulate matter (PM), and lead (Pb). Neither of the sites is located in a nonattainment area. However, portions of Missouri are nonattainment for lead and ozone. A portion of Jefferson County and an area within the city limits of Herculaneum, Missouri are in nonattainment for lead. Jefferson County is the county located just south of the St. Louis area and the city of Herculaneum is located within Jefferson County. Jefferson County, Franklin County, St. Charles County, St. Louis County, and the city of St. Louis are all in nonattainment for ozone. All of the counties are located on the eastern border of the State, surrounding and within the St. Louis metropolitan area.

Both of the sites are located in attainment areas for all air criteria pollutants. In addition, the Metropolitan Kansas City Interstate Air Quality Control Region (AQCR) is currently in attainment. However, in recent years, the Metropolitan Kansas City AQCR has had occasional exceedances of the ozone standard, but not enough to push it into nonattainment status. Both Forbes and Norborne sites are outside of the Kansas City AQCR. Therefore, there should be no significant obstacles to obtaining an air emissions permit at either of the sites. As a result both of the sites were assigned a score of five. Since air quality impacts are not considered a decisive concern because these sites are located in attainment areas, this criterion was assigned a weight of ten.

**Forbes Site**

The Forbes site area is located in Holt County, Missouri which is in attainment for all criteria air pollutants. The Forbes site is located approximately 235 miles (375 km) to the northwest of the edge of the nearest nonattainment area (St. Louis metropolitan area). The nearest Class I area is Hercules-Glades, approximately 270 miles (430 km) from the site. Therefore, the Forbes site is not expected to have a significant impact on Class I air quality or visibility. There should be no significant obstacles to obtaining an air permit at this site. The site was given an air impact rating five.

**Norborne Site**

The Norborne site area is located in Carroll County, Missouri, which is in attainment for all criteria air pollutants. The Norborne site is located approximately 135 miles (215 km) to the northwest from the edge of the nearest nonattainment area (St. Louis metropolitan area). As with the Forbes site, the Hercules-Glades, which is located approximately 188 miles (300 km) to the south, is the nearest Class I area to the Norborne site. Mingo Swamp Class I area is located approximately 250 miles (400 km) to the southwest of the site. Therefore, the Norborne site is not expected to have a significant impact on Class I air quality or visibility. There should be no significant obstacles to obtaining an air permit at this site. The air impact rating for this site is five.

### 6.3.2.2 Fuel Supply

The fuel supply category, which was assigned a total weight of 20 percent, is comprised of three component evaluation criteria. These criteria are described in the following paragraphs.

#### 6.3.2.2.1 Rail Line Proximity

Rail delivery of coal is the only practicable option for this project. In addition, construction techniques and economics favor delivery of power plant components in large prefabricated modules. Transport of these large and/or heavy components to a site is practical over long distances only by rail or barge. However, the Missouri River is not navigable for all seasons of the year at these points along the river[1]; therefore, barges would not be a practical delivery mode for the fuel supply for these sites.

The ideal site for this criterion would be one that is located adjacent to an existing rail line. To reduce economical and environmental impacts from rail line construction, the ratings for this criterion were assigned based on the distance from the site to a potential rail line using the scoring criteria listed below.

- Existing on-site rail spur → Score = 5
- Distance ≤ 5 miles → Score = 4
- 5 miles < Distance ≤ 10 miles → Score = 3
- 10 miles < Distance ≤ 15 miles → Score = 2
- Distance > 15 miles → Score = 1

Following is a description of the rail line proximity and associated scores for each site.

**Forbes Site**

The nearest rail access for the Forbes site is from an existing Burlington-Northern Santa Fe Railroad (BNSF) line located just north of U.S. Highway 159 which borders the site. This site would require the construction of approximately four miles of rail spur and coal unloading loop to connect the proposed generation facility to the existing BNSF line. The rail spur will require a crossing of U.S. Highway 159. There is one residence within a quarter mile of the proposed rail route. The rail proximity rating for this site is a score of four.

[1]According to the U.S. Army Corps of Engineers, Northwestern Division, 1998 System Description and Operation for the Missouri River Basin, the Missouri River navigation channel extends for 734.8 miles from near Sioux City, Iowa (River Mile 732.3) to the mouth near St. Louis, Missouri (River Mile 0). Navigation on the Missouri River is limited to the normal ice-free season with a full length season normally extending from April 1 to December 1 at the mouth.

**Norborne Site**

The nearest rail access for the Norborne site is from an existing BNSF line located approximately 1.5 miles to the south of the site. However, the BNSF, is a principal Intermodal/Automotive Business Units rail line and is dedicated to this type of high speed intermodal traffic. This type of designated rail line may be unavailable and incompatible for delivery of fuel.

The second nearest rail line to the site is a Norfolk Southern Railroad line approximately 1.5 miles to the south. This line runs parallel to and south of the BNSF line. Routing of the rail spur from this line to the proposed power plant would require the rail spur to exit to the south, creating the need for an approximately 400 foot bridge over this line and the existing BNSF line. Total track length for the connection would be approximately 3.5 miles (including the rail spur and coal unloading loop), and would also require an at-grade road crossing of State Road DD and a crossing of the Norborne Drainage Ditch. There are no residences within a quarter mile of this alternate rail route. The rail proximity rating for this site is a score of four.

#### 6.3.2.2.2 Competitive Rail Access

In order to secure the most competitive delivery rates for coal, it is advantageous to locate a generating station where it can be served by more than one rail carrier or multiple delivery modes. The scores for this criterion were assigned based on the distance from the site to the second closest delivery option and the constructability (both from an economical and feasible comparison) of a rail spur to the competing carrier. To reduce economical and environmental impacts from rail line construction, the ratings for this criterion were assigned based on the distance from the site to a potential secondary rail line using the scoring criteria listed below.

- Existing on-site rail spur → Score = 5
- Distance ≤ 5 miles → Score = 4
- 5 miles < Distance ≤ 10 miles → Score = 3
- 10 miles < Distance ≤ 15 miles → Score = 2
- Distance > 15 miles → Score = 1

Sites with a second rail carrier are downgraded if a major river must be crossed to access a second rail carrier or has an unfavorable economic or engineering constraint. Following is a description of the competitive rail access and associated scores for each site.

**Forbes Site**

The nearest rail line owned by a competing carrier is an existing Union Pacific (UP) line located approximately 10 miles to the west of the site in Nebraska. The total track length required for a connection to the UP line would be approximately 15 miles (including an approximately 3-mile long coal unloading loop). This connection would require a bridge over the Missouri River and would cross portions of the Iowa Sac and Fox Indian Reservation. This alternative would also require several at-grade road crossings and several river crossings, including Walnut Creek, Snake Creek, Big Nemaha River, and Mooney Creek. Figure 6-4 illustrates the location of the existing rail lines relative to the Forbes site. There are 10 residences within a quarter mile of the alternate rail route. The competitive rail access rating for this site is a score of one for having to construct a bridge over the Missouri River and crossing portions of an Indian Reservation.

**Norborne Site**

In addition to the BNSF located south of the site, there is also another BNSF line located approximately 7 miles to the north of the site that could be considered for competitive rail. Two alternate rail spur routes have been identified to connect the proposed power plant with the northern BNSF line.

Alternate 1 would roughly follow north of the West Fork of the Wakenda Creek. This alternate would require approximately 7.2 miles of new track, plus an additional 1.5-mile rail spur and coal unloading loop. The proposed rail spur route would require three at-grade road crossings, including County Road (CR) 636, CR 634 and State Road AA. Additionally, the rail spur would cross the West Fork of the Wakenda Creek and approximately five smaller drainages. Approximately 14 residences are located within a quarter mile of this alternate route.

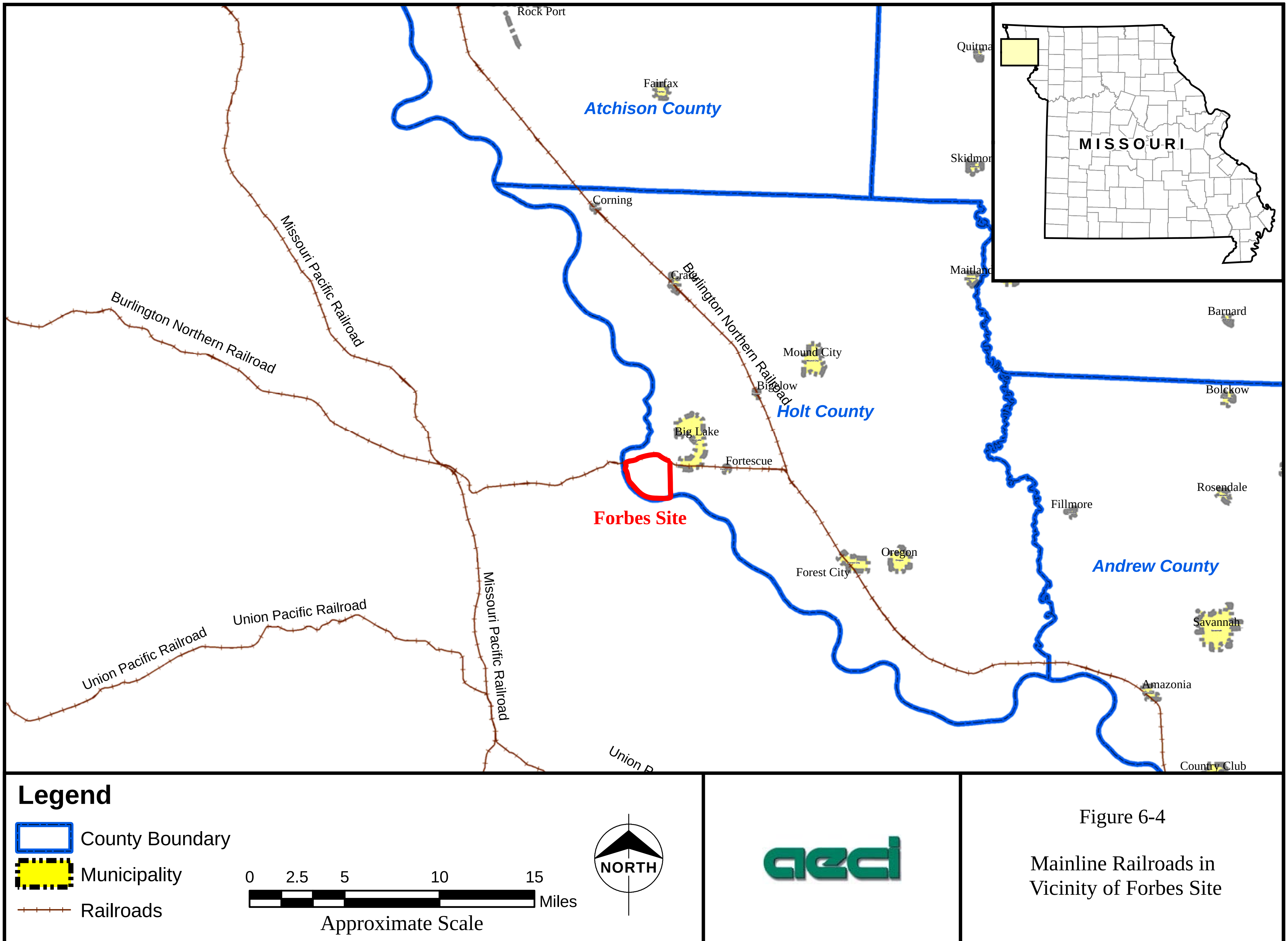



Figure 6-4

Mainline Railroads in Vicinity of Forbes Site

Alternate 2 would roughly follow a route south of Wakenda Creek and would require approximately 6.8 miles of new track, plus an additional 1.5-mile rail spur and coal unloading loop. The proposed rail spur would require seven at-grade road crossings, including CR 636, CR 630, CR 605, CR 624, CR 620, CR 603, and State Road JJ. Additionally, the rail spur would cross the West Fork of the Wakenda Creek and approximately seven smaller drainages. Approximately three residences are within a quarter mile of this alternate route. Figure 6-5 shows the location of the existing rail lines relative to the Norborne Site.

The competitive rail access rating for this site is a score of three since the closest BNSF rail is not feasible and the second BNSF rail is approximately 7 miles away.

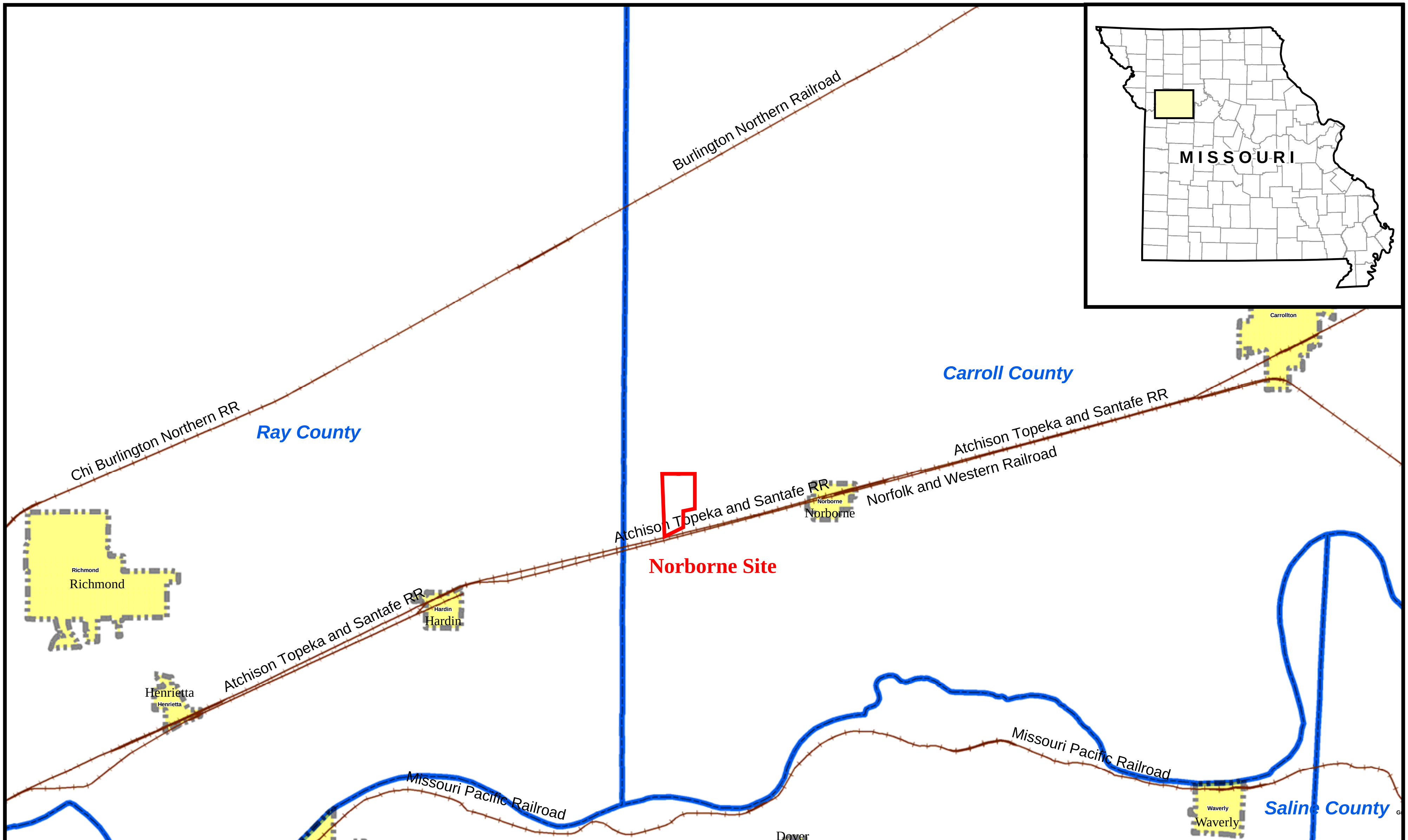
#### 6.3.2.2.3 Railroad Considerations

Following the determination to use railway delivery for the fuel supply, construction of a railroad spur to connect with a mainline railroad would be required for either of the proposed power plant sites. After identification of the railroads within the proximity of the proposed sites, a more defined pathway for the railroad spur alternatives, or macro-corridors, were developed. The railroad macro-corridors relative to the Forbes site are located in Holt County, Missouri and Richardson County, Nebraska. Railroad corridors relative to the Norborne site include Ray and Carroll counties in Missouri. The railroad macro-corridors are approximately one-mile-wide corridors established for each alternative that will ultimately contain more specific railroad spur alignments.

The primary considerations in developing macro-corridors are:

- Presence of residences
- Terrain
- Crossings of the existing tracks, major roadways, or major rivers that would require construction of a bridge

In general, opportunities to connect with a mainline railroad with the shortest distance, with flat topography, avoidance of residences, and no major river crossings requiring bridges would be considered ideal. Terrain was a major consideration during the development of the macro-corridors. Abrupt changes in terrain would result in several constraints, including




## Legend

- County Boundary
- Municipality
- Railroads

0 1 2 4 6 Miles

Approximate Scale

NORTH

aeci

Figure 6-5

Mainline Railroads in Vicinity of Norborne Site added length of the spur required to design a gradual slope, more land disturbance, and greater potential impacts to existing natural and human resources. Additionally, the macro-corridors were sited to minimize potential environmental impacts to existing natural and human resources, and make use of potential opportunity areas, where practicable.

Secondary considerations include:

- Presence of threatened and endangered species and their habitat
- Conservation areas, parks, and refuges
- Presence of wetlands
- Large transmission line right-of-ways

Impacts to a threatened, endangered or otherwise protected species would be considered very serious and probably represent a fatal flaw to route development. A list of Federal and state threatened and endangered species located in the known range of the macro-corridors was obtained specific to the county level in Missouri; however, only the federally listed species specific to the county level is available in Nebraska. The state listed species list for Nebraska was evaluated for species that could potentially be located in Richardson County. Of the total 29 Federal and state threatened and endangered species known to occur in the state of Nebraska, 19 could potentially be found in Richardson County. Table 6-3 summarizes the lists for each of the counties where the corridors are located.

For the Norborne site (Ray and Carroll counties in Missouri), there are four threatened and no endangered species within the known range of the macro-corridors. For the Forbes site (Holt County, Missouri and Richardson County, Nebraska), there are seven threatened and nineteen endangered species within the known range of the macro-corridors. In order to verify the presence of any potential habitat for any of the species at the site, a habitat survey would need to be conducted.

Typically, railroads are not considered compatible uses within conservation areas, parks, and refuges managed for resource conservation. Routing the railroad spur through these lands would create adverse impacts, additional permitting

## Table 6-3 Threatened and Endangered Species – Carroll, MO, Ray, MO, Holt, MO, and Richardson, NE Counties

| Common Name | Scientific Name | State Status | Fed. Status | Counties | | | |
|---|---|---|---|---|---|---|---|
| | | | | Carroll, MO | Ray, MO | Holt, MO | Richardson, NE |
| American bittern | *Botaurus lentiginosus* | E | | | | ✓ | |
| American burying beetle | *Nicrophorus americanus* | E | E | | | | ✓ |
| Bald eagle | *Haliaeetus leucocephalus* | T | T | ✓ | | ✓ | ✓ |
| Blanding's turtle | *Emydoidea Blandingii* | E | | | | ✓ | |
| Blacknose shiner | *Notropis heteropis* | E | | | | | ✓ |
| Eastern massasauga | *Sistrurus catenatus catenatus* | E | | | | ✓ | |
| Finescale dace | *Phoxinus neogaeus* | T | | | | | ✓ |
| Flathead chub | *Platygobio gracilis* | E | | | | ✓ | |
| Indiana bat | *Myotis sodalist* | E | E | ✓ | ✓ | ✓ | |
| Interior least tern | *Sterna antillarum athalassos* | E | E | | | | ✓ |
| Ginseng | *Panax quinquefolium* | T | | | | | ✓ |
| Greater prairie-chicken | *Typmanuchus cupido* | E | | ✓ | | | |
| Lake sturgeon | *Acipenser fulvescens* | E | | ✓ | | | |
| Lake sturgeon | *Acipenser fulvescens* | T | | | | | ✓ |
| Massasauga | *Sistrurs catenatus* | T | T | | | | ✓ |
| Northern harrier | *Circus cyaneus* | E | - | ✓ | | | |
| Northern redbelly dace | *Phoxinus eos* | T | | | | | ✓ |
| Pallid sturgeon | *Scaphirhynchus albus* | E | E | | | ✓ | ✓ |
| Piping plover | *Charadrius melodus* | T | T | | | | ✓ |
| River otter | *Lutra canadensis* | T | | | | | ✓ |
| Scaleshell mussel | *Leptodea leptodon* | E | E | | | | ✓ |
| Small white lady's slipper | *Cypripedium candidum* | T | | | | | ✓ |
| Southern flying squirrel | *Glaucomys volans* | T | | | | | ✓ |
| Sturgeon chub | *Macrhybopsis gelida* | E | | | | | ✓ |
| Topeka shiner | *Notropis topeka* | E | E | | | | ✓ |
| Western fox snake | *Elaphe vulpina vulpina* | E | | | | ✓ | |
| Western prairie fringed orchid | *Platanthera praeclara* | E | T | | | ✓ | |
| Western prairie fringed orchid | *Platanthera praeclara* | T | T | | | | ✓ |
| Whooping crane | *Grus americana* | E | E | | | | ✓ |

Source: Missouri Department of Conservation, 2005, U.S. Fish & Wildlife Service, 2005, Nebraska Game and Parks Commission, 2005

E – Endangered; T – Threatened

requirements, and project delays. Construction of the railroad spur within the corridor could involve construction within wetlands, increasing environmental impacts, complexity, and cost of the project. In addition, locating the railroad spur across a large transmission line right-of-way could require major design considerations and should be avoided, if possible. A description of the railroad considerations for each site, followed by a summary of the associated scores for each site, is provided below.

## Forbes Site

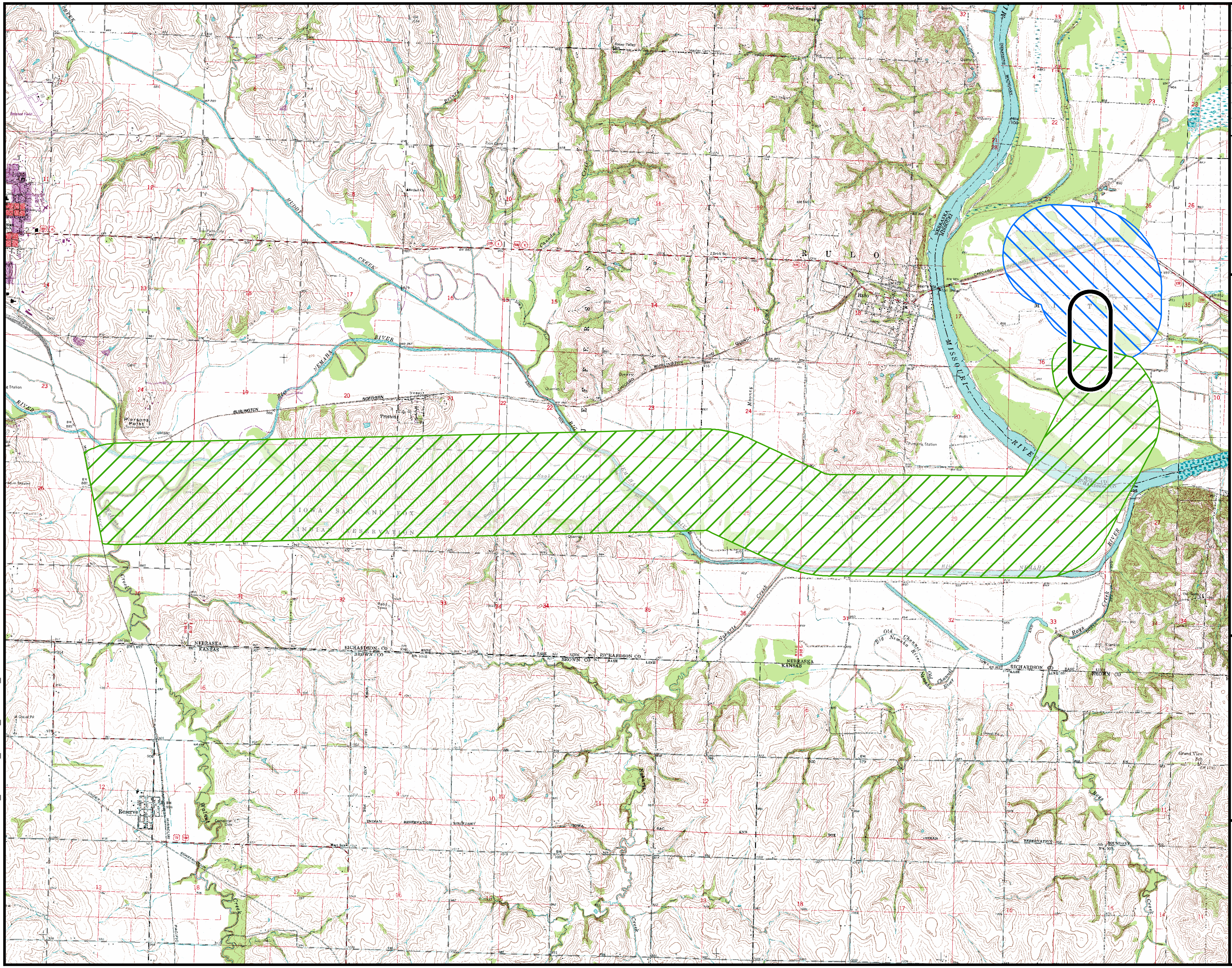
To facilitate the identification of feasible corridors for a new railroad spur to interconnect with the one of the two mainline railroad alternatives from the proposed Forbes Site, two corridors were established based on the environmental and engineering feasibility of constructing the route. There are two mainline railroads located in proximity to the Forbes site. The nearest rail access from the Forbes site is the existing BNSF railroad (Alternative 1) located directly north of the facility. The nearest competing rail access would be the Union Pacific (UP) (Alternative 2) located in Nebraska to the west (Figure 6-6). A description of the macro-corridors identified and the rationale for the development of these particular corridors are provided in the following sections.

### *Forbes to Burlington Northern Santa Fe Railroad (Alternative 1)*

The macro-corridor identified between the proposed Forbes site and the BNSF railroad is approximately four miles in length (Figure 6-7) and would include the area directly north of the plant site to the railroad. The corridor would include portions of Sections 26, 27, 34, 35, in Township 61 North, Range 40 West and Section 16 in Township 1 North, Range 18 East in Holt County, Missouri.

While there are no towns located in the corridor, there are several rural residences in the area with most of the residences located along the county roads and U.S. Highway 159. There is one rural residence located within the one-mile corridor, located adjacent to the centerline of the corridor.

Topography within the corridor is relatively flat. Elevations range from 855 feet to 870 feet. The corridor would allow a direct route from the mainline to the plant site with minimal slope.





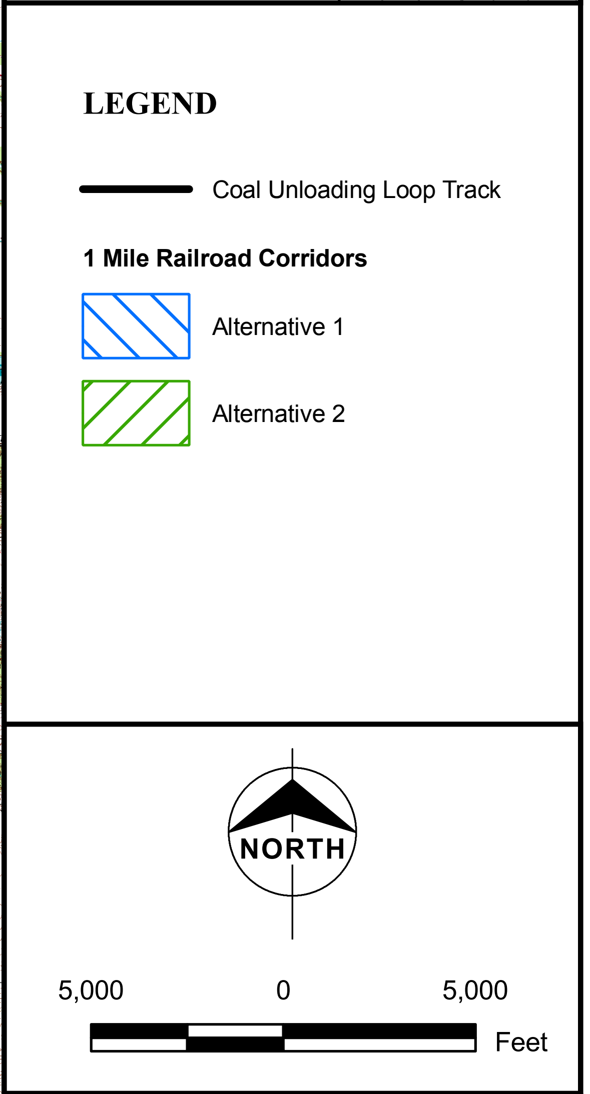



**Figure 6-6**
Associated Electric Cooperative, Inc.
650 MW Coal-Based Power Plant
Forbes Site
Railroad Macro-Corridors

Source: USGS 1:24,000 Topographic Quadrangles: Falls City, Rulo, Big Lake, Reserve, Highland NW, White Cloud.

Revised June 23, 2005

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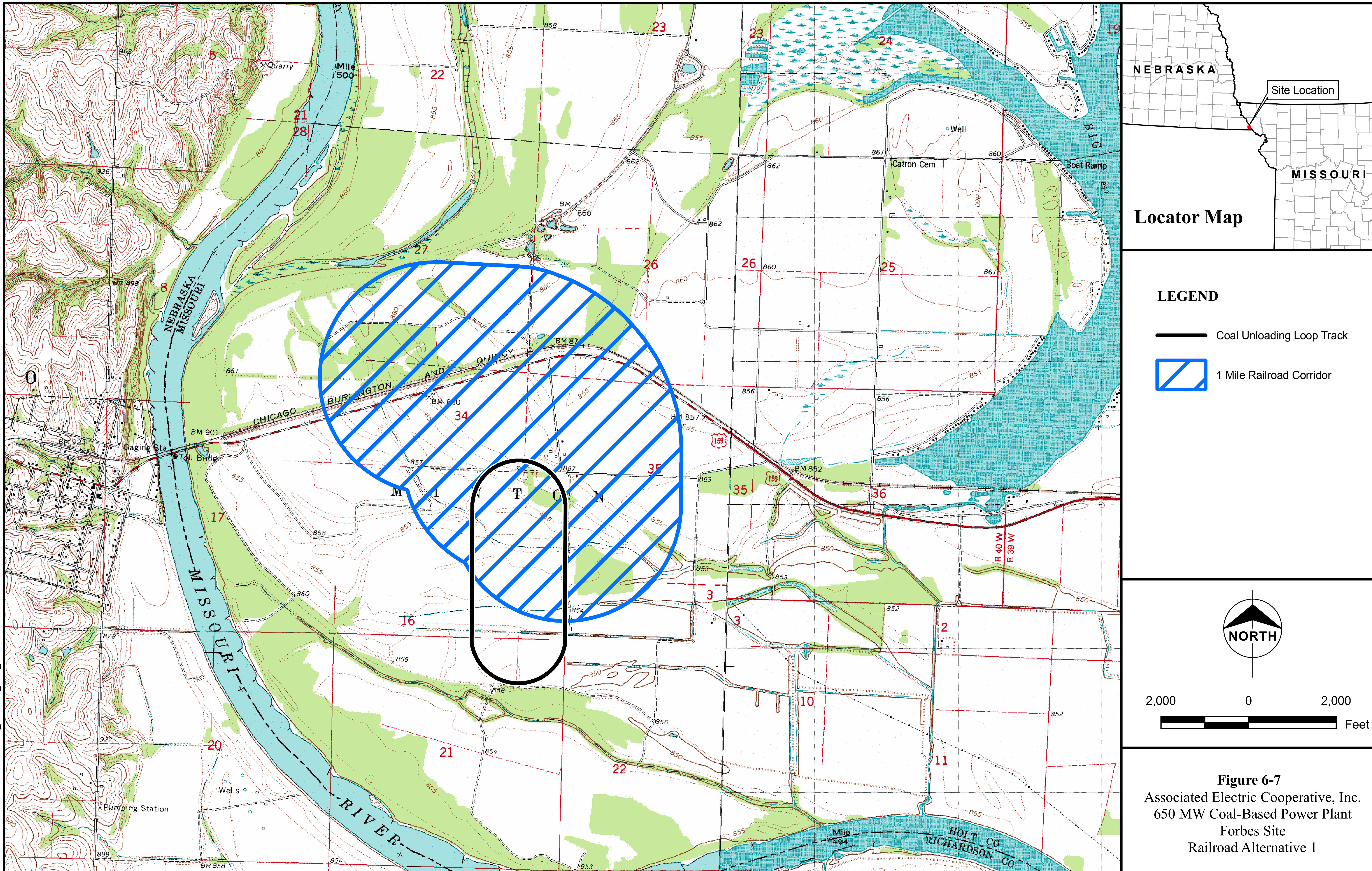


**Figure 6-7**
Associated Electric Cooperative, Inc.
650 MW Coal-Based Power Plant
Forbes Site
Railroad Alternative 1

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Source: USGS 1:24,000 Topographic Quadrangles: Rulo, Big Lake.

Revised June 23, 2005

There are no major river crossings necessary to connect with the BNSF railroad. US Highway 159 parallels the BSNF on the south side of the railroad and is adjacent to the Forbes site. A rail spur connection to the BSNF would most likely require a bridge crossing over U.S. Highway 159.

There are no conservation areas, parks, and refuges located within or near the one-mile corridor.

There are 86 acres of wetlands consisting of (emergent (28 acres), forested (21 acres), scrub-shrub (36 acres), and palustrine unconsolidated bottom (1 acre) located within the macro-corridor (Figure 6-8). It is possible that construction of the spur within the corridor would involve construction within wetlands.

One transmission line (345 kV) crosses the macro-corridor and a crossing of the right-of-way would be unavoidable. The 2002 NESC and the RUS Bulletin, revised September 1992, would require specific design clearance of 31.5 feet over a railroad track. In conclusion, there are few major constraints between the Forbes site and the BNSF Railroad.

***Forbes to Union Pacific Railroad Macro-Corridor (Alternative 2)***

The macro-corridor identified between the proposed Forbes site and the UP railroad is approximately 15 miles in length (Figure 6-9). The corridor would follow a route south across the Missouri River then turn westerly, crossing the Nemaha River and towards the UP railroad. The corridor would include portions of Sections 21, 22, Township 1 North, Range 18 East in Holt County, Missouri; Sections 27, 28, 29, 30, 31, 32, and 33, Township 1 North, Range 18 East; Sections 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, and 30, Township 1 North, Range 17 East; and Sections 23, 24, 25, and 26, Township 1 North, Range 16 East in Richardson County, Nebraska.

There are no towns located in the corridor; however, there are 10 rural residences within the one-mile corridor. An effort was made to avoid residences; however, 7 are within one-quarter mile of the center line. Most rural residences in the area are located along the county roads.

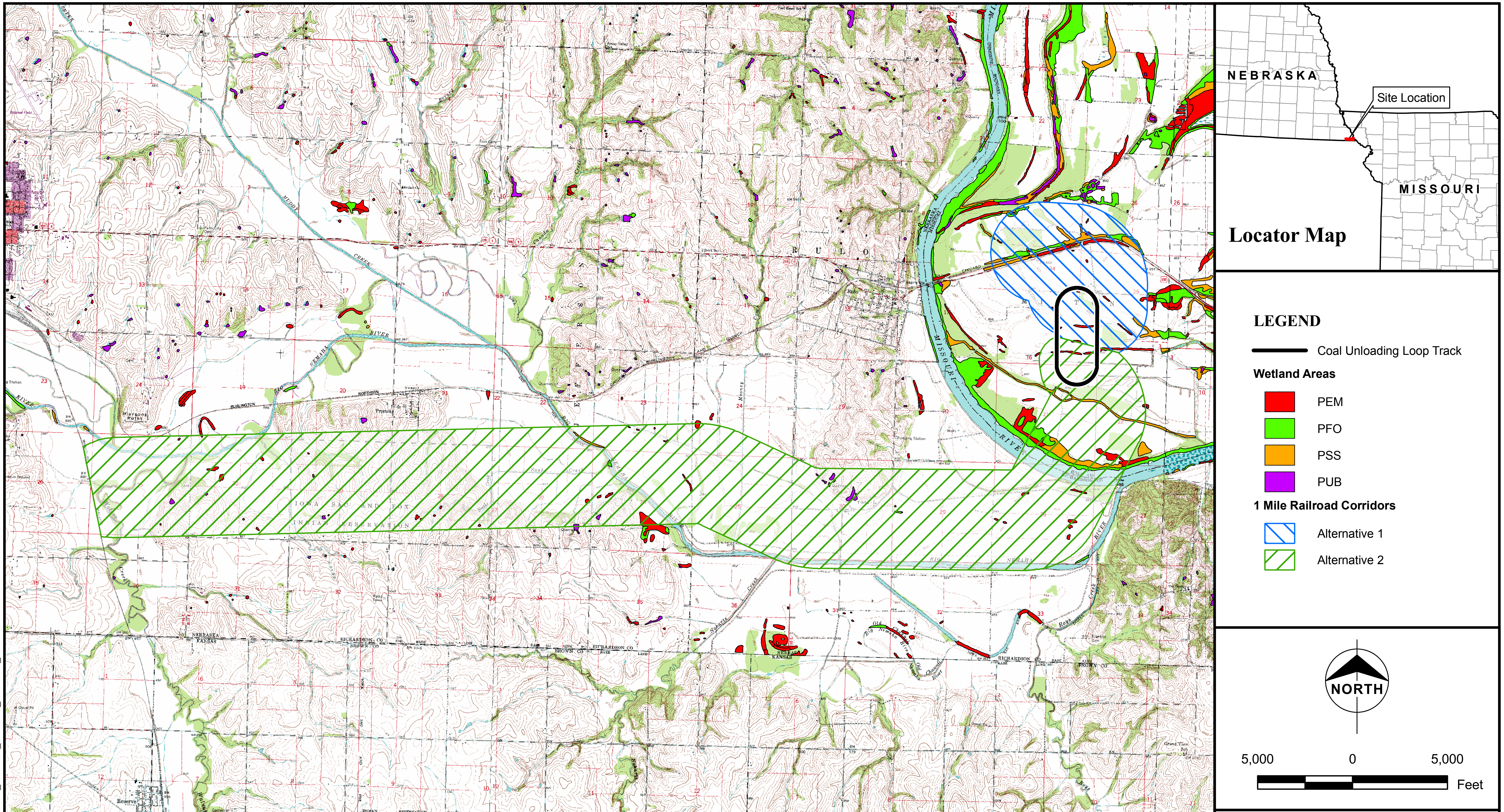


**Figure 6-8**
Associated Electric Cooperative, Inc.
650 MW Coal-Based Power Plant
Forbes Site
Railroad Macro-Corridors
and NWI Wetlands

Source: USGS 1:24,000 Topographic Quadrangles: Falls City, Rulo, Big Lake, Reserve, Highland NW, White Cloud; USFWS NWI Wetlands.

Revised June 23, 2005

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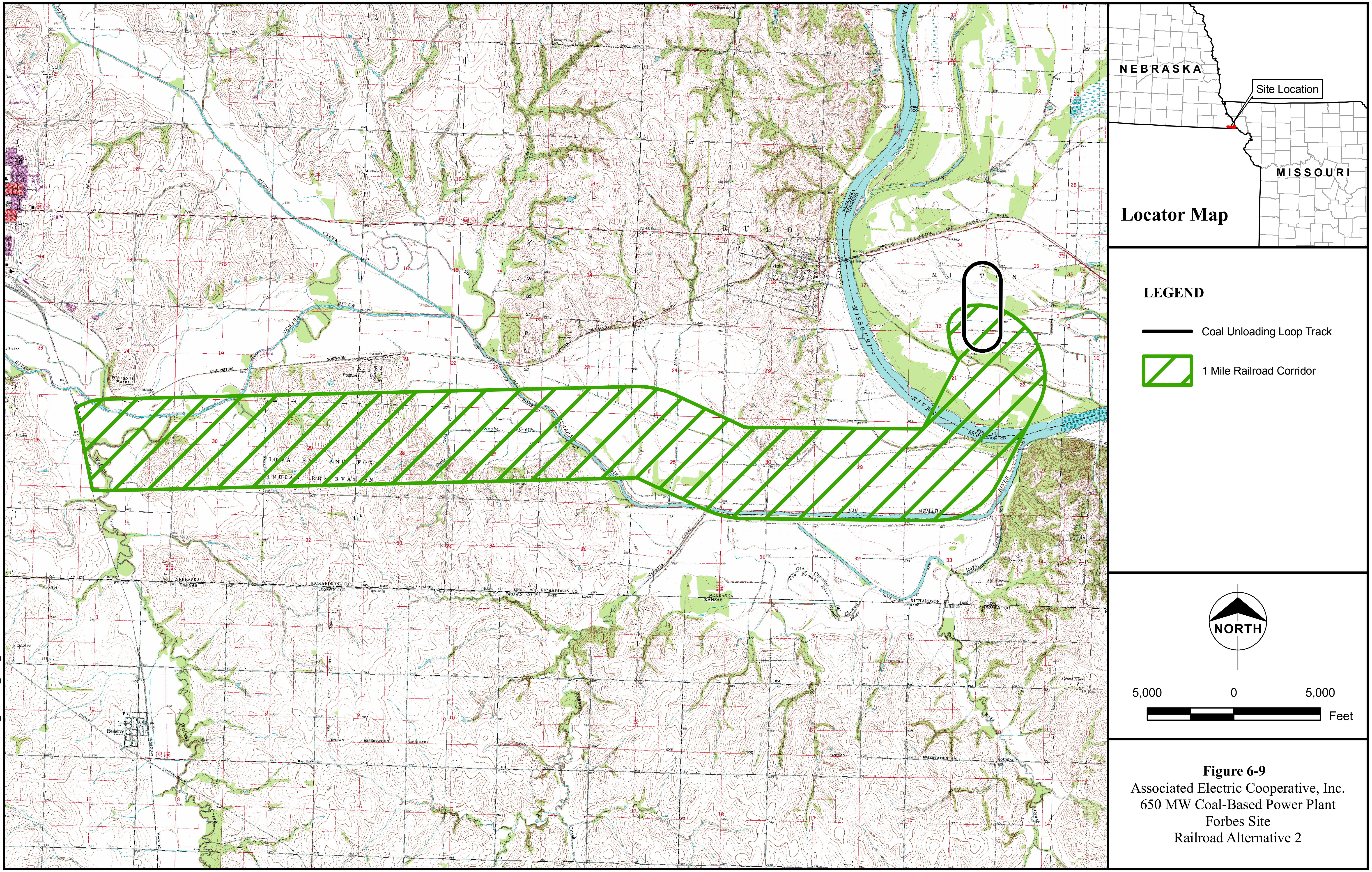


**Figure 6-9**
Associated Electric Cooperative, Inc.
650 MW Coal-Based Power Plant
Forbes Site
Railroad Alternative 2

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Source: USGS 1:24,000 Topographic Quadrangles: Falls City, Rulo, Big Lake, Reserve, Highland NW, White Cloud.

Revised June 23, 2005

Topography within the corridor is relatively flat, except for a narrow band with elevations ranging from 890 to 1000 feet. Elevations for the majority of the corridor are around 850 feet near the Missouri River and gradually slope up to around 880 feet near the railroad. The corridor would allow a direct route from the mainline railroad to the plant site with a gradual slope.

Major river crossings would present an obstacle to developing this corridor connecting to the Forbes site. There are two major rivers, the Missouri and Big Nemaha that would be crossed to connect with the UP railroad. The Missouri River crossing would be located just south of the Forbes site and the Big Nemaha River crossing would be located on the western portion of the railroad corridor in Nebraska. In addition, several smaller perennial and intermittent streams would be crossed, including Walnut Creek and Snake Creek in Nebraska.

Constructing a railroad bridge across the Missouri River would require Section 7 consultation with the U.S Department of Interior, Fish and Wildlife to identify measures to avoid or minimize adverse effects to federally listed endangered species.

According to NWI maps there are 148 acres of wetlands consisting of (emergent (52 acres), forested (37 acres), scrub-shrub (49 acres), and palustrine unconsolidated bottom (10 acres) located within the macro-corridor. It is possible that construction of the spur within the corridor would involve construction within wetlands, both of which would increase the adverse environmental impacts, complexity, and cost of the project.

There are no conservation areas, parks, and refuges located within or near the one-mile corridor. However, the corridor does cross approximately 4 miles of the Iowa Sac and Fox Indian Reservation. The Reservation is located south of the Nemaha River on the west side of the Missouri River in the western portion of the corridor. Although this reservation is currently crossed by the BNSF line to which the plant could be connected (Alternative 1), it is unlikely that the Tribe would approve construction of a second rail line across the Reservation. AECI would be unable to acquire right-of-way for a rail line across the Reservation through eminent domain and would therefore be subject to the costs and conditions established by the Sac and Fox Tribe for permission to construct the rail line.

