New Coal-Fired Power Plant

Site-Selection Study

January 2004

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prepared by

EDAW

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Abbreviations

Dairyland	Dairyland Power Cooperative
MW	Megawatt
RUS	Rural Utility Service
NEPA	National Environmental Policy Act
EIS	Environmental Impart Statement
kW	Kilowatt
$Wh/m^2/day$	Watt-hours per square meter per day
LFG	Landfill biogas
RDF	Refuse Derived Fuel
MSW	Municipal Solid Waste
CTG	Combustion Turbine Generator
HRSG	Heat Recovery Steam Generator
STG	Steam Turbine Generator
Btu	British Thermal Units
CFB	Circulating Fluidized Bed Coal
PC	Pulverized Coal
GIS	Geographic Information Systems
MAPP	Mid continent Area Power Pool
DEM	Digital Elevation Model
SHPO	State Historic Preservation Office
HV	High Voltage
NSP	Xcel Energy Northern States Power
PTDF	Power Transfer Distribution Factor
MISO	Midwest Independent System Operator
NLCD	National Land Cover Data
USGS	United States Geological Survey
WWTP	Wastewater Treatment Plants
FEMA	Federal Emergency Management Agency
T&E	Threatened and endangered
PRB	Powder River Basin
O&M	Operating and maintenance
NO_x	Nitrogen oxides
ZLD	Zero Liquid Discharge
NPV	Net Present Value
ICE	Iowa, Chicago and Western Railroad
CN	Canadian National Railroad

1 Introduction

Dairyland Power Cooperative (Dairyland) proposes to construct a 400 megawatt (MW) coal-fired power plant to address an anticipated shortfall in electricity generation. A Site-Selection Study for the new plant was conducted between April and October, 2003, which identified two primary alternative sites. This report documents that siting study.

As the Rural Utilities Service (RUS) will provide financing to Dairyland for the project, the RUS will be the approval authority under the National Environmental Policy Act (NEPA). This report addresses Rural Utilities Service bulletin 1794A-603, section 3.2.2, which requires the preparation of a Site-Selection Study document prior to the start of the scoping process for generation projects where an Environmental Impact Statement (EIS) is to be prepared. The project will also involve transmission connections into Dairyland's power grid, and the report also addresses section 3.1.2 of RUS bulletin 1794A-603A which requires the preparation of a Macro-Corridor Study for transmission projects, evaluating potential routes for the necessary transmission line connections.

2 Dairyland Power Cooperative

Dairyland, headquartered in La Crosse, Wisconsin, provides wholesale electric power to 25 electric distribution cooperatives and 20 municipal utilities. These cooperatives and municipal utilities, in turn, supply the energy needs of more than half a million people.

Dairyland's service area encompasses 62 counties in five states (Wisconsin, Minnesota, Iowa, Illinois and Michigan). Dairyland's member distribution cooperatives cover nearly one-half the land area of Wisconsin and portions of northeastern Iowa, southeastern Minnesota, and extreme portions of northwestern Illinois and northwestern Michigan's Upper Peninsula. The members' service territories include suburban areas surrounding the larger cities in the region, including La Crosse and Eau Claire, Wisconsin, Rochester, Minnesota, and the Twin Cities of Minneapolis and St. Paul, Minnesota. In addition, Dairyland provides power directly to thirteen municipal systems and to five other municipal systems that are members of Dairyland's wholesale energy marketing unit, GEN~SYS (**Figure 2.1**)

Dairyland's mission is, *as a cooperative organization, to provide competitively priced energy and services to our customers and maximum value to our owners, consistent with the wise use of resources. We will work with our members to improve the quality of life of their customers and the economic and social well-being of the region.*

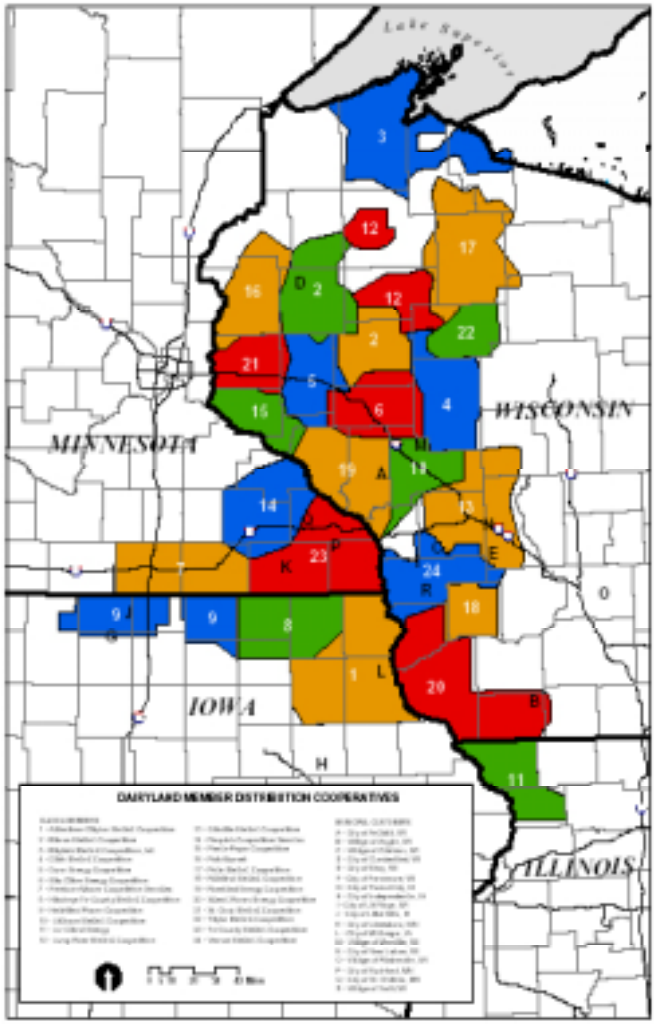


Figure 2.1

Dairyland Member Distribution Cooperatives

3 Purpose and Need

Load Growth

The future numbers of Dairyland's customers and the amount of electricity each one uses define the future load. Load growth within each of these categories and overall load forecasts are discussed below.

Residential

Residential loads account for around 77% of retail electricity sales by Dairyland's member cooperatives. The number of residential customers has been increasing at an annual rate of 1.6% over the last 10 years, with most of this growth coming from residential subdivisions being developed around the larger cities in Dairyland's service territory. The number of farm customers has declined over the last decade, primarily due to the consolidation of farmland into larger individual farms.

Dairyland projections indicate an increase in numbers of residential customers of 1.7% annually over the next 20 years as the expansion of urban areas continues.