Currently, the BNSF rail line extends through the Nemaha River valley before crossing the Missouri River at Rulo, Nebraska. Construction of a second rail line to connect to the UP and avoid the Indian Reservation would likely require at least one, if not two or more, crossings of the BNSF rail line. It is unlikely that the BNSF would allow these crossing by a potential competitor. Such crossings could be forced through authorization from the Surface Transportation Board (formerly the Interstate Commerce Commission, the Federal agency responsible for regulating rail construction and commerce activities). However, such authority is not guaranteed. If approved, crossings of the BNSF could either be at grade with the existing rail line but would more likely require the new rail line to go over the existing line, creating grade-separated overpasses of the existing line. The topography of the Nemaha River valley would require extensive earthwork to create suitable grades and approaches for these grade-separated crosses.

There are no transmission lines crossing within the macro-corridor.

## Norborne Site

Three railroads are located in proximity to the proposed Norborne site. The nearest rail access from the Norborne site is the existing Burlington Northern Santa Fe (BNSF) railroad located directly south of the facility and is a principal Intermodal/Automotive Business Units rail line and not a feasible alternative. The second nearest rail access would be the Norfolk Southern (NS) Railroad to the south. Additionally, a second BNSF line is located to the north of the site. To facilitate the identification of feasible corridors for a new railroad spur to connect with the two railroad alternatives from the proposed Norborne site, three corridors were established based on the environmental and engineering feasibility of constructing the railroad spur. The corridors include one option to the NS railroad (Alternative 1) and two options to the northern BNSF railroad. They include the Norborne to the northern BNSF railroad (east connection) (Alternative 2), and Norborne to the northern BNSF railroad (west connection) (Alternative 3). Following is a description of the macro-corridors identified for each alternative and the rationale for the development of these particular corridors (Figure 6-10).

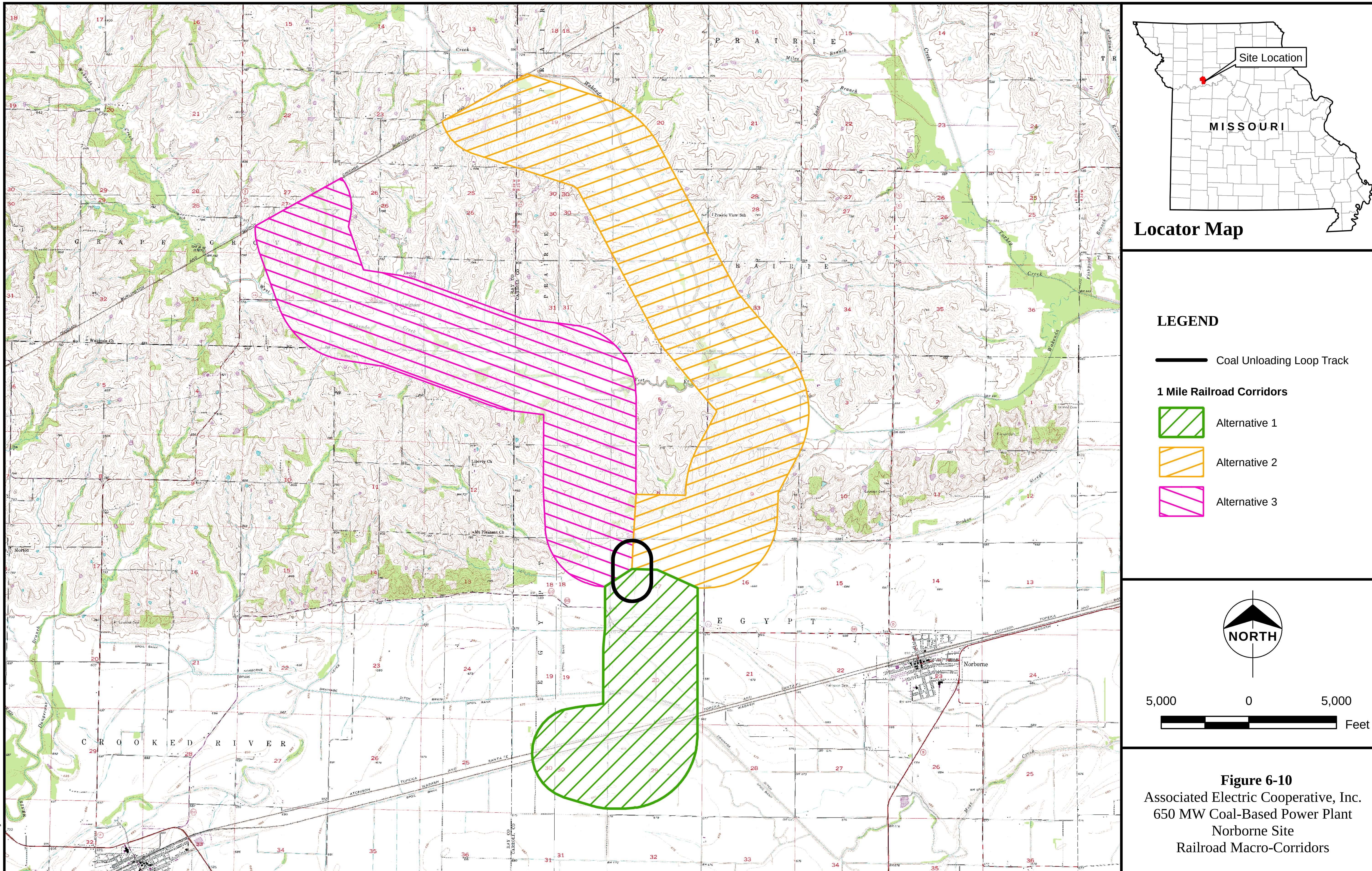


**Figure 6-10**
Associated Electric Cooperative, Inc.
650 MW Coal-Based Power Plant
Norborne Site
Railroad Macro-Corridors

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Source: USGS 1:24,000 Topographic Quadrangles: Norborne, Hardin, Roads, Stet.

Revised August 05, 2005

## Norborne to Norfolk Southern Railroad Macro-Corridor (Alternative 1)

The macro-corridor identified between the proposed Norborne site and the NS railroad is approximately 2.5 miles in length (Figure 6-11). The Norborne to NS Railroad macro-corridor would include the area directly south of the plant site to the railroad, and would include portions of Sections 17, 18, 19, 20, 29, and 30, Township 52 North, Range 25 West in Carroll County.

There are no towns located in the corridor and only a few rural residences in the area. An effort was made to avoid residences. Most of the residences in the area are located along the county roads. There are no rural residences located within the one-mile corridor.

Topography within the corridor is flat. Elevations range from 675 feet to 685 feet. The corridor would allow a direct route from the BNSF mainline to the plant site with minimal slope.

There are no conservation areas, parks, and refuges located within or near the one-mile corridor. No major river crossings are necessary to connect with the southern BNSF railroad. However, a few smaller drainages, including the Norborne Drainage Ditch, would be crossed.

The railroad spur connecting with the NS Railroad would require one extra mile of track and one bridge, 400 feet in length, to cross both the existing NS Railroad track and the existing southern BNSF Railroad track. There are no Interstate or U.S. Highway crossings within the corridor; however, State Road DD does cross the corridor, and an at-grade crossing would most likely be required.

According to NWI maps there are approximately 31 acres of wetlands [(emergent (28 acres), forested (1 acre), scrub-shrub (1 acres), and palustrine unconsolidated bottom (1 acre)] are located within the macro-corridor (Figure 6-12). It is possible that construction of the spur within the corridor would involve construction within wetlands.

There are no transmission lines that cross or are within the macro-corridor.

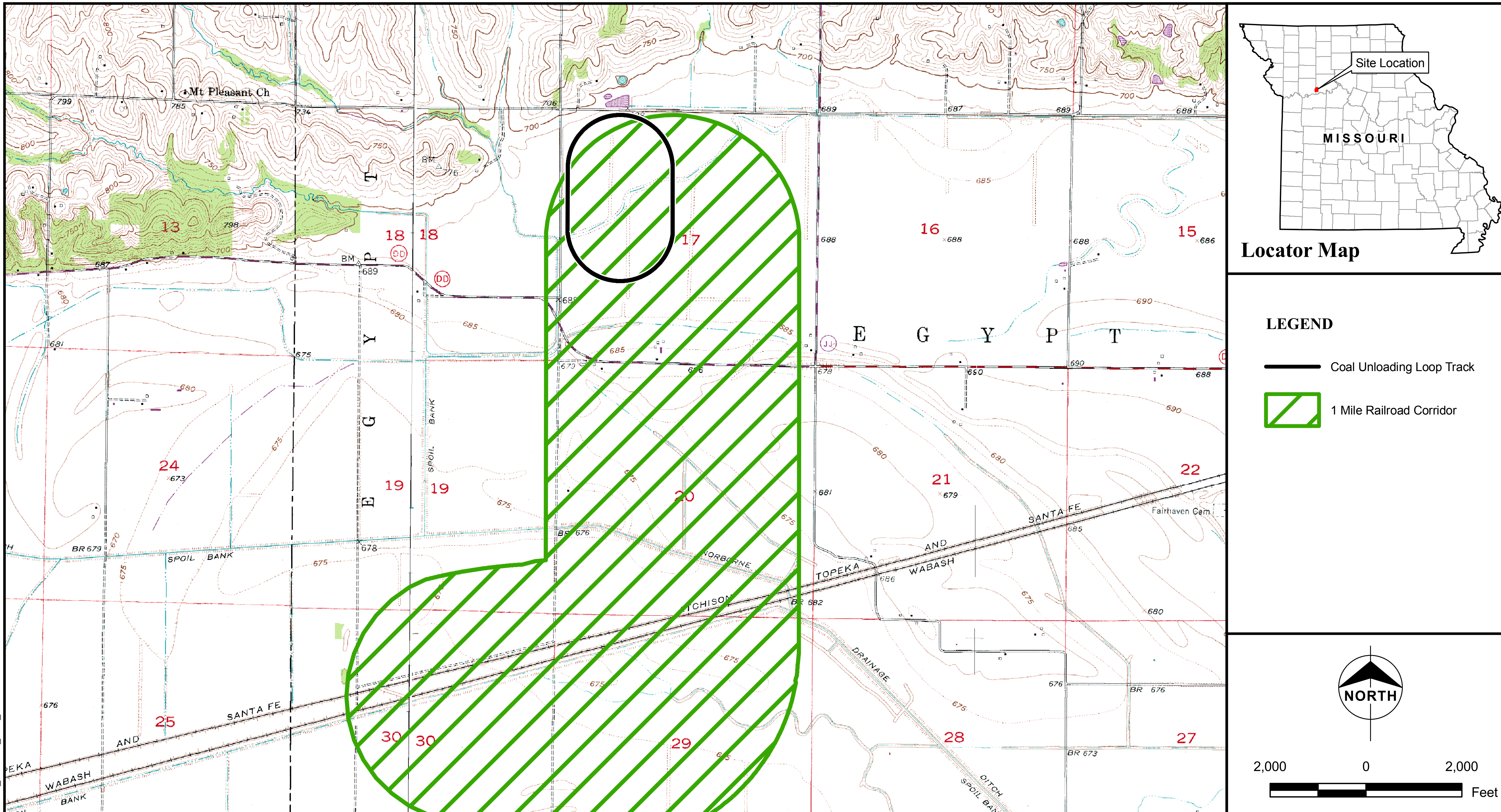


**Figure 6-11**
Associated Electric Cooperative, Inc.
650 MW Coal-Based Power Plant
Norborne Site
Railroad Alternative 2

Source: USGS 1:24,000 Topographic Quadrangles: Norborne, Hardin.

Revised June 23, 2005

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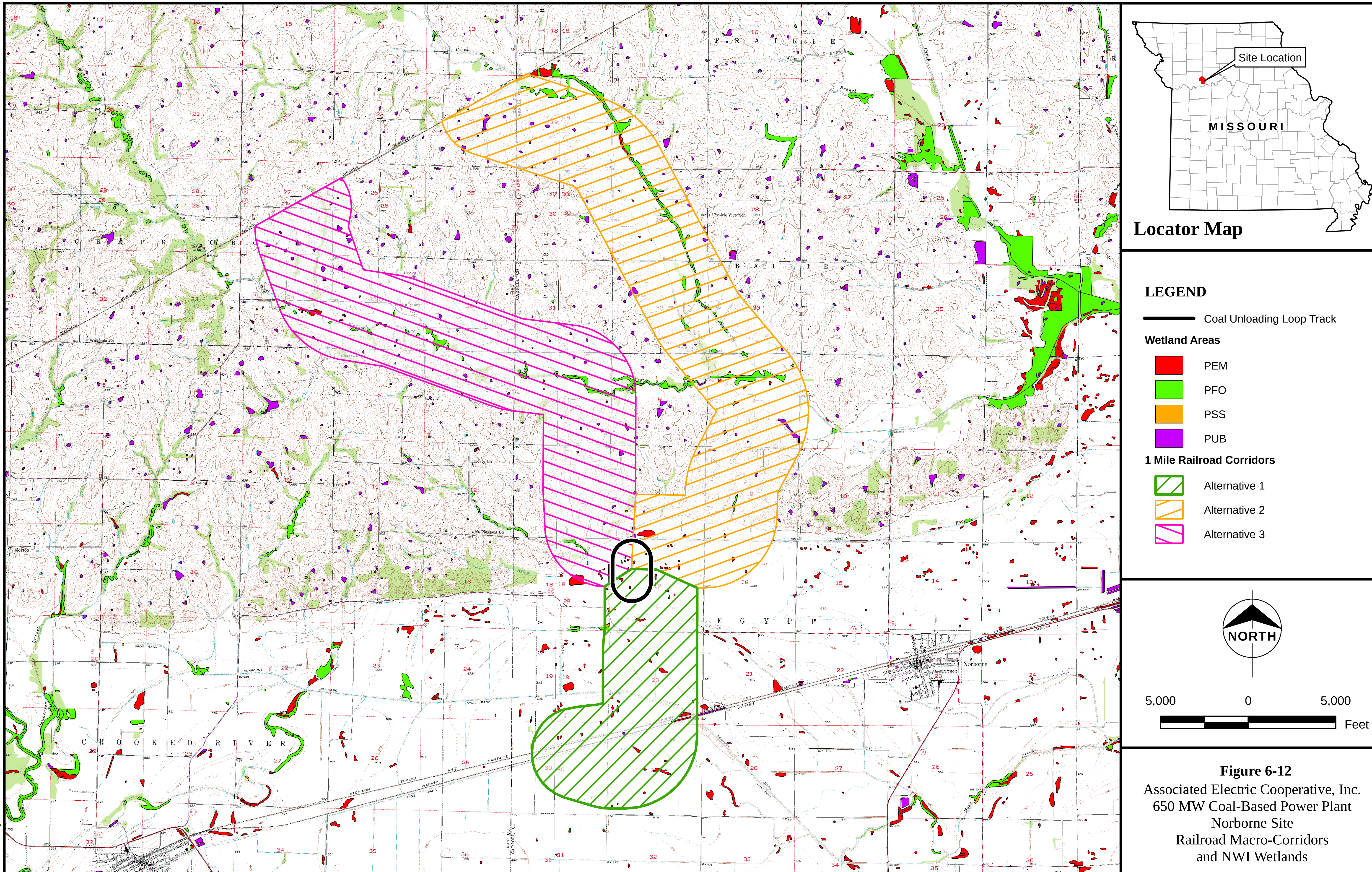


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Source: USGS 1:24,000 Topographic Quadrangles: Norborne, Hardin, Roads, Stet; USFWS NWI Wetlands.

Revised August 05, 2005

In conclusion, the only constraint between Norborne and the NS Railroad would be the required construction of a railroad bridge to cross the two railroad mainlines.

***Norborne to Northern Burlington Northern Santa Fe Railroad (East Connection) Macro-Corridor (Alternative 2)***

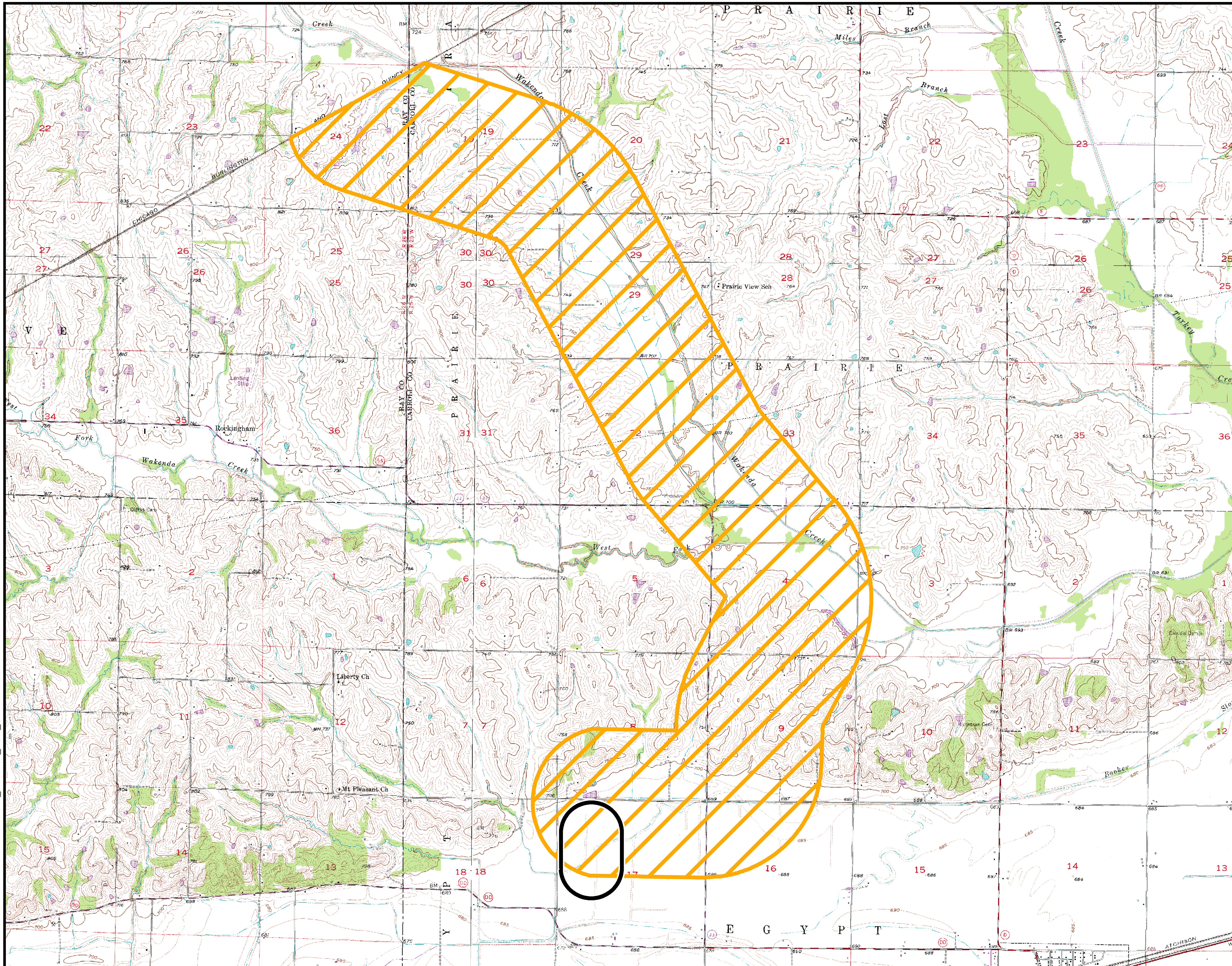
The macro-corridor identified between the proposed Norborne site and the northern BNSF railroad (east connection) is approximately 6.8 miles in length (Figure 6-13). The corridor would follow a route south of the Wakenda Creek from the plant site to the railroad and would include portions of Sections 3, 4, 5, 7, 8, 9, 16, 17, and 18, Township 52 North, Range 25 West, portions of Sections 19, 20, 28, 29, 30, 32, and 33, Township 53 North, Range 25 West in Carroll County, and portions of Section 24, Township 53 North, Range 26 West in Ray County.

The one-mile wide macro-corridor identified to connect with the northern BNSF railroad, described as the eastern connection, would allow for ample area should a deviation from the proposed alignment line be necessary.

There are no towns located in the corridor; however, there are several rural residences in the area. An effort was made to avoid residences. Most of the residences in the area are located along the county roads. There are 26 rural residences located within the one-mile corridor, with seven residences located within one-quarter of a mile from the centerline of the corridor. The one-mile corridor will allow for deviation in an effort to avoid impact to the rural residences in the area.

Topography within the corridor is predominately rolling hills; however, the majority of the route would be located in the relatively flat area of the Wakenda Creek floodplain. Elevations range from 689 feet to 760 feet, with elevations in the floodplain around 705 feet. The corridor would be more direct route by locating the spur in the floodplain, and would allow a moderately direct route from the mainline to the plant site with a gradual slope.

There are no conservation areas, parks, and refuges located within or near the one-mile corridor. However, private land in the area may be used for hunting, and if these hunting




Locator Map


**LEGEND**

Coal Unloading Loop Track

1 Mile Railroad Corridor

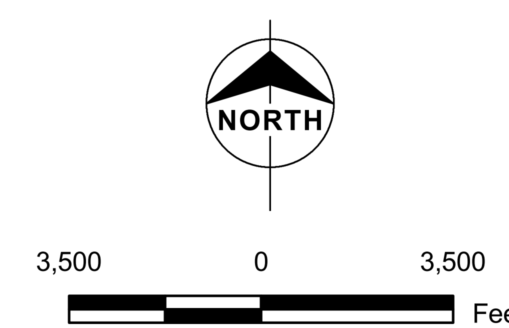



**Figure 6-13**
Associated Electric Cooperative, Inc.
650 MW Coal-Based Power Plant
Norborne Site
Railroad Alternative 2

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Source: USGS 1:24,000 Topographic Quadrangles: Norborne, Hardin, Roads, Stet.

Revised June 23, 2005

areas are present within the one-mile corridor, they would be impacted with the construction of the railroad spur.

There are no major river crossings necessary to connect with the northern BNSF railroad. However, several smaller perennial and intermittent streams would be crossed, including the West Fork of the Wakenda Creek. In total, eight streams/creeks would require crossings.

No Interstate or U.S. Highway crossings are located within the corridor; however, the proposed rail spur route would require seven at-grade road crossings, including County Road (CR) 636, CR 630, CR 605, CR 624, CR 620, CR 603, and State Road JJ.

According to NWI maps there are approximately 166 acres of wetlands consisting of (emergent (23 acres), forested (110 acres), scrub-shrub (3 acres), and palustrine unconsolidated bottom (30 acres) located within the macro-corridor (Figure 6-12). It is possible that construction of the spur within the corridor would involve construction within wetlands.

One transmission line (161-kilovolt (kV)) crosses the macro-corridor and a crossing of the right-of-way would be unavoidable. The 2002 NESC and the RUS Bulletin, revised September 1992, would require a design clearance of 31.5 feet over a railroad track. In conclusion, there are minimal constraints between Norborne and the northern BNSF Railroad.

### ***Norborne to Northern Burlington Northern Santa Fe Railroad (West Connection) Macro-Corridor (Alternative 3)***

The macro-corridor identified between the proposed Norborne site and the northern BNSF railroad (west connection) is approximately 7.2 miles in length (Figure 6-14). The corridor would roughly follow north of the West Fork of the Wakenda Creek from the plant site to the railroad and would include portions of Sections 5, 6, 7, 8, 17, and 18, Township 52 North, Range 25 West, portions of Sections 31 and 32, Township 53 North, Range 25 West in Carroll County, portions of Sections 1, 2, and 3, Township 52 North, Range 26 West, and portions of Sections 26, 27, 34, 35, and 36, Township 53 North, Range 26 West in Ray County.

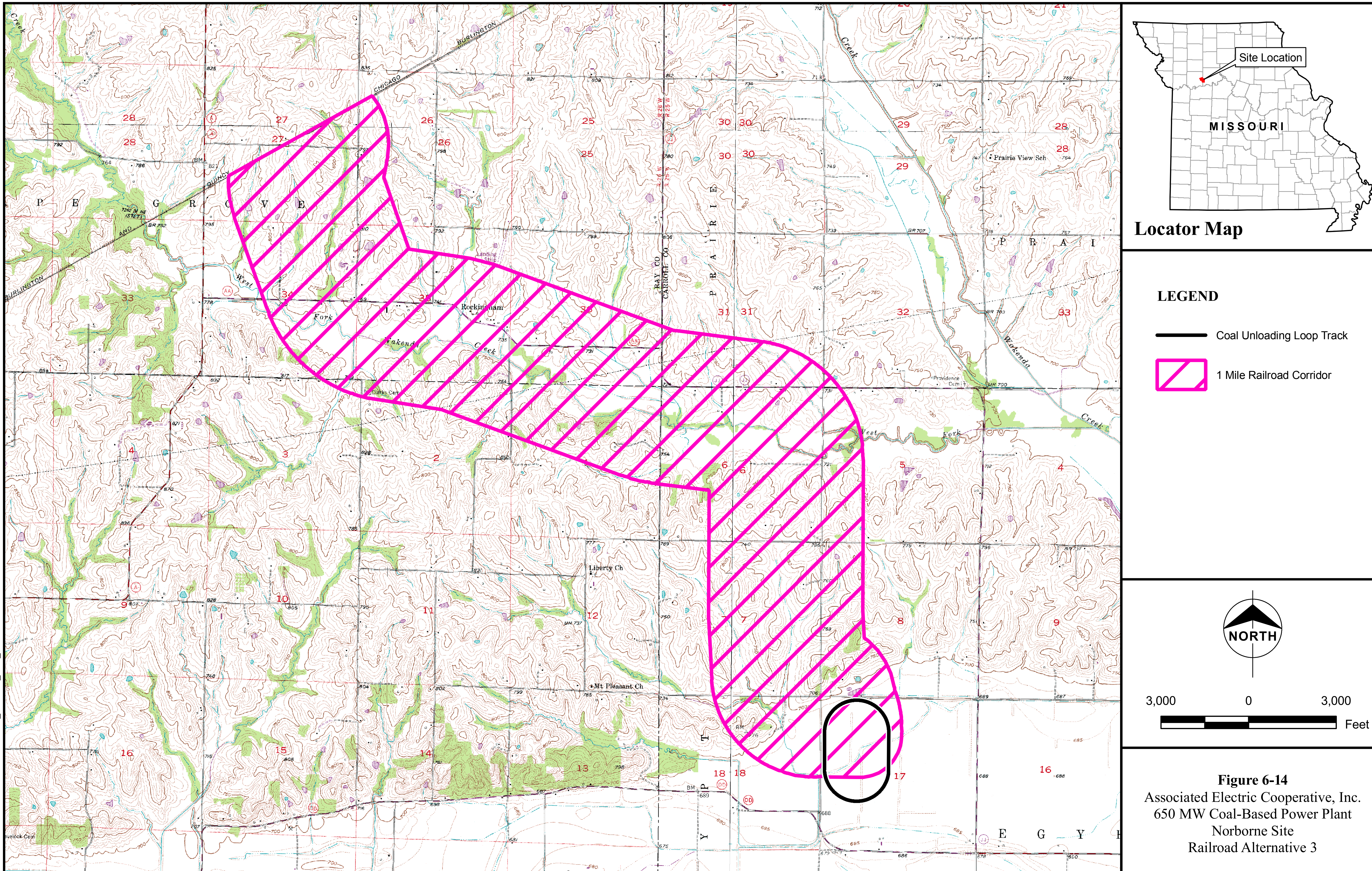


**Figure 6-14**
Associated Electric Cooperative, Inc.
650 MW Coal-Based Power Plant
Norborne Site
Railroad Alternative 3

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Source: USGS 1:24,000 Topographic Quadrangles: Norborne, Hardin, Roads, Stet.

Revised June 23, 2005

The one-mile wide macro-corridor identified to connect with the northern BNSF railroad, described as the western connection, would allow for ample area should a deviation from the proposed alignment line be necessary.

The small community of Rockingham is located in the corridor, along with several rural residences in the area. An effort was made to avoid residences. Most of the residences in the area are located within the community of Rockingham or along the county roads. The one-mile corridor would allow for deviation in an effort to avoid impact to the community and rural residences in the area. There are 34 rural residences located within the one-mile corridor, with 22 residences located within one-quarter of a mile from the centerline of the corridor.

Topography within the corridor is predominately rolling hills; however, the majority of the route would be located in the relatively flat area of the West Fork of the Wakenda Creek floodplain. Elevations range from 685 feet to 760 feet, with elevations in the floodplain around 720 feet. The corridor would be more direct route by locating the spur in the floodplain, and will allow a moderately direct route from the mainline to the plant site with a gradual slope.

There are no conservation areas, parks, and refuges located within or near the one-mile corridor. However, private land in the area may be used for hunting, and if these hunting areas are present within the one-mile corridor, they would be impacted with the construction of the railroad spur.

No major river crossings would be necessary to connect with the northern BNSF railroad. However, several smaller perennial and intermittent streams would be crossed, including the West Fork of the Wakenda Creek. In total, six streams/creeks would require crossings.

There are no Interstate or U.S. Highway crossings within the corridor; however, the proposed rail spur route would require three at-grade road crossings, including CR 636, CR 634 and State Road AA.

According to NWI maps there are approximately 102 acres of wetlands consisting of (emergent (21 acres), forested (57 acres), scrub-shrub (1 acres), and palustrine unconsolidated bottom (23 acres) are located within the macro-corridor (Figure 6-12). It is possible that construction of the spur within the corridor would involve construction within wetlands.

Like Alternative 2, a 161 kV transmission line crosses the macro-corridor and a crossing of the right-of-way would be unavoidable. The 2002 NESC and the RUS Bulletin, revised September 1992, would require a design clearance of 31.5 feet over a railroad track. In conclusion, there are minimal constraints between Norborne and the northern BNSF Railroad.

**Railroad Considerations Conclusions**

The selection of the proposed railroad spur for this project largely depends on the power plant site selected, as well as specific route alignments identified within the corridors. Once the public has had an opportunity to comment on the proposed corridors, more detailed information will be collected and more specific route alignments will be identified. A more definitive comparison of impacts will be made for each route identified for each section. Table 6-4 summarizes each alternative and the constraints considered in the macro-corridor study. Since it is unlikely that a fuel transportation contract will be in place prior to completing the NEPA process, corridors for each competing carrier will be evaluated.

A comparison of the railroad alternatives for each site indicates there are differing types of constraints with each alternative. Forbes Alternative 1 would require a bridge over U.S. Highway 159. The major constraints for the Forbes Alternative 2 are the need for a railroad bridge across the Missouri River and the potential impacts to federally listed threatened and endangered species, the crossing of an Indian reservation, and/or potential crossing of another railroad (BNSF).

The major constraint for the Norborne Alternative 1 is a railroad bridge over two existing railroads. Norborne Alternatives 2 and 3 have uneven terrain and a greater number of residences that could be impacted when compared to Alternative 1.

Both the Forbes and Norborne sites have railroad alternatives with the potential to cross transmission lines. In addition, both have alternatives that are short and long in length and as expected the longer length alternatives contain more constraints. All of the railroad alternatives could impact wetlands; however, the acres of wetlands that might be impacted can not be determined until the actual alignment is determined and wetland delineations have been identified jurisdictional wetlands. Generally, the design of the selected alignment would avoid wetlands as much as possible. Table 6-4 only provides an indication of what would need to be avoided if possible.

The railroad considerations rating for the Forbes site is a score of two; Alternative 1 is closer to the site and has minimal constraints, whereas, Alternative 2 would required considerable permitting and agency approval for the Missouri River and Indian reservation crossings.

The railroad considerations rating for the Norborne site is a score of three; Alternative 1 is closest to the site and has a bridge over two existing railroads, whereas, Alternatives 2 and 3 have longer corridors, uneven terrain, and would impact more residences.

#### 6.3.2.3 Electric Transmission

The electric transmission category was assigned a total weight of 20 percent. (Additional information related to the electrical transmission corridors is located in Section 7) The transmission system required to deliver capacity and energy from a proposed power generating facility to the loads can be a substantial part of the total wholesale power cost and thus, must be considered in a siting study. The generating unit at the proposed power plant must be connected into a regional electrical transmission network. Therefore, a component of the search for prospective power plant sites is the location of existing transmission facilities and efforts to identify sites that can utilize these existing facilities while minimizing the need for new transmission line construction. Construction and operation of some new lines would be required to connect to the electrical grids. Consequently, the distance to these probable interconnection points is an important evaluation criterion. The sites were rated for this criterion using the scoring criteria listed below.

- Distance ≤ 50 miles → Score = 5
- 50 miles < Distance ≤ 100 miles → Score = 4
- 100 miles < Distance ≤ 150 miles → Score = 3

## Table 6-4 Railroad Considerations Summary

| Macro-Corridors | Railroad | Length (miles) | Number of Residences | Terrain | Public Uses | Bridges (major river, road, or rail crossings) | NWI Wetlands (acres) | Transmission Line Crossings | Number of Potential T&E Species in the Area |
|---|---|---|---|---|---|---|---|---|---|
| **Norborne Site** | | | | | | | | | |
| Alternative 1 | NS | 2.5 | 0 | Flat | No | 1 - (400' over BNSF and NS mainline) | 31 | No | 4 |
| Alternative 2 | BNSF | 7 | 26 | Rolling hills, floodplain flat | Possible private hunting | 0 | 166 | 161 kV | 4 |
| Alternative 3 | BNSF | 7 | 34 | Rolling hills, floodplain flat | Possible private hunting | 0 | 102 | 161 kV | 4 |
| **Forbes Site** | | | | | | | | | |
| Alternative 1 | BNSF | 4 | 1 | Relatively flat | No | 1 – (400' over U.S. Highway 159) | 86 | 345 kV | 7 |
| Alternative 2 | UP | 15 | 10 | Flat, rolling hills | No | 1 or 2 - (2000' over Missouri River) (could potentially require a bridge over the Big Nemaha River) | 148 | No | 26 |

- 150 miles < Distance ≤ 200 miles → Score = 2
- Distance > 200 miles → Score = 1

The estimated length of a transmission line from the interconnection point to the site is discussed and the associated scores are provided in the following sections.

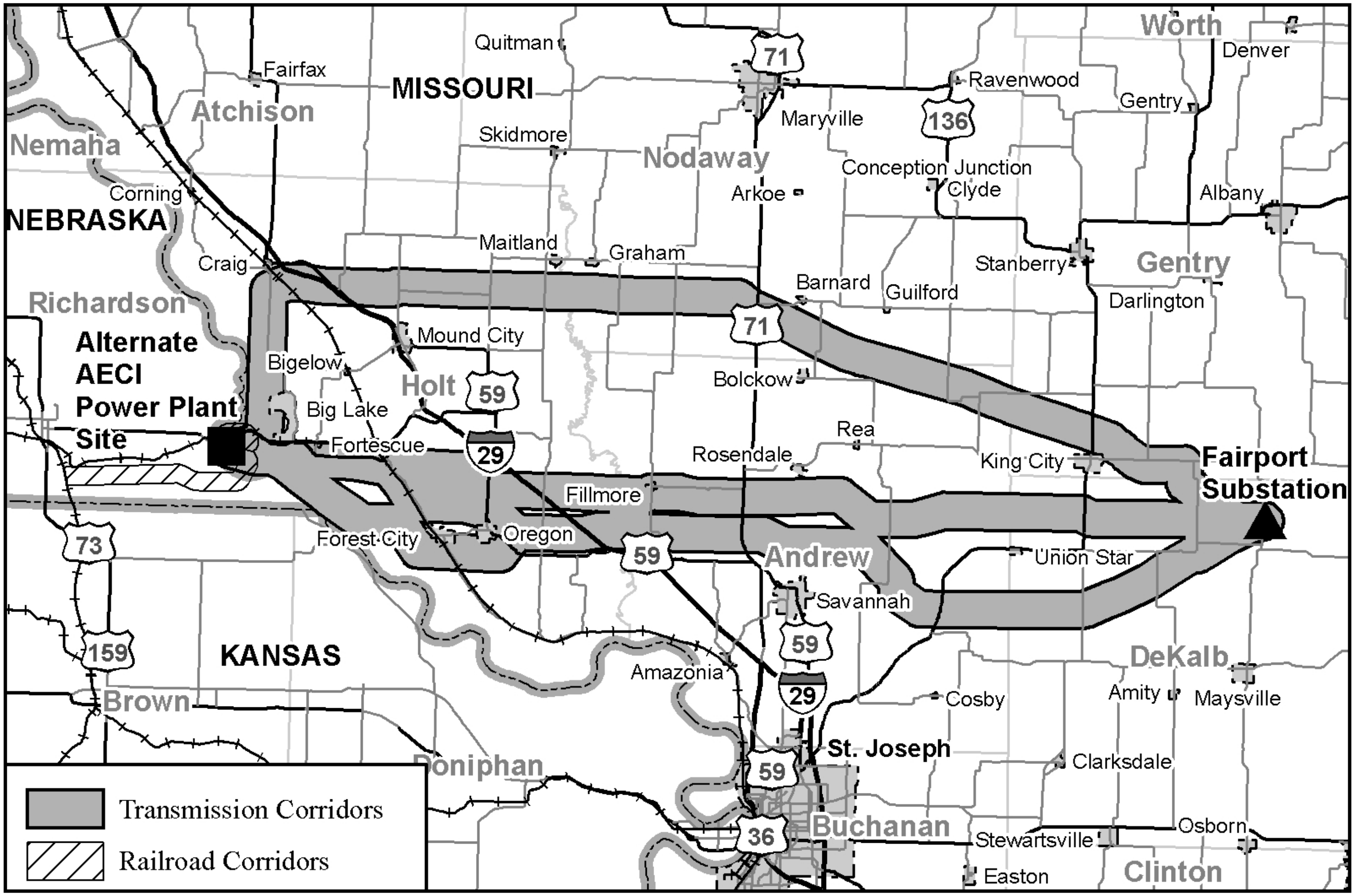
**Forbes Site**

The generating unit proposed at the Forbes site would be interconnected to the AECI electric transmission system. A new double circuit 345-kilovolt (kV) transmission line would be required to connect Forbes to the existing Fairport Substation (Figure 6-15), and then from the Fairport Substation south to a new substation location near Orrick, Missouri (Figure 6-16). From the new Orrick Substation, a 161 kV transmission line would extend to the existing Missouri City Substation and to the Eckles Substation. Total length of new transmission line construction required for the Forbes site would be approximately 125 miles. Figure 6-17 presents a map of the exiting transmission lines in the area of the Forbes site. The approximate distance between the endpoints is summarized in Table 6-5. The electric transmission rating for this site is a score of three. However, further consideration of the difficulty of routing a new transmission line through the built up area of Excelsior Springs from the Fairport Substation to a new Orrick Substation decreased the electric transmission rating for this site from a score of three to a score of one.

**Table 6-5 Forbes Transmission Line Requirements**

| Endpoints | Approximate Mileage Between Endpoints (straight line) |
|---|---|
| Forbes to Fairport Substation | 57 |
| Fairport Substation to New Orrick Substation | 53 |
| New Orrick Substation to Missouri City Substation | 8 |
| New Orrick Substation to Eckles Road Substation | 7 |
| **Total Mileage** | **125** |

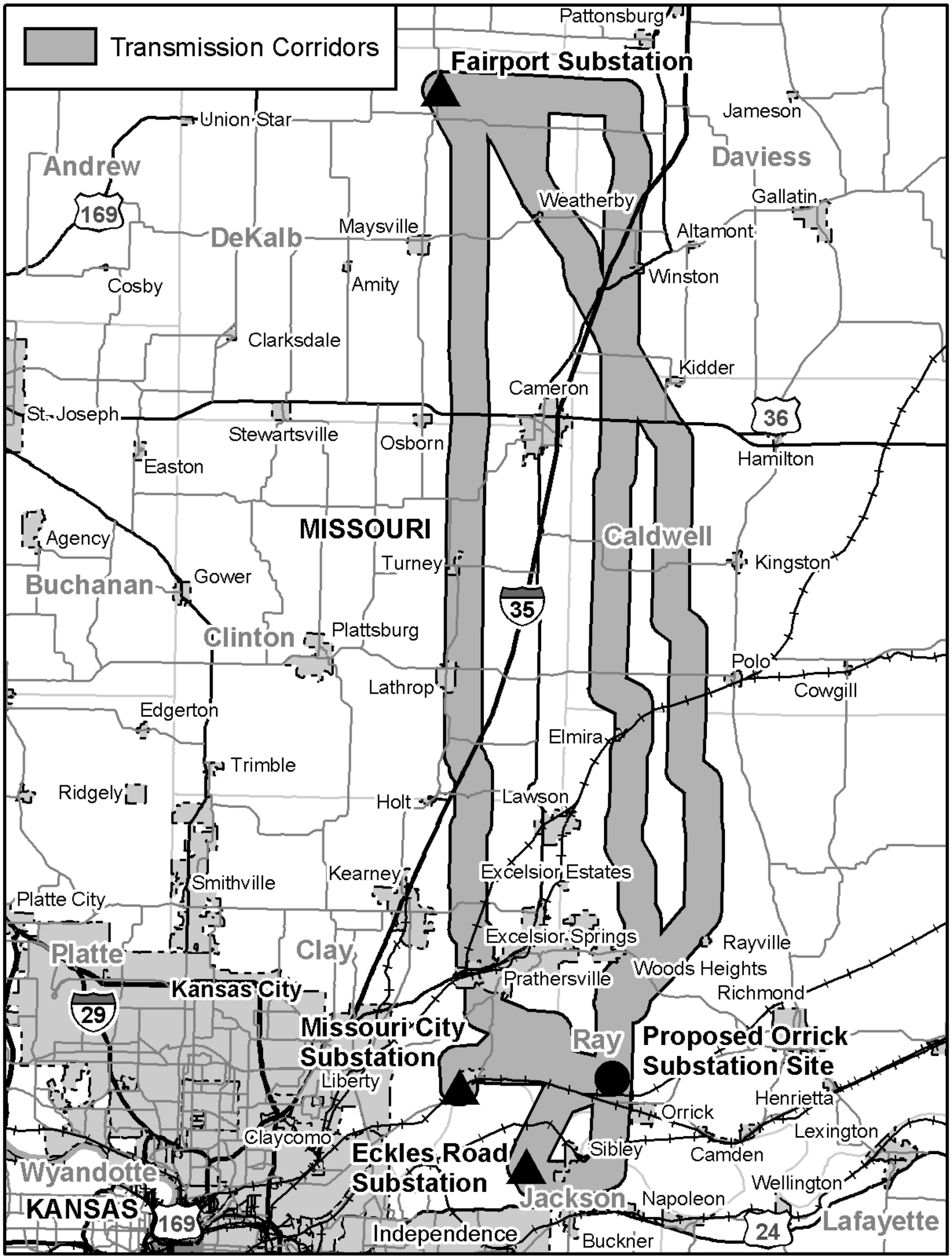
**Figure 6-15 Forbes to Fairport Substation**






Burns & McDonnell SINCE 1898

**Figure 6-16  Fairport Substation to New Orrick Substation**






Burns & McDonnell SINCE 1898

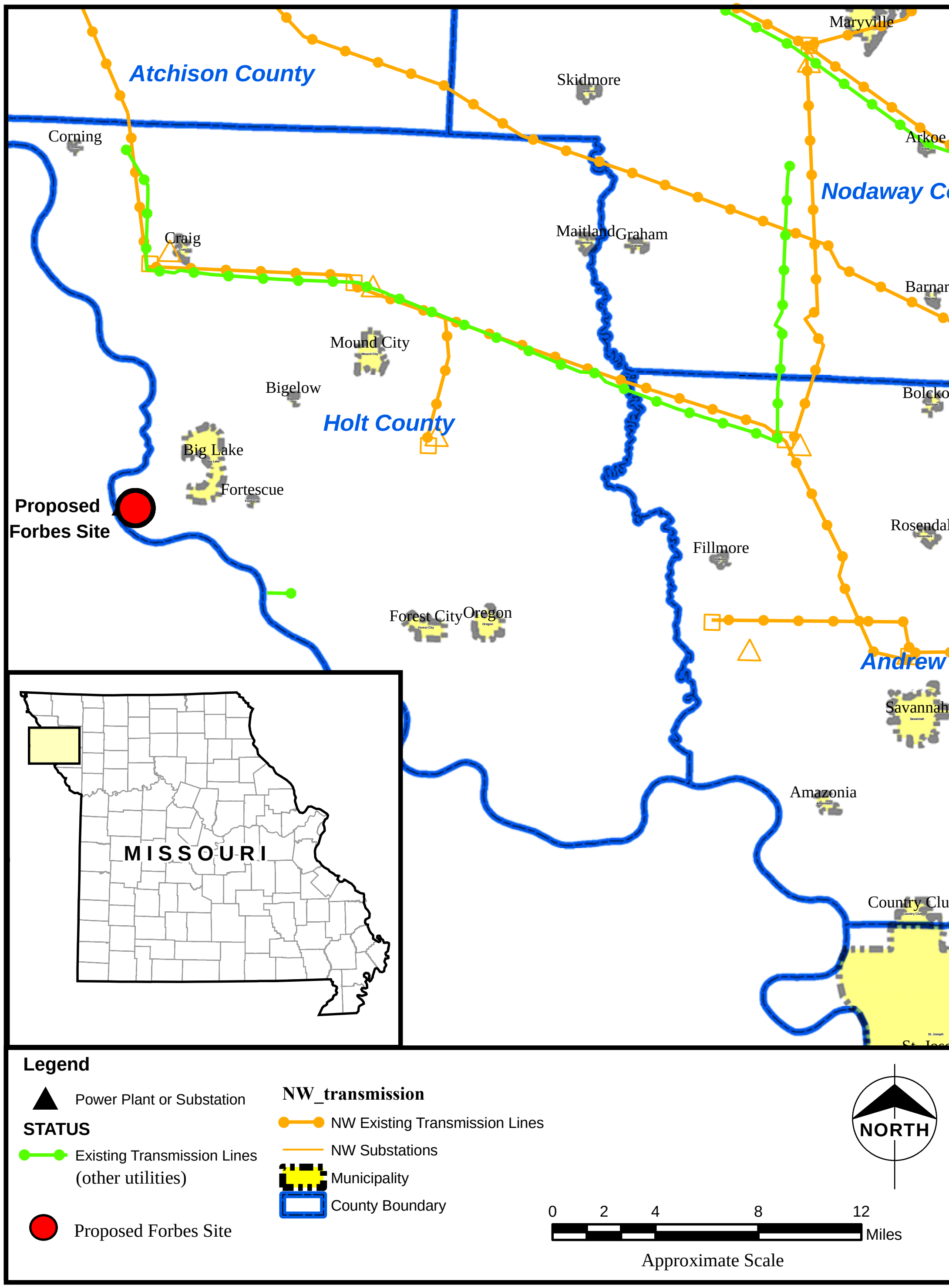


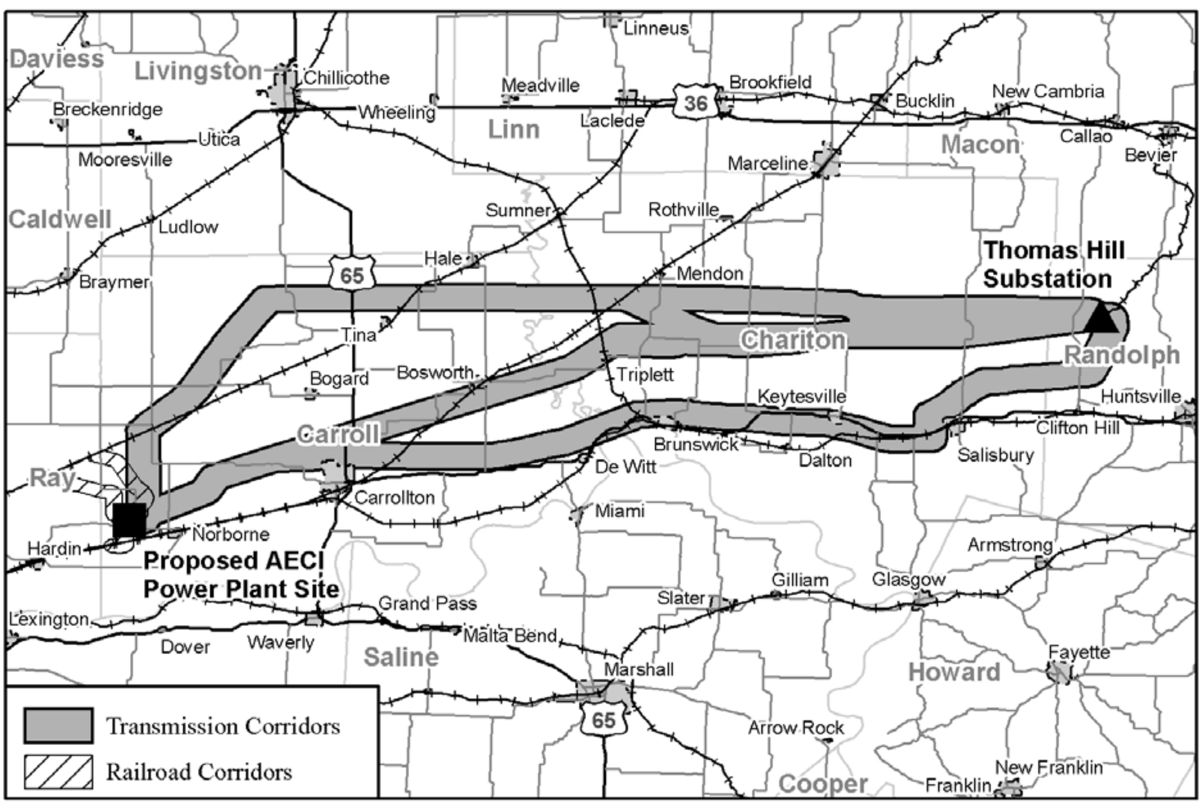

Figure 6-17

Transmission Lines in Vicinity of Forbes Site

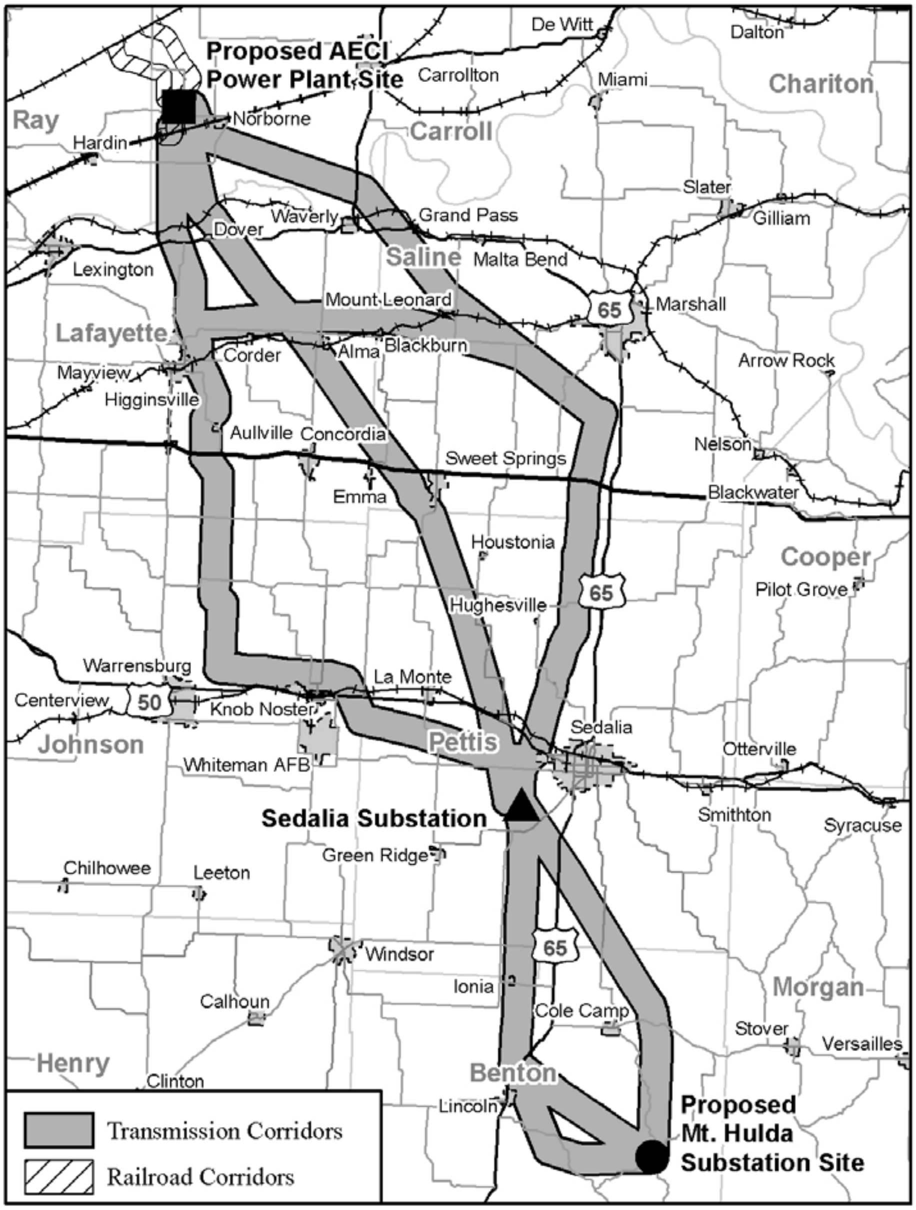
## Norborne Site

The generating unit located at the Norborne site would be interconnected to the AECI electric transmission system. A new 345 kV transmission line would be required to include a connection between Norborne and Thomas Hill Substation (Figure 6-18), and also from Norborne south to the Sedalia Substation and possibly continuing south from the Sedalia Substation to a new substation near Mt. Hulda (Figure 6-19). However, there is a possibility that the new line could stop at the Sedalia Substation. Total length of new transmission line construction required for the Norborne site would be approximately 134 miles if the line is extended to Mt. Hulda. The approximate mileage between the endpoints is depicted in Table 6-6. Figure 6-20 presents a map of the exiting transmission lines in the area of the Norborne site. The electric transmission rating for this site is a score of three.

**Figure 6-18 Norborne to Thomas Hill Substation**



## Figure 6-19 Norborne to Mt. Hulda Substation




## Table 6-6 Norborne Transmission Line Requirements

| Endpoints | Approximate Mileage Between Endpoints (straight line) |
|---|---|
| Norborne to Thomas Hill Substation | 60 |
| Norborne to Sedalia Substation | 50 |
| Sedalia Substation to New Mt. Hulda Substation | 24 |
| **Total Mileage** | **134** |

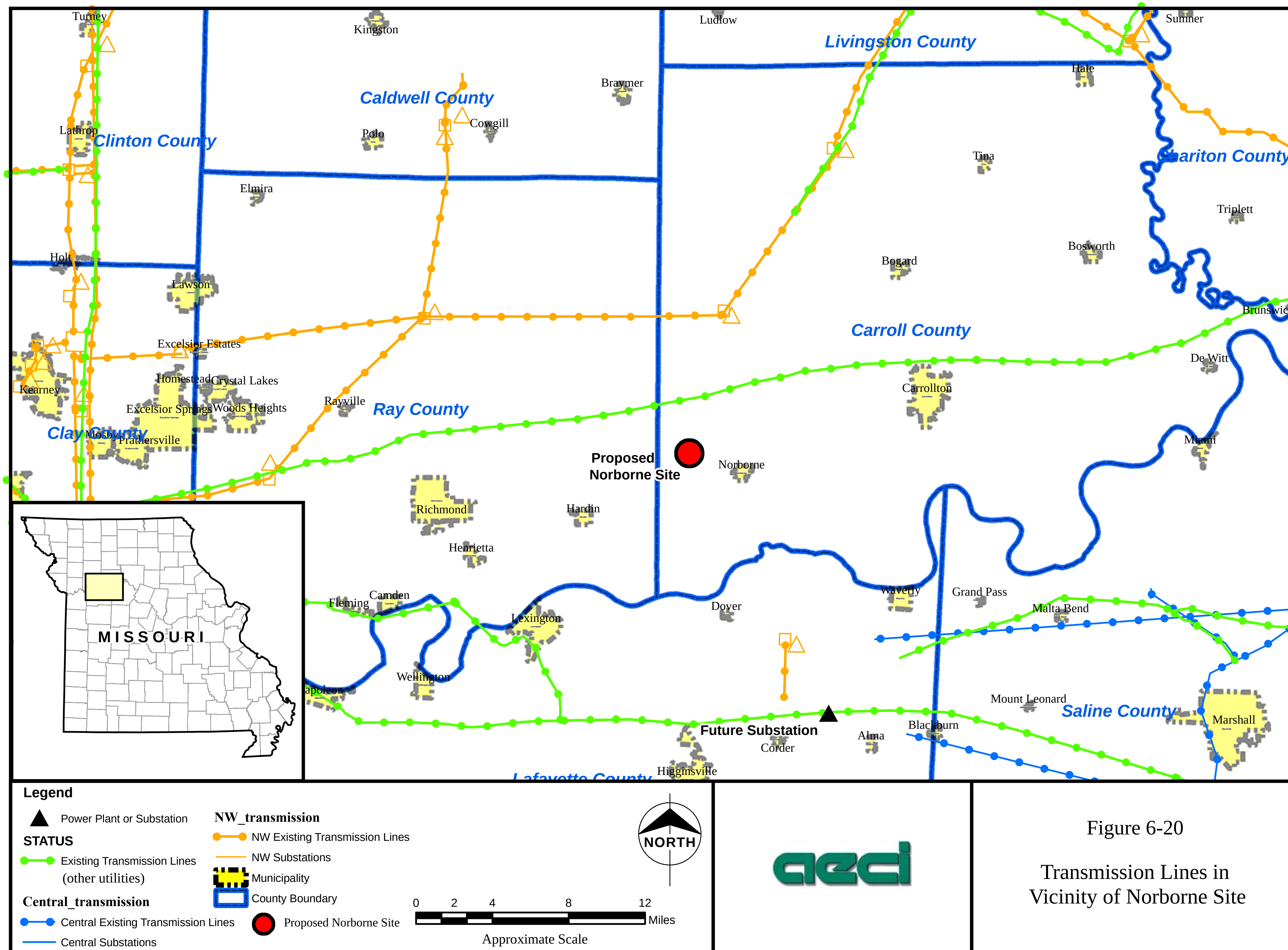



Figure 6-20

Transmission Lines in Vicinity of Norborne Site

### 6.3.2.4 Water Supply

The water supply category was assigned a total weight of 20 percent. The proposed facility will require a significant quantity of water (roughly 8 million gallons per day (mgd), approximately 5,600 gallons per minute (gpm) continuous average, or 12.4 cubic feet per second (cfs)); therefore, the sites must have access to a dependable and substantial water supply. The supply potential of area streams depends on several factors; including runoff, contributing watershed, and available storage. To integrate all of these factors, the supply potential for area streams was based on the estimated 7-day average, 10-year low flow (7Q10). On average, a weekly flow less than the 7Q10 should occur no more than once every ten years. Only those streams with a 7Q10 of at least 124 cfs (10 times the average makeup rate of 12.4 cfs) were considered to be potential water supply sources. The 7Q10 for area streams was estimated from historic streamflow records collected by the U.S. Geological Survey (USGS) at the gauging stations located nearest the sites.

Additionally, to reduce economical and environmental impacts from pipeline construction, the ratings for this criterion were assigned based on the distance from the site to a potential water source using the following scoring criteria:

- Distance < 1 miles → Score = 5
- 1 miles < Distance ≤ 5 miles → Score = 4
- 5 miles < Distance ≤ 10 miles → Score = 3
- 10 miles < Distance ≤ 15 miles → Score = 2
- 15 miles → Score = 1

Following is a description of the water supply proximity and associated scores for each site.

**<u>Forbes Site</u>**

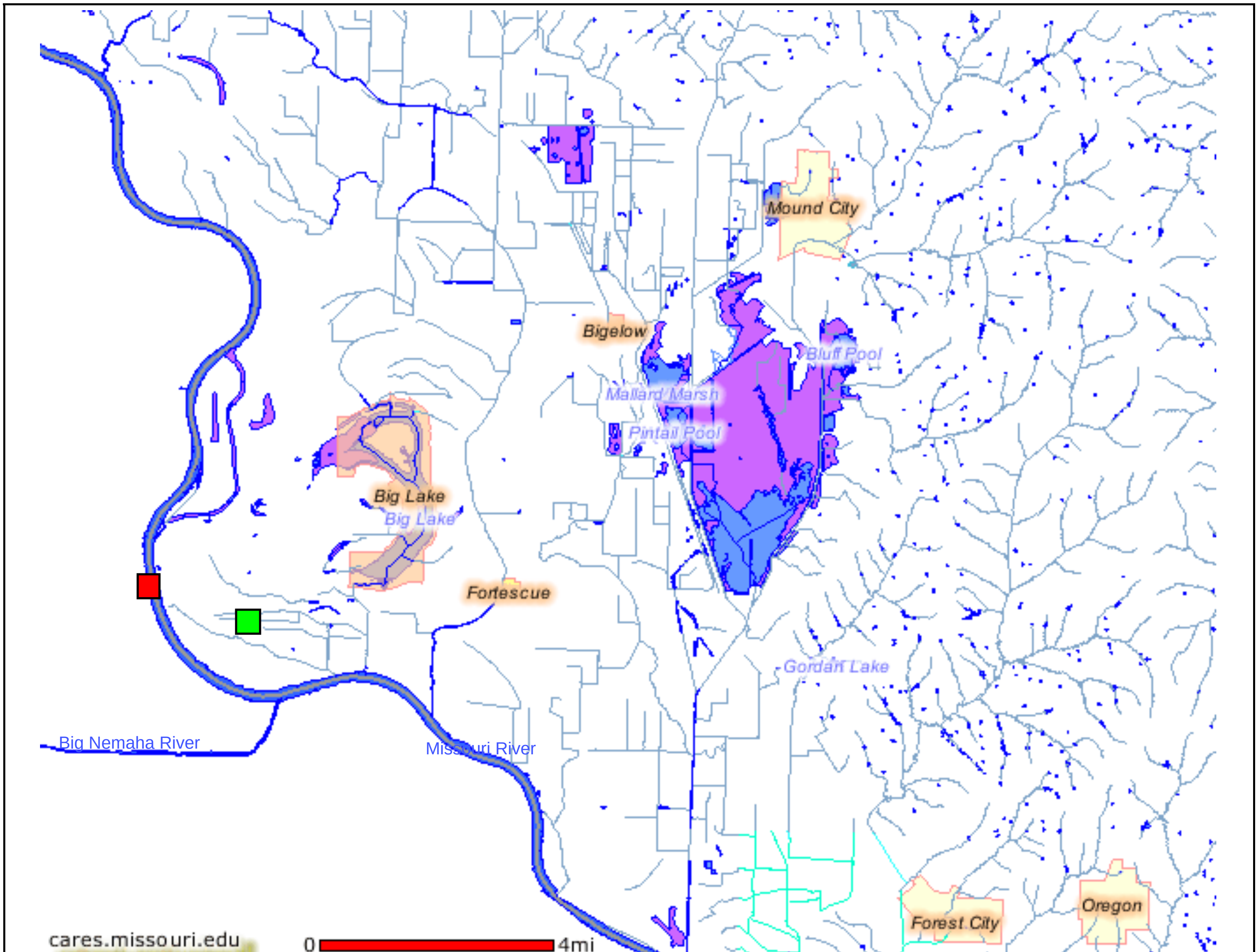
The most likely water supply source for generating units located at the Forbes site would be a well field within the alluvial floodplain of the Missouri River, which is adjacent to the site. Available data from a stream gauge located adjacent to the site (USGS 06813500 at Rulo, Nebraska), the Missouri River indicated an estimated 7Q10 of 7,888 cfs with the drainage area of 418,859 square miles. However, the value calculated using all available data is not representative of existing conditions since the U.S. Army Corps of Engineers has built five mainstem dams on the upper Missouri River. Because of the dams, the river is much more regulated. Therefore, the 7Q10 values were recalculated using data since 1965 only (these dams were completed in the mid-1960s). The resulting 7Q10 value for the Rulo gauge is 11,987 cfs.

Based on these calculations, the 7Q10 at this location on the Missouri River is sufficient to satisfy the major water use requirements of the generating unit. This dry-period flow is nearly 1,000 times larger than the average water requirements of the proposed generating unit. Further analysis of the proposed well field in the alluvial floodplain of the Missouri River will be completed to determine any potential impacts to the groundwater system during the EIS process. Figure 6-21 depicts the location of surface water nearest the Forbes Site and the stream gauge at Rulo, Nebraska. The water supply rating for this site is five.

**Norborne Site**

The most likely water supply source for generating units located at the Norborne Site would be a well field within the alluvial floodplain of the Missouri River, which is approximately seven miles south of the site. The well field would be located on-site or south of the site on land between the site and the Missouri River. Using all the available data from a stream gauge located approximately 14 miles downstream of the proposed well field location (USGS 06895500 at Waverly, Missouri), the Missouri River has an estimated 7Q10 of 6,301 cfs with the drainage area of 485,900 square miles. Based on the Waverly gauge's location downstream from the Rulo gauge, the expectation would be for Waverly to have a higher 7Q10. However, this discrepancy results because of the different periods of record available from the USGS. The Rulo gauge has data from October 1949 through Mar 2005 and the Waverly gauge from October 1928 through September 2004. The data for Waverly spans the 1930's "dust bowl" days; therefore, it has a lower 7Q10. However, as described above, neither of the values calculated using all available data are representative of the present time. Therefore, the 7Q10 values for Waverly were recalculated using data since 1965 only, and the resulting 7Q10 value for Waverly is 12,552 cfs.

Based on these calculations, the 7Q10 at this location on the Missouri River are sufficient to satisfy the major water use requirements of the generating unit. This dry-period flow is nearly 1,000 times larger than the average makeup water requirements of the proposed




**Legend**

County Boundaries

1:24,000 Rivers and Streams

- Perennial Stream/River
- Intermittent Stream/River
- Artificial Path (Approx. Centerline)
- Undifferentiated Stream/River
- Canal or Ditch
- Other Hydrologic Feature

Incorporated Areas

- City
- Town
- Village
- (cont)
- Census Designated Place
- Other

1:24,000 Water Bodies

- Lake or Pond
- Lake or Pond (Intermittent)
- Reservoir
- Stream or River
- Swamp or Marsh
- Canal or Ditch
- Other Water Body

**Location Map**

Map prepared by:
http://cares.missouri.edu, 4/5/2005.

Forbes Site

Stream Gauge (USGS 06813500)

N

Figure 6-21

Surface Water & Stream Gauge Locations Near Forbes Site generating unit, and as a result, withdrawals from the Missouri River are not likely to adversely impact other downstream water users. Figure 6-22 depicts the location of surface water nearest the Norborne site and the stream gauge at Waverly, Missouri. The water supply rating for this site is a score of three.

#### 6.3.2.5 Environmental

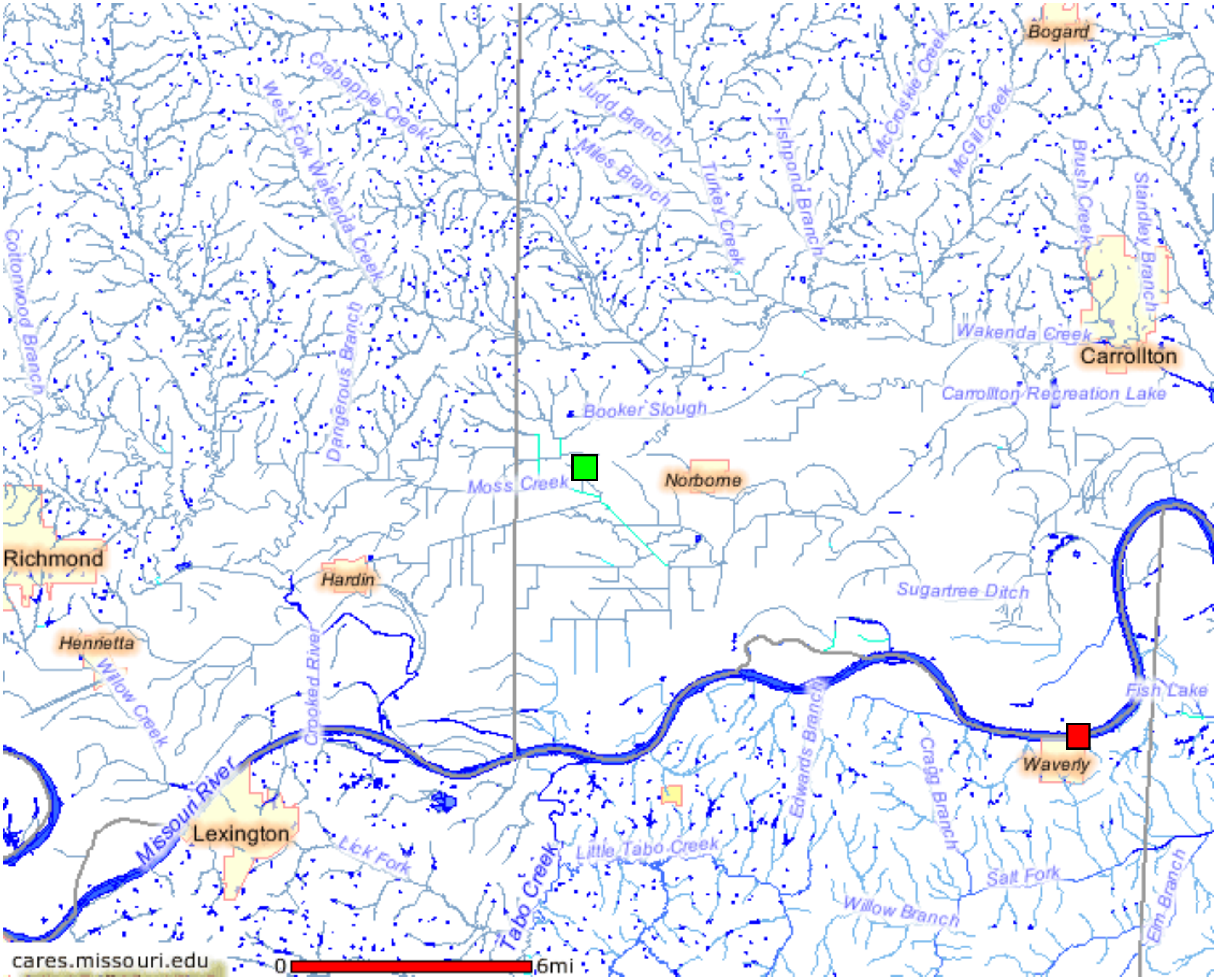
The environmental category, which was assigned a total weight of 20 percent, is comprised of six component evaluation criteria. These criteria are described in the following paragraphs.

##### 6.3.2.5.1 Land Use Compatibility

Coal-based power plants require large, contiguous parcels of land for both the main power generating facility and ancillary facilities such as fuel handling/storage and ash disposal. Coal-based power plants create combustion waste products that must be disposed of either off-site, or in a landfill located onsite, to the extent beneficial reuse of the combustion waste product is not possible. Off-site disposal results in additional truck or rail traffic to haul the combustion waste product from the site to an approved landfill, as well as additional environmental impacts outside of the proposed facility's physical boundaries. This criterion assesses compatibility of a power plant with existing land use on and around each site. The ratings for this criterion were based on a subjective evaluation of compatibility within one mile the site.

- Highly compatible (brownfield land) → Score = 5
- Very compatible (mineral extraction) → Score = 4
- Compatible (agricultural or forestry) → Score = 3
- Somewhat incompatible (active industrial/commercial development) → Score = 2
- Highly incompatible (recreational, institutional or residential development) → Score = 1

A discussion of the predominant land use of each site and the resulting scores for the land use compatibility criterion is described next.




## Legend

County Boundaries

1:24,000 Rivers and Streams

- Perennial Stream/River
- Intermittent Stream/River
- Artificial Path (Approx. Centerline)
- Undifferentiated Stream/River
- Canal or Ditch
- Other Hydrologic Feature

Incorporated Areas

- City
- Town
- Village

(cont)

- Census Designated Place
- Other

1:24,000 Water Bodies

- Lake or Pond
- Lake or Pond (Intermittent)
- Reservoir
- Stream or River
- Swamp or Marsh
- Canal or Ditch
- Other Water Body

## Location Map

Map prepared by:
http://cares.missouri.edu, 4/5/2005.

- Norborne Site
- Stream Gauge (USGS 06895500)

Figure 6-22
Surface Water & Stream Gauge Locations Near Norborne Site

## Forbes Site

The Forbes site consists of approximately 2,000 acres. The nearest towns are the village of Rulo, Nebraska, which is located one mile to the west of the site, and the Village of Big Lake, Missouri, which is located approximately two miles to the east-northeast of the site. Based on the 2000 U.S. Census, the village of Rulo has a population of 226 persons and the Village of Big Lake has a population of 127 persons. The majority of the site area is relatively flat with a ground elevation around 854 feet. Land uses surrounding the site include scattered rural residential housing and agriculture, with approximately 95+ percent of the site used for agriculture. One farmstead is located within the site. Big Lake State Park is located east-northeast approximately 3 miles and Squaw Creek National Wildlife Refuge is located approximately 7.5 miles east of the Forbes site.

Visual characteristics of the Forbes site area are predominantly rural and are typical for this part of Missouri and Nebraska (See photographs in Appendix A). The proposed plant will be a distinctive element in the landscape particularly to residents living in Rulo. Residents living to the south of the site will be moderately shielded from the plant due to the vegetation along both sides of the Missouri River. The plant will be noticeable to people driving along U.S. Highway 159. For residents living in Big Lake the plant will be visible but not the dominant feature due to the distance from the site.

The area is described as mostly prime farmland, with a few scattered areas considered prime farmland if drained. As defined by the U.S. Department of Agriculture (USDA), prime farmland is land that is best suited to food, feed, forage, fiber, and oilseed crops. It may be cultivated land, pasture, woodland, or other land, but it is not urban or built-up land or water areas. The soil qualities, growing season, and moisture supply are those needed for to sustain high yield crop in an economic manner. Over 15,000 acres in Holt County (surveyed by the USDA) meets the soil requirements for prime farmland, or about five percent of the total acreage of the county. An additional 140,000 is available in areas where the soils are drained or are protected from flooding. Typical crops grown in the farmland include corn, soybeans, winter wheat, and grain sorghum. Existing vegetation on the site consists primarily of cropland, with remnants of native grass and a few scattered trees along the Missouri River.

This property is available for purchase. The land use compatibility rating for this site is a score of three. Site photos are included in Appendix A.

### Norborne Site

The Norborne site is approximately 1,400 acres. The nearest town is Norborne, Missouri, which is located approximately three miles to the east-southeast of the site. Based on the 2000 U.S. Census, the city of Norborne has a population of 805 persons. The majority of the site area is relatively flat with ground elevation ranging from 675 to 690 feet. Land uses surrounding the site include scattered rural residential housing and agriculture, with approximately 95 percent of the site used for agriculture. Several farmsteads are located within or adjacent to the site; three are located in the northern portion of the site, two are adjacent to the northeast corner and one is located at the southeast corner of the site.

Visual characteristics of the Norborne site area are predominantly rural and are typical for this part of Missouri. (See photographs in Appendix B) The proposed plant will be a distinctive element in the landscape particularly to residents driving along State Highway DD. Residents living to the north and west of the site will be moderately shielded from the plant due to the rolling topography of the land. For residents living in Norborne, the plant will be visible but not the dominant feature due to the distance from the site and rolling hills in the background.

Most of the area is described as prime farmland if drained, with a few scattered areas considered prime farmland. Over 130,000 acres in Carroll County (surveyed by the USDA) meets the soil requirements for prime farmland, or about 29 percent of the total acreage of the county. An additional 112,500 is available in areas where the soils are drained or are protected from flooding. Typical crops grown in the farmland include corn, soybeans, winter wheat, and grain sorghum. Existing vegetation on the site consists primarily of cropland, with remnants of native grass and scattered stands of trees present in the northwestern corner of the property. This property is also available for purchase. The land use compatibility rating for this site is a score of three. Site photos are included in Appendix B.

#### 6.3.2.5.2 Protected Species

Impacts to a threatened, endangered or otherwise protected species would be considered very serious and probably represent a fatal flaw to site development; however, such impacts are not likely at either of the sites so this criterion was assigned a low relative weighting. Potential impacts to protected species of plants and animals were estimated from county-wide information on species occurrence obtained from the Missouri Department of Conservation (MDC) Natural Heritage Database and review of the habitat available at each site. The scores for this criterion were then assigned based on a qualitative assessment of potential impacts.

- Low potential for protected species (existing disturbance) → Score = 5
- Moderate potential for protected species (existing vegetation may be potential habitat for protected species) → Score = 3
- High potential for protected species(documented occurrence of protects species in area and/or known habitat exists on or near site) → Score = 1

A discussion of potential protected species at each site area and the resulting scores for the protected species criterion are described below.

**Forbes Site**

According to the MDC Natural Heritage Database, the site is located within the known range of seven state or federally threatened or endangered species (Table 6-7). Potential habitat for two species may exist on the site based on its location, however there is very little natural habitat remaining on this farmed land. These species include the bald eagle and the eastern massasauga, a small, timid rattlesnake. The bald eagle requires large trees and deciduous mixed forest for perching, roosting, and nest sites, adjacent to rivers and lakes, where fish are abundant. The eastern massasauga requires marshy areas, wet prairies, sloughs, and floodplains of major rivers. As part of the alternative fuel delivery to the site there is the potential for a bridge across the Missouri River there is the potential to impact the pallid sturgeon. In order to verify the presence of any potential habitat for any of the species at the site, a habitat survey would need to be conducted. Additional coordination will occur with the U.S. Fish and Wildlife Service as part of the EIS process. The protected species potential impact rating for this site is a score of three.

## Table 6-7 Holt County Threatened and Endangered Species

| Common Name | Scientific Name | Status | | Habitat Association | Habitat Likely Present on Site |
|---|---|---|---|---|---|
| | | State Status | Federal Status | | |
| American bittern | *Botaurus lentiginosus* | E | | Marshes, wet meadows, and sloughs with emergent vegetation and permanent water one foot deep | No |
| Bald eagle | *Haliaeetus leucocephalus* | E | T | Requires large trees and deciduous mixed forest adjacent to rivers and lakes, where fish are abundant, for perching, roosting, and nest sites | Possibly |
| Blanding's turtle | *Emydoidea blanddingii* | E | | Marshes, waterholes, sloughs, streams and pond with mud, with organic bottoms and dense vegetation, nests in grasslands | No |
| Eastern massasauga | *Sistrurus catenatus catenatus* | E | | Marshy areas, wet prairies, sloughs, and floodplains of major rivers | Possibly |
| Flathead chub | *Platygobio gracilis* | E | | Pools of small creeks with moderately clear water over gravel and bedrock or in large, turbid rivers with fine sand and gravel bottoms | No |
| Indiana bat | *Myotis sodalist* | E | E | Caves and mines; small stream corridors with well developed riparian woods; upland forests | No |
| Pallid sturgeon | *Scaphirhynchus albus* | E | E | | No |
| Western fox snake | *Elaphe vulpina vulpina* | E | | Native prairie adjoining marshland or cropland near streams or marshes | No |
| Western prairie fringed orchid | *Platanthera praeclara* | E | T | Tallgrass prairie, moist habitats, and sedge meadows | No |

Source: Missouri Department of Conservation, 2005b. United States Fish and Wildlife Service, 2005b
E – Endangered; T - Threatened

**Norborne Site**

According to the MDC Natural Heritage Database, the site is located within the known range of five state or federally threatened or endangered species (Table 6-8). Potential habitat for the bald eagle may exist on the site. As described earlier, the bald eagle requires large trees and deciduous mixed forest for perching, roosting, and nest sites, adjacent to rivers and lakes, where fish are abundant. In order to verify the presence of any potential habitat for any of the species at the site, a habitat survey would need to be conducted. The protected species potential impact rating for this site is a score of three.

**Table 6-8 Carroll County Threatened and Endangered Species**

| Common Name | Scientific Name | Status | | Habitat Association | Habitat Likely Present on Site |
|---|---|---|---|---|---|
| | | State Status | Federal Status | | |
| Bald eagle | *Haliaeetus leucocephalus* | E | T | Requires large trees and deciduous mixed forest adjacent to rivers and lakes, where fish are abundant, for perching, roosting, and nest sites | Possibly |
| Greater prairie-chicken | *Tympanuchus cupido* | E | | Large grassland tracts with herbaceous vegetation and dense stands of native grasses or shrubs and thickets for winter cover | No |
| Indiana bat | *Myotis sodalist* | E | E | Caves and mines; small stream corridors with well developed riparian woods; upland forests | No |
| Lake sturgeon | *Acipenser fulvescens* | E | | Large rivers over sand, gravel, or rocky bottom | No |
| Northern harrier | *Circus cyaneus* | E | | Open fields, prairies, native grass, and shallow marshes, and areas with dense vegetation nearly 100% canopy cover | No |

Source: Missouri Department of Conservation, 2005b. United States Fish and Wildlife Service, 2005b
E – Endangered; T - Threatened

#### 6.3.2.5.3 Noise Impacts

There are a number of factors that will determine whether the noise from construction or operation of the proposed generating station will impact any sensitive receptors in the vicinity, but the number of such receptors close by is one variable that can be easily measured. The ratings for this criterion were assigned based on an estimate of the number of sensitive receptors within one mile of each site using the scoring criteria listed below.

- Number of receptors ≤ 10 → Score = 5
- 10 < Number of receptors ≤ 20 → Score = 4
- 20 < Number of receptors ≤ 30 → Score = 3
- 30 < Number of receptors ≤ 40 → Score = 2
- Number of receptors > 40 → Score = 1

A discussion of the number of receptors at each site and located within a one-mile buffer of the site and the resulting scores for the noise impacts criterion are described below.

**Forbes Site**

The Forbes site is located approximately one mile to the east of Rulo, Nebraska and two miles west of Big Lake, Missouri. The village of Rulo is a small, rural community with a population of 226 and a housing count[2] of 132 units. The village of Big Lake is a small community with only about half of the households being full-time inhabitants (of the 60 households, 37 families reside in the village). The village of Big Lake has a population of 127 and a housing count of 376 units. The other houses are recreational homes used during peak summer months by part-time residents visiting the Big Lake State Park managed by the Missouri Department of Natural Resources (DNR). In addition to the summer homes, visitors to the park also utilize the Missouri DNR's campsite and cabin accommodations. The campgrounds contain 76 campsites, in addition to the two-story motel and eight cabins located on the lake. The campground and lodging accommodations are outside of the one-mile buffer area.

[2] A housing unit is defined by the U.S. Census Bureau as a house, an apartment, a mobile home, a group of rooms, or a single room that is occupied (or if vacant, is intended for occupancy) as separate living quarters.

Noise receptors at or within a one-mile buffer of the site include most of the village of Rulo, a small portion of the village of Big Lake, a small residential neighborhood south of the site and south of the Missouri River in Nebraska with approximately 12 residences, six scattered farmsteads south of the village of Rulo in Nebraska, six residences located within the limits of the Iowa Sac and Fox Indian Reservation south of the site and south of the Missouri River in Nebraska, two farmsteads located north of the site and north of U.S. Highway 159, and one farmstead located within the site. The estimated total (including the residential areas) of noise receptors at or within a one-mile buffer of the site is approximately 180 residences (Figure 6-23). The noise impact rating for this site is a score of one.

**Norborne Site**

The Norborne site is located approximately three miles west-northwest of Norborne, Missouri. The city of Norborne is a rural community with a population of 805 and a housing count of 404 units. However, the city of Norborne is located outside of the one-mile buffer area.

All of the noise receptors at or within a one-mile buffer of the site are rural residences. Within the site there are four residences. Most of the other noise receptors are in the northern half of the buffer area along CR 634 and CR 638 (22 rural residences). The rest of the noise receptors are located between the site and Norborne along State Highway DD and CR 505 (six rural residences), with one noise receptor identified on the southern edge of the buffer area along CR 508. The total number of noise receptors at or within a one-mile buffer of the site is 33 rural residences (Figure 6-24). The noise impact rating for this site is a score of two.

#### 6.3.2.5.4 Wetlands Impacts

Wetlands are a protected resource and any impacts to wetlands must either be avoided or be mitigated by creation of a like or greater amount of wetlands at a nearby location. For this criterion, the sites were rated based on the number of acres of wetlands located within each site, as shown on USFWS National Wetland Inventory (NWI) maps. The rating criteria used to assign scores for the Wetlands criterion are detailed below.

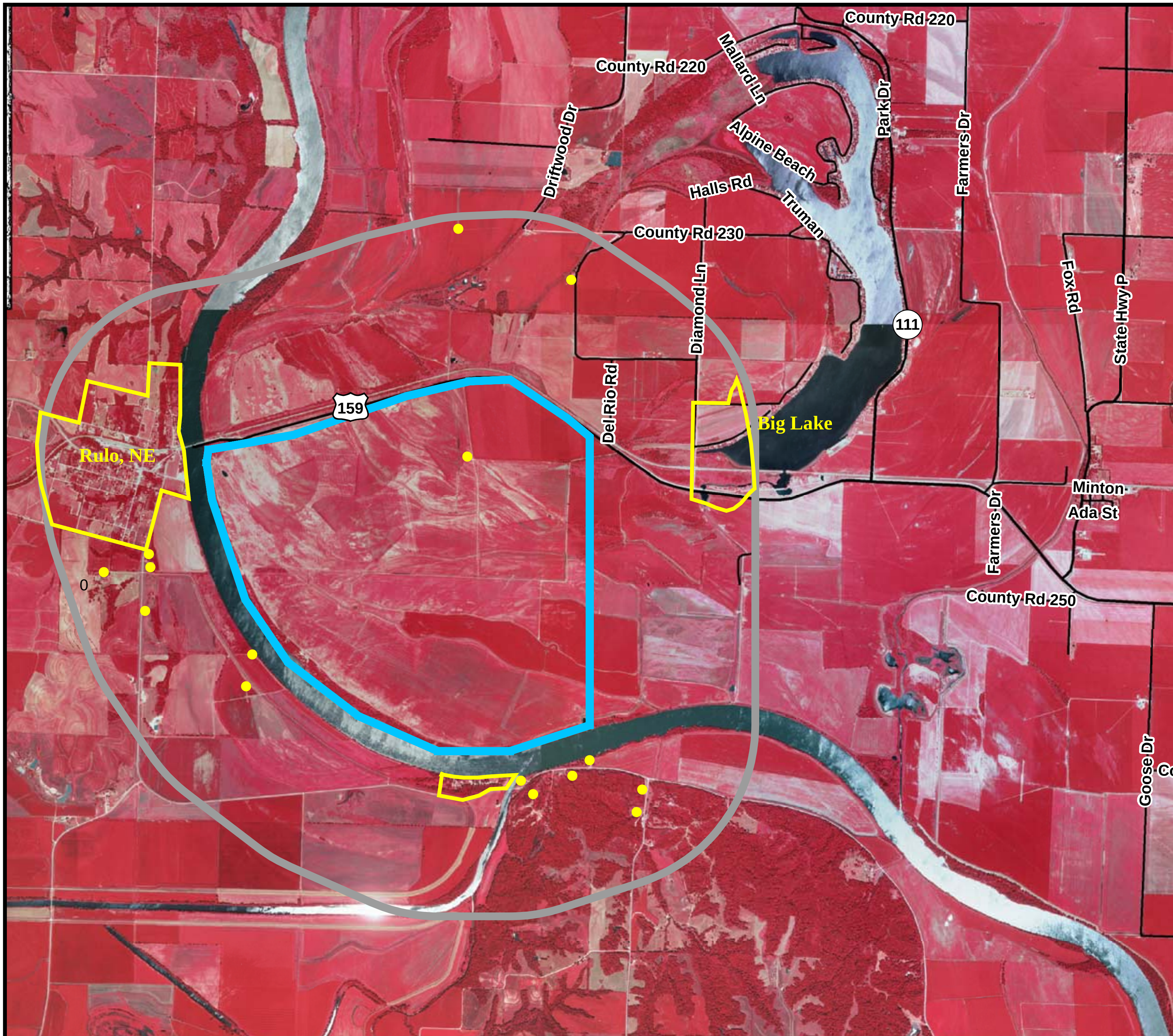



Figure 6-23

Noise Receptor Locations
Forbes Site

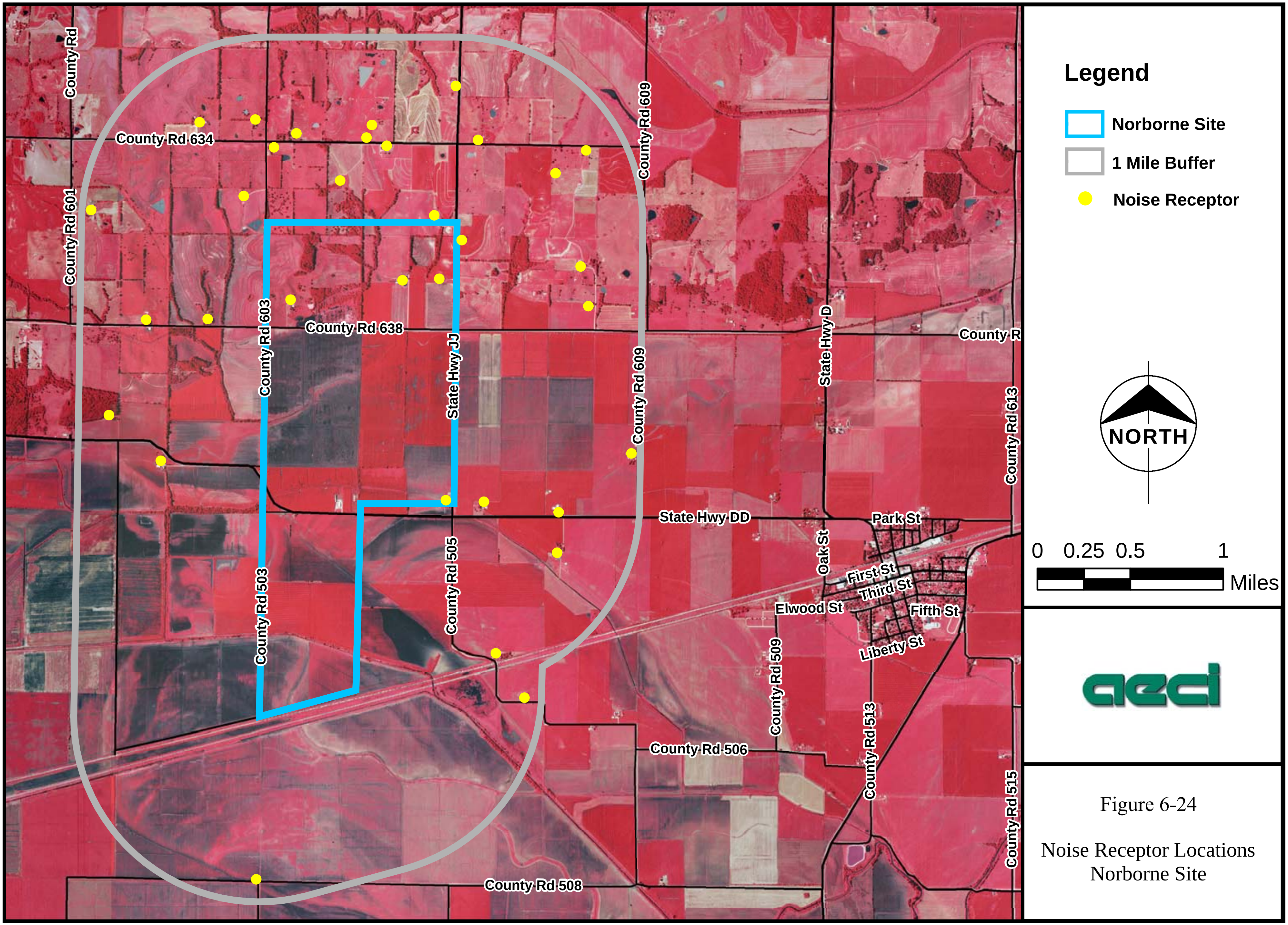



Figure 6-24

Noise Receptor Locations
Norborne Site

- No Wetlands → Score = 5
- Wetlands ≤ 25 acre → Score = 4
- 25 acre < Wetlands ≤ 50 acres → Score = 3
- 50 acres < Wetlands ≤ 75 acres → Score = 2
- Wetlands > 75 acres → Score = 1

A discussion of the wetlands at each site area and the resulting scores for the wetlands criterion are described below.