The amount of electricity used per residential customer is expected to decline at an average annual rate of 0.2% over the next 20 years. Factors influencing individual residential customer use of electricity are the following:

- Lower electricity use for household heating, due to more efficient heating appliances and increased use of natural gas heating
- Increased use of air conditioning
- Lower electricity use for water heating due to more efficient water heaters and increased use of natural gas for water heating
- More efficient refrigerators and freezers
- More efficient lighting
- Increased electricity use per farm because of larger farm size and increased mechanization

Dairyland's forecasts indicate that the decrease in energy use per residential customer will not be enough to offset the increase in the number of customers. Total electricity sales to residential customers are expected to increase 1.4% per year over the next 20 years.

Commercial and Industrial

Dairyland divides its commercial and industrial customers into small and large commercial and industrial customers. Small commercial and industrial customers include restaurants, retail stores, and small manufacturing facilities. Large commercial and industrial customers are mostly larger manufacturing facilities, such as, ethanol plants.

The number of small commercial and industrial customers is expected to increase by 1.8% per year over the next 20 years in line with growth in the regional economy.

Dramatic increases in small commercial and industrial electricity use per customer (4.1% per year over the last 5 years) are expected to level out to a rate of 0.8% per year over the next 20 years. This is due to a more conservative economic forecast and the natural upper limits to facility sizes.

The increase in small commercial and industrial customers is anticipated to result in total electricity use by this sector to increase by 2.6% per year over the next 20 years. This increase will be driven mainly by the increasing number of customers in this category.

Efforts by local governments to encourage industrial development and strong regional economic growth have resulted in large increases in load from the large commercial and industrial sector. This is anticipated to continue with a projection of 4.6% growth per year in sales to this sector.

Other Classes

An increase of 1.4% annually is expected in electricity use for irrigation, street lighting, public authorities, etc. over the next 20 years. This sector of use accounts for about 5% of retail sales by Dairyland's member cooperatives.

Generation

Generating-Capacity Mix

The most economical means of supplying the cyclical load on an electric power system is to have three basic types of generating capacity available:

a. Baseload capacity;
b. Intermediate load range capacity; and
c. Peaking capacity.

Baseload capacity runs near its full rating continuously, day and night, all year long. It is economical to design these units with a maximum of fuel-economizing features, highest practical steam temperatures and pressures, extensive use of regenerative boiler-feedwater heaters, reheat and double-reheat boiler-turbine arrangements, and large condensers with minimum-temperature cooling water. These items increase the cost of the plant but are justifiable because the fuel-cost saving is large due to the large amount of power produced by having the unit run continuously.

The design of the plant is optimized to obtain the balance between high first cost and low fuel cost that will give the lowest overall power cost under the assumption that the unit will be heavily loaded for many years. The best design will vary depending on the unit size, money costs, and fuel type and cost.

Peaking capacity is run only during daily peak-load periods during the seasonal peak times of the year and during emergencies. Since the total annual output is low, high efficiency is not as necessary as for baseload units. Very low first cost is important. Combustion turbines and pumped-stage hydro units are the typical peaking units.

Intermediate load range capacity fits between the baseload capacity and peaking capacity in both first cost and fuel cost. It generally is designed to be *cycled*, that is, turned off regularly at night or on weekends and loaded up and down rapidly during the time it is on the line in order to take the load swings on the system. Some additional cost is required to allow for repeated starts and stops without equipment damage or the need for larger operating staffs. However, owing to the lower annual production, some reduction in efficiency is justified.

Older small baseload units and hydro units with restrictions on water use are sometimes used for intermediate and peaking service.

Dairyland Power Cooperative Generating Facilities

During the summers of 1996, 1997, 1998 and 1999 Dairyland experienced record demand for electrical service. While Dairyland was able to meet that peak demand, it did so with a margin of only 1.4 MW of excess capacity in July of 1999. The entire MAPP (Mid Continent Area Power Pool) was precariously close to going capacity deficit on several occasions in July of 1999. Additionally the transmission grid was severely constrained and subjected to "line loading relief" curtailments. These events have caused the MAPP reliability council to change to seasonal vs. annual URGE (Uniform Rating of Generating Equipment) ratings to more carefully monitor MAPP members' ability to serve their loads. This change in URGE rating requirements resulted in an ~30 MW derate of Dairyland's summer generating capability.

Dairyland has been able to manage a portion of their capacity requirements by purchasing energy and capacity from other MAPP utilities. However, the near term lack of excess capacity in MAPP and increasing transmission constraints have combined to severely diminish the future viability of purchasing capacity from other utilities. MAPP, of which Dairyland is a member, has a projected deficit of generation by the early 2000's. Transmission constraints and line loading relief events continue to interrupt delivery among many MAPP and MAIN (Mid-American Interconnected Network) utilities. Therefore, long-term purchase of transmission, capacity and energy from MAPP and/or MAIN members is not a viable option.

Dairyland and its member cooperatives have already implemented load management in conjunction with incentive pricing and energy conservation programs. Various load management programs are used to control approximately 150 MW of interruptible peak demand with approximately 82,500 radio receivers controlling water heaters, space heaters, water and heat pumps, fans, air conditioners and standby generators. This represents approximately 20% of the Dairyland load.

The Elk Mound Combustion Turbines near Elk Mound, Wisconsin, were added to the Dairyland system in 2001 to address peak capacity needs. Dairyland's two Elk Mound Combustion Turbines add 71 MW of reliable peaking capacity to the Dairyland system and the Upper Midwest. The turbines are used during peak periods—those times when consumers place the greatest demand on Dairyland's generating system. Additionally, the units are equipped with a "black start" system, which will allow the units to start with no external power supply or load signals. This feature enhances reliability, as it would allow Dairyland to bring back its entire system in the event of a widespread blackout. Dairyland has budgeted in 2004 for software upgrades to the Elk Mound Combustion Turbines' controls to increase the capacity rating of each unit by about 2 MW.

Dairyland's Alma Station located near Alma, Wisconsin, consists of five coal-fired generation units. The first two units, Alma #1 and #2, were constructed in 1947. Alma #3 was built in 1950 and Alma #4 in 1957. The largest and final unit, Alma #5, came on-line in 1960. Today, Alma Units #1-3 generate a total of 58.4 MW, Alma #4 generates 57 MW and Unit #5 has a generating capacity of 77.3 MW. The Alma Station burns coal that travels by barge from southern Illinois and by rail and barge from Wyoming via transfer docks situated along the Mississippi River.

The John P. Madgett Station is adjacent to the Alma Station. This generating station has been in commercial operation since November 1979. The single unit station has a generating capacity of 366 MW. JPM burns about one million tons of low sulfur western coal from mines in the Powder River Basin area of Wyoming each year. The coal is received by two unit railroad trains of 115 cars each. Dairyland has budgeted in 2004 for upgrades to the John P. Madgett Station that will increase the units output by approximately 26 MW.

Genoa-3, located near Genoa, Wisconsin, burns coal received by barge from southern Illinois and by rail to barge from Wyoming in the Powder River Basin. The different coals are blended on site for economics and environmental compliance. Cooperative Power, Eden Prairie, Minnesota, has a life-of-the-plant agreement with Dairyland to receive about 170 MW from the 349 MW output of Genoa-3. This leaves Dairyland with 179 MW.

The Flambeau Hydroelectric Station, 22 MW, located on the Flambeau River near Ladysmith, Wisconsin, was built in 1951. The federal operating license expired in 2001 and the facility is operating under the terms of the expired license until a new license is issued. Dairyland expects a new 30 year license to be issued in 2004.

Dairyland has additional peaking capacity available under contract with the municipals that it serves. These municipals, including Arcadia, Argyle, Cashton, Cumberland, Elroy, Fennimore, La Farge, Merrillan, New Lisbon and Viola in Wisconsin, Lanesboro in Minnesota, and Forest City in Iowa, contribute 77 MW of capacity.

Table 3.1 shows the capacity factors achieved in recent years by Dairyland's generating plants. **Table 3.2** shows typical designations of generating plants according to capacity factor.

Table 3.1
Capacity Factors of Dairyland Generating Plants

	1998	1999	2000	2001	2002	Average
Elk Mound – 1				3%	1%	2%
Elk Mound – 2				3%	1%	2%
Alma – 1	29%	25%	32%	29%	28%	29%
Alma – 2	32%	27%	28%	30%	30%	29%
Alma – 3	30%	22%	27%	38%	28%	29%
Alma – 4	55%	45%	59%	35%	59%	51%
Alma – 5	51%	38%	55%	49%	49%	48%
Flambeau	26%	34%	34%	41%	53%	38%
Genoa – 3	52%	63%	71%	69%	77%	66%
J.P. Madgett	68%	72%	75%	79%	72%	73%

Table 3.2
Capacity Factors by Plant Designation

Designation	First Cost	Fuel Cost	Typical annual capacity factor
Base-load capacity	High	Low	65 - 75%
Intermediate-load- range capacity	Intermediate	Intermediate	30 - 40%
Peaking Capacity	Low	High	5 - 15%

Based on the table of Capacity Factors by Plant Designation and MAPP summer seasonal URGE ratings, Dairyland's generating facilities would be classified as:

a. Baseload capacity (545 MW)	
1. Genoa-3	179 (349 - 170 to Cooperative Power)
2. J.P. Madgett	366
b. Intermediate-load range capacity (214.7 MW)	
1. Alma – 1	19.8
2. Alma – 2	20.2
3. Alma – 3	18.4
4. Alma – 4	57.0
5. Alma – 5	77.3
6. Flambeau	22.0
c. Peaking capacity (147.8 MW)	
1. Elk Mound – 1	35.2
2. Elk Mound – 2	35.6
3. Municipals	77.0
Total Generation Capacity	**907.5 MW**

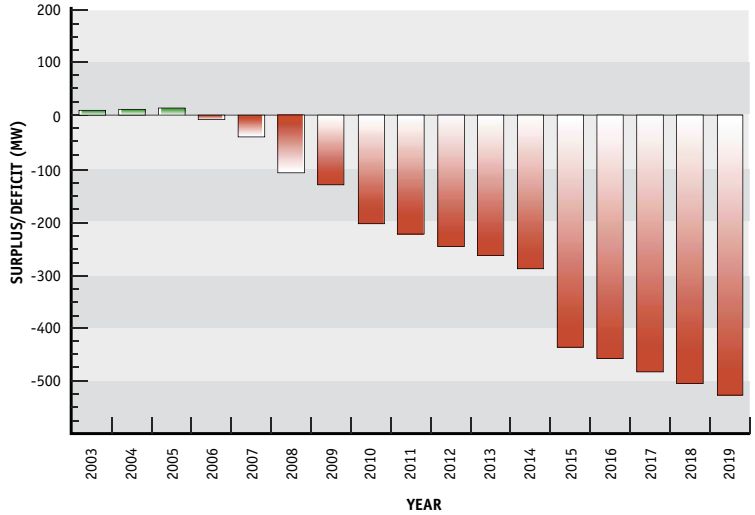


Figure 3.1

Dairyland Generation Surplus/Deficit Projections

Load and Generating Capability

Growth in Generation to Serve Baseload

The present baseload generators of the Dairyland system are Genoa #3 and J.P. Madgett. The combined capability of these two generators is 545 MW. Both generators are presently operating as near to full annual output as is practical, considering their high annual capacity factors, the required weeks of downtime for preventative maintenance and their increasing forced outage rates.

a. Both units' annual capacity factors are high, in the 65-75% range for Genoa 3 and in the 70-80% range for J.P. Madgett.

b. The Forced Outage Rate for both units has begun to rise steadily, indicating a high level of stress on the equipment when operating at the present generating levels.

Dairyland's annual growth in total system peak load for the period 1997-2003 has averaged 2.1%. Dairyland has projected load growth to continue in the 2.0% to 3.0% range through 2008 and then to level off at approximately 1.8% through 2019.

It is projected that there will be a deficit in generation capacity of approximately 205 MW by 2010 and 244 MW by 2012 (**Figure 3.1 and Table 3.3**).

Table 3.3
Dairyland generation and load projections

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Annual adjusted net demand	797	813	842	859	876	898	915	931	948	965	982	1000	1018	1036	1054	1073	1091	1111
Net generating capability	1071	1077	1088	1114	1114	1114	1114	1114	1055	1055	1055	1055	1055	921	921	921	921	921
Participation purchases - total	116	67	61	56	56	50	0	0	0	0	0	0	0	0	0	0	0	0
Participation sales – total	255	201	170	170	170	170	170	170	170	170	170	170	170	170	170	170	170	170
Adjusted net capability	932	944	979	1000	1000	994	944	944	886	886	886	886	886	751	751	751	751	751
Net reserve capacity obligation	120	122	126	129	131	135	137	140	142	145	147	150	153	155	158	161	164	167
Total firm capacity obligation	916	939	968	987	1008	1033	1052	1071	1090	1110	1130	1150	1171	1192	1212	1234	1255	1277
Surplus or deficit in capacity	**16**	**9**	**11**	**13**	**(7)**	**(39)**	**(108)**	**(127)**	**(205)**	**(224)**	**(244)**	**(264)**	**(285)**	**(440)**	**(461)**	**(482)**	**(504)**	**(526)**

Dairyland's baseload energy generators represent approximately 60% of the existing system capacity. The MAPP peak demand on Dairyland's system in 2003 was 813 MW. The system total firm capacity obligation is projected to be approximately 1277 MW in 2019 (10 years after the proposed power plant is in-service).