**Forbes Site**

The entire Forbes site drains into the Missouri River, which is located on the western boundary of the site. As determined by the Rulo, NEBR.-MO. NWI maps, there are wetlands present throughout the site. These areas consist of palustrine emergent (approximately 50 acres), palustrine forested (approximately130 acres), and palustrine scrub/shrub (approximately 70 acres) wetlands, totaling approximately 250 acres of wetlands present on the site (Figure 6-25). However, currently, many of these areas appear to be farmed. Development of the site may require mitigation for wetland losses. An on-site wetland determination would need to be conducted to verify the presence of jurisdictional wetlands within the site. The wetlands impact rating for this site is a score of one.

**Norborne Site**

The entire Norborne site drains into the Booker Slough and the Norborne Drainage Ditch, which are located in the center and on the southern edge of the site, respectively. As determined by the Norborne, MO. NWI maps, there are minimal wetlands present throughout the site. These areas consist of palustrine emergent (approximately 18 acres) and palustrine scrub/shrub (approximately 0.25 acres) wetlands, for a total of approximately 18.25 acres of wetlands present on the site (Figure 6-26). However, many of these areas appear as if they are currently being farmed. Development of the site may require mitigation for wetland losses. An on-site wetland determination would need to be conducted to verify the presence of jurisdictional wetlands within the site. The wetlands impact rating for this site is a score of four.

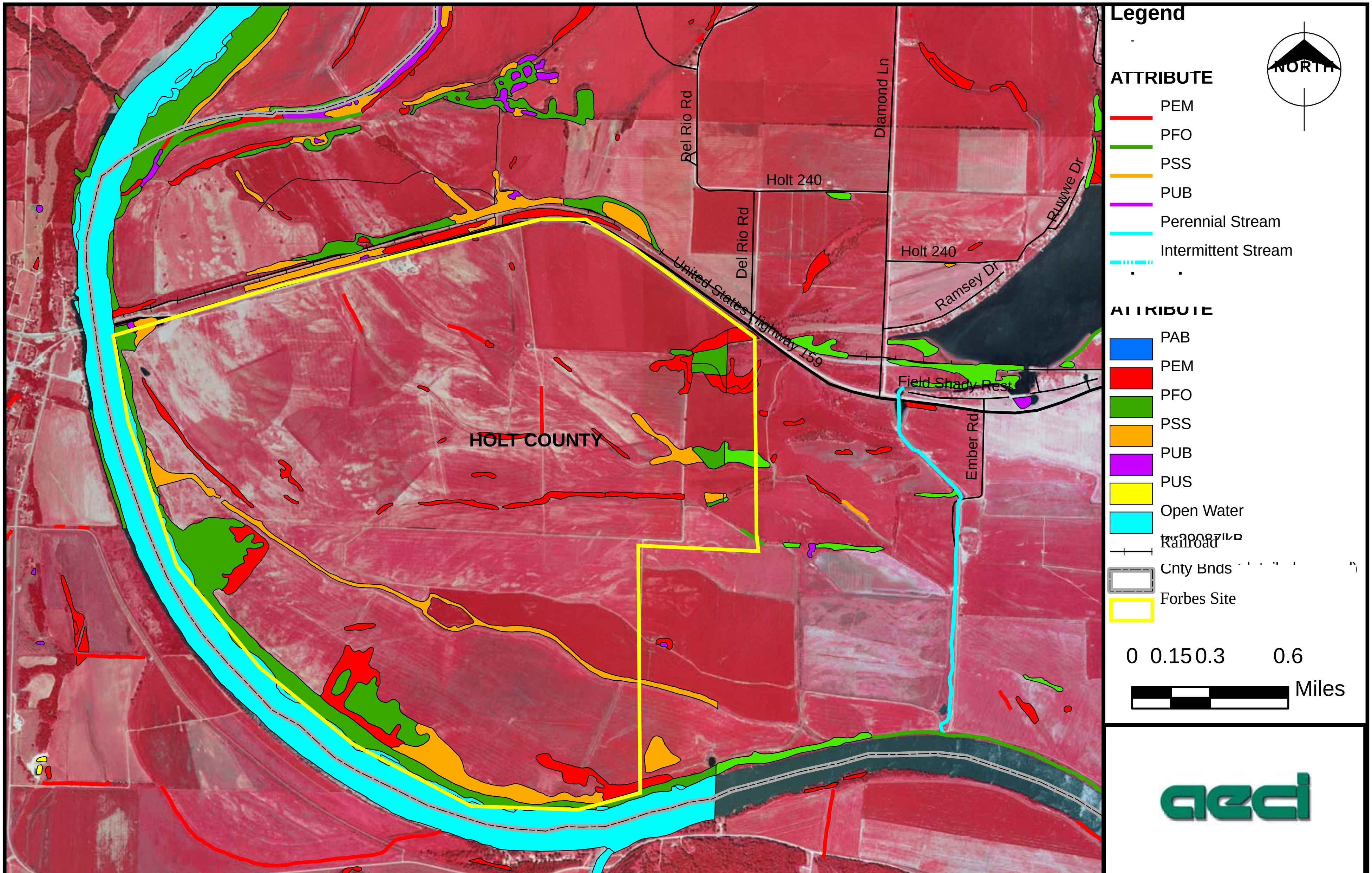



Figure 6-25
NWI Wetland Aerial Map
Forbes Site

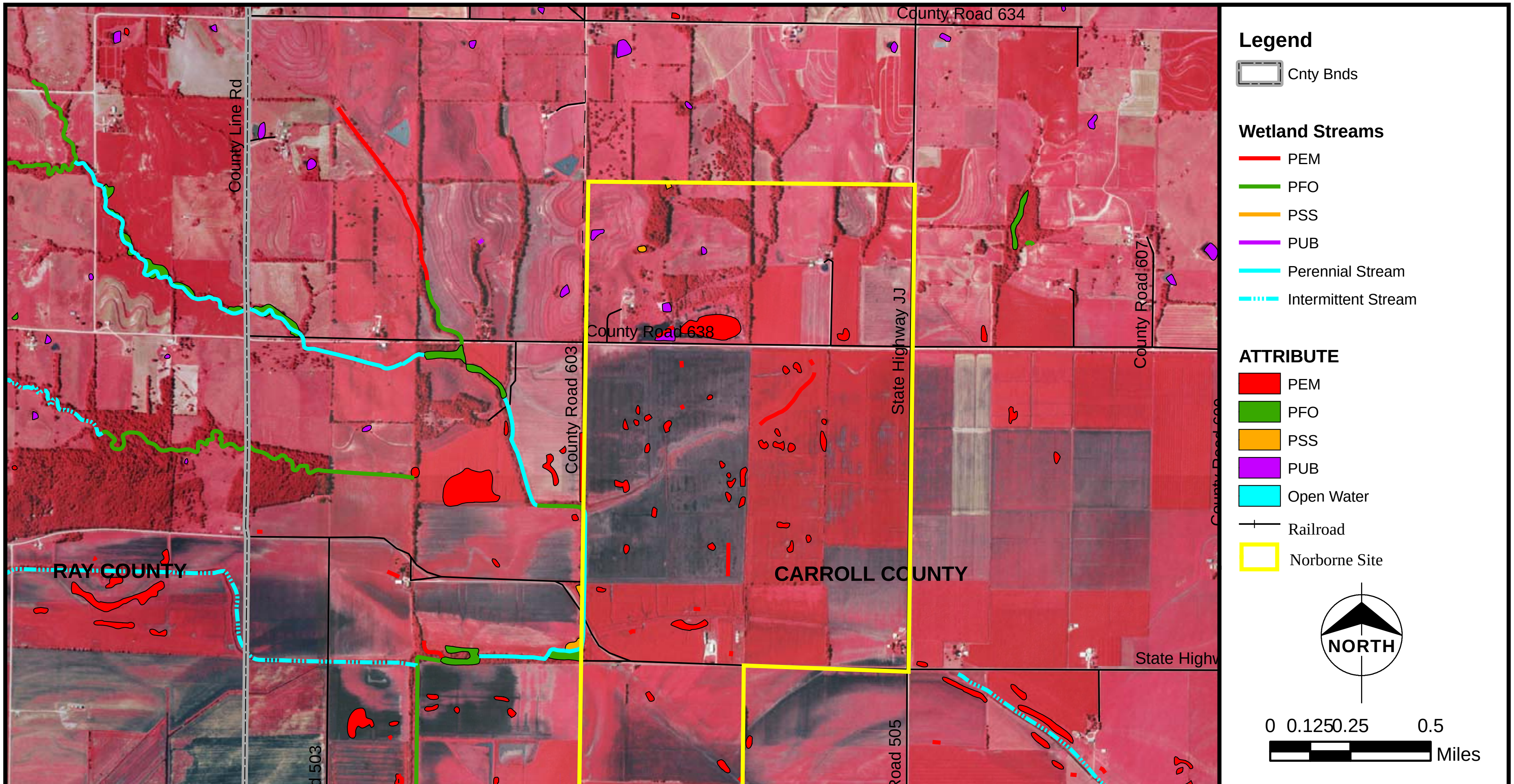



Figure 6-26

NWI Wetland Aerial Map
Norborne Site

#### 6.3.2.5.5 Floodplains Impacts

The entire site must be above the 100-year flood level or it must be feasible to protect the site from a 100-year flood. This eliminates potential down time and loss of equipment in the event of a flood. The ratings criteria used to assign scores for the floodplains criterion are detailed below.

- Entire site above 100-year flood level or site behind a federal levee designed for the 100-year flood level → Score = 5
- Site within the 100-year flood level and not behind a federal levee designed for the 100-year flood level → Score = 3
- Site within the 100-year flood level and within a regulatory floodway area → Score = 1

A discussion of the floodplains at each site and the resulting scores for the floodplain criterion are described next.

**Forbes Site**

According to the 1988 Federal Emergency Management Agency's (FEMA) Flood Insurance Rate Map (FIRM) (Holt County, Missouri and Incorporated Areas Map Number 29087C0095 B, panel 95 of 190), the Forbes site is located within a 100-year floodplain with approximately 30 percent of the site along the Missouri designated as a regulatory floodway. The site is large enough to accommodate the power plant facilities on fill material that would elevate the power plant out of the floodplain. No power plant facilities would be located in the floodway. The floodway would remain as a buffer between the power plant and the river. Detailed site evaluation and engineering plans will be prepared to minimize impacts to the floodplain if this site is selected. Where determined within the site, the base flood elevation line ranges between 858 to 862 feet. The floodplains impact rating for this site is a score of one.

**Norborne Site**

According to the 1986 FEMA's FIRM (Carroll County, Missouri Map Number 29057C0175 B, panel 175 of 225), the Norborne site is located within a 100-year floodplain with base flood elevations and flood hazards determined (Zone A7), with a small portion of the site designated as within the 100-year floodplain with no base elevations and flood hazards determined (Zone A). Detailed site evaluation and engineering plans will be prepared to minimize impacts to the floodplain if this site is selected. Where determined within the site, the base flood elevation line is 688 feet. The floodplains impact rating for this site is a score of three.

#### 6.3.2.5.6 Cultural Resources Impacts

Federal agencies are required to assess the impacts to historic properties prior to issuing permits (36 Code of Federal Regulations (CFR) 800). These include those properties listed in the National Register of Historic Places (NRHP) and those that are eligible for listing (known and unknown). Because not all areas have been surveyed for historic properties and the number is unknown in many areas, the ratings are based upon known and the probability of additional historic properties in any given location. The rating criteria used to assign scores for the cultural resources criterion are as follows.

- Low potential for Cultural Resources → Score = 5
- Moderate potential for Cultural Resources → Score = 3
- High potential for Cultural Resources → Score = 1

A discussion of the cultural resources at each site and the resulting scores for the cultural resources criterion are described below.

**Forbes Site**

Background research at the Archaeological Survey of Missouri (ASM) and an online search of the NRHP was conducted. The results of the background research at ASM showed a great disparity in site density along the Missouri River and its tributaries. This inconsistency in site density can be attributed to the fact that only a few formal archaeological surveys have been conducted over much of the area. Where professional and amateur archaeological surveys have been conducted the pattern of site density and significance can be summed up very easily.

The floodplains of the Missouri River and its tributaries do not contain large numbers of sites but the sites that are found tend to be significant. Prehistoric sites tend to be villages and many are mound sites. Historic sites in the floodplain tend to be farmsteads but some can be from very early in Missouri history. The meanders of the Missouri River and its tributaries tend to limit the age of prehistoric sites to less than 3,000 years old. For historic sites, the flooding and meanders have, in many cases, destroyed the integrity of most of the historic sites. The few prehistoric and historic sites that remain intact tend to be evaluated as significant and eligible for listing in the NRHP.

Other topographically significant areas that in the past have produced large numbers of archaeological sites are the perimeters of meander lakes such as Big Lake, or the edges of large wetland areas such as Squaw Creek NWR (located approximately seven miles to the east). Only one small area on the east side of Squaw Creek NWR has been the subject of archaeological surveys. The majority of the sites that were recorded were on the bluffs overlooking the floodplain, but at least one site was recorded in the floodplain. It is highly likely that the terrace remnants and other relatively high points near these areas will produce a high density of archaeological sites, some of which may be buried.

Specifically for the proposed location of the Forbes site, there are no known or recorded significant archaeological sites listed in the ASM site records that are not on the NRHP. However, there are NRHP listed sites in the area. One is just north of the site, and is identified as the Rulo Bridge (U.S. Highway 159 over the Missouri River), which is a significant architecture/engineering structure. Any potential impacts will be addressed in the EIS West of the Missouri River in Nebraska is the Leary Site (25RH1), which is a prehistoric Oneonta site described as a village. The Leary Site contains Native American burials. Finally, a site known as No. JF00-062, located southeast of Rulo, Nebraska, is listed as a historic site significant because of its association with the exploration and settlement of the United States. While there are no recorded sites on the Forbes site this can be attributed to the lack of archaeological investigations in the area. In similar settings the site density near the Missouri River or its tributaries has been moderate and on the floodplain there may be buried sites. Where archaeological surveys have been conducted on the bluffs overlooking the Missouri River or its tributaries, the site density can be considered high. In addition, the proximity of the Iowa Sac and Fox Indian Reservation raises the possibility of Traditional Cultural Properties (TCPs). Consultation with the Iowa Sac and Fox will be undertaken to ensure no TCPs will be affected by the proposed project. The impact rating for this site is two, because of moderate to high potential for cultural resources.

**Norborne Site**

Background research at the ASM and an online search of the NRHP was conducted. The results of the background research at ASM showed a great disparity in site density along the Missouri River and its tributaries. This inconsistency in site density can be attributed to the fact that only a few formal archaeological surveys have been conducted over much of the area.

One NRHP site is located in the city of Norborne. It is the Farmers Bank Building and should not be affected by the proposed project. Two archaeological sites are known to exist within one mile of the Norborne site, but neither is considered eligible for the NRHP.

Few archaeological investigations have been conducted near Norborne. However, one archaeological survey for the construction of U.S. Highway 65 in Carroll County was conducted and the site density in the floodplain for this narrow corridor was high, averaging 3 to 5 sites per linear mile. Considering the narrow width of this corridor it can be expected that the site density per square mile in this portion of the Missouri River floodplain could be as high as 15 to 20 sites. The impact rating for this site is three, for moderate potential for cultural resources.

### 6.3.2.6 Other Evaluations

The other category, which was assigned a total weight of 10 percent, is comprised of three component evaluation criteria. These criteria are described in the following paragraphs.

#### 6.3.2.6.1 Site Accessibility

The proposed power plant site must be accessible from an all-weather road for construction and operating personnel and for delivery of materials and equipment. These roads must also be capable of supporting heavy truck traffic for delivery of equipment during construction.

The distance of the site from a major highway is an important evaluation factor. The condition of local roads which connect the site to a major highway is another transportation-related evaluation factor. Therefore, the ratings for this criterion were based on the distance to a major highway, which is defined as either a U.S. or Interstate highway. The criteria for site accessibility are listed below.

- Distance ≤ 1 miles → Score = 5
- 1 miles < Distance ≤ 5 miles → Score = 4
- 5 miles < Distance ≤ 10 miles → Score = 3
- 10 miles < Distance ≤ 15 miles → Score = 2
- Distance > 15 miles → Score = 1

The distance of the site to the nearest U.S. or Interstate highway is discussed and the associated scores are provided below.

**Forbes Site**

Construction access for heavy hauling to the Forbes Site would be available from the BNSF railroad to the railroad spur and on U.S. Highway 159 located off of Interstate 29. The Forbes site is located approximately 14 road miles (along U.S. Highway 159) west of the nearest interchange exit from Interstate 29. The proposed construction traffic route would be to exit Interstate 29 at U.S. Highway 159, and proceed west on U.S. Highway 159 to the proposed site. The site accessibility rating for this site is a score of five.

**Norborne Site**

Construction access for heavy hauling to the Norborne Site would be available from the BNSF railroad to the railroad spur and on State Highway 10 located off of U.S. Highway 24. The Norborne site is located approximately four road miles (along State Road DD) west of the nearest intersection from State Highway 10. The nearest intersection from U.S. Highway 24 from the intersection of State Highway 10 and State Road DD is located approximately 10 road miles (along State Highway 10) to the east. The proposed construction traffic route would be to exit Interstate 70 onto State Highway 13/State Highway 213 through Higginsville to U.S. Highway 24 towards Waverly. At Waverly, U.S. Highway 24 will head north across the Missouri River and travel towards Carrollton. The exit onto State Highway 10 is just south of Carrollton. At State Highway 10, the route would continue to Norborne and exit at State Road DD, and then proceed west on State Road DD to the proposed site. The site accessibility rating for this site is a score of four.

#### 6.3.2.6.2 Land Availability

Favorable land acquisition conditions at a given potential site area are those where the size of the property provides for possible future expansion and is available for acquisition. The relative attractiveness of the sites with regard to land availability is generally based on the size of the property and ease of purchase from willing sellers.

Both of the sites are appropriate in size and are available for acquisition. Therefore, for this evaluation, both sites were assigned a score of five.

#### 6.3.2.6.3 Constructability

Constructability can be assessed by evaluating various criteria such as topography and drainage that determine the amount of site preparation and grading necessary at the site. Site areas with significant variations in ground surface elevations would require more grading and other site preparation effort to level an area for plant development. Therefore, the ratings for this criterion were based on the amount that the site must be raised, in order to minimize costs for earthwork, retaining walls, erosion control, drainage, roadwork, and track work. The criteria for constructability are listed below.

- Site grading ≤ 3 feet → Score = 5
- 3 feet < Site grading ≤ 6 feet → Score = 4
- 6 feet < Site grading ≤ 10 feet → Score = 3
- 10 feet < Site grading ≤ 15 feet → Score = 2
- Site grading > 15 feet → Score = 1

Following is a description of each alternative site in terms of constructability.

**<u>Forbes Site</u>**

The majority of the site area is relatively flat with ground elevation around 854 feet. Land uses surrounding the site include scattered rural residential housing and agriculture, mainly cropland. The majority of the site (95+ percent) is presently used for cropland. It is anticipated that the amount of grading and other site preparation at this site would be moderate, based on the potential that the entire site would need to be raised out of the 100-year floodplain and regulatory floodway (base flood elevation lines ranges between 858 to

862 feet) or construction of a levee to protect the site would be necessary. The constructability rating for this site is a score of three.

**Norborne Site**

The majority of the site area is relatively flat with ground elevation ranging from 675 to 689 feet, with the majority of the site at elevation 688 feet. The majority of the site is presently used for rural residential housing and agriculture, mainly cropland. There are drainage courses present throughout the site. It is anticipated that the amount of grading and other site preparation at this site within the actual footprint to be determined would be minimal; however, potentially the entire site would need to be slightly raised out of the 100-year floodplain or construction of a levee to protect the site would be necessary. The constructability rating for this site is a score of two.

#### 6.3.2.7 Evaluation Summary

The individual scores for each site and criterion are summarized in Table 6-9. These scores were used along with the corresponding weights to calculate a weighted composite score for each site. These composite scores are calculated as the sum of the products of each individual score and criterion weight. To further illustrate how the composite scores are calculated, the Forbes site is used as an example. This site received a score of four for the rail line proximity criterion, which has a weight of 10 percent. Multiplying these two values gives a product of 40. A similar calculation is then made for each of the 13 remaining criteria. The 15 score-weight products that result are then summed yielding a total composite score for the Forbes site of 297. Since the individual criterion scores range from one to five and the criteria weights total 100 percent, the minimum possible composite score is 100 and the maximum possible composite score is 500. The higher the site's composite score, the most favorable the site based on all of the criteria.

From the site evaluation summary, the results demonstrate that both of the sites appear to be environmentally acceptable; however, the Norborne site scores higher than the Forbes site overall in terms of the evaluation criteria.

**Table 6-9 Site Evaluation Summary**

| Major Category/Criterion | Weight | Forbes | Norborne |
|---|---|---|---|
| Air Impacts | **10%** | 5 | 5 |
| Fuel Supply | **20%** | | |
| Rail Line Proximity | 10% | 4 | 4 |
| Competitive Rail Access | 6% | 1 | 3 |
| Railroad Considerations | 4% | 2 | 3 |
| Transmission | **20%** | 1 | 3 |
| Water Supply | **20%** | 5 | 3 |
| Environmental | **20%** | | |
| Land Use Compatibility | 2% | 3 | 3 |
| Protected Species Impacts | 3% | 3 | 3 |
| Noise Impacts | 6% | 1 | 2 |
| Wetlands Impacts | 3% | 1 | 4 |
| Floodplains Impacts | 3% | 1 | 3 |
| Cultural Resources Impacts | 3% | 2 | 3 |
| Other | **10%** | | |
| Site Accessibility | 2% | 5 | 4 |
| Land Availability | 4% | 5 | 5 |
| Constructability | 4% | 3 | 2 |
| Weighted Total Score | **100%** | **297** | **336** |

### 6.3.3 Differential Site Development Costs

The current estimate for site development costs at the Norborne and Forbes sites is $269,000,000 and $333,000,000 in 2011 dollars, respectively. These costs include coal transportation, transmission, site fill, water supply, primary and secondary rail connection, and plant infrastructure.

### 6.3.4 Selection of Proposed and Alternative Sites

The siting review indicated that construction at the Norborne site was the most cost-effective and less environmentally impacting of the two options. It has sufficient land to accommodate all of the components on site, adequate water supply, and two rail lines to provide competitive access for coal delivery.

Norborne was selected as the proposed site and the Forbes as the alternative site. Table 6-10 summarizes the evaluation results.

**Table 6-10 Evaluation Results**

| Criteria | Constraints | |
|---|---|---|
| | **Forbes** | **Norborne** |
| Water Supply | On-site wells | Requires construction of supply pipeline |
| Transmission Capability | TBD | TBD |
| Fuel Delivery | Construction of 4- mile rail spur to site (alternate rail spur 15 miles crossing over of major river | Construction of 3.5-mile rail spur to site with bridge over two existing rail tracks (alternate rail spur options 8-9 miles ) |
| Air Quality | None | None |
| Site Accessibility | Upgrade construction of access road | Upgrade construction of access road |
| Land Use and Availability | Requires property purchase | Requires property purchase |
| Constructability | Moderate to high grading | Moderate to minimal grading |
| Site Permitting Constraints | High to moderate potential for archaeological sites<br>Moderate potential for T&E species<br>High potential for wetlands | Moderate potential for archaeological sites.<br>Moderate potential for T&E species<br>Moderate potential for wetlands |
| Existing Development & Noise Receptors | High number of potential noise receptors | Moderate to high number of potential noise receptors |

## 6.4 SITE DESCRIPTION

The Norborne Site is located in Carroll County, Missouri, just north of the Missouri River. The site consists of approximately 1,400 acres located 4 miles west of Norborne, Missouri on the north side of Highway DD. Access to the plant is from State Highway 10. Norborne lies approximately 58 miles east from Kansas City, Missouri; 70 miles north of Sedalia, Missouri; and 225 miles west of St. Louis, Missouri. Figure 6-27 shows the site location.

Class I rail connections for coal and equipment delivery would be made via railroad spurs off of the Burlington Northern-Santa Fe or the Norfolk Southern Railroads, providing competitive rail access. The area surrounding the plant is primarily agricultural with sparse residential use.

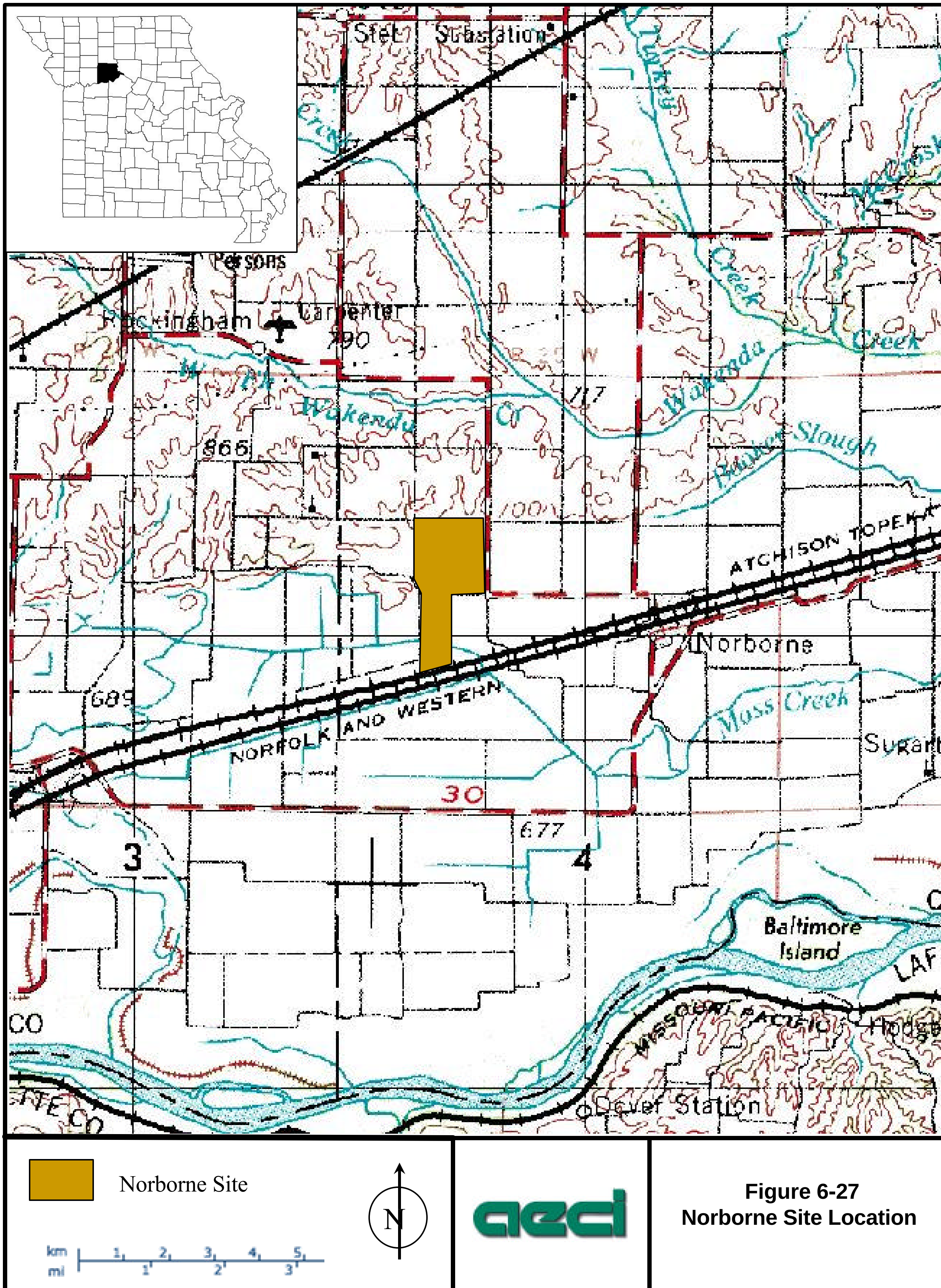



**Figure 6-27**
**Norborne Site Location**

The water supply source at the Norborne Site would be a well field located within the alluvial floodplain of the Missouri River, which is approximately seven miles south of the site. The water will be used in the cooling tower, for service water needs such as fire protection and equipment cooling, for drinking water and treated further to achieve ultra-pure water for the boiler.

## 6.5 PROJECT DESCRIPTION

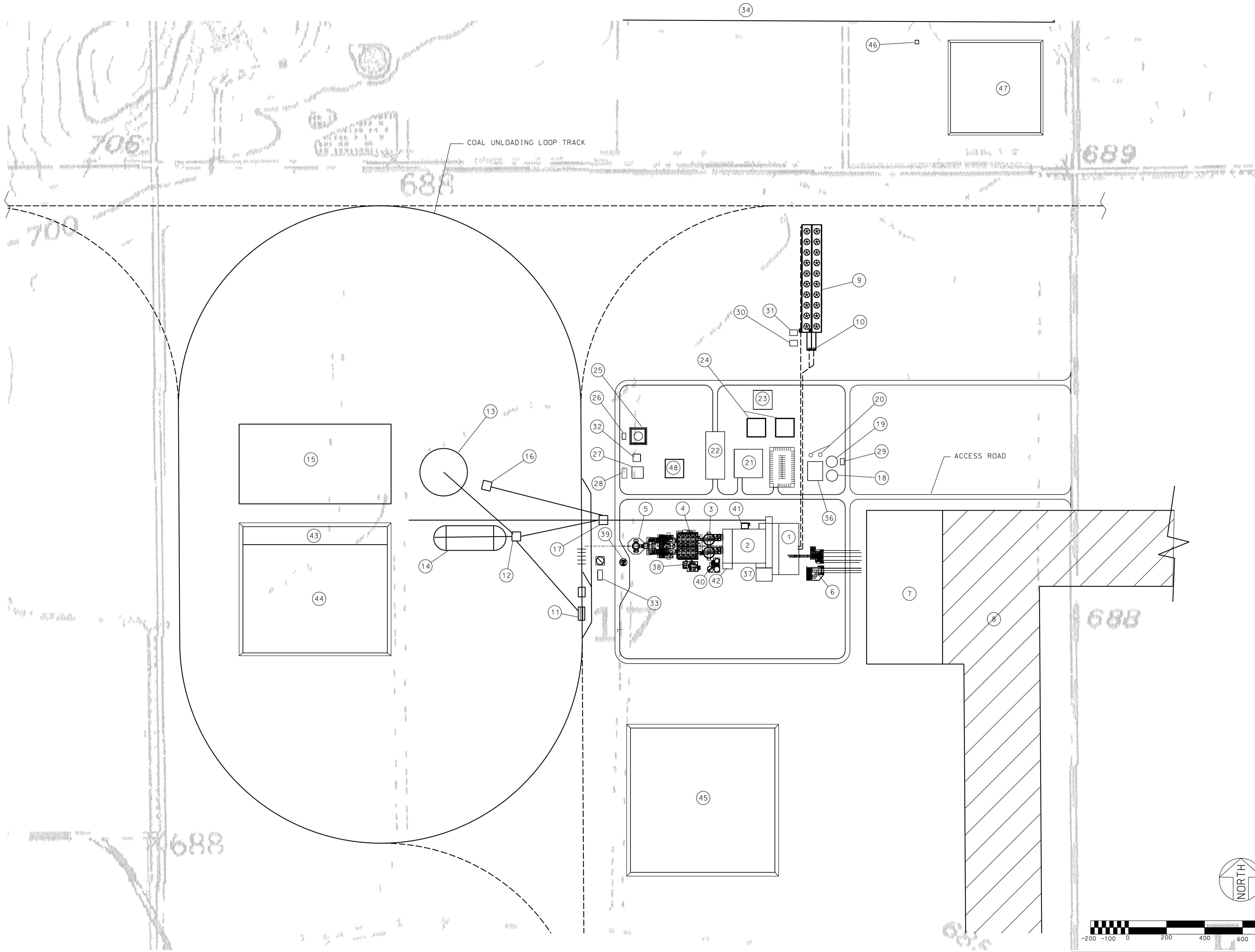
Design of the project has not been completed. The following sections generically describe the major components of the proposed electric generating facility, proposed air quality emission controls, transmission requirements, fuel use and waste disposal, water supply and wastewater disposal, operating characteristics of the proposed unit, expected noise levels construction and operation, transportation system to be utilized during construction and operation, the project schedule, project costs and employment requirements.

### 6.5.1 Facility Equipment and Layout

The proposed electric generating facility will consist of a single new, 660 MW base-load pulverized coal electric generating unit. The Project's major components will include a pulverized coal-fired boiler, steam turbine generator, cooling tower, emission control equipment, and stack. Figure 6-28 illustrates a generic site layout of the facility. This is a modern coal plant design that uses the most recent commercially available boiler, turbine generator, air emission control, and cooling tower equipment.

Coal delivered to the plant by rail will be unloaded via a rotary railcar dumper and transported by conveyor to either the coal yard for storage or to the power block area where it is placed in storage bunkers adjacent to the boiler. Combustion will take place in the boiler furnace where water is converted to steam. The forced draft fans provide combustion air.

Steam is produced in the boiler area and heated in both the furnace and convection sections of the boiler. Steam at high pressure and temperature from the boiler enters the steam turbine. Steam from the high-pressure turbine section is reheated in the boiler for improved cycle efficiency. Steam continues to flow through the turbine converting steam pressure and




LEGEND:

| | |
|---|---|
| 1 | TURBINE BUILDING |
| 2 | BOILER BUILDING |
| 3 | FGD ABSORBERS |
| 4 | BAGHOUSE |
| 5 | STACK |
| 6 | TRANSFORMERS |
| 7 | SWITCHYARD |
| 8 | TRANSMISSION CORRIDOR |
| 9 | COOLING TOWER |
| 10 | CIRCULATING WATER PUMPS |
| 11 | CAR DUMPER |
| 12 | COAL TRANSFER HOUSE |
| 13 | COAL STOCKOUT PILE |
| 14 | ACTIVE COAL STORAGE |
| 15 | INACTIVE COAL STORAGE |
| 16 | COAL RECLAIM HOPPER |
| 17 | COAL CRUSHER HOUSE |
| 18 | DEMINERALIZED WATER TANK |
| 19 | SERVICE/FIRE WATER TANK |
| 20 | CLARIFIERS |
| 21 | ADMINISTRATION BUILDING/MAINTENANCE SHOP |
| 22 | WAREHOUSE |
| 23 | WASTEWATER TREATMENT BUILDING |
| 24 | WASTEWATER BASINS |
| 25 | FUEL OIL TANK |
| 26 | FUEL OIL UNLOADING & FORWADING PUMPS |
| 27 | AMMONIA TANKS |
| 28 | AMMONIA UNLOADING |
| 29 | FIRE WATER PUMP HOUSE |
| 30 | CIRCULATING WATER CHEMICAL FEED BUILDING |
| 31 | CIRCULATING WATER ELECTRICAL BUILDING |
| 32 | BULK GAS STORAGE AREA |
| 33 | LIME UNLOADING STATION & BLOWER BUILDING |
| 34 | SOLID WASTE STORAGE AREA |
| 35 | WATER SUPPLY WELL |
| 36 | WATER TREATMENT BUILDING |
| 37 | CONTROL BUILDING |
| 38 | WASTE ASH BLOWER BUILDING |
| 39 | WASTE ASH SILO |
| 40 | LIME PREPARATION AREA |
| 41 | BOTTOM ASH STORAGE AREA |
| 42 | AUXILIARY BOILER |
| 43 | COAL PILE RUNOFF CLEANOUT BASIN |
| 44 | COAL PILE RUNOFF WETLAND TREATMENT AREA |
| 45 | STORM WATER DETENTION POND |
| 46 | SOLID WASTE STORAGE AREA LEACHATE COLLECTION SUMP |
| 47 | SOLID WASTE STORAGE AREA RUNOFF POND |
| 48 | CHEMICAL WASTE WATER STORAGE BASIN |

PRELIMINARY

CONTRACTOR/INSTALLER SHALL TAKE ALL APPROPRIATE PRECAUTIONS TO ENSURE THE SAFETY OF ALL PEOPLE LOCATED ON THE WORK SITE, INCLUDING CONTRACTOR'S/INSTALLER'S PERSONNEL (OR THAT OF ITS SUBCONTRACTOR(S)) PERFORMING THE WORK.

DRAWING RELEASE RECORD

| REV. | DATE REL'D. | PREPARED | REVIEWED | APPROVED | PURPOSE | FILM |
|---|---|---|---|---|---|---|
| 0 | 03-16-2005 | A. KHAN | S.L.WAHLERT | | FOR INFORMATION | |
| 1 | 03-25-2005 | A. KHAN | S.L.WAHLERT | | FOR INFORMATION | |

SCALE 1"=200'

PROJECT NUMBER 11630-001

Figure 6-28
Preliminary Site Plan

Sargent & Lundy LLC

DRAWING NO. GA-02A REV. 1

SHEET OF

FORM GDS 2.6.1 REV. 1 (05/93)

.../norborne/norborne-one-GA02.dgn 3/28/2005 4:54:54 PM temperature energy to mechanical energy turning the generator to produce electricity. When the steam reaches the lowest practical pressure (i.e., significantly below atmospheric pressure, which results in higher cycle efficiency), it leaves the turbine and enters the

condenser. The condenser functions to remove heat from the low pressure steam and condense it for return to the condensate system.

Heat entering the condenser is transferred through the condenser tubes into the cooler circulating water system which is returned to the cooling towers where the heat is rejected to the atmosphere.

After the steam is condensed, condensate and boiler feed pumps return the water to the boiler through the feed water heaters. The feed water heaters improve the cycle efficiency by heating the water before it enters the boiler. This often-used regenerative design is called the advanced Rankine Cycle.

Makeup water (new water added to the boiler circuit) is needed because some water and steam is lost in the boiler, turbine, and other equipment and systems and because it is necessary to periodically drain (blow down) a portion of the boiler water to maintain the needed water chemistry. The makeup water is pumped from the service water storage and treated in a demineralizing system.

### 6.5.2 Emissions Controls

Activities are underway to ultimately secure an air (Prevention of Significant Deterioration (PSD)) permit for construction of the project. The plant is planned to have state-of-the-art environmental controls that correspond to current Best Available Control Technology for criteria pollutants and Maximum Achievable Control Technology for hazardous air pollutants. Control technologies and predicted emissions rates will be such that Norborne will be one of the cleanest coal-fired plants in the country. Table 6-11 provides the expected estimated annual emissions of the project based on recent permits and average annual conditions and typical fuel analyses. These emissions are not dependent on the capacity factor and are dictated by the Best Achievable Control Technology (BACT).

The boiler is expected to use low nitrogen oxide ($NO_x$) burners, which have staged fuel and air mixing and over-fire air. These burners reduce the flame temperature, which results in lower $NO_x$ concentrations in the boiler exhaust flue gas. Equipment for control of boiler emissions is expected to include a selective catalytic reduction (SCR) system, to provide very efficient $NO_x$ emission control.

Low-$NO_x$ burner designs are currently available that generate less than 50 percent $NO_x$ compared to burner designs available 10 to 15 years ago. This reduction is accomplished mainly with staged combustion and with over-fire air. Over-fire air provides the oxygen needed to complete the combustion of the mixture of air and fuel gradually so burner flame temperatures are lower, resulting in lower $NO_x$.

**Table 6-11 Estimate of Potential Annual Emissions**

| Pollutant | Facility Total (tons per year (tpy)) |
|---|---|
| CO* | 3,800 |
| $NO_x$ † | 2,000 |
| $PM_{10}$ ‡ | 400 |
| $SO_2$ § | 2,500 |
| VOC ¶ | 100 |
| Pb** | 0.59 |

*CO emissions estimates are based on manufacturer's specifications at 0.15 lb/million British thermal units (MMBtu)

†$NO_x$ emissions estimates are based on a typical permit limit of 0.08 lb/MMBtu

‡$PM_{10}$ emissions estimates are based on a typical permit limit of 0.015 for the coal-fired unit. All particulate emissions are assumed to be $PM_{10}$, and represent both filterable and condensable particulates.

§$SO_2$ emissions estimates are based on a typical permit limit of 0.10 lb/MMBtu

¶VOC emissions estimates are based on a typical permit limit of 0.0036 lb/MMBtu for the coal-fired unit

**Lead emissions estimates are based on a typical permit limit of 0.60 tpy

The boiler flue gas (i.e., combustion exhaust) enters the SCR unit for conversion of $NO_x$ to water and nitrogen. SCR equipment in combination with low-$NO_x$ burners treats the boiler exit gas to reduce $NO_x$ by approximately 80 percent. $NO_x$ is converted by injecting ammonia upstream of a catalyst. In the presence of the catalyst, $NO_x$ reacts with ammonia and produces water and nitrogen. The catalyst is located downstream of the boiler economizer and before the air heater where boiler exit gas temperature is at an optimum. Installation of SCRs on coal plants is a relatively new development, but sufficient experience has been established to have a high confidence in proper operation of this equipment. This equipment is being employed to meet the anticipated emission limits.

The delivered coal, which has a low-sulfur content, in combination with a flue gas desulfurization (FGD) (likely a spray dryer (dry scrubber) and fabric filter baghouse) will provide the required sulfur dioxide ($SO_2$) control. FGD systems can generally be classified as either wet or dry processes. In both the wet and dry process alkaline slurry contacts the flue gas in an absorber module resulting in the removal of sulfur dioxide from the gas. In the wet FGD process (wet scrubber), large quantities of alkaline slurry are sprayed into the flue gas so the gas temperature is reduced to the adiabatic saturation temperature. In the dry FGD process (dry scrubber), the quantity of water introduced is carefully controlled so the flue gas remains well above the saturation temperature.

With a wet scrubber, dry fly ash is removed upstream of the FGD vessel by a fabric filter baghouse and either sold as an alternative for cement or transported to the landfill by either truck or overland conveyor. A limestone and water slurry is sprayed into the FGD vessel. This limestone slurry, consisting mainly of calcium oxide, is atomized in the wet scrubber chamber. Calcium oxide reacts with sulfur in the boiler exhaust gas to produce a calcium sulfur compound that is subsequently dewatered and removed from the absorber recycle slurry. Dewatered wet scrubber waste, gypsum, will discharge to a concrete bunker. Gypsum would be transferred by truck for off-site sales or disposal in the landfill.

With a dry scrubber, a lime and water slurry is sprayed into the FGD vessel. This lime slurry, consisting mainly of calcium oxide, is atomized in the spray dryer chamber. Calcium oxide reacts with sulfur in the boiler exhaust gas to produce calcium sulfur compounds and oxygen. The downstream fabric filter collects the calcium sulfur compound waste product.

The combination of low sulfur fuel and $SO_2$ removal equipment results in low $SO_2$ emissions. Existing commercial sources are available to supply the needed lime, which are delivered to the Project by rail or truck.

The fly ash particulates generated during the combustion process will be removed by a fabric filter (baghouse) system or an electrostatic precipitator (ESP) unit. Most of the boiler fly ash particulate and calcium sulfate from the FGD system entrained in the boiler exhaust gas are also removed in the fabric filter baghouse or ESP unit. The air permit that will be issued for this power plant will set emission limits for various air pollutants. The FGD system that will be used for this power plant will be determined during the air permitting process.

Ash from the bottom of the boiler and baghouse accumulates in separate hoppers and is carried by truck or conveyor to the disposal area. Induced draft fans aid in moving the combustion gases through the boiler and emission control equipment with subsequent exhaust to the stack.

The SCR system will use a catalyst for $NO_x$ control. In a SCR system, $NO_x$ reacts in the presence of a catalyst to form nitrogen gas and water. A SCR system must be operated within a narrow temperature range (about 600-800 degrees Fahrenheit ($^oF$)) to achieve efficient $NO_x$ removal. The SCR system will be located between the economizer and air heaters where gas temperature will typically fall within this range.

If aqueous ammonia will be used as the catalyst in the SCR system, it will be stored in a closed tank to minimize release of odors. The ammonia storage tank will be equipped with safety relief valves that may be a source of odors in the event of over-pressurization of the storage tank. During loading and unloading a vent back to the delivery truck is used; therefore, no odors are expected. A Risk Management Plan is not required for the aqueous ammonia at the 19 percent concentration irrespective of the quantity stored on site.

Low NOx burners and SCR produces the best cost NOx control per ton of ash removed. Because the potential site locations are in air quality attainment areas for all criteria, no further controls are necessary.

Fabric filters provide better $PM_{10}$ removal than cyclones or electrostatic precipitators. The cost to remove $PM_{10}$ with a fabric filter system would be considered on a per ton basis of $PM_{10}$ removed. Selection of control technology will occur as part of the permitting process.

### 6.5.3 Transmission Requirements

A new 345 kV transmission line would be required to connect into the AECI electric transmission system. For the proposed site, a connection between Norborne and Thomas Hill Substation, and also from Norborne south to the Sedalia Substation and south from the Sedalia Substation to a new substation near Mt. Hulda would be needed. Total length of new transmission line construction required for the Norborne site would be approximately 134 miles. For the alternative site, a connection between Forbes and Fairport, then from Fairport to Orrick, and also from Orrick to Missouri City and Eckles would be required. Total length of new transmission line construction required for the alternative site would be approximately 125 miles. See Section 7.0, Transmission Line Macro-Corridor Analysis, for further information.

Power needs during construction would require a 69 kV connection to the transmission system. This temporary 69 kV transmission line would be sited within the proposed 345 kV transmission line corridor.

### 6.5.4 Fuel Use and Waste Disposal

Sub-bituminous coal will be the primary fuel for the generating unit. For planning and air permitting purposes, Powder River Basin coal mined in Wyoming and Montana is the coal of choice. The generating unit is estimated to have a coal consumption of 8,800 tons per day, or roughly 3.2 million tons per year.

Coal will be delivered to the power plant site by rail in unit trains consisting of approximately 130 to 150 rail cars averaging 15,000 to 18,000 tons per train. Rail cars will be unloaded with a rotary car dumper. A unit train positioner may be provided to accommodate the 150-car unit trains.

Total on-site storage capacity is approximately 90 days of storage or about 789,000 tons of coal. Coal will be stored in uncovered outdoor piles. Storm water runoff from the coal storage area will be collected in stormwater ponds that detain the runoff to settle suspended solids and reduce downstream flooding. All storm water discharges will meet the requirements of the facility’s storm water NPDES permit.

Coal belt conveyors handling crushed coal will be located inside enclosed galleries; conveyors handling uncrushed coal will be covered. Galleries will be provided with service water for washdown, compressed air, welding outlets, lighting, fire protection, and ventilation. Transfer buildings will include the same ancillary features for clean-up as the coal conveyor galleries.

Solid waste will consist primarily of bottom ash and combustion waste material. Bottom ash would consist of noncombustible coal material that settles to the bottom of the boiler, where it is cooled and collected in a hopper. Combustion waste material consists of noncombustible coal material entrained in the flue gas exhaust (fly ash) and is collected in the fabric filter baghouse. Solid wastes will be disposed onsite in accordance with the State of Missouri permitting requirements.

### 6.5.5 Water Supply and Wastewater Disposal

Water for the Project systems will be supplied by a ground water or alluvial well system at a location somewhere between the plant site and the Missouri River. During the EIS process, an analysis of potential impacts to existing nearby wells would be performed and any issues or concerns would be resolved.

Expected water usage for the operating unit is approximately 5,600 gpm based on annual average consumption. The size of the surge and storage tanks will be determined during the detailed design phase of the Project. Nearly all makeup water for the Project will be required in cooling towers, with the remaining water likely going to the FGD system, service water supply and the supply of demineralized water to the boiler systems.

A softener may be used to treat the raw water supply. Treated water is used for preparation of the lime slaking slurry used in the spray dryer FGD system. All of this water is evaporated and discharged to the atmosphere with the boiler flue gas from the stack.

The proposed Project design includes a wet cooling system which condenses steam in a tube-and-shell heat exchanger (a condenser) with water. Cool water enters the condenser where it is warmed by the steam. The warm water is circulated from the condenser through a wet mechanical draft-cooling tower, cooled and returned to circulate again through the condenser.

The majority of the water entering the cooling tower will be consumed by evaporation and drift. The remaining cooling tower blowdown will be sent to the FGD system.

Water for fire protection would be drawn directly from the service water storage tank by dedicated fire pumps. Potable water may be obtained from a public water supply or by treating well water with a carbon filter and chlorinator system.

Sanitary waste may be treated in a packaged waste water treatment system with treated effluent discharging to the process water holding pond. Plant equipment and floor drains that may be potentially contaminated with oil are routed through an oil/water separator prior to disposal. Filter backwash wastewater, coal storage area runoff, oil/water separator overflow, and treated sanitary wastewater may be combined in a common process water holding pond before disposal. A portion of the wastewater from the process water holding pond may be used for combustion waste product handling needs.

All wastewater leaving the site will be treated and discharged in accordance with the appropriate National Pollution Discharge Elimination System (NPDES) permit conditions. This will be determined during the preliminary design phase of the project and the water requirements will be finalized.

### 6.5.6 Operating Characteristics

The plant is expected to operate 7,884 hours per year at a capacity factor of approximately 90 percent. Plant operations are monitored for staff safety, meeting environmental requirements, and providing reliable and efficient operations while striving to achieve power output objectives, limiting emissions and minimizing fuel and other consumables.

Planned maintenance will be coordinated to reduce the impact of having the unit shut down for maintenance and overhauls. Normally, this work is planned during spring when the need for electricity is reduced. Short maintenance periods of one to two weeks will likely occur once each year or two. Longer maintenance periods of 6 to 8 weeks for major steam turbine overhauls probably will occur once every 6 to 9 years.

### 6.5.7 Noise

During construction of the power plant and associated facilities, short-term noise sources would include heavy mobile equipment (e.g., bulldozers, backhoes, cranes, rock drills, heavy trucks, pumps, generators, compressors, loaders, and compactors). Construction equipment operation would vary considerably during the Project and during any given day. During the construction periods, the heavy mobile equipment is typically not run continuously and construction noise would generally occur only during the daytime hours.

Near the end of the Project construction, it would be necessary to generate steam in the boiler and release it to the atmosphere to clean the steam piping. This operation is usually a one-time event and would be done during the day, one operation per day generally over a two-week period. The steam blow silencer will be used to reduce the steam discharge noise which would result in moderate noise levels. Notices providing the schedule for these operations will be given to nearby residents and others in the community.

Although the construction noise levels could be audible at nearby receptors and may be considered an annoyance during the various construction phases, the construction noise impacts are predicted to be low. Construction noise would normally only occur during the day and residents are typically less sensitive to noise during the day than they are at night.

The major noise producing equipment associated with power plant operations includes fans, cooling towers, pulverizers, pumps, air compressors, valves and turbine generators. Table 6-12 lists the potential project noise sources. Other periodic noises of short duration are produced by boiler blowdowns, pressure reliefs and other venting processes. Noise frequencies generated by these sources run the entire range of audible sound from 20 hertz to 16,000 hertz.

Noise attenuating equipment and materials will be incorporated into the equipment design to reduce sound impacts of the facility on the surrounding area.

**Table 6-12 Project Noise Sources**

| Exposed Plant Equipment | Associated Facility/Coal Handling Equipment |
|---|---|
| Air-cooled condensing units | Coal pile bulldozers |
| Main transformers | Enclosed Transfer Tower |
| Induced-draft (ID) fans | Crushers in crusher house-enclosed |
| | Forced-draft fans |
| | Primary-air fans |

### 6.5.8 Transportation

Existing roads will be used for construction access to the site. No upgrades to off-site roads are anticipated. Construction traffic will include all craft labor, construction management staff, contractors, contractor equipment, vendors, and material and equipment deliveries. In addition to road vehicular traffic, the existing rail facilities will be utilized occasionally for delivery of large equipment. The frequency of the daily auto traffic will be proportionate to on-site labor projections.

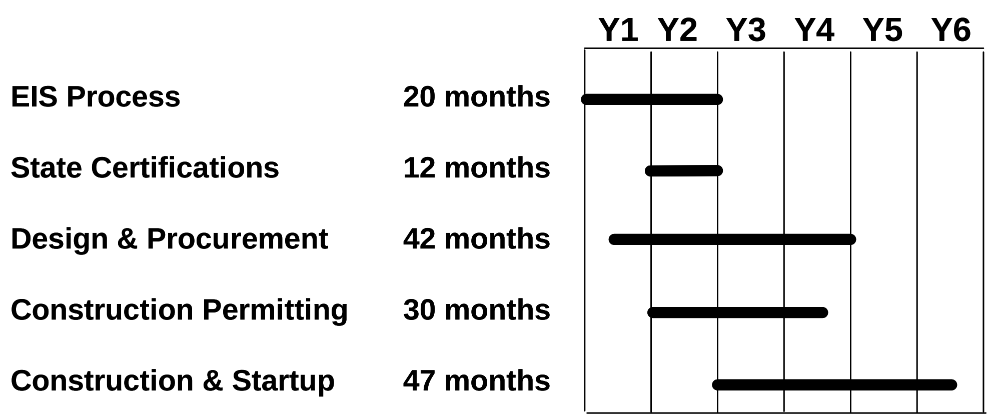
In addition to the auto traffic, deliveries of construction materials, primarily by large truck, can average between 15 and 25 a day. Special deliveries, for such items as structural steel and concrete, may occasionally exceed 50 on a given day. However under normal conditions, truck deliveries during the day should not coincide with the early morning, late afternoon labor traffic.

Traffic impacts associated with the additional site construction traffic will most likely occur around the starting and quitting times of the construction craft labor when auto traffic will be at its peak. The amount of added traffic will also be dependent on the phase of construction. It will start moderately and continue to increase until the peak period of construction. Additional traffic caused by material deliveries will have a lesser impact as they are typically intermittently spread throughout the day. There will be exceptions when truck traffic will significantly increase for a given day due to a special construction process. Permits and/or fees may be required for driveways or access roads off of county roads, impacts to arterial roads, and for upgrading portions of county road rock-gravel to pavement.

### 6.5.9 Project Schedule

Early permitting coordination was initiated in early 2005. Table 6-13 provides a list of the potential federal, state, and local permits and/or approvals this project may require. A schedule outline for permitting and construction activities is provided in Figure 6-29. A 20-month time span is available from September 2005 until April 2007 to receive EIS and PSD permit approvals and to begin construction. RUS financing will also be contingent on environmental approvals. Award of a steam-generator, emissions control equipment and steam turbine-generator is planned by May1, 2006, which would then lead to a start of construction a year later by May 1, 2007 pending environmental release to construct. A 47-month construction period is required to meet a commercial operation date of April 2011.

**Figure 6-29 Project Schedule**




The following sequence provides the anticipated order of construction:

- site preparation
- underground utilities installation
- start foundation installation
- start building steel erection
- start boiler erection
- start air quality control equipment erection
- start turbine erection
- start balance of plant mechanical erection

## Table 6-13 Federal, State, Local Permits, Approvals, and Authorizing Actions

| ISSUING AGENCY | PERMIT/APPROVAL NAME | NATURE OF PERMIT | AUTHORITY |
|---|---|---|---|
| **Federal Government** | | | |
| Federal Aviation Administration | Notice of Proposed Construction or Alteration | Structure location and height relative to air traffic corridors | 49 United States Code (U.S.C.) 1501; 13 Code of Federal Regulations (CFR) §77, Objects affecting navigable air space |
| Environmental Protection Agency (EPA)/Missouri Department of Natural Resources (MDNR) | Title IV Acid Rain Permit | This permit requires monitoring and reporting so as to comply with Sulfur Dioxide allowances | 40 CFR §72 |
| US Army Corps of Engineers (USCOE) | Section 404 Permit (Clean Water Act) Nationwide Permit/Individual Permit | Controls discharge of dredged or fill materials in wetlands and other waters of the US | Section 404 of the Clean Water Act (33 CFR §323.1) |
| | Section 10 Permit of the Rivers and Harbors Act | Included with Section 404 Permit submittal. Regulates the construction of all structures that could impact functioning of navigable waterways, such as an outfall or intake structure. | Section 10 of the rivers and Harbors Act (33 USC. § 403) |
| US Fish and Wildlife Service (FWS) | Threatened and Endangered Species Clearance | Clearance to ensure that federal listed protected species and/or their habitat will not be impacted | Endangered Species Act (16 USC §1531 et seq.) |
| **State Government** | | | |
| Missouri Department of Natural Resources (MDNR) | Wetland or Dredge and Fill Approval (Section 401 Water Quality Certification) | Review of potential adverse water quality impacts potentially associated with discharges of dredged or fill materials in wetlands and other waters of the US | Section 401 of the clean Water Act and 10 Code of State Regulations (CSR) §20-6.060 |
| MDNR, Water Pollution Control Program | National Pollutant Discharge System (NPDES) Storm Water Discharges associated with Construction Activities and Storm Water Pollution Prevention Plan | Apply for coverage under General Permit in order to authorize storm water discharges to surface waters of the state associated with the construction of the Project | Section 402 of the Clean Water Act and 10 CSR §20-6.200 |

| ISSUING AGENCY | PERMIT/APPROVAL NAME | NATURE OF PERMIT | AUTHORITY |
|---|---|---|---|
| MDNR, Water Pollution Control Program | NPDES Storm Water Discharges associated with Facility Operation and SWPPP | Apply for coverage under General Permit in order to authorize stormwater discharges to surface waters of the state associated with the operation of the Project | Section 402 of the Clean Water Act and 10 CSR §20-6.200 |
| MDNR, Water Pollution Control Program | NPDES Missouri State Construction and Operating Permit | Apply for coverage under Individual Permit in order to authorize construction of treatment works and industrial and storm water discharges to surface waters of the state associated with the Project | Section 402 of the Clean Water Act and 10 CSR §20-6.010(1)(A), 20-6.200 |
| MDNR, Water Pollution Control Program | Missouri Water Pollution Control Form P – Notification of Hydrostatic Testing under Permit by Rule – MO780-1874 | Permit for discharging waters associated with hydrostatic testing of pipelines and storage tanks | Section 402 of the Clean Water Act and 10 CSR §20-6.200 |
| MDNR, Air Pollution Control Program | Prevention of Significant Deterioration (PSD) Permit | Permit to construct, install and operate a major emission source in Missouri. Typically consist of BACT, Air Dispersion Analysis, and Air Quality Related Values Analysis. | 40 CFR §52.21, 10 CSR §10-6.060 |
| MDNR, Air Pollution Control Program | Title V Operating Permit | Permit for operation of major equipment or major facilities that may directly or indirectly cause or contribute to air pollution | 10 CSR §10-6.060 |
| MDNR, Solid Waste Management Program | Solid Waste Disposal Area Construction Permit | Permit for construction of solid waste disposal facilities | 10 CSR §80-1.010 through 80-4.010 and 10 CSR §80-11.010 |
| MDNR, Solid Waste Management Program | Solid Waste Disposal Area Operating Permit | Permit for operation of solid waste disposal facilities | 10 CSR §80-2.020 |
| MDNR, Geological Survey and Resources Assessment Division | Major Water Users Registration | A major water user, defined as withdrawing or diverting 100,000 gallons or more per day from any stream, river, lake, well, or other source, must register their water use annually. | Revised Statutes of Missouri (RSMo) §256.400 to 256.430 |

| ISSUING AGENCY | PERMIT/APPROVAL NAME | NATURE OF PERMIT | AUTHORITY |
|---|---|---|---|
| MDNR, Geological Survey and Resources Assessment Division | Water Well Registration and Certification | Registration and certification for construction of any water well, monitoring well, mineral exploratory well or ground source heat pump system. | Certification: 10 CSR §23-3.010, 23-3.060, 23-4.020 and 23-5.020.<br>Registration: 10 CSR §23-3.025, 23-3.060, 23-3.110, 23-4.080, 23-5.080 and 23-6.050. |
| Missouri Department of Conservation (MDC) | Threatened & Endangered Species Clearance | Clearance to ensure that state listed protected species and/or their habitat will not be impacted by the project | State Endangered Species Program |
| Missouri State Historic Preservation Office (SHPO) | Section 106 of the National Historic Preservation Act | Consult with project applicants and state agencies regarding impacts on cultural resources that are either listed or eligible for listing on the National Register of Historic Places | National Historic Preservation Act |
| **Local Government** | | | |
| Carroll County Planning & Zoning Office | Special Use Permit/Rezone from agricultural to industrial<br><br>Building Permit<br>Floodplain Development Permit<br>Entrance Permit<br><br>Transportation Fee<br>Road Improvement Fee | Obtain county rezoning approval prior to construction<br>Permit to construction buildings<br>Permit to construct in a flood zone<br>Permit for driveway or access road off of county road<br>Fee for impacts to arterial roads<br>Fee for upgrading portions of county road rock-gravel to pavement. | To Be Determine (TBD) |

- start electrical construction
- perform plant startup and initial operation activities
- commercial operation

The construction activities will be sequenced according to an overall project schedule using industry proven techniques augmented by current technology.

### 6.5.10 Project Cost

The current capital cost estimate (for the plant only) without transmission or interest during construction is $1,000,000,000. The initial project engineering will occur in 2005 and procurement and construction would span from January 2007 to April 2011.

### 6.5.11 Employment

Based on similar type projects, the Project employment begins with approximately 50 construction workers in the first year and rises to a peak of approximately 1,000 in year three. All construction activity is completed by year four. The operational staff will be approximately 135 employees.

# 7.0 TRANSMISSION LINE MACRO-CORRIDOR ANALYSIS

## 7.1 INTRODUCTION

Associated Electric Cooperative, Inc. (AECI) is proposing to construct a new coal-fired power plant either in Carroll County near Norborne, Missouri (Norborne Site) or in Holt County southwest of Big Lake, Missouri (Forbes Site). For power generated from the new power plant to reach AECI's growing member loads, new 345 kV and 161 kV transmission facilities will be needed. Four transmission line study areas and two to three alternative corridors within each study area were identified. Figure 7-1 shows a broad overview of the entire project and the proposed study areas and transmission corridors for each power plant site, which are described in more detail in the following sections. The study areas are: Norborne to Thomas Hill, Norborne to Sedalia / Mt. Hulda, Forbes to Fairport, and Fairport to Orrick / Missouri City / Eckles Road.

For the Norborne Plant, AECI determined that two 345 kV transmission lines and related new and upgraded substation facilities would be required to provide adequate outlet capacity for the plant. First, a line from the Norborne Substation (located east of the proposed plant site) to the Thomas Hill Substation in Randolph County would be built (Figure 7-2). A second 345 kV line would be built from Norborne to Central Electric Power Cooperative's (Central) Sedalia Substation in Pettis County and then to the Mt. Hulda Substation in Benton County. Transformers (345/161 kV) and related switching, safety and control equipment would be added to one or both of these substations.

Adequate outlet capacity in the area will be provided by the 69, 138 and 161 kV sub-transmission system. This system will consist of existing facilities as well as new and upgraded facilities that are in various stages of planning. All will be in place prior to the planned 2011 startup of the Norborne Plant.

To provide adequate outlet capacity for the Forbes Plant, a new double-circuit 345 kV transmission line would be needed from the site to the existing Fairport Substation north of Fairport, Missouri, in DeKalb County (Figure 7-3). This will provide a connection to the Missouri-Iowa-Nebraska Transmission (MINT) 345 kV line. Additionally, a single-circuit 345 kV transmission line would be needed south from the Fairport Substation to a new

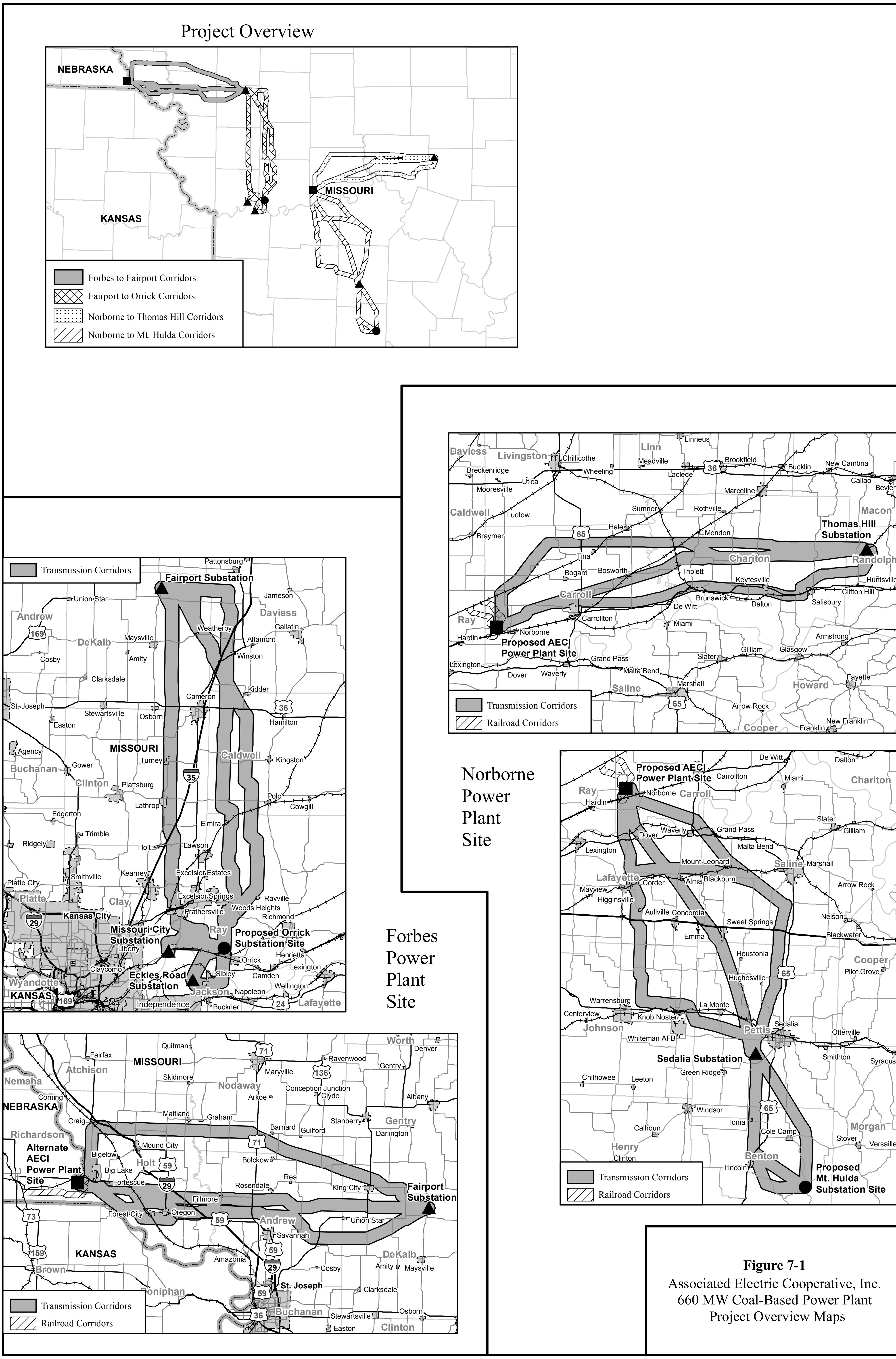
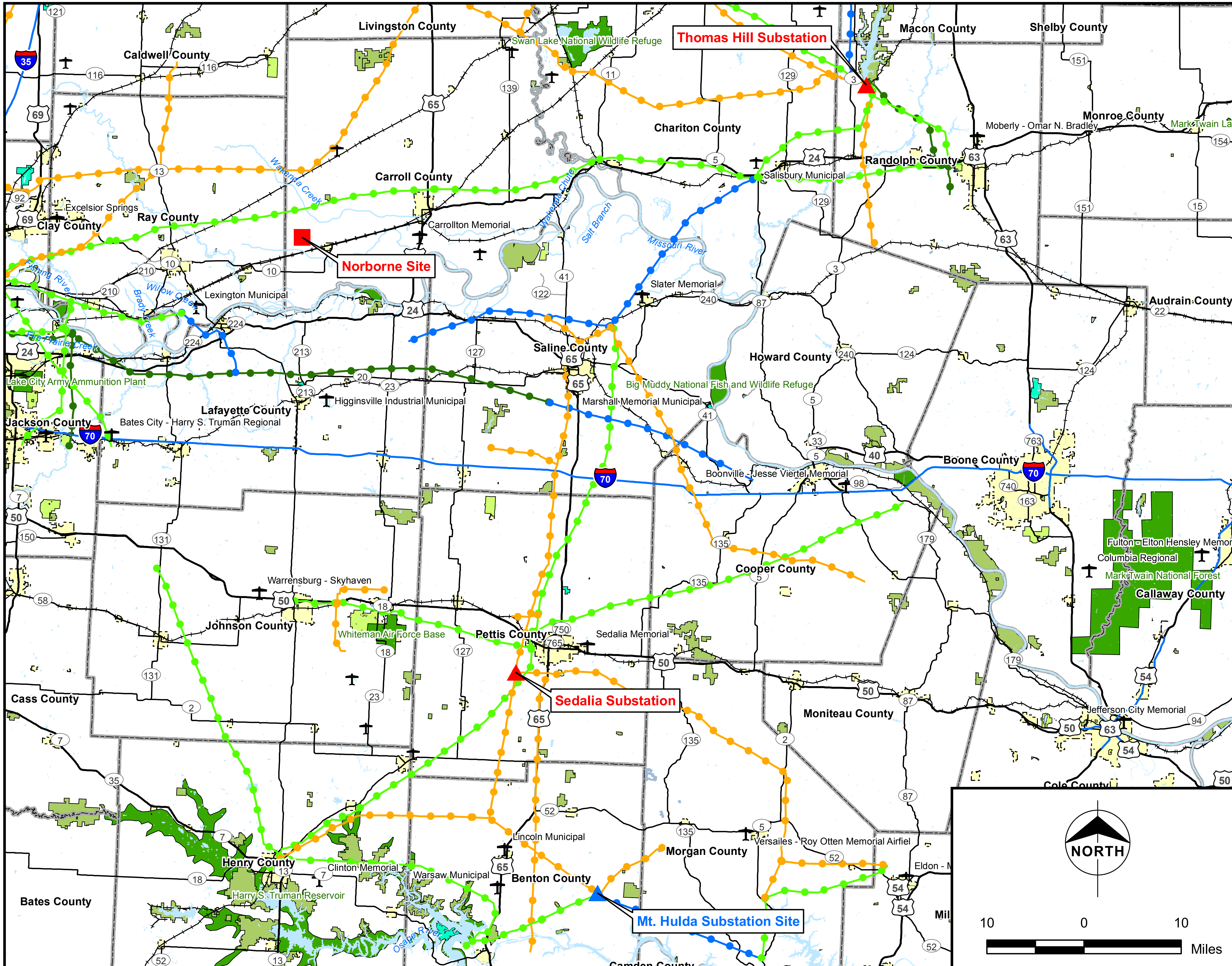



**Figure 7-1**
Associated Electric Cooperative, Inc.
660 MW Coal-Based Power Plant
Project Overview Maps






Disclaimer: Existing transmission lines are shown to the extent they could be verified within the project study areas using aerial photography, topographic maps, and NW and Central Cooperative's system planning maps. They are not necessarily complete or represent all existing transmission lines in the area.

**LEGEND**

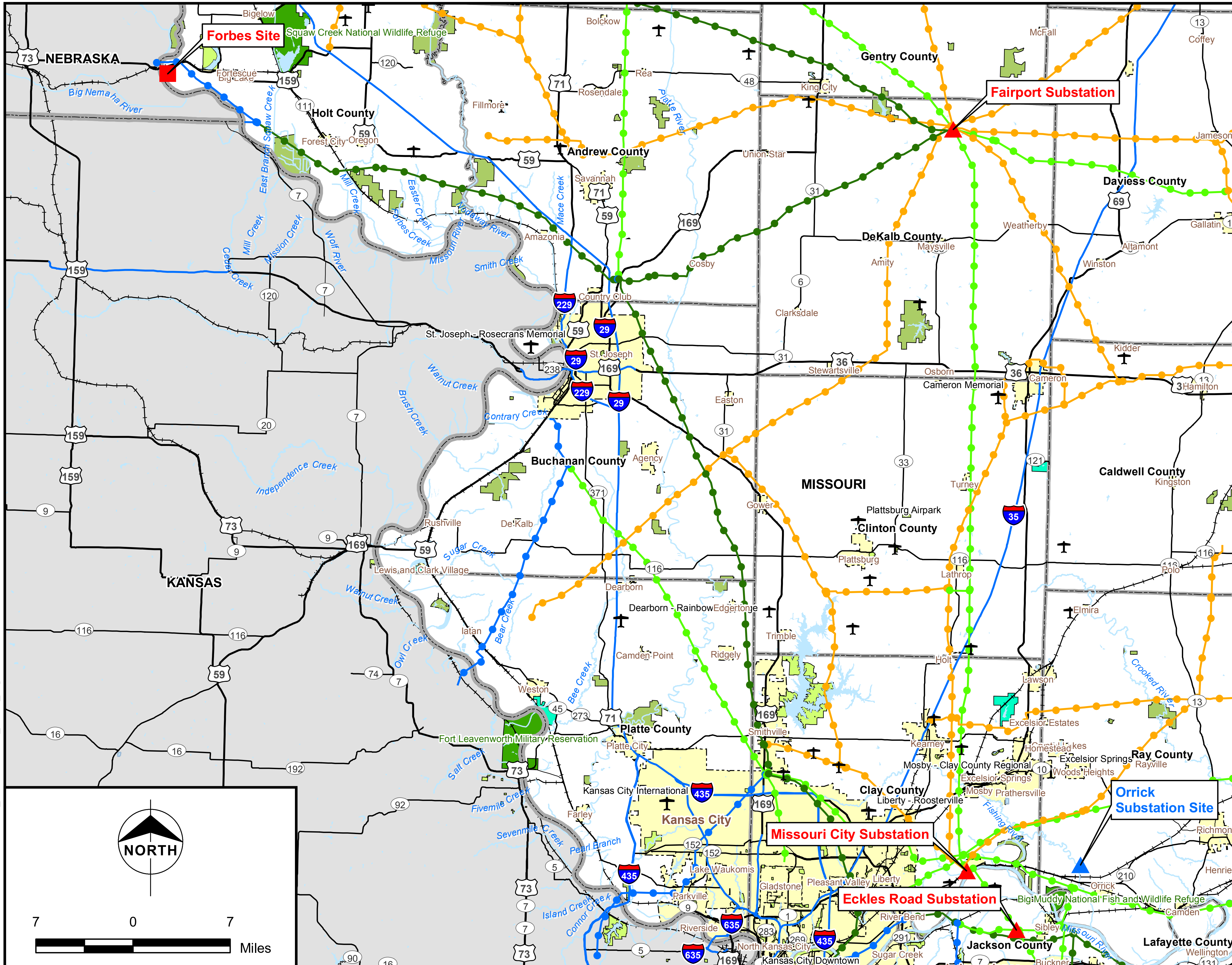
- Power Plant Site
- Existing Substations
- Future Substations

**Existing Transmission Lines**

- 345-kV
- 161-kV
- 69-kV
- Voltage Unknown
- Federal Lands
- Department of Conservation Lands
- Missouri DNR Parks
- Parks (Local)
- Municipality
- County Boundary
- Airports / Airstrips

**Figure 7-2**
Associated Electric Cooperative, Inc.
660 MW Coal-Based Power Plant
Norborne Site
Interconnection Points

Revised July 27, 2005




Disclaimer: Existing transmission lines are shown to the extent they could be verified within the project study areas using aerial photography, topographic maps, and NW and Central Cooperative's system planning maps. They are not necessarily complete or represent all existing transmission lines in the area.

## LEGEND

- Power Plant Site
- Existing Substations
- Future Substations

**Existing Transmission Lines**

- 345-kV
- 161-kV
- 69-kV
- Voltage Unknown
- Federal Lands
- Department of Conservation Lands
- Missouri DNR Parks
- Parks (Local)
- Municipality
- County Boundary
- State Boundary
- Airports / Airstrips

**Figure 7-3**
Associated Electric Cooperative, Inc.
660 MW Coal-Based Power Plant
Forbes Site
Interconnection Points

Revised July 27, 2005

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345/161 kV substation located near the town of Orrick in Ray County. From Orrick, two new 161 kV transmission lines would need to extend to the Missouri City Plant on the west side of Missouri City (in Clay County) and to the existing Eckles Road Substation located west of Sibley in Jackson County.

To identify the potential locations for these new transmission line and related facilities, Burns & McDonnell conducted an investigation of the existing human and natural resources within the study areas identified for these new facilities. This investigation centered on identifying those resources within the areas between the Norborne and Forbes Sites and the interconnections described above that would present issues or concerns for the routing of new transmission facilities. This study also sought to identify opportunities within the study area that would provide a potential corridor or alignment for new transmission lines. The goal of the investigation was to identify and define macro-corridors, areas approximately two miles wide, extending between the desired end-points, within which the proposed transmission lines could be constructed.

## 7.2 STUDY AREAS FOR TRANSMISSION FACILITIES

Separate study areas were developed for the proposed transmission facilities for the Norborne Site and for the Forbes Site. Areas of sufficient size to incorporate the desired end-points and provide feasible potential corridors for the location of the new transmission lines were established. The study areas for the Norborne Site encompassed the Norborne Plant and Substation Sites, the Thomas Hill Plant, the Sedalia Substation and the proposed site for a new Mt. Hulda Substation, as well as substantial lands between these points. The overall Norborne study area, which consists of portions of eight counties in Missouri, was subdivided into two smaller study areas: Norborne to Thomas Hill and Norborne to Sedalia / Mt. Hulda. The study area for the Forbes Site encompasses the proposed Forbes Plant Site, the Fairport Substation, the proposed Orrick Substation site, the Missouri City Substation and Plant, and the Eckles Road Substation. The Forbes study area incorporates portions of eleven Missouri counties and it too was subdivided into two smaller study areas: Forbes to Fairport and Fairport to Orrick / Missouri City / Eckles Road. Subdividing the overall Norborne and Forbes study areas facilitated the evaluation of opportunities and constraints for the various interconnections needed for each site.

The following sections include a description of the study areas and identify the macro-corridors identified within each for further investigation.

### 7.2.1 NORBORNE SITE

Two study areas were identified for the Norborne Site: Norborne to Thomas Hill and Norborne to Sedalia / Mt. Hulda (refer to Figure 7-1 for an overview). A transmission line would be needed for both of these study areas, one heading east to Thomas Hill and one heading south to Sedalia and Mt. Hulda, should the Norborne site be the site selected for the proposed power plant. Each of these transmission lines would originate at the proposed Norborne Substation Site, which is located approximately 2.5 miles northwest of the town of Norborne and about 11 miles northeast of Lexington, on the northeast corner of State Highways JJ and DD. The transmission line within the Norborne to Thomas Hill study area would terminate at the Thomas Hill Substation northwest of Moberly. The transmission line within the Norborne to Sedalia / Mt. Hulda study area would first connect to the Sedalia Substation and then continue to and terminate at a new substation near the existing Mt. Hulda Substation, south of the town of Cole Camp.

#### 7.2.1.1 Norborne to Thomas Hill Study Area

The Norborne to Thomas Hill study area extends eastward from the proposed site of the Norborne Power Plant approximately 60 miles to the Thomas Hill Plant (Figure 7-4). This area includes Carroll County, Chariton County, and the western portion of Randolph County. Saline and Howard counties were excluded from the study area because corridors through these counties would require two crossings of the Missouri River, substantially increasing the environmental impact of the proposed project. Including these counties in the study area would also unnecessarily increase the amount of public involvement activities and oversight into the project. The Thomas Hill Plant is located on the south side of the Thomas Hill Reservoir between State Highway 3 and State Highway F, approximately eight miles northwest of Huntsville and 15 miles southwest of Macon. The most dominant features in the area between the Norborne Site and the Thomas Hill Plant include Swan Lake National Wildlife Refuge (NWR), the Missouri River, the Grand River, the Chariton River, and the Thomas Hill Reservoir. Highway 24 connects the towns of Carrollton, DeWitt, Brunswick,

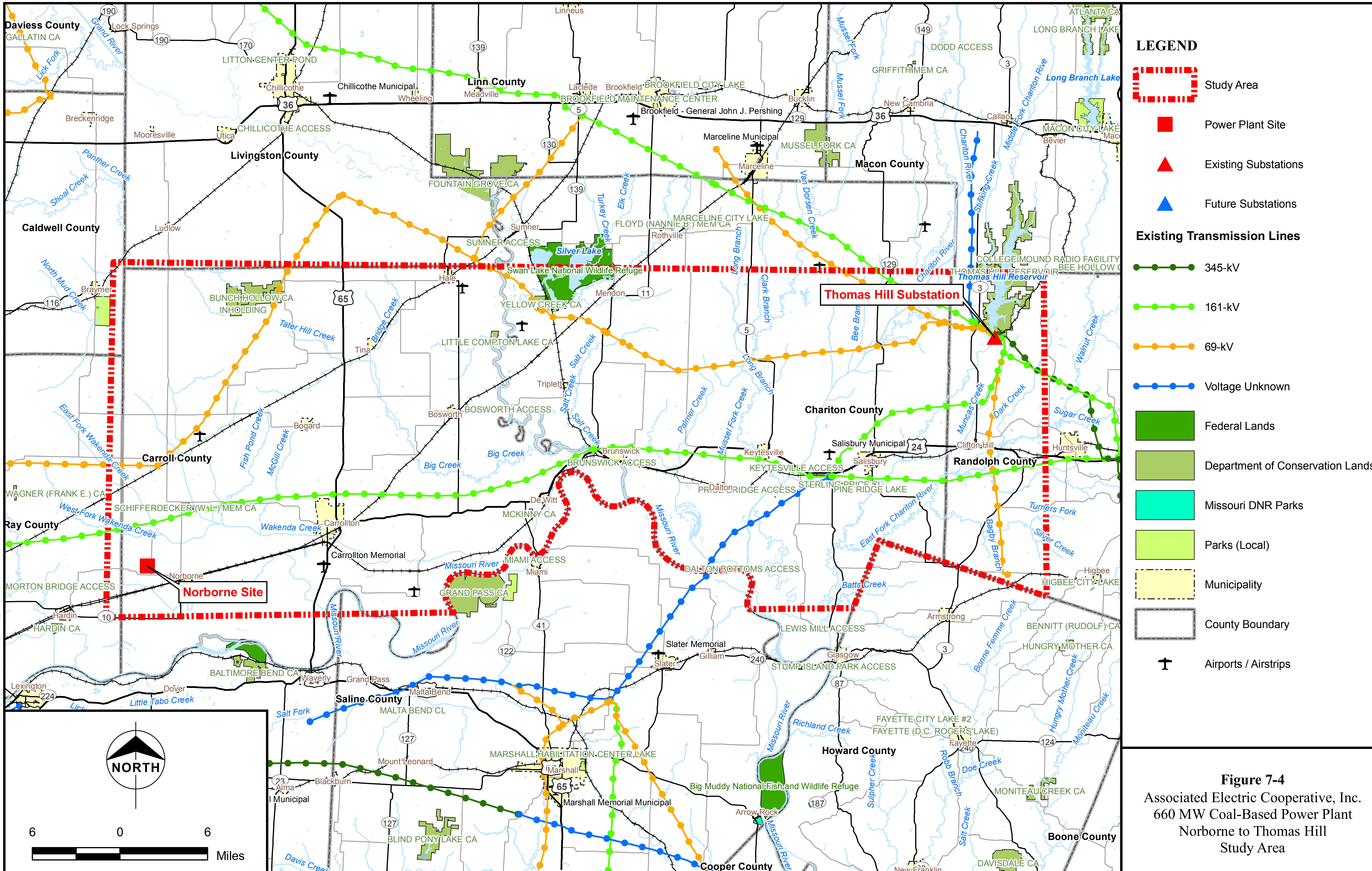


**Figure 7-4**
Associated Electric Cooperative, Inc.
660 MW Coal-Based Power Plant
Norborne to Thomas Hill
Study Area

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Disclaimer: Existing transmission lines are shown to the extent they could be verified within the project study areas using aerial photography, topographic maps, and NW and Central Cooperative's system planning maps. They are not necessarily complete or represent all existing transmission lines in the area.

Revised July 27, 2005

Keytesville, Salisbury, and Clifton Hill along the southern portion of the study area. Some other towns within the study area include Norborne, Bosworth, Triplett, Hale, and Bogard. In addition, a Norfolk Southern (NS) line generally parallels Highway 24 across the central portion of the study area and two Burlington Northern Santa Fe (BNSF) lines extend from southwest to northeast through the western half of the study area.

#### 7.2.1.1.1 Human Resources

**Land Use:** The Norborne to Thomas Hill study area contains primarily undeveloped, rural lands. Specific land use information was not available from any of the three counties in the study area. However, based on recent aerial photography and ground surveillance, crop production appears to be the dominant land use throughout the study area. Soybeans are the dominant crop grown in the study area, but corn, wheat and other grains are grown as well (U.S. Department of Agriculture, 2002). Rural residences associated with large tracts of agricultural land occur throughout the study area in addition to scattered small towns and communities.

**Population:** Of the three counties within the study area, Carroll and Chariton counties showed a negative population change from the census years 1990 to 2000. All counties experienced considerably less growth than the state average (U.S. Census Bureau, 2000a). General population data for these counties are included in Table 7-1. Larger communities such as the City of Carrollton, in Carroll County contain concentrated areas of residential and commercial land use surrounded by agricultural land.

**Table 7-1 Population for Norborne to Thomas Hill by County**

| County | Population 1990 | Population 2000 | Population Estimate 2003 | Population % Change (1990 – 2000) |
|---|---|---|---|---|
| Missouri | 5,117,073 | 5,595,211 | 5,704,484 | 9.3 |
| Carroll | 10,748 | 10,285 | 10,149 | -4.3 |
| Chariton | 9,202 | 8,438 | 8,251 | -8.3 |
| Randolph | 24,370 | 24,663 | 25,045 | 1.2 |

Source: U.S. Census Bureau, 2000a

Several communities are located within the study area, including Norborne, Carrollton, Bogard, Braymer, Bosworth, Tina and DeWitt in Carroll County; Triplett, Brunswick, Dalton, Keytesville and Salisbury in Chariton County; and Clifton Hill in Randolph County. None of these communities had 2000 populations greater than 5,000 people (Table 7-2). Carrollton, located at the intersection of U.S. Highway 65 and U.S. Highway 24 is the largest community in the study area, followed by Salisbury, which is located on U.S. Highway 24 at State Highway 29 in Chariton County. All other towns and communities in the study area had populations of less than 1,000 people in 2000. Norborne, Braymer, and Brunswick are the largest of the communities with less than 1,000 people. The populations of most of the towns within the study area stayed the same or declined between 1990 and 2000, including the bigger towns of Carrollton and Salisbury (U.S. Census Bureau, 2000c).