Table 3.4 shows Dairyland's historical load and energy requirements. System peak capacity requirements increased on average by 16.1 MW annually from 1997 to 2002. Allowing for the 15% reserve requirement, shows that Dairyland's average energy generation requirement is increasing by 14 MW annually. System energy requirements have been increasing on average by 91,618 MWh annually from 1997 through 2002. The average increase in system energy requirements requires a 75% capacity factor from the average increase in capacity. This indicates that Dairyland is adding load at a baseload rate.

Table 3.4
Dairyland historical load and energy requirements

	Peak (MW)	Class A (MWh)	Class D (MWh)	Losses (MWh)	Total (MWh)
1997	716.0	3,381,718	459,592	198,347	4,039,658
1998	728.8	3,384,066	413,572	196,092	3,993,730
1999	762.9	3,464,304	414,219	200,269	4,078,792
2000	757.0	3,583,166	425,736	207,001	4,215,903
2001	792.5	3,654,377	428,586	210,825	4,293,788
2002	796.4	3,825,771	451,140	220,840	4,497,750
Avg. Increase	**16.1**			**Avg. Increase**	**91,618**

Conclusion

The addition of 250 MW to 300 MW of baseload capacity in 2009 will allow Dairyland to meet capacity and energy requirements in that time frame and allow for additional growth in following years. The addition of 400 MW of baseload capacity in 2009 will allow Dairyland to work with a partnering utility to achieve greater economies of scale to reduce generation costs.

4 Alternatives to Meet Project Objectives

An Alternative Evaluation Study was conducted to determine the most appropriate way to meet Dairyland's needs for additional generation capacity. This included an evaluation of different generation technologies as well as alternatives to constructing new generation facilities such as energy conservation and purchasing power from other utilities. The different generation technologies evaluated are described below.

Wind

The greatest advantage of wind power is its potential for large-scale, though intermittent, electricity generation without emissions of any kind. In addition, over the years, wind energy's production cost has benefited from improvements in technology and increased reliability.

The development of wind power is increasing in many regions of the United States, including Wisconsin. Installed wind electric generating capacity expanded by nearly 10 percent during 2002 in the United States to 4,685 MW. Wind energy installations across the United States are expected to reach 6,000 MW by the end of 2003 (Ref. 10). Technological advances have improved the performance of wind turbines and driven down their cost. In locations where the wind blows steadily, wind power has been shown to compete favorably with coal and natural gas fired power plants based on receiving the federal Renewable Energy Production Incentive.

Solar (Photovoltaic and Thermal)

The sun is a direct source of energy. Using renewable energy technologies can convert that solar energy into electricity. However, solar energy varies by location and by the time of year. Solar resources are expressed in watt-hours per square meter per day ($Wh/m^2/day$). This is roughly a measure of how much energy falls on a square meter over the course of an average day.

Collectors that focus the sun (like a magnifying glass) can reach high temperatures and efficiencies. These are called solar concentrators. Typically, these collectors are on a tracker, so they always face the sun directly. Because these collectors focus the sun's rays, they only use the direct rays coming straight from the sun.

Other solar collectors consist of simply flat panels that can be mounted on a roof or on the ground. Called flat-plate collectors, these are typically fixed in a tilted position correlated to the latitude of the location. This allows the collector to best capture the sun. These collectors can use both the direct rays from the sun and reflected light that comes through a cloud or off the ground. Because they use all available sunlight, flat-plate collectors are the best choice for many northern states.

Solar resources are greatest in the middle of the day — the same time that utility customers have the highest demand, especially during the summer months.

Hydroelectric

Flowing water creates energy that can be captured and turned into electricity. This is called hydroelectric power or hydropower.

The most common type of hydroelectric power plant uses a dam on a river to store water in a reservoir or a run of the river approach, which does not result in the construction of a large reservoir. Water released from the reservoir flows through a turbine, which in turn activates a generator to produce electricity. Another form of hydroelectric power does not necessarily require a large dam but instead uses a small canal to channel the river water through a turbine.

Another type of hydroelectric power plant, referred to as a pumped storage plant, has the capacity to store energy. The power is sent from a power grid into the electric generators. The generators then turn the turbines backward, which causes the turbines to pump water from a river or lower reservoir to an upper reservoir, where the energy is stored. To use the energy, the water is released from the upper reservoir back down into the river or lower reservoir. This turns the turbines forward, activating the generators to produce electricity.

Geothermal

Geothermal energy is contained in underground reservoirs of steam, hot water, and hot dry rocks. Electric generating facilities utilize hot water or steam extracted from geothermal reservoirs in the Earth's crust to drive steam turbine generators to produce electricity. Moderate-to-low temperature geothermal resources are used for direct-use applications such as district and space heating. Lower temperature, shallow ground, geothermal resources are used by geothermal heat pumps to heat and cool buildings. Dairyland currently provides incentives to install geothermal heat pumps. Hence, the only geothermal resources that may be considered to generate power are the high temperature sources.

Biomass

For heating applications or electricity generation, biomass can be directly burned in its solid form, or first converted into liquid or gaseous fuels by off-stoichiometric thermal decomposition. Biomass power technologies convert renewable biomass fuels into heat and electricity using modern boilers, gasifiers, turbines, generators, fuel cells, and other methods.

Biomass resource supply includes the use of five general categories of biomass: urban residues, mill residues, forest residues, agricultural residues, and energy crops. Of these potential biomass supplies and the quantities cited below, most forest residues, agricultural residues, and energy crops are not presently economic for energy use. New tax credits or incentives, increased monetary valuation of environmental benefits, or sustained high prices for fossil fuels could make these fuel sources more economic in the future. In addition, forest fires in the past several years in western states have generated increased stimulus to initiate forest thinning programs. Several biomass plants are being proposed in the west to use forest thinnings as a major fuel source.

Biogas

The same types of anaerobic bacteria that produced natural gas also produce methane rich biogas today. Anaerobic bacteria break down or *digest* organic material in the absence of oxygen and produce *biogas* as a waste product. (Aerobic decomposition, or composting, requires large amounts of oxygen and produces heat.) Anaerobic processes can be managed in a *digester* (an airtight tank) or a covered lagoon (a pond

used to store manure) for waste treatment. The primary benefits of anaerobic digestion are nutrient recycling, waste treatment, and odor control. Except in very large systems, biogas production is a highly useful but secondary benefit.

Digester biogas produced in anaerobic digesters consists of methane (50% to 80%), carbon dioxide (20% to 50%), and trace levels of other gases such as hydrogen, carbon monoxide, nitrogen, oxygen, and hydrogen sulfide. The relative percentage of these gases in biogas depends on the feed material and management of the process. Anaerobic digesters are used in municipal wastewater treatment plants and on large farm, dairy, and ranch operations for disposal of animal waste.

Landfill biogas (LFG) is created when organic waste in a landfill naturally decomposes. This gas consists of about 50% methane, about 50% carbon dioxide, and a small amount of non-methane organic compounds. Instead of allowing LFG to escape into the air, it can be captured, converted, and used as an energy source. Using LFG helps to reduce odors and other hazards associated with LFG emissions, and it helps prevent methane from migrating into the atmosphere and contributing to local smog and global climate change.

The various types of biogas can be collected and used as a fuel source to generate electricity using conventional generating technology.

Municipal Solid Waste

Municipal Solid Waste (MSW) typically uses a Refuse Derived Fuel (RDF) technology in waste-to-energy facilities to combust trash, garbage, and other combustible refuse. The material is received in its as-discarded form and subjected to segregation of some of the recyclables and shredding prior to being fed into the boilers for combustion. MSW provides energy for power production and at the same time provides waste volume reduction. The plants range upward to 90 MW in size using multiple boilers to provide steam to a single condensing steam turbine generator. There are also a number of mass burn units in operation that burn the MSW directly in its as-discarded form with only the larger non-combustibles removed. Mass burn technology has largely given way to RDF in response to pressure to recycle materials and because the boilers designed to handle RDF are more economical to build.

Natural Gas Combined Cycle

Combustion turbine generators (CTGs) are used for simple cycle and combined cycle applications. In simple cycle operation, gas turbines are operated alone, without any recovery of the energy in the hot exhaust gases. Simple cycle gas turbine generators are typically used for peaking or reserve utility power applications, which primarily are operated during the peak summer months (June through September) at less than a total of 2,000 hours per year. Simple cycle applications are rarely used in baseload applications because of the lower heat rate efficiencies compared to a combined cycle configuration.

Combined cycle operation consists of one or more combustion turbine generators exhausting to one or more heat recovery steam generators (HRSGs). The resulting steam generated by the HRSGs is then used to power a steam turbine generator (STG).

There is a wide range of gas turbine size ranging from approximately 1 MW output up to “G” and “H” class machines which are rated at 240 MW and higher. Gas turbines for electric utility services generally range from a minimum of 20 MW for peaking service up to the largest machines for use in combined cycle mode.

Microturbines

Microturbines are small electricity generators that burn gaseous and liquid fuels to create high-speed rotation that turns an electrical generator. Current microturbine technology is the result of development work in small stationary and automotive gas turbines, auxiliary power equipment, and turbochargers, much of which was pursued by the automotive industry beginning in the 1950’s. Microturbines entered field testing around 1997 and began initial commercial service in 2000.

The size range for microturbines commercially proven and currently available is from 30 to 70 kW, compared to conventional gas turbine sizes that range from approximately 1 to 240 MW. Microturbines operate at high speeds and may be used in simple cycle or cogeneration systems. They are able to operate on a variety of fuels, including natural gas, sour gas, landfill gas, anaerobic digester gas and diesel fuel/distillate heating oil. In resource recovery applications, they burn waste gases that would otherwise be flared.

Microturbines are ideally suited for distributed generation applications due to their small power output and space requirement, flexibility in connection methods, ability to be stacked in parallel to serve larger loads, ability to provide stable and reliable power, and low emissions. Types of applications include stand-alone primary power, backup/standby power, peak shaving and primary power (grid parallel), primary power with grid as backup, resource recovery and cogeneration.

Pulverized Coal

Pulverized coal plants represent the most mature of technologies considered in this analysis. Coal plants, although having a high capital cost relative to some alternatives, have an advantage over other non-renewable combustible energy source technologies due to the relative low and stable cost of coal.

Modern pulverized coal plants generally range in size from 80 MW to 1,300 MW and can use coal from various sources. Coal is most often delivered by unit train to the site, although barges or trucks are also used. Many plants are situated adjacent to the coal source where coal delivery can be by conveyor. Coal can have various characteristics with varying heating values, sulfur content, and ash constituents. The source of coal and coal characteristics can have a significant effect on the plant design in terms of coal-handling facilities and types of pollution control equipment required.

Regardless of the source, the plant coal-handling system unloads the coal, stacks out the coal, reclaims the coal as required, and crushes the coal for storage in silos. Then the coal is fed from the silos to the pulverizers and blown into the steam generator. The steam generator mixes the pulverized coal with air, which is combusted, and in the process produces heat to generate steam. Steam is conveyed to the steam turbine generator, which converts the steam thermal energy into mechanical energy. The turbine then drives the generator to product electricity.

The steam generator produces combustion gases, which must be treated before exiting the exhaust stack to remove fly ash, NO_x, and SO_2. The pollution control equipment includes either a fabric filter (baghouse) or electrostatic precipitator for particulate control (fly ash), SCR for removal of NO_x, and FGD

system for removal of SO_2. Limestone is required as the reagent for the most common wet FGD process, limestone forced oxidation desulfurization. A limestone storage and handling system is a required design consideration with this system.

Coal plants produce several forms of liquid and solid waste. Liquid wastes include cooling tower blowdown, coal pile runoff, chemicals associated with water treatment, ash conveying water, and FGD wastewater. Solid wastes include bottom and fly ash and FGD solid wastes. Disposal of these wastes is a major factor is plant design and cost considerations.

Circulating Fluidized Bed Coal

In the mid 1980s, an alternative to the standard PC fired plant emerged called Circulating Fluidized Bed (CFB) combustion. The fuel delivery system is similar, but somewhat simplified, to that of a pulverized coal unit but with a greater fuel cost advantage in that a wider range of fuels and lesser quality of fuel can be used (coal, coke, biomass, etc.). The bed material is composed of fuel, ash, sand, and sorbent (typically limestone). CFB units compete in the marketplace in sizes up to 300 MW with larger sizes available soon.

CFB combustion temperatures are significantly lower than a conventional boiler at 1,500 to 1,600 degrees Fahrenheit (°F) vs. 3,000°F which results in lower NO_x emissions and reduction of slagging and fouling characteristic of pulverized coal units. In contrast to a pulverized coal plant, sulfur dioxide can be partially removed during the combustion process by adding limestone to the fluidized bed.