### Table 7-2 Population by Size for Norborne to Thomas Hill Towns

| Town | 2000 Population |
|---|---|
| 1,000 to 5,000 | |
| Carrollton | 4,122 |
| Salisbury | 1,726 |

Source: U.S. Census Bureau, 2000

**Employment Statistics:** The agricultural influence on the study area is evident in the percentage of people that rely on agriculture or closely related fields as their primary source of income. According to the 2000 Census, the percentage of the working population of Carroll, Chariton, and Randolph counties that report the agriculture industry (agriculture, forestry, fishing and hunting, and mining) as their source of employment is significantly higher than the statewide percentage. The employment statistics for the three counties reflect a variety of occupations and industries. Overall, the majority of people living in the study area are employed in the “education, health and social services” and “manufacturing” industries (U.S. Census Bureau, 2000b). Table 7-3 lists the employment statistics by category for the counties in the study area, and for the state of Missouri for comparison.

**Recreational Facilities:** Recreational opportunities may be found at the Swan Lake NWR, which is located in the northwestern portion of the study area in Chariton County. The 10,795-acre refuge was established in 1937 along the Grand River near its confluence with the Missouri River. The U.S. Fish and Wildlife Service (USFWS) uses wetland restoration, grassland management and cooperative farming to provide habitat for migratory waterfowl and other birds including bald eagles. Bird watching is a major attraction at Swan Lake NWR. The refuge is visited by approximately 18,000 people each year (U.S. Fish and Wildlife Service, 2005a). The Thomas Hill Reservoir in northern Randolph County is a dominant outdoor recreation feature in

**Table 7-3 Percent Employment by Industry for Norborne to Thomas Hill Counties**

| Industry | Missouri | Chariton | Randolph | Carroll |
|---|---|---|---|---|
| Agriculture, forestry, fishing and hunting, and mining | 2.2 | 12.0 | 2.6 | 12.9 |
| Construction | 6.9 | 7.9 | 5.1 | 7.1 |
| Manufacturing | 14.8 | 16.1 | 19.4 | 17.3 |
| Wholesale trade | 3.7 | 2.8 | 3.7 | 3.7 |
| Retail trade | 11.9 | 9.4 | 12.4 | 8.8 |
| Transportation and warehousing, and utilities | 5.7 | 7.0 | 7.2 | 7.3 |
| Information | 3.0 | 4.3 | 1.4 | 2.6 |
| Finance, insurance, real estate, and rental and leasing | 6.7 | 5.5 | 6.6 | 4.3 |
| Professional, scientific, management, administrative, and waste management services | 7.5 | 2.3 | 3.5 | 4.6 |
| Educational, health and social services | 20.4 | 20.8 | 20.5 | 19.9 |
| Arts, entertainment, recreation, accommodation and food services | 7.8 | 2.7 | 6.6 | 2.4 |
| Other services (except public administration) | 5.0 | 4.7 | 4.4 | 4.8 |
| Public administration | 4.6 | 4.5 | 6.4 | 4.3 |

Source: U.S. Census Bureau, 2000b Census Data

the region. The southern half of the reservoir is within the study area. The facilities at the reservoir that are within the study area include two boat docks (one accessible), four boat ramps, and primitive camping areas. Activities available at Thomas Hill include fishing, camping, and hunting.

The Missouri Department of Conservation (MDC) manages the 3,294-acre Bunch Hollow Conservation Area (CA) in Carroll County. The Bunch Hollow CA has 4.5 miles of multi-use trails for horseback riding, bicycling and hiking; other activities include hunting, fishing and camping. The MDC manages the 620-acre Yellow Creek CA in Chariton County, which offers hunting, fishing, camping, and hiking trails (Missouri Department of Conservation, 2005c). There are numerous other smaller conservation areas, river accesses and local parks throughout the study area.

**Transportation and Utilities:** A variety of roads, airstrips and airports, and transmission lines occur throughout the study area (Figure 7-4).

- Roads - The primary roadway in the study area is U.S. Highway 24. Other roadways include U.S. Highway 65 and numerous state highways and county roads. U.S. Highway 24 extends east to west through the southern portion of the study area from Carrollton on the west side of the study area to Clifton Hill on the east side. U.S. Highway 65 runs north/south through Carrollton. The site of the proposed Norborne power plant is accessed from State Highway 10, east of Carrollton; the Thomas Hill substation site is accessed by State Highway 3, north from Clifton Hill (DeLorme, 1998).
- Airports - There are several airstrips and airports located in the study area, including the Carrollton Memorial Airport, south of Carrollton; and the Salisbury Memorial Airport, west of Salisbury. Other airstrips in the study area are primarily small private facilities (AirNav, LLC, 2005). Three rail lines cross the study area, two of which are BNSF lines that cross the area from southwest to northeast. These rail lines provide service to agricultural customers in the region and coal delivery to the Thomas Hill Power Plant. A Norfolk Southern line is parallel to the BNSF line from Norborne to Carrollton where it splits from the BNSF line and generally follows U.S. Highway 24 to Clifton Hill.
- Transmission Lines - Several existing transmission lines occur within the study area. A 69 kV line crosses the northern portion of the study area, leaves the area west of Swan Lake and enters again to cross the northwest corner. One 161 kV line crosses the northeast corner of the study area, while another crosses the study area from the northeast portion to the south-central portion. Another 161 kV line crosses the study area generally along Highway 24 from east to west. A 345 kV line crosses a small part of the study area east of Thomas Hill Reservoir. Numerous other sub-

transmission and distribution lines are located along area roadways providing electrical service to local residents and commercial and industrial customers.

#### 7.2.1.1.2 Natural Resources

Photographs representative of the typical vegetation and terrain of the area are included at the end of this section for reference.

**Physiography and Topography:** The Norborne to Thomas Hill study area is located in the Central Dissected Till Plains physiographic region. The topography in the area is generally flat in the floodplains with steep to rolling hills above the floodplain. Two major rivers and numerous smaller rivers and streams flow through the study area. Drainage is generally toward the Missouri River, which forms the boundary of a portion of the southern edge of the study area between Carroll County and Saline County. The Grand River forms the line between Carroll and Chariton counties in the central part of the study area. The Grand River joins the Missouri River south of the town of Brunswick. The floodplains of these rivers form the flat topography described above. The Chariton River crosses the eastern part of the study area and joins the Missouri River south of Keytesville. The middle fork of the Little Chariton River, which is the source of water for the Thomas Hill Reservoir, crosses the northeast part of the study area (DeLorme, 1998).

**Vegetation:** Vegetation throughout the study area is a combination of cultivated crops and native plants. The fertile soils in the broad floodplains are well suited for crop production. Almost all of the land in the Norborne to Thomas Hill study area is considered prime farmland, prime farmland if drained or not flooded, or farmland of statewide importance. Typically, impacts from transmission lines to prime farmland are minimal. All of the agricultural land crossed by the line, with the exception of where the pole is placed and where possible guy wires are anchored, can remain in agricultural production. Most flat land in the study area has long been cleared for agricultural use. Flat land left uncultivated for crops can support such native grass species as big and little bluestem, Indian grass and switchgrass. Cottonwood, sycamore, American elm, honey locust and black walnut are common bottom land tree species, whereas oak and hickory species are better adapted to upland hills and steep slopes.

**Wetlands:** There are three categories of wetlands found in the study area. These three types are included in the broad category of palustrine wetlands. The Palustrine System includes all non-tidal, vegetated wetlands. Palustrine wetlands are further defined by the plant types that dominate them, such as trees, shrubs and emergents (herbaceous plants) (Cowardin et al. 1979). The study area contains wetlands from all three main groups of palustrine wetlands: emergent, forested, and scrub-shrub. Small isolated emergent and scrub-shrub wetlands are randomly scattered throughout the study area. Larger areas of forested wetlands are primarily associated with rivers, streams and lakes. Small wetlands that can be spanned by a transmission line typically do not present a serious routing constraint. In the event a final route would cross wetlands that are too big to span or would require clearing of vegetation, a wetland permit from the U.S. Army Corps of Engineers (COE) and the Missouri Department of Natural Resources (MDNR) may need to be acquired prior to construction.

**Wildlife:** Swan Lake NWR, in the north part of the study area, contains vegetative communities representative of the entire study area. The refuge is managed to provide habitat for migratory birds and resident wildlife and has open water, wetlands, native grass, woodlands and cultivated crop fields. Common wildlife species at Swan Lake include white-tailed deer, coyote, raccoon, beaver, muskrat, opossum, fox squirrels, and cottontail rabbits. Common bird species include Canada geese, mallards and other waterfowl, bob-white quail, red-tailed hawk and harrier. The proximity of the Swan Lake NWR to the study area and similarity of habitat types make it likely that the wildlife common to the refuge are representative of those found in the study area (U.S. Fish and Wildlife Service, 2005a).

**Threatened and Endangered Species:** A preliminary search of USFWS and MDC data identified two federally-listed and six state- listed species as potentially occurring in Carroll, Chariton and Randolph counties. The federally threatened bald eagle is likely to roost in large trees along the Missouri River and around Thomas Hill Reservoir and Swan Lake NWR. The federally endangered Indiana bat prefers forested habitat with loose-barked tree species such as shagbark hickory. Such habitat is found throughout the study area on steep slopes above the floodplain. Table 7-4 provides a complete list of the threatened and endangered species found in the study area counties. Some of these species may not occur in the actual study area but in portions of the county outside the study area.

### Table 7-4 Threatened and Endangered Species – Norborne to Thomas Hill by County

| Common Name | Scientific Name | State Status | Federal Status | Counties | | |
|---|---|---|---|---|---|---|
| | | | | Carroll | Chariton | Randolph |
| Bald Eagle | *Haliaeetus leucocephalus* | E | T | ✓ | ✓ | |
| Indiana Bat | *Myotis sodalis* | E | E | ✓ | ✓ | |
| Eastern Massasauga | *Sistrurus catenatus* | E | | | ✓ | |
| Lake Sturgeon | *Acipenser fulvenscens* | E | | | ✓ | |
| Northern Harrier | *Circus cyaneus* | E | | ✓ | | |
| Greater Prairie Chicken | *Tympanuchus cupido* | E | | ✓ | | |

Source: Missouri Department of Conservation, 2005b. United States Fish and Wildlife Service, 2005b
E – Endangered; T – Threatened

**Cultural Resources:** A preliminary search of records at the Archaeological Survey of Missouri (ASM) in Columbia, Missouri and the National Park Service web site of National Register of Historic Places (NRHP) was conducted for each study area. From the preliminary investigation the following assessment of conditions was made for each of the transmission line study areas.

- The Missouri River flood plain and the bluffs overlooking the Missouri River contain a high density of potentially significant prehistoric and historic archaeological sites. This conclusion is based upon the density of sites where archaeological surveys have been completed and where sites have been recorded by amateurs. The majority of the proposed project near the Missouri River has not been investigated by professional or amateur archaeologists.
- The tributaries to the Missouri River have the same potential for producing prehistoric and historic archaeological sites as along the Missouri River. This too is based upon the density of sites where archaeological surveys have been completed. As with the Missouri River, the majority of the proposed project area has not been investigated by a professional or amateur archaeologist.

- The upland areas, along the proposed project corridor(s), away from the tributaries and other permanent water sources, appear to have the lowest potential for containing significant prehistoric archaeological sites and yet have the highest potential for containing historic sites such as farmsteads that are over 50 years old. Few of the upland areas have been surveyed by a professional archaeologist and few sites have been recorded by amateur archaeologists.
- The listed NRHP properties are essentially confined to towns and cities along the proposed corridors. A few farmsteads and archaeological sites are also on the NRHP listing, but it does not appear that any of the NRHP properties would be adversely affected by the proposed project. The limited NRHP listings reflect the fact that few surveys have been conducted to identify historic buildings and the surveys that have been conducted were focused upon the cities and towns. It is also possible that remnants of the Santa Fe or Oregon Trails may be present near or in the proposed corridor(s).
- The areas along the Missouri River through central and western Missouri are known to contain many examples of historic farmsteads dating from approximately 1830 to 1860. In the 1820s and 1830s, an influx of settlers from Kentucky and Tennessee, who brought their southern lifestyle, including their slaves, with them, arrived in the Missouri river valley. This influx was so pervasive in central and western Missouri along the Missouri river that the area became known historically and later archaeologically as “Little Dixie”. The early settlement, transplanting of the southern lifestyle, and the presence of slaves are contributing factors when evaluating the architectural significance of the historic farmsteads and make the area more likely to be determined eligible for the NRHP.
- It is unknown if the project will affect any Traditional Cultural Properties (TCP) but at least one of the corridors abuts the Sac and Fox-Iowa Indian Reservation. TCP’s can be located anywhere within the traditional areas that have been occupied by Indian tribes and the tribes should be consulted prior to any ground disturbing activities in such areas.

### 7.2.1.2 Norborne to Sedalia / Mt. Hulda Study Area

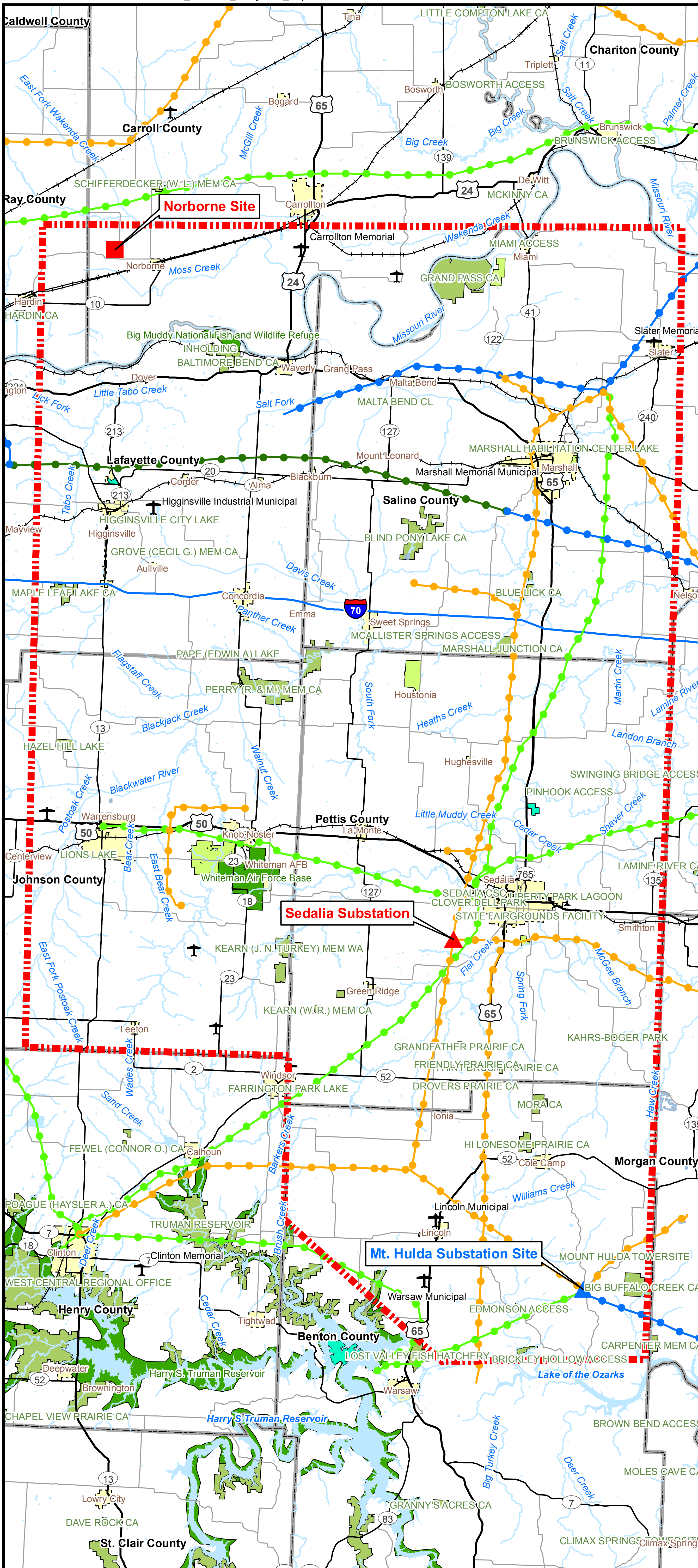
The Norborne to Sedalia / Mt. Hulda study area first extends southeast from the proposed Norborne Substation Site in Carroll County, Missouri approximately 50 miles to Central's Sedalia Substation in Pettis County (Figure 7-5). The Sedalia Substation is located approximately 2.5 miles southwest of Sedalia, about three miles west of U.S. Highway 65 between State Highways Y and B. An additional two acres of land may need to be acquired to expand the existing substation. The general transmission pathway then continues southeast approximately 24 miles to the Mt. Hulda area, where a new substation would be constructed in the vicinity of Central's existing Mt. Hulda Substation, which is located in Benton County near the intersection of State Highways B and W. Approximately two acres of land would be required for the fenced portion of the new Mt. Hulda substation. A total of about 15 acres would be purchased around the fenced substation.

The Norborne to Sedalia / Mt. Hulda area encompasses all or a portion of six Missouri counties: Carroll, Lafayette, Saline, Johnson, Pettis and Benton. The most dominant features in the study area include the Missouri River, the Big Muddy NWR, Whiteman Air Force Base (AFB), and Knob Noster State Park. Cities include Higginsville, Marshall, Waverly, Warrensburg, Knob Noster, Sedalia, Concordia, Sweet Springs and a small portion of Windsor. A variety of relatively large conservation areas including Blind Pony Lake CA, Perry Memorial CA, Marshall Junction CA, and Kearn Memorial Wildlife Area are also located throughout the study area.

#### 7.2.1.2.1 Human Resources

**Land Use:** Land use in the study area consists of large areas of timber and open grasslands with scattered cities and towns. The northern and central portions of the study area are generally flat to rolling with large areas of open grassland. The southern portion, near the Mt. Hulda Substation, is dominated by woodlands. Residential and commercial development is generally sparse throughout the less-developed parts of the study area and more concentrated within and near incorporated communities.

**Population:** The Norborne to Sedalia / Mt. Hulda study area includes southern Carroll, eastern Lafayette and Johnson, western Saline and Pettis, and northwest Benton counties.




Disclaimer: Existing transmission lines are shown to the extent they could be verified within the project study areas using aerial photography, topographic maps, and NW and Central Cooperative's system planning maps. They are not necessarily complete or represent all existing transmission lines in the area.

## LEGEND

- Study Area
- Power Plant Site
- Existing Substations
- Future Substations

**Existing Transmission Lines**

- 345-kV
- 161-kV
- 69-kV
- Voltage Unknown
- Federal Lands
- Department of Conservation Lands
- Missouri DNR Parks
- Parks (Local)
- Municipality
- County Boundary
- Airports / Airstrips

NORTH

6.5 0 6.5 Miles

**Figure 7-5**
Associated Electric Cooperative, Inc.
660 MW Coal-Based Power Plant
Norborne to Sedalia/Mt. Hulda
Study Area

Revised July 27, 2005

Carroll, Lafayette, Saline, and Pettis counties experienced negative or no population growth and were less than the state average. Johnson and Benton counties experienced a population growth greater than the state average between 2000 and 2003 (U.S. Census Bureau, 2000a). General population information about these counties is presented in Table 7-5. The most developed areas of the study area include the community of Norborne in Carroll County, Higginsville and Concordia in Lafayette County, Marshall and Sweet Springs in Saline County, Warrensburg and Knob Noster in Johnson County, La Monte and Sedalia in Pettis County, Windsor in Henry and Pettis counties, and Lincoln and Cole Camp in Benton County. The 2000 population for the larger cities is shown in Table 7-6. There are no towns with populations between 5,000 and 10,000 people (DeLorme, 2002).

**Table 7-5 Population for Norborne to Sedalia / Mt. Hulda by County**

| County | Population 1990 | Population 2000 | Population Estimate 2003 | Population % change 1990 - 2000 |
|---|---|---|---|---|
| **Missouri** | **5,117,073** | **5,595,211** | **5,704,484** | **9.3** |
| Carroll | 10,748 | 10,285 | 10,149 | -4.3 |
| Lafayette | 31,107 | 32,960 | 32,951 | 6.0 |
| Saline | 23,523 | 23,756 | 22,887 | 1.0 |
| Johnson | 42,514 | 48,258 | 50,262 | 13.5 |
| Pettis | 35,437 | 39,403 | 39,344 | 11.2 |
| Benton | 13,859 | 17,180 | 18,076 | 24.0 |

Source: U.S. Census Bureau, 2000a

Sedalia, which is the county seat of Pettis County, is the largest community in the study area. It was founded as a railroad town in the late 1800's. Today the town is the home of the Missouri State Fair, one of the largest state fairs in the U.S. Sedalia is crossed by U.S. Highway 50 from west to east and from north to south by U.S. Highway 65. Sedalia's business district is concentrated at the intersection of these two major roadways (City of Sedalia, 2005).

The town of Warrensburg is located in the west central part of the study area approximately 15 miles west of Sedalia and 50 miles east of Kansas City. Warrensburg is the second most populated community in the study area (U.S. Census Bureau, 2000c). U.S. Highway 50

### Table 7-6 Population by Size for Norborne to Sedalia / Mt. Hulda Towns

| Town | 2000 Population |
|---|---|
| > 20,000 | |
| Sedalia | 20,339 |
| 10,000 to 20,000 | |
| Warrensburg | 16,340 |
| Marshall | 12,433 |
| 1,000 to 5,000 | |
| Higginsville | 4,682 |
| Whiteman AFB | 3,814 |
| Windsor | 3,087<br>(97 in Pettis County) |
| Knob Noster | 2,462 |
| Concordia | 2,360 |
| Slater | 2,083 |
| Sweet Springs | 1,628 |
| Cole Camp | 1,028 |
| Lincoln | 1,026 |

Source: U.S. Census Bureau, 2000c

crosses the north side of town from east to west and State Highway 13 crosses through the center of town from north to south. Warrensburg is the county seat of Johnson County and the home of Central Missouri State University (CMSU). The main business district, including the County Courthouse, is located downtown. Other commercial development is located along highways 50 and 13.

Marshall, the third most populated community in the study area, is located in the northeast part of the study area in Saline County, approximately 25 miles north of Sedalia on U.S. Highway 65. Marshall is the home of Missouri Valley College (City of Marshall, 2005).

Quite a few other towns with populations greater than 1,000 people are located throughout the study area. Higginsville, which is located on State Highway 13, north of Warrensburg and Interstate 70, is in Lafayette County, as is Concordia, which is located in the north central portion of the study area along Interstate 70. Knob Noster is located in Johnson County, between Warrensburg and Sedalia, and adjacent to Whiteman AFB. Slater and Sweet Springs are located in Saline County. Slater is located at the eastern edge of the study area and Sweet Springs is located in the southern part of the county along Interstate 70. The town of Windsor is located primarily outside the study area in northeast Henry County and northwest Pettis County, while Lincoln and Cole Camp are located in the southwestern portion of the study area in Benton County. About half the larger towns in the study area experienced growth between the 1990 and 2000 census, including Concordia, LaMonte, Knob Noster, Lincoln, Sedalia, Sweet Springs, Warrensburg, and Windsor (U.S. Census Bureau, 2000c).

Many other smaller communities are dispersed throughout the study area, including Waverly, Alma, Blackburn, Corder, Dover, Emma, Green Ridge, Houstonia, Hughesville, Leeton, Malta Bend, Miami City, Mount Leonard, Norborne, Smithton, Aullville, and Ionia, all with 2000 populations less than 1,000. Most of these smaller communities experienced negative growth between 1990 and 2000 (U.S. Census Bureau, 2000c).

A small Amish community is located near the town of Windsor, in the southern part of the study area. There have been Amish settlements in Missouri since the 1850's, but all those established prior to 1930 are no longer in existence. Missouri has several Amish communities, and at one time had the fastest growing Amish population by percentage in the U.S. The Amish in Missouri primarily make their living from farming - a way of life that helps to create the sense of community that is fundamental to their religious way of life. The Amish community in Windsor consists of several homes, two sawmill operations, a general store, and a country store that sell foods and craft items to visitors from outside the community (Missouri Life Magazine, 2000).

**Employment Statistics:** The employment statistics for the six counties in the study area reflect a variety of occupations and industries. Overall, the majority of people living the study area are employed in the "educational, health and social services" and "manufacturing" industries. General employment information for these counties is presented in Table 7-7.

**Recreational Facilities:** The study area has numerous opportunities for recreation and entertainment including state and local parks, wildlife areas and an historic site. The Katy Trail State Park, managed by the Missouri State Parks and Historic Sites, is a 225-mile gravel-surfaced bicycle and walking trail, which crosses the center of Missouri from Clinton to St. Charles. The trail crosses the southern part of the study area from Windsor through

## Table 7-7 Percent Employment by Industry for Norborne to Sedalia / Mt. Hulda Counties

| Industry | Missouril | Carroll | Lafayette | Saline | Johnson | Pettis | Benton |
|---|---|---|---|---|---|---|---|
| Agriculture, forestry, fishing and hunting, and mining | 2.2 | 12.9 | 3.9 | 6.4 | 2.9 | 3.6 | 8.0 |
| Construction | 6.9 | 7.1 | 9.7 | 5.8 | 7.1 | 7.1 | 11.9 |
| Manufacturing | 14.8 | 17.3 | 15.3 | 19.6 | 15.6 | 23.5 | 15.7 |
| Wholesale trade | 3.7 | 3.7 | 3.7 | 2.6 | 1.7 | 3.6 | 2.2 |
| Retail trade | 11.9 | 8.8 | 12.9 | 10.7 | 12.1 | 12.2 | 13.2 |
| Transportation and warehousing, and utilities | 5.7 | 7.3 | 6.5 | 5.2 | 3.9 | 4.6 | 3.9 |
| Information | 3.0 | 2.6 | 2.5 | 1.8 | 2.3 | 2.3 | 1.7 |
| Finance, insurance, real estate, and rental and leasing | 6.7 | 4.3 | 5.1 | 3.2 | 4.1 | 3.6 | 4.3 |
| Professional, scientific, management, administrative, and waste management services | 7.5 | 4.6 | 4.5 | 3.7 | 4.2 | 3.8 | 3.6 |
| Educational, health and social services | 20.4 | 19.9 | 19.8 | 25.7 | 25.9 | 19.0 | 18.7 |
| Arts, entertainment, recreation, accommodation and food services | 7.8 | 2.4 | 6.2 | 6.9 | 9.5 | 7.3 | 6.6 |
| Other services (except public administration) | 5.0 | 4.8 | 5.1 | 3.8 | 4.7 | 5.4 | 5.4 |
| Public administration | 4.6 | 4.3 | 4.9 | 4.7 | 6.1 | 4.0 | 4.6 |

Source: U.S. Census Bureau, 2000b

Sedalia and continues east. The majority of the Katy Trail is built on the former rail bed of the Missouri-Kansas-Texas (MKT) Railroad, better known as Katy. A 30-mile section of trail from Clinton to Sedalia is on rail bed donated by the Union Pacific Railroad (Missouri Department of Natural Resources, 2005a).

In 1994, following extensive flooding of the Missouri River in the summer of 1993, the USFWS established the Big Muddy NWR. This wildlife area was created to restore portions of the Missouri River floodplain to its pre-settlement condition. Since its establishment, the Big Muddy NWR has grown to include eight units along the Missouri River from Kansas City to St. Louis. The Baltimore Bend portion of the Big Muddy is located on 1,490 acres of land in the Missouri River floodplain adjacent to the MDC Baltimore Bend CA.

Recreational opportunities at the Big Muddy NWR include fishing, hunting, hiking and wildlife watching (U.S. Fish and Wildlife Service, 2005d).

A number of MDC-managed areas are located throughout the study area, including Baltimore Bend, Blind Pony Lake, Perry, Blue Lick and Marshall Junction CAs in the northern portion of the study area and Kearn, Hi Lonesome Prairie, Mora, Grandfather Prairie, and Paint Brush Prairie in the south. The Baltimore Bend CA is located in the Missouri River floodplain in north Lafayette County. Approximately 80 percent of the 1,192-acre conservation area is forested. The area is managed for wildlife habitat. Recreational opportunities include hunting, fishing, hiking, and primitive camping (Missouri Department of Conservation, 2005a).

The Blind Pony Lake CA is a 2,207 acre multiple-use area, which includes a lake, warm-water fish hatchery, and 1,800 acres of land devoted to wildlife. Activities available at the Blind Pony Lake CA include hunting, fishing, hiking, bird watching, photography, picnicking, and frogging.

The 4,094 acre Perry Memorial CA is located in Johnson, Pettis, and Saline Counties. The area has over 800 acres of wetlands, 1,708 acres of forest land, and 700 acres of grass and cropland. Recreational activities include hunting, trapping, and fishing. The 773-acre Marshall Junction CA, located in southern Saline County is located on the Blackwater River and offers fishing, camping, hunting, and canoeing. The Blue Lick CA consists of 390 acres primarily for hunting and fishing.

In the southern portion of the study area, the 1,674-acre Kearn Memorial Wildlife Area, located in Johnson County, south of Warrensburg, provides recreational opportunities such as hunting, fishing, and bird watching. The Mora CA is a 320-acre area in Benton County managed as open grassland and old fields for doves, and includes opportunities for hunting, fishing and hiking. The Grandfather Prairie, Paint Brush Prairie, Drovers Prairie, Friendly Prairie and Hi Lonesome Prairie areas are tall-grass prairie remnants in Pettis and Benton counties, on which people can view prairie wildflowers in the spring, summer, and fall, as well as hunt and fish on some of the area's lands. The Hi Lonesome Prairie is the largest of the three areas, at 627 acres. Grandfather, Drovers, Paint Brush, and Friendly Prairies are considerably smaller (all are 80 acres or less).

Other recreational opportunities in the study area include the Confederate Memorial State Historic Site north of Higginsville; and numerous other small conservation areas and local parks. Higginsville City Lake, east of Higginsville, offers opportunities to fish, picnic, hike, hunt, and observe wildlife. Facilities associated with the lake include picnic areas and tables, restrooms, a fishing pier, and boat ramps. A privately owned golf course is located adjacent to the lake, as is the Higginsville Industrial Municipal Airport.

Knob Noster State Park is located between the towns of Warrensburg and Sedalia, in the center of the study area. The 3,567 acre state park includes public and group camping facilities as well as opportunities for fishing, horseback riding and hiking.

As previously mentioned, Sedalia is home to the Missouri State Fair. For 10 days each August, the state fair offers a wide variety of entertainment and educational opportunities. The state fair grounds are also used for concerts, stock car racing and livestock exhibits throughout the year (City of Sedalia, 2005).

**Transportation and Utilities:** The Norborne to Sedalia / Mt. Hulda study area contains an extensive network of roadways, both paved and unpaved, railroads, airports, and transmission lines (Figure 7-5).

- Roads - Interstate Highway 70 runs east/west across the north part of the area. U.S. Highway 65 runs north/south down the east side of the area through the communities of Marshall and Sedalia. U.S. Highway 50 runs east/west through the center of the study area past Warrensburg, Knob Noster and through Sedalia.
- Railroads - The Union Pacific Railroad runs east/west through the center of the study area though the communities of Warrensburg and Sedalia. In addition to carrying freight, agricultural products and coal, this railroad provides Amtrak service from Kansas City to St. Louis. A second Union Pacific line crosses the northern part of the study area from east to west through Marshall. A third rail line operated by Kansas City Southern Railroad (formerly Gateway Western Railroad) also crosses the north part of the study area through Higginsville and Marshall (DeLorme, 1998).

- Airports - Whiteman AFB is located between Warrensburg and Sedalia, just south of the town of Knob Noster. The base was established in 1942 as a training facility for glider pilots and has been the site of various Strategic Air Command (SAC) wings. From the early 1960's to 1995, it was the site of SAC's Fourth Minute Man Missile Wing. Whiteman AFB is currently home base for the B-2 Bomber. The area surrounding Whiteman presents potential transmission line routing constraints. At a minimum, the approach surface of the base's runways would require an unrestricted glide path of 50:1 for a distance of 50,000 feet from the end of each runway. A 100-foot transmission line pole could not be within 5,000 feet of the runway end, or nearly one mile. Other zoning and security issues or other associated military facilities, such as VOR sites (air navigational radio aids), may need to be addressed to route a transmission line near this military installation (509$^{th}$ Bomb Wing Public Affairs, 2005).

  A number of small airports and airfields were identified within the study corridor. The Marshall Memorial Airport is located between U.S. Highway 65 and Business 65 south of Marshall. The Higginsville Industrial Municipal Airport is located on State Route AA, 1.5 miles east of the town of Higginsville. The Sedalia Memorial Airport is located north of U.S. Highway 50 on the east side of Sedalia. The Skyhaven (Max Swisher) Airport is located on U.S. Highway 50 about two miles west of Warrensburg. The Windsor Municipal Airport is located on the north side of Windsor off of State Route B. Restricted areas of varying dimensions, depending on the airport facilities and capabilities, extend beyond the property boundaries for each of these airports as defined by 14 CFR, Part 77 of the FAA Regulations. In addition to these airfields, a number of small, private landing strips may also be scattered throughout the area (AirNav LLC, 2005).
- Transmission Lines - Several transmission lines cross the study area operated by Aquila, KCPL, and NW and Central Electric Cooperatives. A 345 kV line runs west to east through the northern portion of the study area. 161 kV lines criss-cross the study area. One 161 kV line angles from near Marshall southwest to Sedalia; another enters the study area from Cooper County, heads into Sedalia, and then continues southwest to Clinton, and one runs between Warrensburg and Sedalia, generally

parallel to Highway 50. A 69 kV line crosses the study area from Marshall south to Sedalia and beyond, where it splits to head toward Clinton and the Mt. Hulda area. Another 69 kV line runs west to east, on the south side of Sedalia. A 69 kV line also heads almost due south from Sedalia, eventually crossing an arm of Lake of the Ozarks. Numerous other sub-transmission and distribution lines are located along area roadways and elsewhere providing electrical service to local residents and commercial and industrial customers.

#### 7.2.1.2.2 Natural Resources

Photographs representative of the typical vegetation and terrain of the area are included at the end of this section for reference.

**Physiography and Topography:** The northern part of the Norborne to Sedalia/Mt. Hulda study area, which includes Carroll, Lafayette and Saline counties, is located in the Central Dissected Till Plains physiographic region. The topography in this portion of the study area is generally flat on the north side of the Missouri River, with rolling hills south of the river. Johnson, western Pettis, and northern Benton counties are in the Osage Plains region. This is Missouri's prairie region, which is characterized by plains and gently rolling hills. The extreme southern part of the study area in Benton County is in the Ozark Highlands Region. The topography in this region changes to steeper hills with narrow valleys.

Numerous small rivers and streams flow through the study area. Drainage is generally toward the Missouri River, which crosses the northern part of study area, forming the south boundary of Carroll County and the north boundary of Saline County. The Blackwater River runs north of Warrensburg, across southern Saline County. Truman Reservoir, the largest flood control lake in Missouri, consisting of approximately 166,000 acres of public land and water, and Lake of the Ozarks, with a shoreline of more than 1,150 miles, are located at the southernmost edge of the study area. Most of the features of these two lakes are located outside the Norborne to Sedalia/Mt. Hulda study area. Numerous other creeks and streams are scattered throughout the study area.

**Vegetation:** Vegetation throughout the study area is a combination of cultivated crops and native plants. In the northern part of the study area, the Missouri River floodplain is well suited for crop production. The central portion of the area is dominated by open grasslands dissected by wooded hillsides and stream banks. Prior to settlement, much of this region supported prairie grass species. Today, land left uncultivated for crops can support such native grass species as big and little blue stem, Indian grass and switch grass. Cottonwood, sycamore, American elm, honey locust and black walnut are common tree species along stream banks. The southern portion of the study area that falls within the Ozark Highlands Physiographic Region is dominated by oak and hickory species, which are well adapted to upland hills and steep slopes.

Almost all of the land in the Norborne to Sedalia / Mt. Hulda study area is considered prime farmland, prime farmland if drained or not flooded, or farmland of statewide importance. Typically, impacts from transmission lines to prime farmland are minimal. All of the agricultural land crossed by the line, with the exception of where the pole is placed and where possible guy wires are anchored, can remain in agricultural production.

**Wetlands:** Wetlands are found scattered over the entire Norborne to Mt. Hulda study area. Wetlands in the study area include numerous small isolated wetlands associated with farm ponds and larger communities associated with rivers, streams and lakes.

**Wildlife:** The varied landscapes within the study area provide habitat for a wide variety of wildlife species. Canada geese, mallard ducks and other waterfowl are common bird species in the crop fields and wetlands along the Missouri River. Bird species such as red-tailed hawks and bob-white quail and mammals such as cottontail rabbits are common in the open grasslands of the central study area. Mammals such as raccoon, opossum, white-tailed deer, striped skunk and coyote are likely found throughout the entire study area.

**Threatened and Endangered Species:** The natural history database of the MDC and USFWS county distribution list of Missouri's federally-listed species were searched for the six counties in the study area. Preliminary investigation identified four federally-listed endangered species that could occur in the study area. The Topeka Shiner is listed by the USFWS as possibly occurring in small prairie streams in Pettis County. The pallid sturgeon is listed by the USFWS as possibly occurring in the Missouri River in Saline and Lafayette counties. The gray bat is listed by the MDC and the USFWS as possibly occurring in caves in Benton County. The Indiana bat is listed by the USFWS as possibly occurring in wooded areas of Carroll and Benton counties. The preliminary search also identified two federally-threatened species and eleven state-endangered species as potentially occurring in the study area. Table 7-8 provides a complete list of the protected species found in the study area counties. Some of these species may not occur in the actual study area, but rather in areas within the counties beyond the study area boundaries.

**Table 7-8 Threatened and Endangered Wildlife Species – Norborne to Sedalia / Mt. Hulda by County**

| Common Name | Scientific Name | State Status | Federal Status | Counties | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Carroll | Lafayette | Saline | Johnson | Pettis | Benton |
| American Bittern | *Botaurus lentiginosus* | E | -- | | ✓ | ✓ | | | |
| Bald Eagle | *Halliaeetus leucociphalus* | E | T | ✓ | | ✓ | | | ✓ |
| Barn Owl | *Tyto alba* | E | -- | | | ✓ | | | |
| Black-Tailed Jackrabbit | *Lepus californicus* | E | -- | | | | | ✓ | ✓ |
| Greater Prairie-Chicken | *Tympanuchus cupido* | E | -- | ✓ | | | ✓ | ✓ | ✓ |
| Gray Bat | *Myotis grisescens* | E | E | | | | | | ✓ |
| Indiana Bat | *Myotis sodalis* | -- | E | ✓ | ✓ | | | | |
| King Rail | *Rallus elegans* | E | -- | | | ✓ | | | |
| Lake Sturgeon | *Acipenser fulvescens* | E | -- | ✓ | | ✓ | | | |
| Niangua Darter | *Etheostoma nianguae* | E | T | | | | | | ✓ |
| Northern Harrier | *Circus cyaneus* | E | -- | ✓ | | | | ✓ | |
| Pallid Sturgeon | *Scaphirhynchus albus* | -- | E | | ✓ | ✓ | | | |
| Topeka Shiner | *Notropis topeka* | E | E | | | | | ✓ | |

Source: Missouri Department of Conservation, 2005b. United States Fish and Wildlife Service, 2005b
E – Endangered; T – Threatened

**Cultural Resources:** In general, the study area has the potential to contain an abundance of cultural and archaeological resources, primarily along the floodplain and bluffs overlooking the Missouri River and its tributaries. See Section 7.2.1.1.3, Norborne to Thomas Hill, for a description of the potential cultural resources in the study area.

### 7.2.2 FORBES SITE

Two transmission study areas were identified for the Forbes Site: Forbes to Fairport and Fairport to Orrick / Missouri City / Eckles Road (refer to Figure 7-1 for an overview). A transmission line would be required for each of these study areas, one heading generally east to Fairport and one heading generally south from Fairport to Orrick, should the Forbes site be chosen as the site of the proposed power plant. The Forbes to Fairport section of the proposed transmission corridors originates at the Forbes site, which is located in Holt County on the east side of the Missouri River, about three miles west of Big Lake, Missouri and 0.5 mile east of Rulo, Nebraska. The site is located just south of U.S. Highway 159. The Fairport Substation is located in DeKalb County off State Highway A, about halfway between State Highways E and Z. The Fairport to Orrick / Missouri City / Eckles Road section begins at the Fairport Substation, the terminus for the Forbes to Fairport section, and continues to a new Orrick Substation near the town of Orrick. From Orrick the line would continue west to the Missouri City Substation and southwest to the Eckles Road Substation.

#### 7.2.2.1 Forbes to Fairport Study Area

The Forbes to Fairport study area extends east approximately 57 miles from the proposed Forbes Site in Holt County to NW's Fairport Substation in DeKalb County (Figure 7-6). The study area crosses five counties, including Holt, Nodaway, Andrew, Gentry, and DeKalb. As described previously, the Fairport Substation is located off State Highway A between State Highways Z and E, approximately 18 miles northwest of Cameron, Missouri. Primary features within this study area include Squaw Creek NWR, Big Lake State Park, and a variety of relatively large conservation areas, including Nodaway Valley CA, Brown CA, Happy Holler CA, and King Lake CA. The Platte River, One Hundred and Two River, and Nodaway River are major bodies of water that cross the study area. Major towns within the study area include Mound City, Oregon, Forest City, Savannah, and King City.

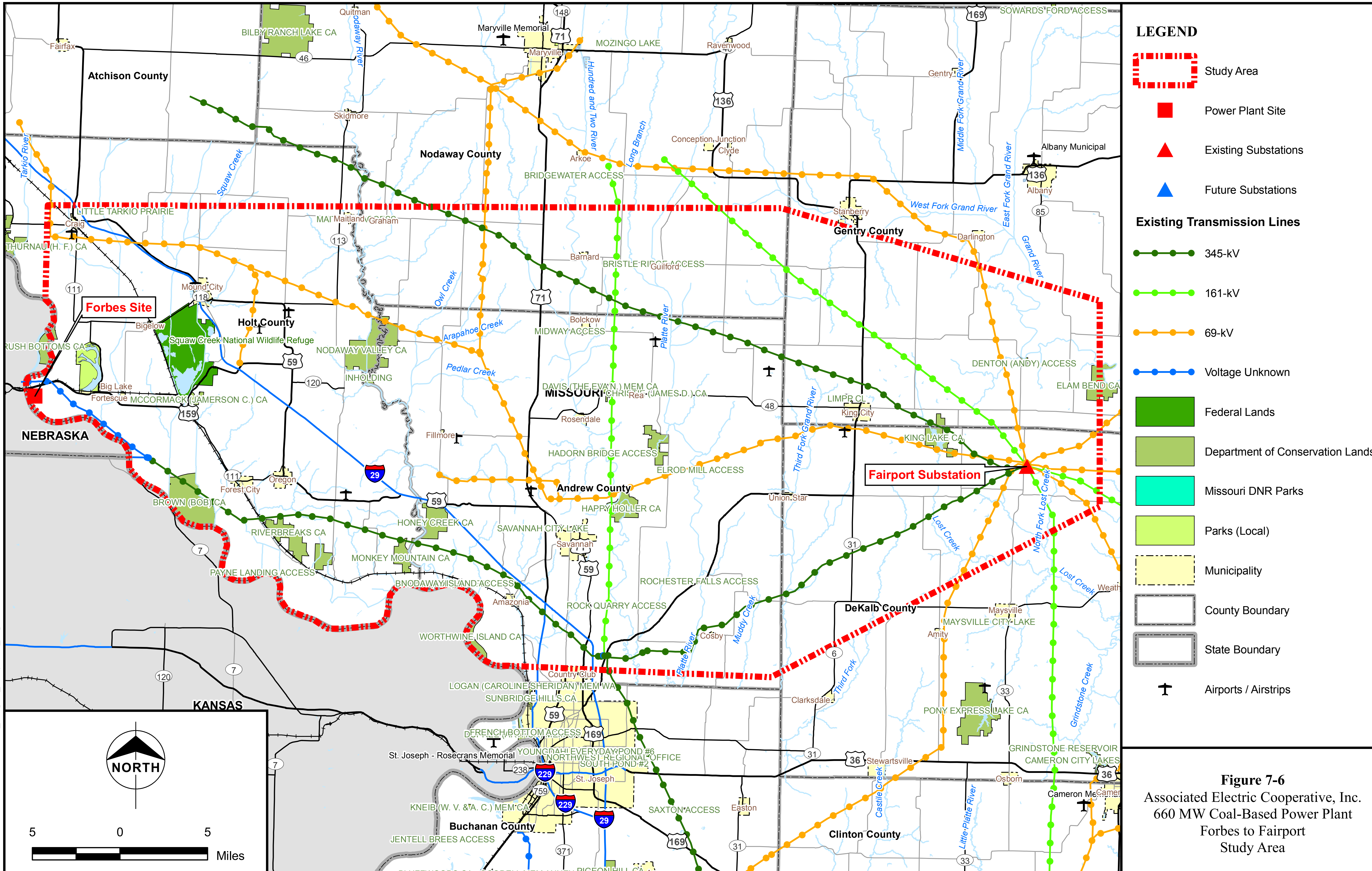



**Figure 7-6**
Associated Electric Cooperative, Inc.
660 MW Coal-Based Power Plant
Forbes to Fairport
Study Area

Disclaimer: Existing transmission lines are shown to the extent they could be verified within the project study areas using aerial photography, topographic maps, and NW and Central Cooperative's system planning maps. They are not necessarily complete or represent all existing transmission lines in the area.