Integrated Gasification Combined Cycle Coal

Coal gasification for use in power generation reacts coal with steam and oxygen under high pressure and at high temperature to produce a gaseous mixture consisting primarily of hydrogen and carbon monoxide. The gaseous mixture requires cooling and cleanup to remove contaminants and pollutants to produce a synthesis gas suitable for use in the combustion turbine portion of a combined cycle unit. The combined cycle portion of the plant is similar to a conventional combined cycle. The most significant differences in the combined cycle are modifications to the combustion turbine to allow use of a 250 to 300 Btu/SCF gas and steam production via heat recovery from the raw gas in addition to the combustion turbine exhaust (HRSG). Specifics of a plant design are influenced by the gasification process, degree of heat recovery, and methods to clean up the gas.

Table 4.1 below summarizes the results of the Alternative Evaluation Study in terms of the ability for the different technologies described above to meet Dairyland's project objectives. This table indicates that a new coal-fired power plant is the only alternative that meets all project objectives.

Table 4.1
Ability of different generation technologies to meet project objectives

	300MW in 2009	Baseload operation	Environmentally permitable	Cost-effective	Fuel cost stability	High reliability	Commercially available	Meets all criteria
Wind	Yes	No	Yes	Yes	Yes	Yes	Yes	No
Solar – Photovoltaic	No	No	Yes	No	Yes	Yes	Yes	No
Solar – Thermal	No	No	Yes	No	Yes	No	Yes	No
Hydroelectric	No	No	Difficult	Yes	Yes	Yes	Yes	No
Geothermal	No	Yes	Yes	N/A	Yes	Yes	No	No
Biomass	No	Yes	Yes	No	Yes	Yes	Yes	No
Biogas	No	Yes	Yes	Yes	Yes	Yes	Yes	No
Municipal Solid Waste	No	Yes	Difficult	No	Yes	No	Yes	No
Natural Gas Combined Cycle	Yes	Yes	Yes	Yes	No	Yes	Yes	No
Microturbines	No	No	Yes	No	No	Yes	Yes	No
Pulverized Coal	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Circulating Fluidized-Bed Coal	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Integrated Gasification Combined Cycle Coal	Yes	Yes	Yes	No	Yes	No	Yes	No

5 Power Plant Operational Criteria

The power plant operational criteria used for the siting study were based on the need for base load capacity that would provide competitively priced energy to Dairyland's customers consistent with the wise use of resources. To this end, the following operational criteria were developed that would result in the selection of a site that would meet the requirements for a highly efficient and cost effective base load electric generating facility:

- Base load plant with a capacity of up to 400MW
- Pulverized coal technology
- Environmentally compliant
- Cost effective
- High level of reliability
- Provide fuel cost stability
- Commercially available and proven technology
- Deliverable (new generation must be connected to the Dairyland system at injection points capable of distributing the power or require limited additional transmission resources)
- Located inside of or in reasonably close proximity to Dairyland's service territory
- Operational availability by 2009
- Fuel source is Powder River Basin coal
- Condenser cooling by cooling towers or once through cooling
- Cooling water system must minimize impacts to the environment
- Must meet all applicable air quality standards and permitting requirements
- Absolute minimum site area of 80 acres, with preferred minimum site area of 160 acres
- Water source must be available for condenser cooling and other make up requirements
- Site must be in close proximity to at least one rail line and/or barge delivery of coal
- Facility must have a competitive Net Present Value to be cost-effective for Dairyland's customers.

6 Approach to the Site-Selection Study

The site-selection process was established and conducted under a central guiding principal: *identify the site of least overall land use and environmental impact at a reasonable economic cost*. To meet his objective, the study needed to be comprehensive, both geographically and with respect to the types of information gathered and considered through the course of the study.

The study was carried out in three-phases:

- Phase 1 - using available land use and environmental data to identify **areas of highest opportunity**;
- Phase 2 - using more refined criteria and data to identify **candidate sites** within these areas; and
- Phase 3 - a comparison of these sites against a range of detailed land use and environmental criteria to identify a small number of alternative sites (two primary alternative sites have been identified). The study process is shown in **Figure 6.1**.

The site-selection study involved extensive use of Geographical Information Systems (GIS), which facilitated the iterative approach needed to quickly and comprehensively review the results of various suitability analyses covering this 44,500 square mile siting area, which approximates the Dairyland Service Territory boundary. At the same time, it provided the needed ability to look in detail at increasingly smaller areas and sites as the study progressed from one phase to another. The study area resource maps that formed the basis of the analysis are included in **Appendix A**.

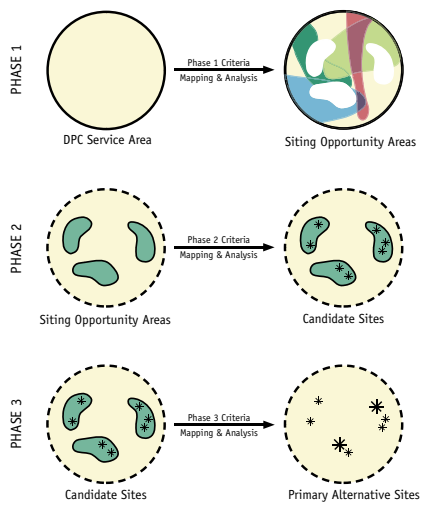


Figure 6.1
The Site-Selection Process

7 Phase 1

The primary objective of Phase 1 was reducing the 44,500 square mile study area to a number of potential siting areas that could be analyzed in more detail in later phases. To achieve, this a relatively small number of fundamental opportunity and constraint criteria were identified. These were combined to identify areas of highest opportunity that could be carried forward to subsequent phases of the site selection process (**Figure 7.1**)

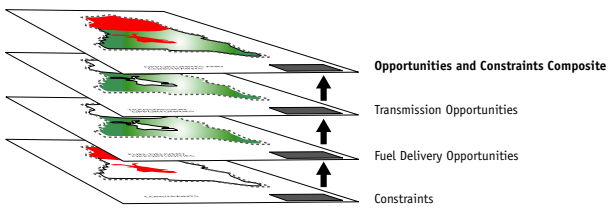


Figure 7.1
Phase 1 Process

The proximity to suitable transmission and to a means of fuel (coal) delivery were identified by the project team as the most important factors in the siting of a new power plant. Different levels of opportunity were assigned based on how close to these two elements a particular area is. It can be assumed in general terms that areas of higher opportunity would tend to have lower costs and lower impacts because of less fuel delivery and transmission infrastructure being required. Phase 1 opportunity criteria are listed below.

Fuel Delivery

- Lands within 2,5,10 and 20 miles of existing railroads (operative, plus abandoned lines connected to an operative railroad).

Transmission

- Lands within 2,5,10 and 20 miles of an existing transmission line that is 161kV or above without capacity constraints (as identified by MAPP).
- Lands within 2,5,10 and 20 miles of a potentially suitable injection point (generally either an existing substation or switching station where a connection can effectively be made with Dairyland's electric system. This category also includes 345kV transmission lines because of their greater capacity.)

The 2,5,10 and 20 mile buffers for transmission and fuel delivery were given numerical scores, to enable a combined opportunity value to be created when the two criteria are overlaid. The closer an area is to a suitable transmission line, injection point and/or fuel delivery route, the greater the opportunity level.

Access to barge facilities, although a possible means of fuel delivery, was not included as an individual opportunity criterion because of the inconsistency of available data. Almost the entire Mississippi River shore is however in close proximity to a railroad and is identified as a high opportunity area for fuel delivery.

Phase 1 constraint areas comprised *exclusion areas* and *avoidance areas*. Exclusion areas are areas where a power plant could not reasonably be expected to be sited. Avoidance areas are not desirable from a siting perspective but under some circumstances may be considered. Phase 1 constraint criteria were as follows.

Exclusion Areas

Air Quality

- Lands within Class I airshed area (as defined by the U.S. Environmental Protection Agency).

Reserved Land

- National Scenic Riverway
- National Wildlife Area
- National Forest
- Military reservation
- State Forest
- State Parks
- Wildlife Area (Wisconsin)
- Wildlife Management Area (Minnesota)

Avoidance Areas

Land with Special Designations

- Sovereign tribal lands

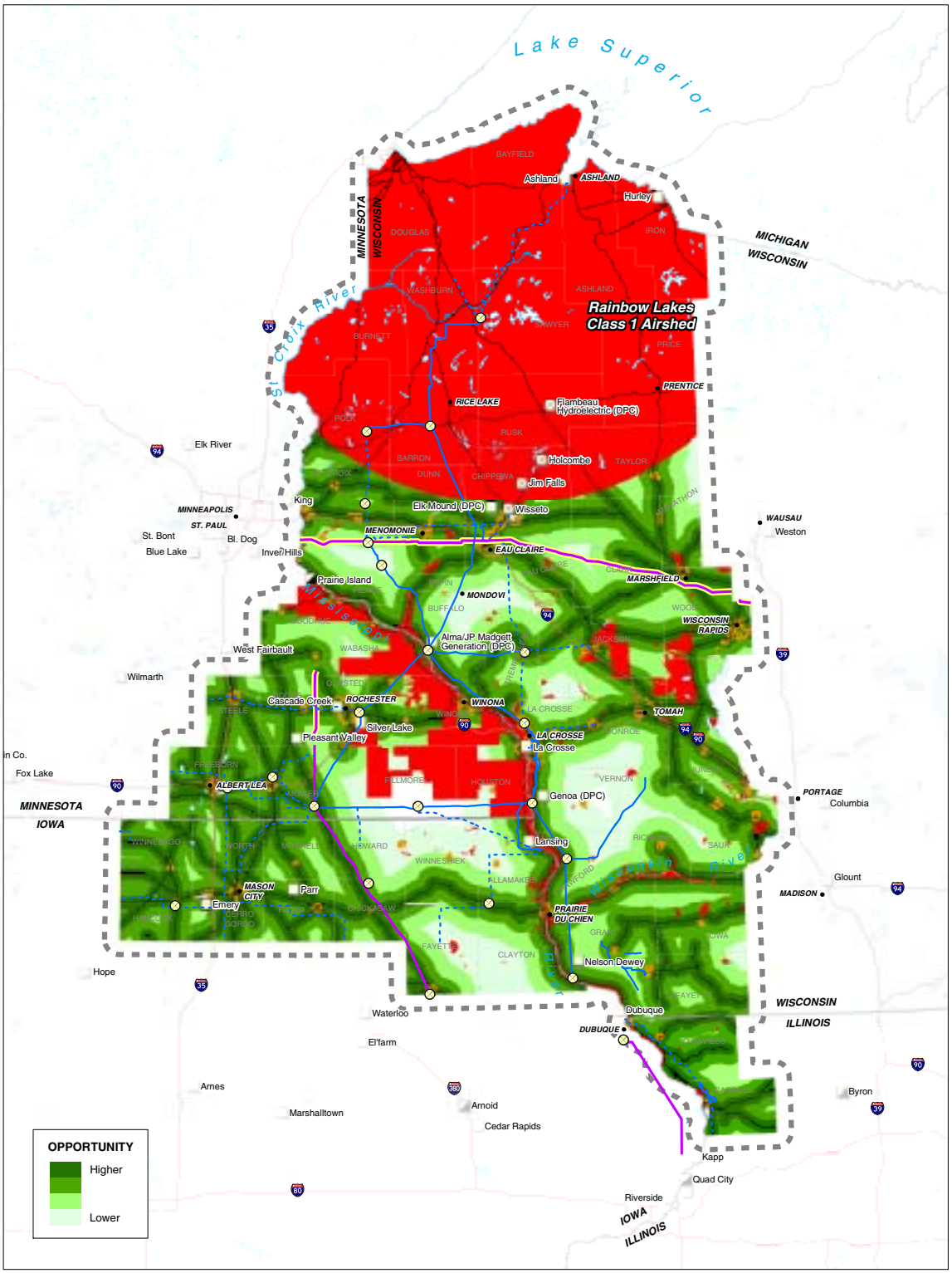
Urban Areas

- Incorporated city and town limits

Figure 7.2 shows fuel delivery opportunities. These are shown in various shades of green, the darkest shade being lands within 2 miles of a suitable railroad The next lighter tone represents lands between 2 and 5 miles from a railroad, and the third lightest tone are lands at a distance of 5-10 miles. Shown in the lightest tone are lands within 10-20 miles of an existing railroad.

Almost all lands within the study area are within 20 miles of an existing railroad line. More significantly however, the fuel delivery opportunity map provides the ability to focus the search for suitable sites within close proximity (e.g. within 2 miles) of this needed infrastructure. Constructing a shorter rail line will generally result in fewer adverse effects to people and the environmental and cost less.