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#### 7.2.2.1.1 Human Resources

**Land Use:** The Forbes to Fairport study area extends from west to east across northwest Missouri and includes Holt, Andrew, southern Nodaway, southwest Gentry and northwest DeKalb counties. The western portion of the study area in Holt County is located in the Missouri River floodplain. This area is rural in nature and land use is primarily agricultural. This portion of the study area is well suited for crop production and the majority of the usable land has long been cleared and cultivated for this purpose. This portion of the study area consists primarily of large cultivated crop fields separated by gravel county roadways. Crops such as soybeans and corn are the dominant crops grown in this part of the study area. Center pivot irrigation systems are used extensively in this area, which is likely due to sandy soils with poor water-retention qualities. These irrigation systems are less common in crop fields located further east of the Missouri River floodplain. Center pivot irrigation systems consist of a series of water pipes with spray heads, mounted on a motor driven wheel assembly connected to a well head. The entire system rotates in a circular motion around the well head. The system will not function properly if there are obstacles in the path of the moving pipe. To avoid interference with crop production, fields using center pivot irrigation systems are considered a prohibitive constraint and efforts would be made to identify routes along the tangent of the center pivot systems. Land use in the eastern portion of the study area is also rural and primarily agricultural. Crop fields in the eastern portion of the area are smaller than those in the floodplain and shaped to fit the uneven terrain.

**Population:** General population information about the study area counties is presented in Table 7-9. Holt County was the only county to experience a population decline between 1990 and 2000, but Nodaway and Gentry counties experienced only a slight increase, much less than the state average. Andrew and DeKalb counties experienced a growth greater than the Missouri average (U.S. Census Bureau, 2002a).

Residential and commercial development is generally sparse throughout the entire study area. Rural residences and farmsteads are associated with areas of agriculture and small- to medium- sized communities are located in and around the study area. The overall population of the study area is low. Table 7-10 lists the towns in the study area with populations greater than 1,000 people. No cities with 2000 populations over 5,000 people are located in the

### Table 7-9 Population for Forbes to Fairport by County

| County | Population 1990 | Population 2000 | Population 2003 | Population % Change 1990 - 2000 |
|---|---|---|---|---|
| **Missouri** | **5,117,073** | **5,595,211** | **5,704,484** | **9.3** |
| Holt | 6,034 | 5,351 | 5,145 | -11.3 |
| Andrew | 14,632 | 16,492 | 16,813 | 12.7 |
| Nodaway | 21,709 | 21,912 | 21,743 | 0.9 |
| Gentry | 6,848 | 6,861 | 6,566 | 0.1 |
| DeKalb | 9,967 | 11,597* | 13,063 | 16.4 |

Source: U.S. Census Bureau, 2000a
*The Missouri Office of Administration, which sites the U.S. Census as their source, reports the 2000 population of DeKalb County as 13,073.

### Table 7-10 Population by Size for Forbes to Fairport Towns

| Town | 2000 Population |
|---|---|
| **1,000 to 5,000** | |
| Savannah | 4,762 |
| Mound City | 1,193 |
| King City | 1,012 |

Source: U.S. Census Bureau, 2000c

study area. According to the 2000 U.S. Census, the largest town in the study area is Savannah, which is located in Andrew County in the south central part of the study area. Mound City in Holt County and King City in Gentry Country were the only other towns with populations over 1,000. All other towns in the study area, such as Oregon, Forest City, Amazonia, Barnard, Big Lake, Cosby, Craig, Fillmore, Fortescue, Graham, Guilford, Maitland, Rea, Rosendale, Bolckow, and Union Star had 2000 populations under 1,000 people. Most of the communities in the study area declined or remained generally the same in population between 1990 and 2000 (U.S. Census Bureau, 2002c).

**Employment Statistics:** The employment statistics for the five counties in the study area reflect a variety of occupations and industries. Overall, the majority of people living the study area are employed in the area of education, or health and social services. The percentage of people employed in agricultural- related industries exceeds the average for the State of Missouri and reflects the general rural nature of the study area. General employment information for these counties is presented in Table 7-11.

### Table 7-11 Percent Employment by Industry for Forbes to Fairport Counties

| Industry | MISSOURI | Holt | Andrew | Nodaway | Gentry | DeKalb |
|---|---|---|---|---|---|---|
| Agriculture, forestry, fishing and hunting, and mining | 2.2 | 12.9 | 4.7 | 7.1 | 10.5 | 7.0 |
| Construction | 6.9 | 8.4 | 9.9 | 4.6 | 6.0 | 8.7 |
| Manufacturing | 14.8 | 12.1 | 16.1 | 19.1 | 11.6 | 12.4 |
| Wholesale trade | 3.7 | 3.8 | 3.0 | 1.4 | 4.4 | 2.6 |
| Retail trade | 11.9 | 12.1 | 8.8 | 11.2 | 11.7 | 9.9 |
| Transportation and warehousing, and utilities | 5.7 | 5.3 | 7.4 | 2.2 | 5.2 | 7.4 |
| Information | 3.0 | 1.2 | 1.4 | 2.0 | 1.7 | 2.1 |
| Finance, insurance, real estate, and rental and leasing | 6.7 | 4.7 | 6.4 | 3.2 | 4.8 | 6.3 |
| Professional, scientific, management, administrative, and waste management services | 7.5 | 3.2 | 4.5 | 3.5 | 2.7 | 3.4 |
| Educational, health and social services | 20.4 | 19.8 | 22.4 | 27.4 | 27.6 | 18.5 |
| Arts, entertainment, recreation, accommodation and food services | 7.8 | 7.7 | 5.4 | 9.9 | 3.7 | 6.4 |
| Other services (except public administration) | 5.0 | 3.6 | 5.2 | 4.5 | 4.0 | 5.8 |
| Public administration | 4.6 | 5.1 | 4.8 | 3.8 | 6.2 | 9.5 |

Source: U.S. Census Bureau, 2000b

**Recreational Facilities:** Opportunities for recreation and entertainment in the study area generally include state and local parks, wildlife areas, and historic sites. Squaw Creek NWR is the dominant recreational feature in the study area. The refuge is managed by the USFWS and is located in Holt County, east of Interstate Highway 29 in the Missouri River floodplain. The 7,350-acre refuge was established in 1935 by Franklin D. Roosevelt to provide habitat for migratory birds and other wildlife species. Vegetation and water levels in wetland areas are maintained to benefit migratory birds during spring and fall. Crops such as corn, wheat and soybeans are planted to provide food for waterfowl, deer and upland birds. Grasslands on the refuge are managed to encourage native prairie species. Recreational opportunities at

Squaw Creek include bird and wildlife watching, hiking and picnicking (U.S. Fish and Wildlife Service, 2005d).

Big Lake State Park is located east of Interstate Highway 29 in Holt County. The 435-acre park provides picnic areas, a swimming pool, boat launch, fishing, bird watching, dining facilities and facilities for lodging and camping. The park is located on Missouri's largest oxbow lake, which was formed by the Missouri River before its course was controlled by canalization. Because of the park's proximity to Squaw Creek NWR, the area is a major feeding and resting place for birds and migratory waterfowl (Missouri Department of Natural Resources, 2005b).

The MDC manages several conservation areas in the study area. The Nodaway Valley CA in Andrew and Holt counties is 3,813 acres and offers hunting, fishing, camping, canoeing, hiking and bird watching. The 2,207-acre Happy Holler CA in Andrew County offers canoeing on the One Hundred and Two River, fishing, and hunting. The Bob Brown CA in Holt County is managed for waterfowl and pheasant hunting with over 1,300 acres of wetlands and nearly 2,000 acres of grassland and old fields. The 1,148-acre Honey Creek CA in Andrew County has 13 miles of multi-use trails in addition to camping, fishing, and hunting. Other relatively large conservation areas include Monkey Mountain CA (787 acres) just west of the Nodaway River in Holt and Andrew counties, Davis and Christie CAs (204 acres) in Andrew County, King Lake (1,273 acres, including a 186-acre fishing lake) in DeKalb and Gentry counties, Riverbreaks CA (2,306 acres) in Holt County, Rush Bottoms CA (811 acres) along the Missouri River in Holt County, McCormack CA (227 acres, including the McCormack Loess Mound Natural Area) in Holt County and Limpp Lake (29 acres) in Gentry County. Conservation areas such as these typically offer opportunities for hunting, fishing, hiking and occasionally camping, biking, and horseback riding. The Riverbreaks CA also has an un-staffed shooting range on site.

Additional recreational facilities include other small conservation areas and local parks near towns. The City of Savannah has a golf course and other park facilities.

**Transportation and Utilities:** The Forbes to Fairport study area contains a network of roadways that includes major interstates, state and county highways, and both paved and unpaved roads, railroads, small airports, and a network of existing transmission lines (Figure 7-6).

- Roads - Interstate Highway 29 runs diagonally across the west end of the study area from southwest Andrew County to northwest Holt County. U.S. Highway 71 crosses the study area from Savannah to central Nodaway County. U.S. Highway 59 winds through the southwest corner of the study area from Savannah to Mound City. U.S. Highway 169 crosses the eastern part of the study area.
- Railroads - The BNSF line runs along the western edge of the study area through the Missouri River floodplain, parallel to Interstate 29.
- Airports - Several small airfields were identified within the study corridor. All of these are private airstrips and do not provide general passenger service. They include the Crop Care Airport, located near Mound City; the Simerly Airport, located near Filmore; the Market Air Strip near Oregon; the Worth Airport north of Savannah; the Hannah Airport near Blockow; and the Fairbanks and Fizzle Ridge Airports near King City. The Worth Airport has a paved runway and the Crop Care Airport's runway is gravel. The remaining fields have grass runways (AirNav LLC, 2005). Due to the rural nature of the study area, it is possible that other private airstrips exist that have not yet been identified.
- Transmission Lines - Several transmission lines cross the Forbes to Fairport study area, and a number of lines extend into and out of the Fairport Substation. Two 345 kV lines, one heading northwest and one heading southwest, angle out of the Fairport Substation. One 161 kV line heads to the Fairport Substation from the northwest, while two other 161 kV lines connect to the Fairport Substation from the south and southeast. Six 69 kV lines terminate at the Fairport Substation, from the north, south, east and west. A 161 kV line extends north to south through the center of the study area, while a 345 kV line angles from the southeast along the western edge of the study area. There are also several other 69 kV lines that converge from the northwest, north, east, and southeast in the center of the study area. Numerous other sub-transmission and distribution lines are located along area roadways providing electrical service to local residents and commercial and industrial customers.

#### 7.2.2.1.2 Natural Resources

Photographs representative of the typical vegetation and terrain of the area are included at the end of this section for reference.

**Physiography and Topography:** The study area is located in the Central Dissected Till Plains physiographic region. The topography in the western portion of the study area is generally flat in the Missouri River floodplain. The terrain becomes steep at the eastern edge of the floodplain. Rolling hills with flat valleys are found in the central and eastern portions of the study area. The study area includes one major river and numerous small rivers and streams. The Missouri River is located at the western end of the study area and forms the western boundary of Holt County. The Nodaway River crosses the study area from north to south creating the boundary between Holt and Andrew counties and drains into the Missouri River. The One Hundred and Two River and the Platte River cross the study area from north to south through eastern Nodaway and Andrew counties. The far eastern portion of the study area drains easterly toward the Grand River, which is outside the study area. Numerous small streams and creeks join to form these rivers, which eventually extend to the Missouri River (DeLorme, 1998).

**Vegetation:** Vegetation throughout the study area is a combination of cultivated crops and native plants. Cultivated crops are the dominant vegetation in the portion of the study within the Missouri River floodplain. Bottom land tree species such as cottonwood, sycamore and elms can also be found along creeks and drainages. At the edge of the floodplain, the study area features steep slopes that support hard wood species such as oaks and hickories. The loess hill formations in the central and eastern parts of the study area contain small areas of native prairie. These areas also support cottonwood, sycamore, American elm, honey locust and black walnut tree species along stream banks (U.S. Department of Agriculture, 1981).

Almost all of the land in the Forbes to Fairport study area is considered prime farmland, prime farmland if drained or not flooded, or farmland of statewide importance. Typically, impacts from transmission lines to prime farmland are minimal. All of the agricultural land crossed by the line, with the exception of where the pole is placed and where possible guy wires are anchored, can remain in agricultural production.

**Wetlands:** Wetlands are located throughout the study area and are typically associated with rivers, streams and lakes. Two major wetland complexes are found in the eastern portion of the study area. The largest one is in Squaw Creek NWR. Nearly the entire area of Squaw Creek is a series of small islands of upland surrounded by a combination of emergent, scrub-shrub and forested wetlands. The north end of Big Lake, in Big Lake State Park is also a large complex of different wetland types. Both of these areas are a representation of the local pre-settlement landscape. Wetlands such as these provide high quality habitat for migratory birds and other wildlife and are considered a major constraint when routing a transmission line.

**Wildlife:** The varied landscapes within the study area provide habitat for a wide variety of wildlife species. Canada geese, mallard ducks and other waterfowl are common bird species in the wetlands and crop fields along the Missouri River. Bald eagles are common winter visitors around Squaw Creek NWR. Bird species such as red-tailed hawks and bob-white quail are common in upland areas. Wild turkey are found throughout the study area, particularly where crop fields are surrounded by wooded areas. Pheasant, although not as common as wild turkey, are also found in crop fields throughout the study area. Mammal species common to the study area include cottontail rabbits, raccoon, opossum, white-tailed deer, striped skunk and coyote.

The natural history database of the MDC and USFWS county distribution list of Missouri's federally-listed species were searched for the seven counties in the study area. Our investigation identified two federally-listed endangered species that could occur in the study area: the Indiana bat and the pallid sturgeon. The search also identified one federally-threatened species and eleven state-endangered species as potentially occurring in the study area. Table 7-12 provides a complete list of the threatened and endangered species found in the study area counties. Some of these species could occur in the counties, but outside this project's study area.

In general, the study area has the potential to contain an abundance of cultural and archaeological resources, primarily along the Missouri River floodplain and bluffs. See

Section 7.2.1.1.3, Norborne to Thomas Hill, for a description of the potential cultural resources in the study area.

**Table 7-12 Threatened and Endangered Species – Forbes to Fairport by County**

| Common Name | Scientific Name | State Status | Federal Status | Counties | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | Holt | Andrew | Nodaway | Gentry | DeKalb |
| American Bittern | *Botaurus lentiginousus* | E | | ✓ | | | ✓ | |
| Bald Eagle | *Haliaeetus leucocephalus* | E | T | ✓ | ✓ | | | |
| Blanding's Turtle | *Emydoidea blandingii* | E | — | ✓ | | | | |
| Barn Owl | *Tyto alba* | E | | | | | | ✓ |
| Eastern Massasauga | *Sistrurus catenatus* | E | — | ✓ | | | | |
| Flathead Chub | *Platanthera praeclara* | E | — | ✓ | ✓ | | | |
| Greater Prairie Chicken | *Tympanuchus cupido* | E | — | | | ✓ | | |
| Indiana Bat | *Myotis sodalis* | E | E | ✓ | ✓ | ✓ | ✓ | ✓ |
| Northern Harrier | *Circus cyaneus* | E | — | | | | | ✓ |
| Pallid Sturgeon | *Scaphirhynchus albus* | E | E | ✓ | ✓ | | | |
| Western Fox Snake | *Elephe vulpina* | E | — | ✓ | | | ✓ | |
| Western prairie fringed orchid | *Platanthera praeclara* | E | T | ✓ | | | | |

Source: Missouri Department of Conservation, 2005b. United States Fish and Wildlife Service, 2005b
E – Endangered; T – Threatened

### 7.2.2.2 Fairport to Orrick / Missouri City / Eckles Road Study Area

The Fairport to Orrick / Missouri City / Eckles Road study area continues south approximately 53 miles from the Fairport Substation in DeKalb County to a proposed substation located approximately 1.5 miles northwest of the town of Orrick, Missouri in Ray County (Figure 7-7). The proposed Orrick Substation (approximately two to five acres in size) would be located between State Highway O and State Highway 210. The study area also includes 161 kV transmission alternatives from the new Orrick Substation west about eight miles to the Missouri City Plant in Clay County and from Orrick southwest about seven

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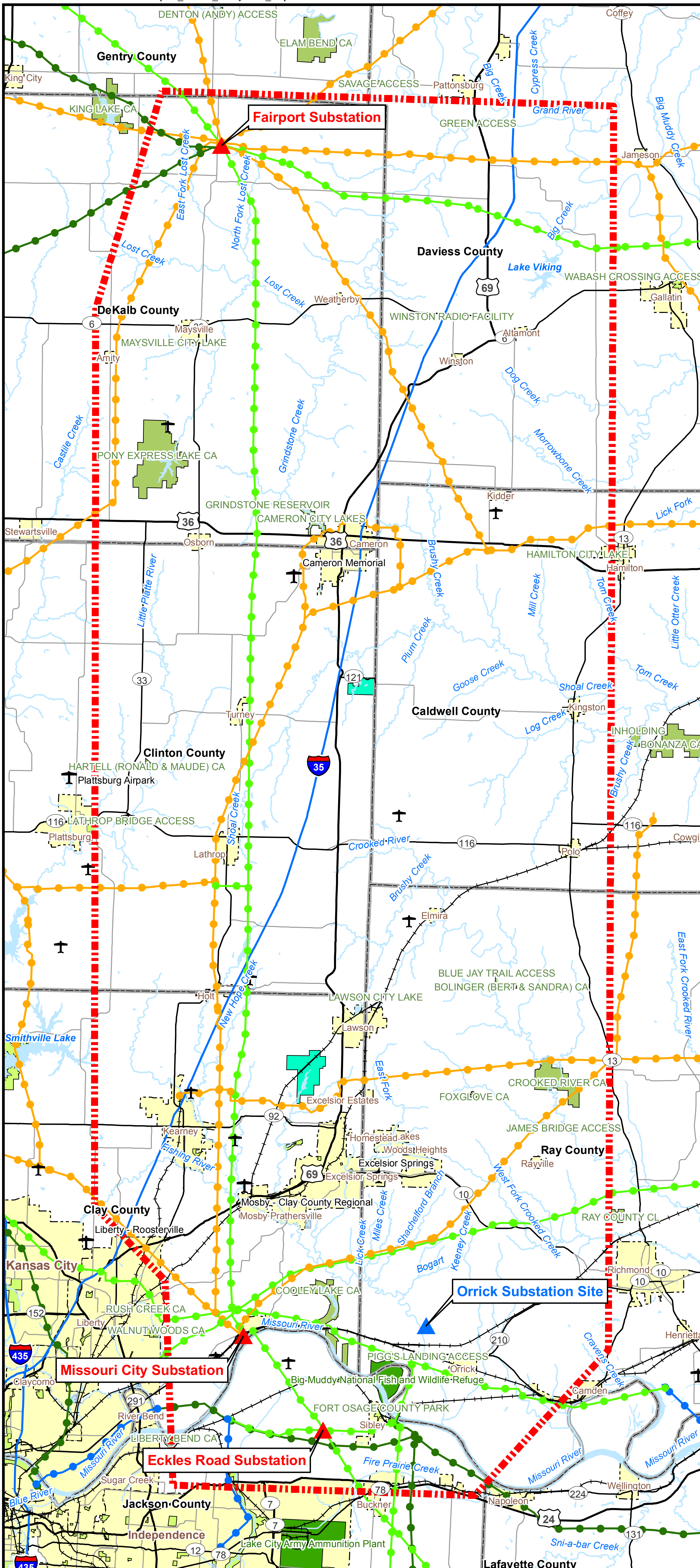


Disclaimer: Existing transmission lines are shown to the extent they could be verified within the project study areas using aerial photography, topographic maps, and NW and Central Cooperative's system planning maps. They are not necessarily complete or represent all existing transmission lines in the area.

**LEGEND**

- Study Area
- Power Plant Site
- Existing Substations
- Future Substations

**Existing Transmission Lines**

- 345-kV
- 161-kV
- 69-kV
- Voltage Unknown
- Federal Lands
- Department of Conservation Lands
- Missouri DNR Parks
- Parks (Local)
- Municipality
- County Boundary
- Airports / Airstrips

NORTH

4.5 0 4.5 Miles

**Figure 7-7**
Associated Electric Cooperative, Inc.
660 MW Coal-Based Power Plant
Fairport to Orrick/Missouri City/Eckles Rd
Study Area

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miles to NW's existing Eckles Road Substation in Jackson County. The Missouri City Plant and Substation are located on the southwest edge of Missouri City, between State Highway 210 and the Missouri River. The existing Eckles Road Substation is located approximately two miles west of Sibley and two miles north of Independence on Eckles Road. The study area encompasses portions of seven Missouri counties, including DeKalb, Daviess, Clinton, Caldwell, Clay, Ray, and Jackson. Dominant features within this study area include Interstate 35 (which angles from southwest to northeast through the study area), the Watkins Woolen Mill State Park and Historic Site, Wallace State Park, the Big Muddy NWR, several conservation areas, and the cities of Maysville, Lathrop, Cameron, Lawson, Kearney, Excelsior Springs, Mosby, Prathersville, Woods Heights, Orrick, Missouri City, and Sibley. A Union Pacific Railroad extends between Liberty, Mosby, Lawson, and Polo within the study area. Most of these features are found in the southern portion of the study area.

#### 7.2.2.2.1 Human Resources

**Land Use:** The Fairport to Orrick/Missouri City/Eckles Road study area includes portions of DeKalb, Daviess, Clinton, Caldwell, Clay, Ray, and extreme northern Jackson counties. The study area contains both undeveloped and rural lands and developed towns and communities. Land use in the area is a combination of agricultural land with rural residents, and developed residential and commercial areas located in and around the larger cities and towns. In the southern portion of the study area, in southern Ray and Clay counties and northern Jackson County, the area is dominated by the Missouri River floodplain. The portions of the floodplain that have not been set aside for conservation are used for crop production. A few center-pivot irrigation systems are used in the southern portion of this study area. The majority of the undeveloped portions of the study area is dominated by agricultural land, including pastureland, hayland and cropland, surrounded by wooded areas mostly occurring in low areas along creeks, streams and rivers, which are generally unfit for agricultural uses.

**Population:** General population data for the study area counties is included in Table 7-13. All the study area counties experienced growth between 1990 and 2000, but DeKalb, Clinton, and Clay experienced growth greater than the state average. Jackson is the most populated county in the study area and Clay is the second most populated. The greater Kansas City metropolitan area is located in Jackson and Clay counties just outside the southwest portion of the study area. Kansas City and the surrounding suburbs account for much of the population for both of these counties (U.S. Census Bureau, 2000c). This area around Kansas City, which includes the cities of Liberty in Clay County and Independence in Jackson County, was purposefully excluded from the study area to avoid crossing high-density residential and commercial areas.

**Table 7-13 Population for Fairport to Orrick/Missouri City/Eckles Road by County**

| County | Population 1990 | Population 2000 | Population 2003 | Population % Change 1990-2000 |
|---|---|---|---|---|
| **Missouri** | **5,117,073** | **5,595,211** | **5,704,484** | **9.3** |
| DeKalb | 9,967 | 11,597* | 13,063 | 16.4 |
| Daviess | 7,865 | 8,016 | 8,004 | 1.9 |
| Clinton | 16,595 | 18,979 | 20,140 | 14.4 |
| Caldwell | 8,380 | 8,969 | 9,159 | 7.0 |
| Clay | 153,411 | 184,006 | 194,247 | 19.9 |
| Ray | 21,971 | 23,354 | 23,926 | 6.3 |
| Jackson | 633,232 | 654,880 | 659,723 | 3.4 |

Source: U.S. Census Bureau, 2000a
*The Missouri Office of Administration, which sites the U.S. Census as their source, reports the 2000 population of DeKalb County as 13,073.

The larger communities within the study area include: the greater Excelsior Springs area (which has been defined to include Excelsior Springs, as well as adjacent Mosby, Prathersville, Homestead, Crystal Lakes, and Woods Heights municipalities), Kearney, Cameron, Lathrop, Lawson, and Maysville. Table 7-14 presents the population data for communities in the study area with 2000 populations greater than 1,000 people, arranged by size. The community of Excelsior Springs is located on the eastern edge of Clay County and western Ray County in the south-central part of the study area. Excelsior Springs was formed in the late 1880's around the discovery of a mineral water spring. The mineral water springs and supporting businesses that made Excelsior Springs a popular destination in the 1880's remain a part of the local economy today (City of Excelsior Springs, 2005). The 2000 population of Excelsior Springs itself was 10,847, making it the most populated community in the study area. Excelsior Springs is adjacent to several other smaller municipalities, including Mosby, Prathersville, Excelsior Estates, Homestead, Crystal Lakes, and Woods

Heights, which increases the overall size of the greater Excelsior Springs area. This area experienced over a five percent growth rate between 1990 and 2000 (U.S. Census Bureau, 2000c).

### Table 7-14 Population by Size for Fairport to Orrick / Missouri City / Eckles Road Towns

| Town | 2000 Population |
|---|---|
| **10,000 to 20,000** | |
| Greater Excelsior Springs area (including Excelsior Springs, Mosby, Prathersville, Excelsior Estates, Homestead, Crystal Lakes, and Woods Heights) | 12,769 |
| **5,000 to 10,000** | |
| Cameron | 8,312 |
| Kearney | 5,472 |
| **1,000 to 5,000** | |
| Lawson | 2,336 |
| Lathrop | 2,092 |
| Maysville | 1,212 |

Source: U.S. Census Bureau, 2000c

The town of Cameron in northeast Clinton County is the second most populated community in the study area. Cameron experienced a tremendous growth rate between 1990 and 2000 of over 70 percent, from 4,831 people in 1990 to 8,312 in 2000, according to the U.S. Census (U.S. Census Bureau, 2000c). This population increase was due in large part to prison construction (the city population includes inmates). The medium-security Western Missouri Correctional Center and maximum- security Crossroads Correctional Center are located in Cameron. Cameron was founded in the 1830's and soon became an important railroad town with the construction of the Hannibal & St. Joseph Railroad. A second rail line, the Chicago, Rock Island and Pacific, extended a line to Cameron in the 1870's. Industries such as concrete, insulation and wood gun stocks have all been an important part of the local economy to Cameron (City of Cameron, 2005).

The town of Kearney, located in Clay County, grew approximately 205 percent between 1990 (1,790 people) and 2000 (U.S. Census Bureau, 2000c). Kearney began in the 1850's as a rural farming community. Today, Kearney includes modern residential and commercial developments, while maintaining a feel for its rural past.

Lathrop is located in the west-central portion of the study area in Clinton County. In World War One, Lathrop was the site of the largest pack mule production farm in the world. It is the home of the Clinton County Fairgrounds. Lawson is located north of Excelsior Springs in Clay and Ray counties. Maysville is located in the northwestern portion of the study area, just south of the Fairport Substation, and is the county seat of DeKalb County. Each of these communities grew between 1990 and 2000 (U.S. Census Bureau, 2000c).

Other communities within the study area, including Weatherby, Winston, Altamont, Amity, Camden, Turney, Kidder, Osborn, Elmira, Kingston, Holt, Polo, Rayville, Missouri City, Orrick and Sibley, had 2000 populations less than 1,000 people. About an equal number of these smaller towns stayed the same or declined in population as those that increased between 1990 and 2000 (U.S. Census Bureau, 2000c).

**Employment Statistics:** Employment data for the counties comprising the study area is in Table 7-15. Like most of the other sections described, the primary trade employed by residents in this study area is educational, health, and social services, followed by manufacturing and retail trade. In all except Clay and Jackson counties, which consist largely of the greater metropolitan Kansas City area, the agricultural trade was practiced more than the average for Missouri, again reflecting the overall agricultural nature of the study area.

**Recreational Facilities:** Recreational opportunities may be found in the many parks and conservation areas found throughout the study area. Watkins Mill State Park is located in Clay County near the town of Lawson. The park features a restored 1870’s woolen mill, which is a National Historic Landmark. The park has public camping facilities, a fishing lake and a 3.75-mile paved bicycle path. Wallace State Park is located near Cameron, in Caldwell County. The 500-acre park offers such recreational opportunities as hiking, fishing and public camping.

## Table 7-15 Percent Employment by Industry for Fairport to Orrick / Missouri City / Eckles Road Counties

| Industry | Missouri | DeKalb | Daviess | Clinton | Caldwell | Clay | Ray | Jackson |
|---|---|---|---|---|---|---|---|---|
| Agriculture, forestry, fishing and hunting, and mining | 2.2 | 7.0 | 12.3 | 3.4 | 7.8 | 0.6 | 4.0 | 0.3 |
| Construction | 6.9 | 8.7 | 9.5 | 9.6 | 10.0 | 6.2 | 8.3 | 6.6 |
| Manufacturing | 14.8 | 12.4 | 12.1 | 13.2 | 15.1 | 12.0 | 19.4 | 11.1 |
| Wholesale trade | 3.7 | 2.6 | 2.7 | 3.3 | 3.2 | 5.5 | 4.2 | 3.8 |
| Retail trade | 11.9 | 9.9 | 11.8 | 12.4 | 12.1 | 11.9 | 11.4 | 11.3 |
| Transportation and warehousing, and utilities | 5.7 | 7.4 | 6.0 | 8.6 | 6.0 | 8.0 | 7.5 | 5.4 |
| Information | 3.0 | 2.1 | 2.0 | 1.7 | 2.0 | 3.9 | 2.3 | 5.3 |
| Finance, insurance, real estate, and rental and leasing | 6.7 | 6.3 | 4.5 | 5.4 | 6.0 | 8.8 | 5.8 | 8.8 |
| Professional, scientific, management, administrative, and waste management services | 7.5 | 3.4 | 3.0 | 4.6 | 2.6 | 9.6 | 4.5 | 9.6 |
| Educational, health and social services | 20.4 | 18.5 | 18.1 | 19.6 | 17.9 | 16.0 | 17.4 | 18.6 |
| Arts, entertainment, recreation, accommodation and food services | 7.8 | 6.4 | 5.1 | 7.5 | 4.4 | 8.2 | 6.9 | 8.5 |
| Other services (except public administration) | 5.0 | 5.8 | 4.3 | 4.9 | 5.1 | 4.6 | 4.8 | 5.5 |
| Public administration | 4.6 | 9.5 | 8.4 | 5.7 | 7.8 | 4.5 | 3.4 | 5.3 |

Source: U.S. Census Bureau, 2000b

In 1994, following extensive flooding of the Missouri River in the summer of 1993, the USFWS established the Big Muddy NWR. This wildlife area was created to restore portions of the Missouri River floodplain to its pre-settlement condition. Since its establishment, the Big Muddy NWR has grown to include eight units along the Missouri River from Kansas City to St. Louis. The portion of the Big Muddy NWR in the Fairport to Orrick/Missouri City/Eckles Road study area is located on the north bank of the Missouri River across from Sibley. Recreational uses of this area include fishing, hunting, hiking and wildlife watching (U.S. Fish and Wildlife Service, 2005c).

The Fort Osage National Historic Site is located across the Missouri River from the Big Muddy NWR in the town of Sibley in Jackson County. Fort Osage is a reconstructed 1800's military fort. The fort was originally established in 1808 to help preserve peace in the Louisiana Purchase. Fort Osage served as a trading post for settlers and local Osage Indians until it was abandoned in the late 1920's. Annual events are held at Fort Osage to offer visitors a chance to see what life was like for a U.S. soldier during this time period (Fort Osage, 2005).

Other recreational opportunities in the study area include several MDC-managed areas with facilities for fishing, hunting and wildlife watching, and local community parks, such as the Mouth of the Little Blue County Park. The larger conservation areas within the study area include Crooked River, Pony Express Lake, and Cooley Lake CA's and Cameron City Lakes. The Crooked River CA is a 1,420-acre area in Ray County near the eastern border of the study area. The area contains an oxbow lake, but offers no hiking trails, a few primitive camping sites, and some hunting and fishing opportunities. Much of the area is managed for doves. Pony Express Lake is one of the larger lakes in the region at 240 acres with a maximum depth of 29 feet. The lake sits on the Pony Express CA which covers over 3,000 acres. The area contains a few short hiking trails, and also offers camping, picnicking, boating, hunting, and fishing opportunities. Cooley Lake CA is 1,348 acres consisting of an oxbow lake and associated wetlands. The Cooley Lake CA is located in Clay County just north of the Missouri River. The area offers viewings from a deck or tower of migrating waterfowl and bald eagles, as well as some hunting. The Cameron City Lakes consist of three reservoirs, all located in DeKalb County north of Cameron. Cameron Lake #3 is the largest at 96 acres. It provides the drinking water for the city of Cameron. Other than fishing and archery hunting, there are no recreational opportunities in the 186 acres of forestland around the lake. Just west of the Cameron City Lakes is the Cameron Grindstone Reservoir, a 180-acre lake offering fishing and archery hunting as well. The Bolinger CA is an 80-acre area that has been donated to the MDC (Missouri Department of Conservation, 2005a).

**Transportation and Utilities:** Numerous roads, railroads, airports, and utilities are located within the study area (Figure 7-7).

- Roads - Major roads in the study area include Interstate 35, which crosses through the center of the study area from north to south; U.S. Highway 69, which also runs north to south through the study area, crossing through the communities of Cameron and Excelsior Springs; and U.S. Highway 36, which crosses the northern part of the study area from east to west, also crossing through Cameron. Numerous other state highways and local roads cross the study area including Missouri Highway 210, which crosses the south part of the study area from Liberty to Orrick.
- Railroads - Several rail lines owned and operated by BNSF; Union Pacific; Norfolk Southern; and Iowa, Chicago, and Eastern cross the study area. The majority of these are located in the southern portion of the study area near the Missouri River (DeLorme, 1998).
- Airports - There are numerous airports in the study area ranging from public airports with paved runways to small private airfields with grass runways. The Clay County Regional Airport located in Mosby is the largest public airport in the study area. The Cameron Memorial Airport and the Excelsior Springs Memorial Airport are both public airports with paved runway surfaces. Other airfields in the study area include the Cayton Pony Express Airport in Maysfield, the Mays Homestead Airport in Polo, the Northwood Airport and Block Air Village Airport in Holt, and the Peterson Farm Airport in Kearney. All of these are private airfields with turf or dirt runway surfaces. Restricted-use areas for each airport, as defined by FAA Part 17 Regulations, will be determined to ensure the lines are not located where they would obstruct the normal operations of the airports or airstrips (AirNav LLC, 2005).
- Transmission Lines - Electrical transmission lines operated by NW, KCPL, and Aquila are located throughout the study area. A 161 kV line extends southward the entire length of the study area from the Fairport Substation to the Missouri City Substation. 69 kV lines also run from the Missouri City Substation, north to southeastern DeKalb County and eastward, from Missouri City to Orrick and beyond, east out of Kearney, from the Fairport Substation southwest through DeKalb and Clinton counties and from Fairport to the southeast a few miles. In the southern portion of the study area, a variety of mostly 161 kV lines head into and out of the

Missouri City Plant and the Sibley Plant and associated substations, and the Eckles Road Substation. A 345 kV line runs south of Sibley into Kansas City.

#### 7.2.2.2.2 Natural Resources

Photographs representative of the typical vegetation and terrain of the area are included at the end of this section for reference.

**Physiography and Topography:** The Fairport to Orrick/Missouri City/Eckles Road study area is located in the Central Dissected Till Plains physiographic region. Topography varies from nearly level in floodplains to moderately steep in the uplands. Numerous streams and creeks are found throughout the study area. Drainage is generally toward the south to the Missouri River. The study area is divided into two land resource areas. The northern part of the area is in the Iowa and Missouri Heavy Till Plain. This resource area is defined by slopes that are mostly rolling to hilly with broad ridge tops that are nearly level. The southern part of the study area is within the Iowa and Missouri Deep Loess Hills land resource area. The topography ranges from nearly flat along the Missouri River floodplain to steep high ridge tops outside the floodplain (U.S. Department of Agriculture, 2005).

**Vegetation:** Vegetation and wildlife in the study area are similar to that described previously for the Forbes to Fairport study area. Much of the study area that once supported native prairie species has long been cleared and cultivated for farming. Steep hillsides support hardwood species such as oaks and hickories and deep valleys and creek banks support cottonwood, sycamore, elm and other riparian species.

Almost all of the land in the Fairport to Orrick/Missouri City/Eckles Road study area is considered prime farmland, prime farmland if drained or not flooded, or farmland of statewide importance. Typically, impacts from transmission lines to prime farmland are minimal. All of the agricultural land crossed by the line, with the exception of where the pole is placed and where possible guy wires are anchored, can remain in agricultural production.

**Wildlife:** Common wildlife species include white-tailed deer, raccoon, coyote, red fox cottontail rabbit and gray and fox squirrels. The Missouri River valley in the south part of the study area supports a variety of resident and migratory waterfowl as well as numerous other bird species.

**Threatened and Endangered Species:** Several state and federal threatened and endangered species are listed in the counties within the Fairport to Orrick/Missouri City/Eckles Road study area. The federally-endangered pallid sturgeon has been known to occur in portions of the Missouri River near Clay, Jackson, and Ray Counties. The federally-threatened bald eagle is also known to frequent the forested area along the Missouri River in these counties during the winter months. Table 7-16 provides a complete list of the threatened and endangered species found in the study area counties. Some of these species may not occur in the actual study area.

### Table 7-16 Threatened and Endangered Species – Orrick / Missouri City / Eckles Road by County

| Common Name | Scientific Name | State Status | Fed. Status | Counties | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | DeKalb | Daviess | Clinton | Caldwell | Clay | Ray | Jackson |
| Northern Harrier | *Circus cyaneus* | E | - | ✓ | | | | ✓ | | |
| Barn Owl | *Tyto alba* | E | - | ✓ | | | | | | ✓ |
| Indiana Bat | *Myotis sodalis* | E | E | ✓ | ✓ | ✓ | | ✓ | ✓ | |
| Topeka Shiner | *Notropis topeka* | E | E | | ✓ | | | | | |
| Pallid Sturgeon | *Scaphirhynchus albus* | E | E | | | | | ✓ | ✓ | ✓ |
| Plains Spotted Skunk | *Spilogale putorius* | E | - | | | | | ✓ | | |
| Peregrine Falcon | *Falco peregrinus* | E | - | | | | | | | ✓ |
| Bald Eagle | *Haliaeetus leucocephalus* | T | T | | | ✓ | ✓ | ✓ | ✓ | ✓ |

Source: Missouri Department of Conservation, 2005b. United States Fish and Wildlife Service, 2005b
E – Endangered; T – Threatened

**Cultural Resources:** In general, the study area has the potential to contain an abundance of cultural and archaeological resources, mostly along the Missouri River floodplain and bluffs. See Section 7.2.1.1.3, Norborne to Thomas Hill, for a description of the potential cultural resources in the study area.

## 7.3 MACRO-CORRIDORS

Prior to identifying alternative corridors for each proposed plant site and interconnection, several steps were undertaken, which were discussed earlier in this section:

- Needed transmission interconnections were determined
- Study areas for each proposed power plant site and interconnection were identified
- Locations of natural and human resources were identified and mapped
- Natural and human resources classified as macro-level constraints or opportunities for co-location with other utilities within each study area

Using the above information, two to three two-mile-wide corridors were established for each study area and interconnection which minimize potential environmental impacts to existing natural and human resources, and make use of potential opportunity areas, where practicable. Ultimately, more specific route alignments will be identified within these macro-corridors using the data collected for the macro-corridor development as well as other more detailed information.

### 7.3.1 NORBORNE SITE

To facilitate the identification of feasible corridors for transmission lines to interconnect with the proposed Norborne Site, the study area was subdivided into two sections: Norborne to Thomas Hill and Norborne to Sedalia / Mt. Hulda, as described previously. Following is a description of the macro-corridors identified for each sub-area and the rationale for the development of these particular corridors.

#### 7.3.1.1 Norborne to Thomas Hill Macro-Corridors

Macro-corridors identified between the proposed Norborne Plant switchyard site and the Thomas Hill Plant substation ranged from 61.8 to 69.4 miles in length. The primary considerations in developing the macro-corridors are listed below:

- The presence of two existing transmission lines, one extending west to east, north of the Norborne site and south of the Thomas Hill Plant, generally parallel to U.S. Highway 24, and the other running northeast from this line to the Thomas Hill Plant
- Communities of Carrolton, Brunswick, Keytesville, and Salisbury along U.S. Highway 24;
- Swan Lake NWR and Bunch Hollow CA
- Crossings of the Missouri River, Grand River, and Chariton River

Three macro-corridors were identified for the Norborne to Thomas Hill section of the project (Figure 7-8). In general, opportunities to follow existing transmission lines in the area were utilized as much as possible. One macro-corridor follows existing lines almost all the way from Norborne to Thomas Hill. The other corridors make use of existing lines that travel in the same general direction for some of their lengths. The intent for these corridors would be to parallel the existing lines as much as possible, except where residences or other constraints are present adjacent to the existing line. The two-mile-wide corridors allow for ample area should a deviation from the alignment of the existing lines be necessary.

While most of the towns in the study area are relatively small, an effort was made to avoid encroaching into their municipal boundaries. Most of the towns that fall within an identified two-mile wide corridor occur along U.S. Highway 24, where the corridor parallels an existing transmission line. Corridors that did not completely avoid towns were modified to exclude the municipal boundaries so that no specific routes would be proposed within the town boundaries. Similarly, conservation areas that were not completely avoided by the two-mile-wide corridors were excluded from the corridor boundaries, resulting in corridor constriction points near these resources. These points are most evident at the Yellow Creek CA and Swan Lake NWR, the Little Compton Lake CA, Thomas Hill Reservoir, and the Sterling Price CA. The Bunch Hollow CA was completely avoided during the development of macro-corridors.

Typically, transmission lines are not considered compatible uses within conservation areas, parks, and refuges managed for resource conservation. Routing the transmission line through these lands could create potentially greater adverse environmental impacts, additional permitting requirements, and project delays.

The Missouri River presented an obstacle to developing corridors that headed due east out of Norborne. Approximately 28 miles east of the Norborne site, the Missouri River, which until this point was heading generally east, turns to the north for several miles before returning to an easterly and then eventually southerly flow. Corridors heading due east out of the Norborne site would cross the Missouri River a minimum of two times, crossing into Saline County. A crossing of the Missouri River presents several concerns, including the potential

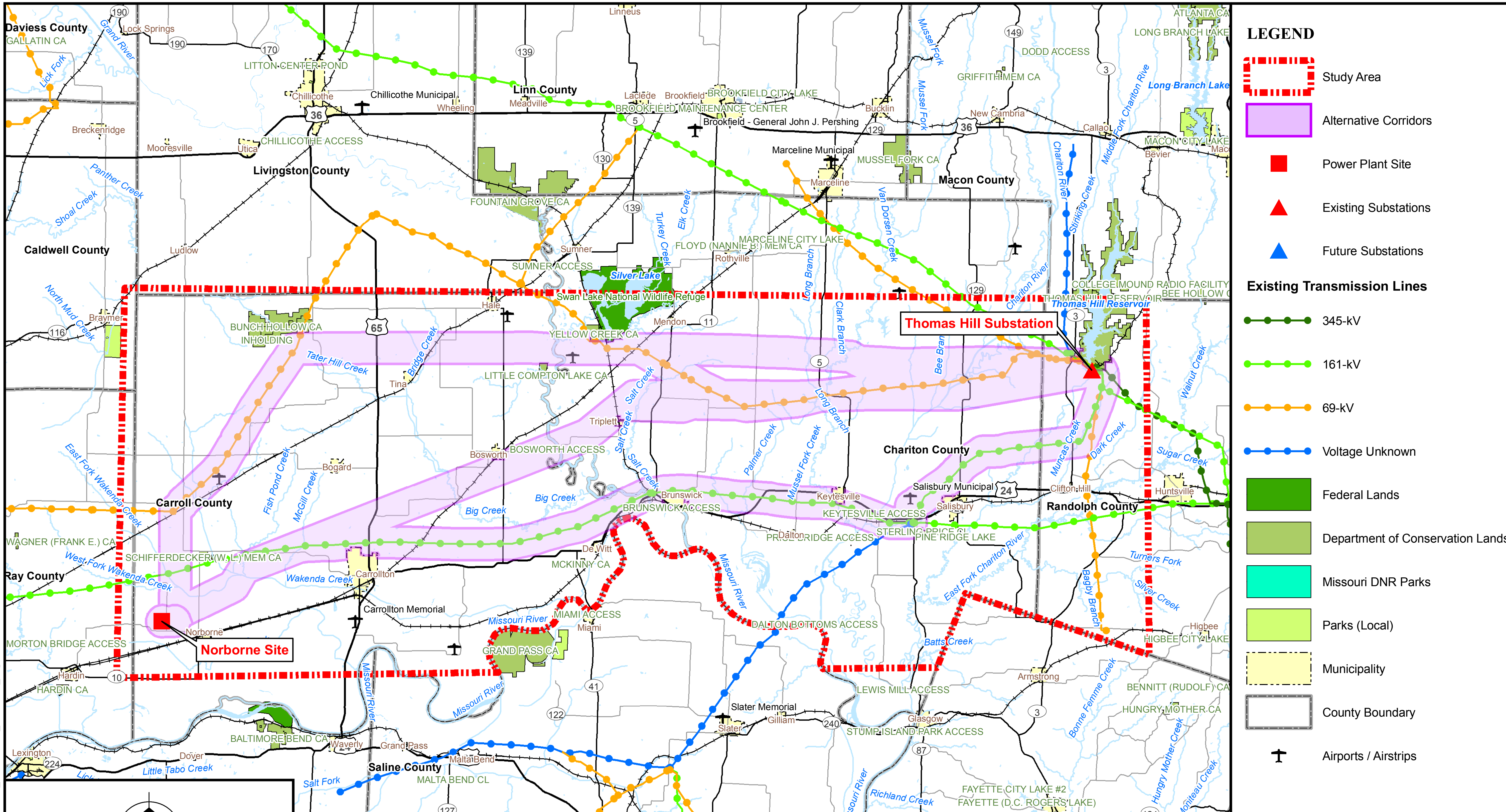


**Figure 7-8**
Associated Electric Cooperative, Inc.
660 MW Coal-Based Power Plant
Norborne to Thomas Hill
Alternative Macro-Corridors

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Disclaimer: Existing transmission lines are shown to the extent they could be verified within the project study areas using aerial photography, topographic maps, and NW and Central Cooperative's system planning maps. They are not necessarily complete or represent all existing transmission lines in the area.

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for impacts to threatened and endangered species found along the river, such as the bald eagle, a likely increase in the occurrence of Native American archeological artifacts along the river and the associated floodplain, and impacts to wetlands, the floodplain, and visual quality. The availability of other corridor alternatives for this section that would not cross the Missouri River made such crossings unnecessary. The study area was adjusted to indicate the avoidance of these river crossings by excluding Saline County.

Unlike the Missouri River, where alternatives could be identified that would avoid a crossing, the Grand River could not be avoided by any corridor developed for this section. The presence of numerous wetlands and accessibility along the Grand River were considerations in the development of corridors. Many locations along the river would either be inaccessible or involve construction within wetlands, both of which would increase the adverse environmental impacts, complexity, and cost of the project. The most accessible crossings of the Grand River within the study area are at Highway M or U.S. Highway 24, where corridors were developed. Accessibility was not as critical for the crossing of the Chariton River, but locations with few wetlands were identified for the proposed macro-corridors. The BNSF railroad is another potential corridor opportunity that was investigated, but the railroad is less accessible than roads, and it crosses the Grand River where there is a significantly large wetland complex. The railroad also travels through the towns of Bosworth and Carrolton.

One of the three corridors (the south corridor) extends along the existing 161 kV transmission line that is located north of the Norborne site, heading east (Figure 7-8). The existing line is near U.S. Highway 24 for much of its length in the study area, and as a result, approaches the municipal boundaries of several towns, including Carrolton, Brunswick, and Keytesville. West of the town of Salisbury, the corridor turns to follow an existing 161 kV transmission line that heads directly to the Thomas Hill Plant. This line is in the vicinity of the town of Salisbury. The macro-corridor was modified from the normal two-mile width where it crosses the boundaries of these towns to restrict the location of routes to be identified within the corridors.

A second macro-corridor (the central corridor) would generally angle northeast across the study area to the point where State Highway M crosses the Grand River, then continue almost due east to the Thomas Hill Plant. A portion of this corridor includes the option of following an existing 69 kV transmission line about 16 miles toward the Thomas Hill Plant. A connecting corridor was developed that would follow the same 69 kV line between the northernmost corridor (see below) and this central corridor. The Chariton River could be crossed at the same location as the existing line to minimize cumulative impacts to the river.

A third corridor (the northern corridor) begins by heading north to an existing 69 kV transmission line running northeast, which the proposed corridor would follow for approximately 13 miles. Near the Bunch Hollow CA, the proposed corridor would turn east, heading nearly due east all the way to the Thomas Hill Plant. The corridor would cross the Grand River just south of the Swan Lake NWR and Yellow Creek CA, where there are significant wetlands. More defined routes would not be identified within the Refuge or conservation area boundaries. The corridor crosses the Chariton River where there are no existing roads or transmission lines.

#### 7.3.1.2 Norborne to Sedalia / Mt. Hulda Macro-Corridors

Corridor lengths for this section of the project ranged between 76.2 and 90.4 miles. These widely-ranging lengths were due in large part to the presence of numerous constraints in the study area. There were several considerations involved in defining the corridor alternatives for the Norborne to Sedalia / Mt. Hulda section of the project. These considerations include:

- The need to connect to the Sedalia Substation before continuing to the Mt. Hulda Substation
- Crossing of the Missouri River
- Big Muddy NWR
- Cities of Waverly, Higginsville, Marshall, Warrensburg, Knob Noster, and Sedalia, and other smaller communities in the area
- Whiteman AFB
- Knob Noster State Park
- Scattered, variably-sized conservation areas, including Perry CA, Blind Pony Lake CA, Baltimore Bend CA, and Marshall Junction CA

The proposed line needs to connect to the Sedalia Substation before continuing southward to the proposed Mt. Hulda Substation. As a result, three corridors were identified that connect Norborne to the Sedalia Substation, and two primary corridors were identified that connect the Sedalia Substation to the proposed Mt. Hulda Substation (Figure 7-9). This constraint limited the variability of alternatives west of Warrensburg and east of Sedalia because such corridors would add significant, unnecessary length to the proposed project, thereby increasing environmental and social impacts, and project cost.

Once the interconnections were established, macro-corridors were developed which avoided known constraints and which made use of opportunities to co-locate the line with existing linear facilities. No existing transmission facilities extend the entire length from the proposed Norborne site to the Sedalia Substation or from Sedalia to the Mt. Hulda Substation. Portions of four corridors developed between Norborne, Sedalia and Mt. Hulda parallel existing corridors when practicable. Most of these are 69 kV or 161 kV lines owned by various utilities. When developing more specific routes, the intent would be to parallel the existing lines as much as possible, using the flexibility of the two-mile-wide corridor where there are unavoidable constraints along the existing lines.

For this section of the project, a crossing of the Missouri River was unavoidable because the Norborne site is located north of the river and the Sedalia and Mt. Hulda Substations are located to the south. The only existing crossing of the Missouri River in the vicinity is at the Highway 65 bridge north of Waverly. An alternative parallel to the bridge was not identified because the line would have to extend into the city limits of Waverly, resulting in significantly greater social impacts than other alternative crossings. Because a new crossing was necessary, locations were identified that could minimize impacts to wetlands, according to the information available from the USFWS, and where there was relatively little steep terrain, which would make the proposed line difficult to access and construct. Avoidance of the Big Muddy NWR and the contiguous Baltimore Bend CA further limited the identification of corridors for this section. Regardless of the crossing identified, there could be floodplain, threatened and endangered species, archeological, and visual impacts associated with the river crossing. The transmission line would be designed to span the river, with the lines strung between two poles located on opposite sides of the river bank. No poles

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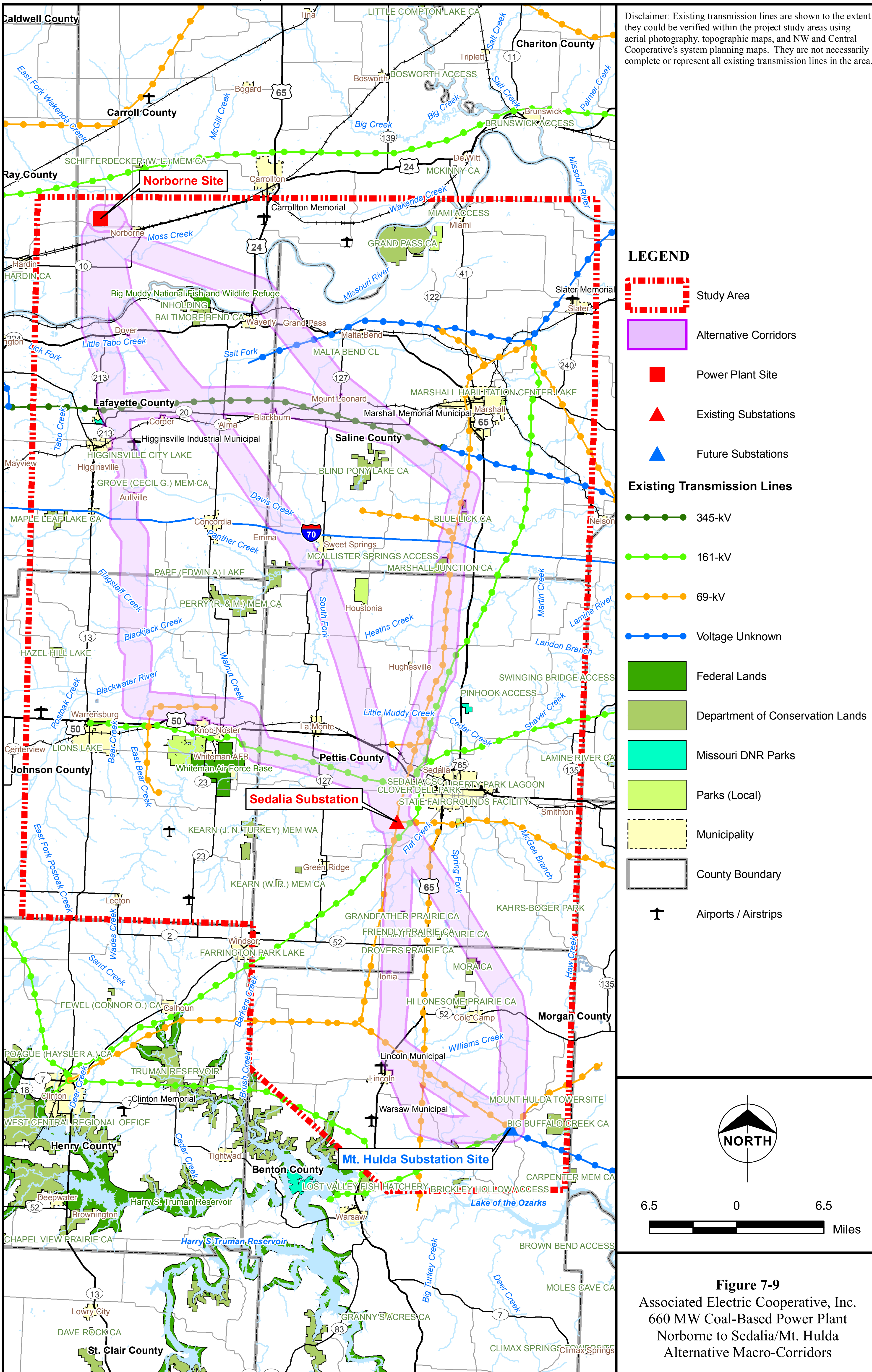


**Figure 7-9**
Associated Electric Cooperative, Inc.
660 MW Coal-Based Power Plant
Norborne to Sedalia/Mt. Hulda
Alternative Macro-Corridors

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would be placed within the river. In some cases, it may be necessary to install poles within the floodplain along the river.

The cities of Higginsville, Marshall, Warrensburg, Knob Noster, and Sedalia presented some of the most obvious constraints to the development of corridors between the Norborne site and the Sedalia Substation. The Knob Noster area was particularly restrictive because of Whiteman AFB, including the associated flight restrictions surrounding the base, and Knob Noster State Park, located west of Whiteman AFB and south of the town of Knob Noster. The greater Knob Noster area and Sedalia are located almost due east of Warrensburg along U.S. Highway 50. Approximately 11.5 miles separate Whiteman AFB and Sedalia, while only four miles separate Warrensburg and Knob Noster State Park. A two-mile-wide corridor could be identified between Warrensburg and the State Park, but this alternative would have to head south of the AFB before turning east to reach the Sedalia Substation. Such a corridor would also have to split the distance between the southern boundary of Whiteman AFB and Kearn Memorial Wildlife Area (WA), between which is a distance of about two miles. In contrast, there is ample space north of Knob Noster for a new corridor, and there is an existing 161 kV transmission line that could be followed for about 9.5 miles into the Sedalia Substation. This corridor was determined to be preferable to an alternative that would weave between Warrensburg, Knob Noster State Park, Whiteman AFB, and the Kearn WA.

Similarly, because Higginsville and Warrensburg are almost directly south of the Norborne site, a southerly corridor had to angle somewhat east to avoid these towns. The Higginsville Industrial Municipal Airport and Higginsville City Lake, located at the eastern edge of the macro-corridor, will further constrain the identification of more specific routes within the westernmost macro-corridor. Development has occurred beyond the official city limits for many of the towns in the study area, effectively extending the area to be avoided by the macro-corridors. For instance, there is considerable commercial development south of Sedalia along Highway 65, making alternatives leaving the Sedalia Substation directly east undesirable.

Another set of constraints is formed by a line beginning at Warrensburg at the southwest end; continuing to the northeast to Perry Memorial CA, the towns of Sweet Springs, Concordia, and Emma, and Blind Pony Lake CA; and ending at Marshall. In addition, there are numerous riparian wetlands along the Blackwater River, which connects Warrensburg, Perry CA, Sweet Springs and then Marshall Junction CA to the east. Corridors were developed that entirely avoided most of these constraints. Where some of these features could not be avoided by the two-mile width or more, the macro-corridors were modified to exclude their boundaries to encourage the development of routes outside the CA or city limits. These exclusion areas are most evident around the towns of Norborne, Sweet Springs, Higginsville, Knob Noster, Aullville, Ionia, and Lincoln and the Marshall Junction, Blue Lick, Mora, and Grandfather Prairie CAs.

In contrast, there are relatively few major constraints between Sedalia and Mt. Hulda. The primary consideration for corridors developed between Sedalia and Mt. Hulda was length. Corridors that extended further west than the Sedalia Substation or further east than the proposed site for the Mt. Hulda Substation would result in added length, which was unnecessary given the availability of shorter, more direct alternatives. With the exception of a few conservation areas, such as Paint Brush Prairie, Mora, and Hi Lonesome Prairie, and the towns of Cole Camp and Lincoln, which eliminated a direct corridor alternative between the Sedalia Substation and the proposed Mt. Hulda Substation, most constraints in the southern half of the study area are relatively small on a macro-corridor level. They will feature more prominently during the next phase of more specific routing.

Another consideration in the development of corridors for this section was the Katy Trail. The Sedalia Substation is located only about a tenth of a mile north of the Katy Trail. While one crossing of the trail is unavoidable to reach the Mt. Hulda Substation, it was determined that it would be best crossed near the existing substation, which is also close to Sedalia, where the views from the trail are not likely to be as pristine as views from other sections of the trail with less development.

A number of strip mines and gravel quarries are scattered throughout the study area between Norborne and Mt. Hulda. Most of these operations are not large enough to be considered at the macro-corridor level, but will need to be addressed during the identification of more defined routes. Because of the large machinery that is used to excavate quarries and landfills, these areas are typically considered constraints to the location of a transmission line, due to height restrictions near the line. In addition, land adjacent to the quarries may be acquired and/or excavated in the future, making the location of the line along the excavated perimeters risky. On the other hand, because of the visual intrusion already present, locating the transmission line near these sites, while avoiding the potentially excavated areas, could be considered an opportunity for co-location.

Essentially three macro-corridors were identified between the Norborne site and the Sedalia Substation, with a connector running west to east between them. Two primary macro-corridors were identified between the Sedalia Substation and the proposed Mt. Hulda Substation (Figure 7-9).

One of the corridors from Norborne to Sedalia, the eastern alternative, would head generally southeast out of the proposed Norborne site, cross the Missouri River east of Waverly, and continue southeast to an existing 69 kV transmission line. The corridor would then turn south, following the existing line toward Sedalia to reach the Sedalia Substation.

The other two corridors (western and central alternatives) would extend south out of the Norborne site. The western corridor would extend southward approximately 36 miles, avoiding Higginsville, and then turn east before reaching Warrensburg. The corridor would turn southeast, north of Knob Noster, to meet and follow an existing 161 kV transmission line for several miles. About 3.5 miles north of the Sedalia Substation, the corridor would join the central corridor (see below) and head south/southeast into the substation.

After heading south out of the Norborne site for about six miles, the central corridor would angle to the southeast on a nearly direct alignment between Norborne and the Sedalia Substation, skirting the town of Sweet Springs and a tract of the Perry Memorial CA.

A connector corridor was identified running west to east between the western, central and eastern macro-corridors, along an existing transmission line approximately 14 miles south of the Norborne site. This corridor would enable the use of any of the initial corridors leaving the Norborne site in combination with any of the more southern corridors developed to the Sedalia Substation.

From Sedalia to the proposed Mt. Hulda Substation, there are two basic corridors. One heads due south from the Sedalia Substation, then either meets and follows an existing 69 kV transmission line that heads southeast toward the existing Mt. Hulda Substation, or continues southeast by the town of Lincoln, and then turns east to the proposed substation site. More defined routes within the corridors will eventually be identified which avoid the town of Ionia, and the Drover's Prairie, Friendly Prairie, and Grandfather Prairie CA's, which were located within the two-mile-wide corridor. The eastern alternative would head southeast out of the Sedalia Substation for approximately 16 miles, then turn south about nine miles north of the Mt. Hulda Substation site. The Mora CA and Spring Fork Lake are the only major constraints which may constrict the location of a route within this identified macro-corridor.

### 7.3.2 FORBES SITE

To facilitate the identification of feasible corridors for transmission lines to interconnect with the proposed Forbes Site, the study area was subdivided into two sections: Forbes to Fairport and Fairport to Orrick / Missouri City / Eckles Road. Following is a description of the macro-corridors identified for each sub-area and the rationale for the development of these particular corridors.

#### 7.3.2.1 Forbes to Fairport Macro-Corridors

The macro-corridors identified between Forbes and Fairport ranged from 57.6 to 68.4 miles in length (Figure 7-10). The primary considerations which featured prominently in the development of the corridors include:

- The Missouri River, and crossings of the Nodaway, Platte and One Hundred and Two rivers
- Big Lake State Park and surrounding community
- Communities of Mound City, Forest City, Oregon, Savannah, Rosendale, Belckow, and King City

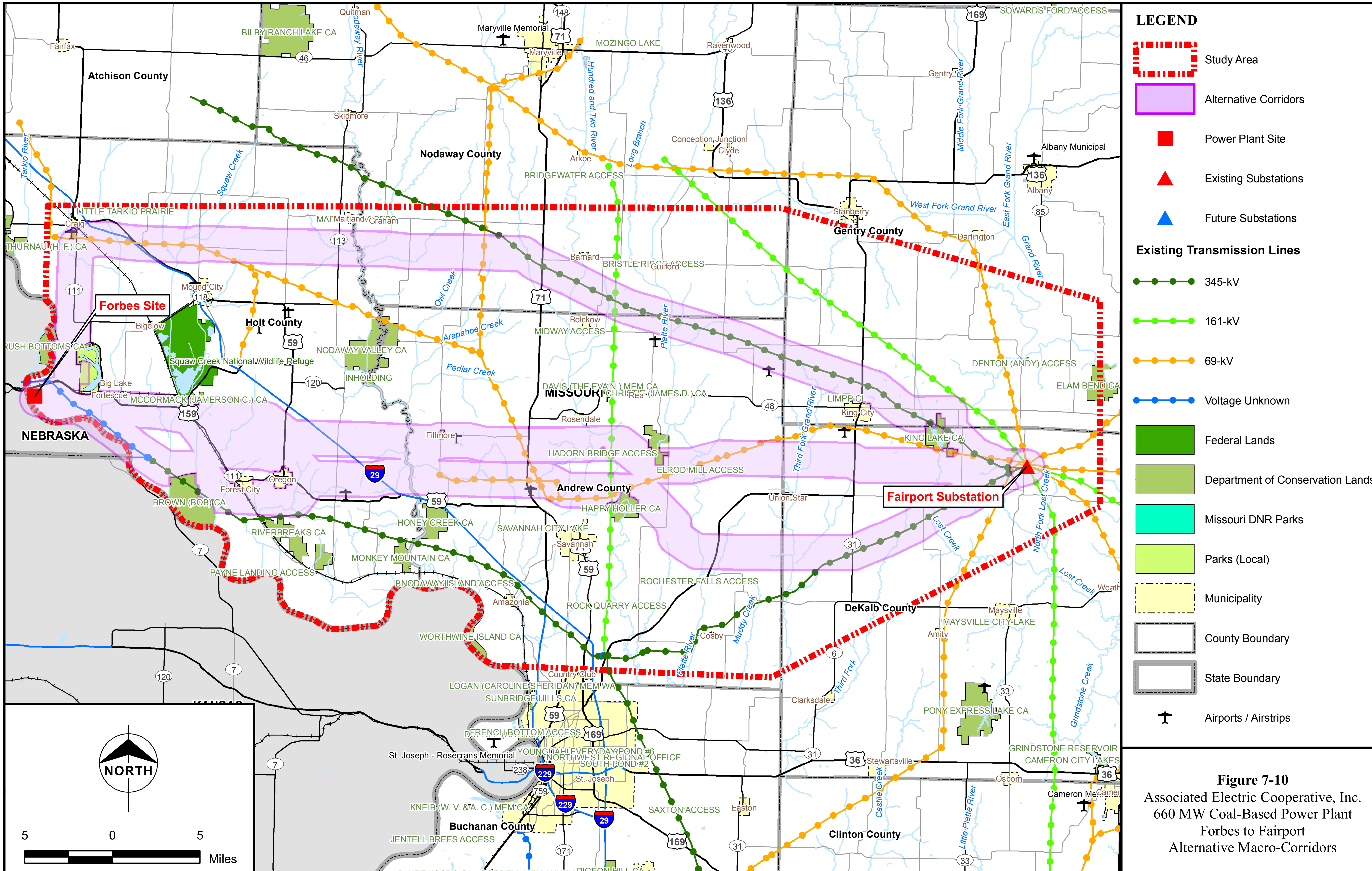


**Figure 7-10**
Associated Electric Cooperative, Inc.
660 MW Coal-Based Power Plant
Forbes to Fairport
Alternative Macro-Corridors

Disclaimer: Existing transmission lines are shown to the extent they could be verified within the project study areas using aerial photography, topographic maps, and NW and Central Cooperative's system planning maps. They are not necessarily complete or represent all existing transmission lines in the area.

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- Numerous, scattered conservation areas, including Rush Bottom, Brown, McCormack, Riverbreaks, Nodaway Valley, Honey Creek, Monkey Mountain, Happy Holler, and King Lake CAs

**Constraint Considerations Near The Forbes Site:** The fact that the Forbes site is located immediately adjacent to and is partly surrounded by the Missouri River is somewhat limiting for the development of macro-corridors out of the Forbes site. Missouri River crossings were considered unacceptable for this section of the project. Two crossings would be required, which would unnecessarily compound the environmental impacts of the project. There would also be additional oversight into the approval process for the project from other states (Nebraska and/or Kansas).

In addition, the presence of center-pivot irrigation systems throughout the floodplain in this area will further limit the location of routes within the identified macro-corridors. Two-mile-wide macro-corridors could not be identified that completely avoided center-pivot irrigation systems. An existing transmission line that angles southeast near the Forbes site could provide an opportunity for minimizing impacts to irrigation in the vicinity, but the line runs through the Brown CA and then quickly heads too far south to be useful for much of the length of the proposed project.

Big Lake State Park, Squaw Creek NWR, and Rush Bottoms CA further limit corridor alternatives near the Forbes site. The intent was to avoid any transmission line routes through these state and federal lands.

**Constraint Considerations to the South:** Feasible corridors heading south and east from the Forbes site are restricted by the Missouri River, Brown CA, Riverbreaks CA, Honey Creek CA, Monkey Mountain CA, and the towns of Forest City and Oregon. Alternatives heading southeast from the Forbes site become angular to avoid these features. A distance of approximately four miles separates the Squaw Creek NWR and McCormack CA to the north from the Brown CA and the towns of Forest City and Oregon to the south. All corridors heading south and east out of the Forbes site must be located within this four-mile-wide area, so the macro-corridor was widened to allow for additional flexibility in developing more specific routes in this area.

**Constraint Considerations in the Central Portion of the Study Area:** In the central portion of the study area, a line of constraints is formed by the town of Savannah, two separate tracts of the Happy Holler CA, the Hadorn Bridge Access land, the towns of Rosendale, Rea, and Belckow, and the Davis and Christie Memorial CAs. All of these features, with the exception of Savannah, are bounded by the One Hundred and Two River to the west and the Platte River to the east, both of which run generally north/south. Though there do not appear to be large wetland complexes associated with these rivers according to NWI data, care was taken to identify corridors that would avoid multiple crossings of the rivers where they meander. Attempts were also made to identify corridor crossings of these rivers where there was relatively flat terrain, for ease of accessibility. Where practicable, existing transmission line crossings were incorporated into the macro-corridors to help minimize impacts at the river crossings. Similar considerations were given the Nodaway River crossing.

Terrain and scattered private airstrips may also be considerations during the later development of specific routes within the macro-corridors. The terrain abruptly changes from flat floodplain to rolling hills demarcated by Highway 111 to the south and Interstate 29 to the north. Several private airstrips have also been identified throughout the study area, and more are likely to be revealed as additional information is acquired for routing.

**Opportunities for Co-Location:** Interstate 29 is a prominent feature in the western portion of the study area, but it did not figure prominently in the development of corridors because it angles away from the Forbes and Fairport sites and because there is relatively little development along the Interstate in this area. Crossing locations were not a major concern.

In addition to the existing transmission line near Forbes, several other lines cross portions of the study area and provide opportunities for co-location, at least for a portion of this section. One of these lines, a 345 kV line, enters the study area from the northwest about halfway between Forbes and Fairport. Approximately 31 miles of this existing line are followed by one of the corridors. Portions of three other existing transmission lines that travel generally toward the Fairport Substation are also followed for seven to 12 miles.

Essentially three different corridors were identified from the Forbes site to the Fairport Substation (Figure 7-10). One corridor heads north from the Forbes site, heading between the Rush Bottoms CA and Big Lake State Park, for approximately 10 miles to an existing 69 kV transmission line. The corridor follows this existing line for approximately 7 miles, then continues east after the existing line turns southward. After about 18 miles heading east, the northern corridor meets a 345 kV line, which it follows for about 31 miles to the Fairport Substation. Where the existing line traverses the King Lake CA, the proposed macro-corridor deviates from the existing line to avoid crossing the CA. Otherwise, the intent would be to parallel the existing line as much as possible.

The other two corridors identified for the Forbes to Fairport section initially extend east from the Forbes site. The central corridor, which runs south of the Squaw Creek NWR, continues basically east all the way to the Fairport Substation, with a few southerly jogs to avoid the town of Fillmore and a portion of the Happy Holler CA. Approximately six miles of an existing 69 kV transmission line could be followed by the corridor, but otherwise, the corridor parallels no other existing infrastructure.

The southernmost alternative corridor follows an existing 345 kV transmission line to the southeast for about seven miles, through fields containing center-pivot irrigation systems, and then turns east and south between the Brown and Riverbreaks CAs, and the towns of Forest City and Oregon. The corridor would continue east for about 19 miles, following portions of an existing 69 kV line. Near the Happy Holler CA, the corridor turns southeast and then east, partly to provide geographical diversity from the central corridor (the corridors conjoin between the two separate tracts of the Happy Holler CA), and partly to meet and follow an existing AECI-owned 345 kV line into the Fairport Substation. The corridor follows the existing line for approximately 12 miles.

#### 7.3.2.2 Fairport to Orrick / Missouri City / Eckles Road Macro-Corridors

Corridors for this section were identified between the Fairport Substation and a proposed Orrick Substation, and then from the proposed Orrick Substation site to the existing Missouri City Substation, and from the proposed Orrick Substation site to the existing Eckles Road Substation. The Fairport to Orrick corridors ranged from 58.4 to 66.4 miles in length. The

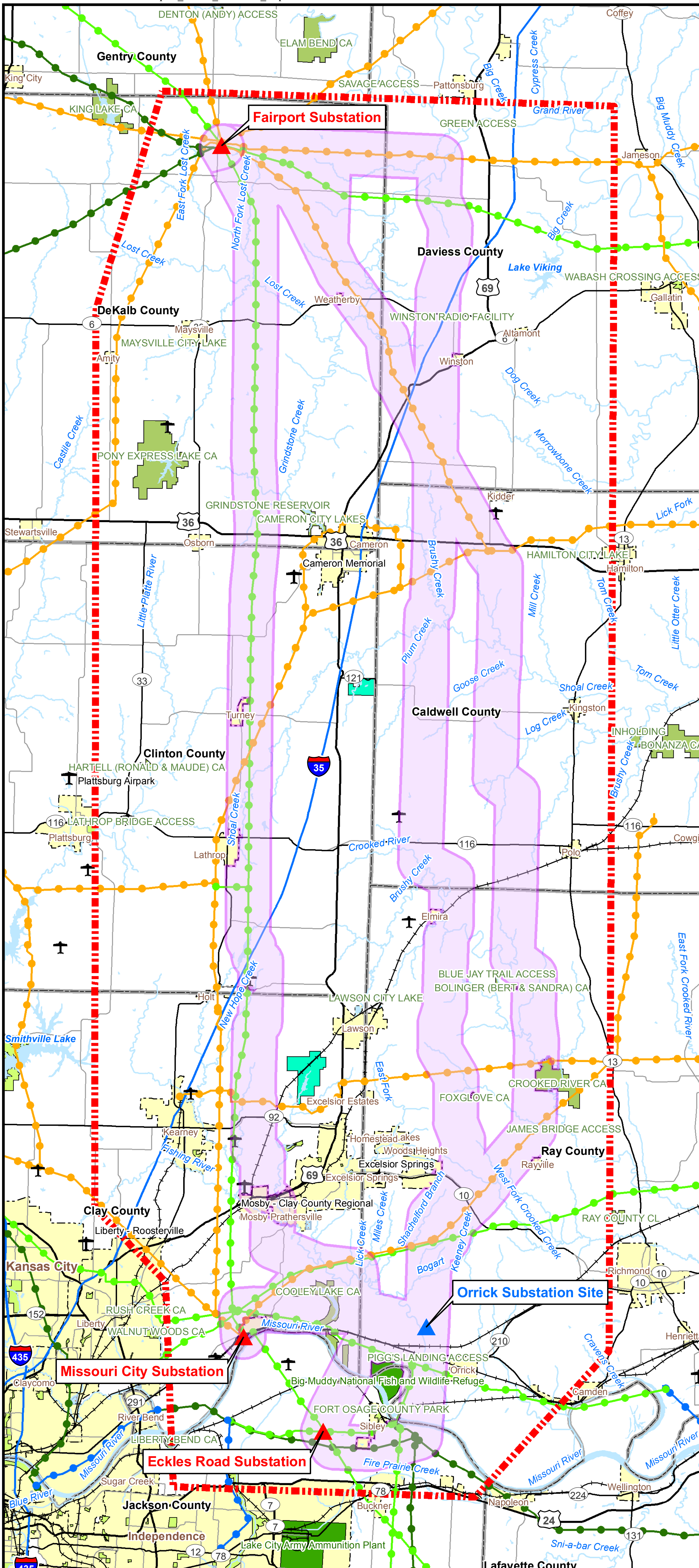
Orrick to Missouri City corridors ranged from 9.6 to 12.4 miles, and the Orrick to Eckles Road alternatives ranged from 7.1 to 9.7 miles in length (Figure 7-11). There were numerous features to be avoided within this section of the project, including:

- Scattered towns and cities throughout the study area, including Cameron, Osborne, Maysville, Lathrop, Lawson, Missouri City, Orrick, and Sibley
- Extensive urban development around Kearney and greater Excelsior Springs (including Mosby, Prathersville, Woods Heights, Crystal Lakes, and Homestead)
- Watkins Mill State Park and Historical Site, and Wallace State Park
- Big Muddy NWR
- Crooked River CA, Cooley Lake CA, Pony Express Lake CA, and Cameron City Lakes
- Numerous private and public airstrips and airports
- Presence of an existing 161 kV transmission line running between the Fairport Substation and Missouri City, and other existing transmission lines heading into and out of the Fairport Substation

**Fairport Substation to Proposed Orrick Substation Site**

While Interstate 35, U.S. Highway 69, and U.S. Highway 36 bisect the study area, they were not elements that featured prominently in the development of macro-corridors. Paralleling these highways was not feasible because none of them extend in the same general direction needed for this project. Their locations relative to Fairport and Orrick necessitate a crossing somewhere along their lengths. Each corridor crosses these highways only once, in relatively undeveloped locations, with the exception of the corridor that follows the existing 161 kV line. Just north of Interstate 35, the existing line crosses through the Arrowhead Lake residential community. The new line, should it parallel this existing line, would also extend through this residential area near Interstate 35.

Many of the features constraining the development of corridors for this section of the project are located in the southern half of the area. The only major constraints located in the northern half are the city of Cameron and its associated Cameron City Lakes and Municipal Airport, Pony Express Lake CA, and the towns of Maysville and Osborne. Maysville, Pony




Disclaimer: Existing transmission lines are shown to the extent they could be verified within the project study areas using aerial photography, topographic maps, and NW and Central Cooperative's system planning maps. They are not necessarily complete or represent all existing transmission lines in the area.

## LEGEND

- Study Area
- Alternative Corridors

**Existing Transmission Lines**

- 345-kV
- 161-kV
- 69-kV
- Voltage Unknown
- Power Plant Site
- Existing Substations
- Future Substations
- Federal Lands
- Department of Conservation Lands
- Missouri DNR Parks
- Parks (Local)
- Municipality
- County Boundary
- Airports / Airstrips

NORTH

4.5 0 4.5 Miles

**Figure 7-11**
Associated Electric Cooperative, Inc.
660 MW Coal-Based Power Plant
Fairport to Orrick/Missouri City/Eckles Rd
Alternative Macro-Corridors

Revised July 27, 2005

Express Lake, and Osborne form a line directly south of the Fairport Substation that serves to limit alternative corridors heading due south or southwest from Fairport, which is not particularly troublesome since the Orrick Substation site is located to the southeast. Corridors heading southwest from Fairport would have an excessive length compared to other more direct alternatives, and would be further constrained in the south half of the study area by Kearney and the greater Excelsior Springs area.

Two existing 69 kV lines provide opportunities for co-location out of the Fairport Substation. One of the lines heads due east from the substation, while the other line heads southeast to the vicinity of the town of Kidder, where it taps into another existing 69 kV line that changes direction and as a result becomes undesirable as a corridor opportunity.

Cameron, Lawson and Wallace State Park in the north and the greater Excelsior Springs area and Watkins Mill State Park and Historical Site in the south, form a line down the approximate center of the study area that restrict the most direct alternatives between Fairport and Orrick. The existing 161 kV transmission line running north/south at the western edge of the study area was the only potential opportunity that could be identified west of Excelsior Springs. A review of aerial photography from 2002 indicates that there may be room for a new line parallel to the existing right-of-way, at least for the majority of the corridor. The primary constraints along the existing line are Lake Arrowhead (see earlier discussion) and development in and around the towns of Holt, Mosby and Prathersville. While all other cities and towns were excluded from the corridors, Mosby and Prathersville had to remain because the only possible alternative for a route in this area would be through their municipal jurisdictions (in relatively undeveloped locations) due to excessive development near the existing line, where it runs west of the towns. It is possible that additional development could occur in Mosby and Prathersville that would make this alternative corridor undesirable in the near future. Another constraint to be considered during the development of specific routes within this corridor will be the Clay County Regional Airport and other private airstrips that are currently within the two-mile corridor width. In addition, south of the greater Excelsior Springs area, the Fishing River and Cooley Lake CA further constrain options available within the westernmost corridor to reach the proposed Orrick Substation site.

Fewer, smaller constraints are located east of Cameron and Excelsior Springs, making the eastern portion of the study area the most feasible location for proposed corridors. Lake Viking and the towns of Winston, Altamont, and Kidder constrained corridors north of U.S. Highway 36. The Crooked River CA, a couple of much smaller CAs, and the towns of Kingston, Polo, Elmira, and Rayville were the only macro-constraints to be avoided south of U.S. Highway 36, in the eastern portion of the study area. Most of these constraints were spaced far enough apart that feasible two-mile-wide corridors were readily identifiable, though the corridors that were developed were somewhat angular to avoid some of these features. Several private airstrips could later have an impact on the identification of specific routes within the macro-corridors. Project length constrained the identification of alternatives further east than the Crooked River CA because there would be considerable backtracking to reach the proposed Orrick Substation site from corridors further east. Excessive length results in additional costs and a greater likelihood of environmental and social impacts.

At the south end near the proposed Orrick Substation site, the only co-location opportunity that was identified was a portion of an existing 69 kV line running between the Crooked River CA and the Missouri City Plant, on the west side of Missouri City.

For the Fairport Substation to proposed Orrick Substation section, three basic corridors were developed (Figure 7-11). The western corridor follows an existing 161 kV transmission line out of the Fairport Substation south for approximately 36 miles, at which point the proposed corridor angles slightly east to avoid development near the cities of Holt, Kearney, and Excelsior Springs, as well as a couple of private airstrips and the Clay County Regional Airport located near the existing line. The corridor extends through the towns of Mosby and Prathersville, and then turns southeast for 10 miles, generally following the Fishing River to reach the proposed Orrick Substation site approximately 10 miles south of Mosby. The last seven miles of this corridor doubles as an alternative corridor for the section between Orrick and Missouri City.

Two options are available leaving the Fairport Substation to the east. One option follows an existing 69 kV transmission line due east for approximately 10 miles, then turns south from the existing line for approximately 13 miles before meeting the other option, which follows another 69 kV transmission line heading southeast from the substation for approximately 15 miles. These options in turn lead to two other corridor options than continue south to the Orrick Substation site. The central option heads almost due south for approximately 42 miles, skirting the towns of Elmira and Woods Heights to reach the proposed site of the Orrick Substation. The eastern option continues southeast along a 69 kV line for about seven miles, then turns south for approximately 26 miles, skirting the Bolinger and Crooked River CA's. At this point, the corridor meets another existing 69 kV transmission line right-of-way and follows it southwest for approximately seven miles before turning south to terminate at the proposed Orrick Substation site after about four more miles.

**Proposed Orrick Substation to Missouri City Substation**

Only about eight miles separate the proposed site of the Orrick Substation and the Missouri City Substation. Alternative corridors between these two points were longer than eight miles to avoid several large constraints. The Missouri City Substation is located west of the Orrick Substation site on the west side of Missouri City, and at the edge of the Missouri River at the river's northernmost point in the vicinity. To avoid the majority of the development in and around Missouri City, corridors would have to approach from the north, south, or west. Corridors from the west were not practical because the Orrick Substation site is east of the Missouri City Substation. Alternatives approaching Missouri City from the south would result in two crossings of the Missouri River, which would be unnecessary given the availability of northern corridors that would require no river crossings. Because the river crossings result in additional environmental impacts and construction challenges, and could be avoided, no southern corridor alternatives were developed.

Similar to the western corridor identified between the Fairport Substation and Orrick, the Orrick to Missouri City section also involves the Cooley Lake CA, which is spread out in several tracts along the edge of the Missouri River. The largest tract is a horseshoe-shaped area, once a Missouri River oxbow, which extends north from the Missouri River about 2.5 miles. One of the corridors identified for this section would be longer, but could completely avoid the Cooley Lake CA (Figure 7-11). This corridor would extend west from the Orrick Substation, angle north to miss the CA, and then angle back southwest to the Missouri City

Substation. Two existing lines, one 69 kV line and one 161 kV line, extend in the same general direction and are within the two-mile-wide corridor. Further investigation is required to determine if co-location of the proposed project along these lines is feasible. Specific routes developed within this corridor would also need to avoid multiple crossings of the Fishing River, which meanders within the corridor just north of Cooley Lake. This corridor is the same alternative identified for part of the Fairport to Orrick section.

The other alternative corridor identified between Orrick and Missouri City would extend west out of the Orrick site, and cross the Cooley Lake CA on a more direct path to the Missouri City Substation. A 161 kV transmission line, coming up from the southeast, crosses part of the Cooley Lake CA, and is within the two-mile-wide proposed corridor for this project. To minimize impacts to the CA, routes could be developed which cross the CA parallel to the existing right-of-way.

### Proposed Orrick Substation to Eckles Road Substation

Two corridors were developed for the proposed Orrick Substation to Eckles Road Substation section of the project (Figure 7-11). Because the Eckles Road Substation is located on the opposite side of the Missouri River from the proposed Orrick Substation site, a crossing of the Missouri River is unavoidable. Crossing locations and potential corridors were restricted by Cooley Lake CA, the Mouth of the Little Blue County Park, and the Big Muddy NWR along the Missouri River, and the towns of Orrick and Sibley. The Big Muddy NWR, Fort Osage County Park, and Sibley prohibit the option of a direct corridor between the proposed Orrick site and the Eckles Road Substation.

One corridor was developed which would head south from the Orrick Substation site, cross the Missouri River, and then extend east along an existing 345 kV line right-of-way to the Eckles Road Substation, crossing the Missouri River between the Cooley Lake CA and the Big Muddy NWR. Routes developed within this corridor would avoid the town limits of Sibley, resulting in a slightly greater overall length than a more direct alternative.

The other corridor would head west from the Orrick site, then angle southwest to the Eckles Road Substation. Routes within this corridor could be designed to avoid the Cooley Lake CA and the Big Muddy NWR, but the Mouth of the Little Blue County Park, which extends about four miles along the river, would be crossed. This park could not be reasonably avoided without impacting either the Cooley Lake CA or the Big Muddy NWR.

## 7.4 MACRO-CORRIDOR STUDY CONCLUSIONS

The selection of the preferred transmission solution for this project largely depends on the power plant site selected, as well as specific route alignments identified within the corridors. Once the public has had an opportunity to comment on the proposed corridors, more detailed constraint information will be collected and more specific route alignments will be identified. A more definitive comparison of impacts will be made for each route identified for each section and a preferred route will be selected based on this analysis of alternatives.

# 8.0 GLOSSARY

**Approach Surface:** A surface longitudinally centered on the extended runway centerline and extending outward and upward from each end of the runway. Denote areas near runways that are restrictive in height to the location of the transmission line.

**Constraint:** Features in the study areas which are considered to be unacceptable, to varying degrees, for the location of the new transmission line.

**Emergent:** Herbaceous wetland vegetation which protrudes above the water level.

**Glide Path:** A descent profile determined for vertical guidance during a final approach or landing of an aircraft.

**Kilovolt:** 1,000 volts. The amount of electric force carried through a high-voltage transmission line is measured in kilovolts. The standard voltage for use in the home is 120 volts.

**Loess:** A soil made up of small particles that were transported by the wind to their present location.

**Macro:** Very large in scale or scope or capability. In this report, used to indicate the relatively large-scale of review and corridor identification.

**Opportunity:** A feature within the study area that is generally considered favorable for co-location of the new transmission line (i.e. other transmission lines, railroads, etc).

**Palustrine:** A wetland classification that includes all nontidal wetlands dominated by trees, shrubs, peristent emergents, emergent mosses or lichen, and all such wetlands that occur in tidal areas where salinities due to ocean-derived salts are less than 5 ppt.

**Physiography:** The natural configuration of the land surface.

**Prime Farmland:** Prime farmland is land on which crops can be produced for the least cost and with the least damage to the resource base. Prime farmland has an adequate and dependable supply of moisture from precipitation or irrigation and favorable temperature and growing season. The soils have acceptable acidity or alkalinity, acceptable salt and sodium content, and a few rocks. They are not excessively eroded. They are flooded less often than once in two years during the growing season and are not saturated with water for a long period. The water table is maintained at a sufficient depth during the growing season.

**Substation:** An assemblage of equipment within a fenced area that switches, changes or regulates voltage in electric transmission and distribution systems. Among other things, substations are used to increase the voltage of electricity so that it can be transported efficiently over long distances and reduce the voltage so that it can be delivered in a practical and economical manner to homes and businesses.

**Terminus:** Endpoint.

**Topography:** The contour of the land surface; the arrangement of the land surface including its relief and the position of its natural and man-made features

**Transmission Line:** Facility for transmitting electrical energy at high voltage from one point to another point. Transmission line voltages are normally 115 kilovolt or larger.

**Voltage:** The force which pushes electricity through a wire.

**VOR:** A type of radio navigation system for aircraft. VOR's broadcast a VHF radio signal encoding both the identity of the station and the angle to it, telling the pilot in what direction he lies from the VOR station, referred to as the radial. Comparing two such measures on a chart allows for a fix. In many cases the VOR stations also provide distance measurement allowing for a one-station fix.

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# Appendix A
# Forbes Site Photos

# FORBES SITE PHOTOS


**Photo 1: Northwest corner of site facing southwest towards the Missouri River**

**Photo 2: Northwest corner of site facing south**

# FORBES SITE PHOTOS

**Photo 3: Northwest corner of site facing southeast**

**Photo 4: Northern center of site facing north towards BNSF Railroad**

# Appendix B
# Norborne Site Photos

# NORBORNE SITE PHOTOS

**Photo 1: Northwest corner of site facing southeast**

**Photo 2: Southwest corner of site facing east**