The greatest concentration of rail lines is in the southwestern portion of the study area in Iowa and Minnesota. A relatively high concentration of rail lines is also present in the far southwestern portion of the study area in Illinois and southern Wisconsin. Rail is virtually continuous along the Mississippi River



LEGEND

- 161 kV Foreign Transmission Line
- 161 kV DPC Transmission Line
- 345 kV Foreign Transmission Line
- Constrained Interface
- DPC Service Territory

Generation Facility

- Fossil Fuel
- Hydroelectric
- Nuclear
- Wind

- Injection Point
- Avoidance Area
- Exclusion Area

Figure 7.2
Opportunities - Fuel Delivery

(coinciding with potential barge access, which for reasons discussed above was not included in the Phase 1 mapping). The south-central portion of the study area has relatively large areas that are more than 10 miles from rail.

Transmission opportunities are shown in **Figure 7.3**. Areas that are in close proximity to both an injection point and a transmission line are given a higher opportunity rating than areas that are in close proximity to a transmission line alone. For the purpose of this analysis, 345kV transmission lines are regarded as being both a transmission line and an injection point and receive the highest transmission opportunity rating.

Because of the capacity of existing transmission lines and the amount of electricity being carried at peak times, not all lines are equally capable of delivering the power that would be generated by the proposed plant. In Phase 1 however, the capacity of transmission lines is treated in general terms, with any transmission line 161kV or greater being regarded as having potentially adequate capacity. Dairyland has a network of 69kV transmission lines, however without significant upgrades, the 69kV transmission lines would not be capable of delivering the volume of power produced by the power plant. The majority of potentially adequate transmission lines occur in two broad north-south corridors in the central portion of the study area. There is much less transmission infrastructure in the far western and eastern portions of the study area.

Constraints are shown in **Figure 7.4**. Approximately the northern quarter of the study area was excluded as a result of the Rainbow Lakes Class I Airshed. Rainbow Lakes is a designated wilderness area under the Wilderness Act of 1964 and consists of approximately 6,600 acres within the Chequamegon National Forest. Because of this designation, its airshed is automatically classified as a Class I airshed under the Clean Air Act and new development cannot have any detrimental effect on air quality in the wilderness area. To identify the size of the exclusion area necessary, a CALPUFF screening model was run. This model identified the likely distance, beyond which a new 400MW power plant would have no impact on the air quality of the Rainbow Lakes Wilderness Area. This was determined to be 150 kilometers (approximately 93 miles). Details on the modeling procedure and results are included in **Appendix B**.

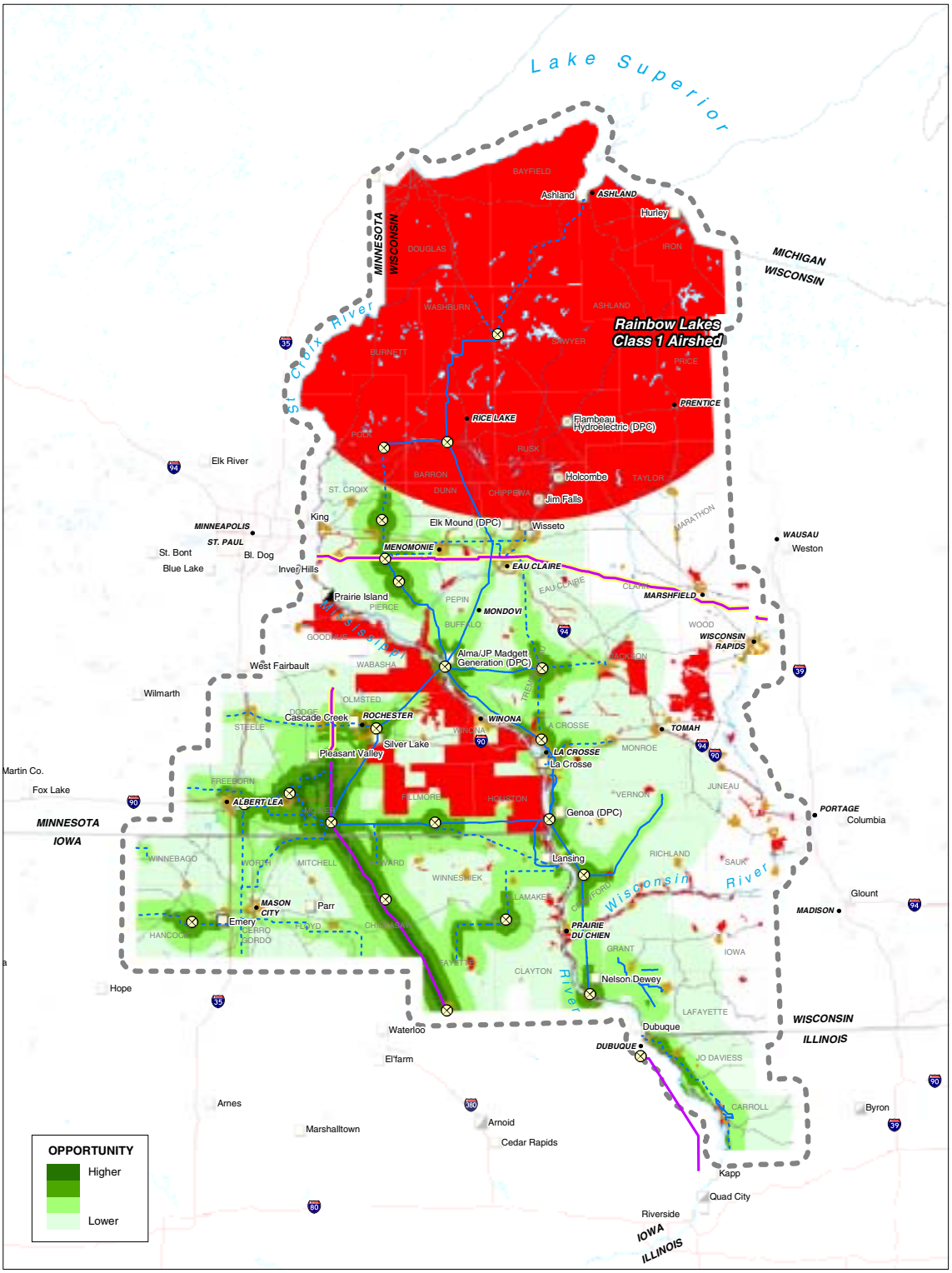
Another extensive area in the central portion of the study area was excluded as a result of the consolidation of reserved lands in that area; much of it associated with the Mississippi River corridor and certain adjacent uplands, such as the Richard J. Dorer Memorial State Forest in eastern Minnesota.

Avoidance areas occur at various locations and include cities, towns and sovereign tribal lands.

The composite of the Phase 1 opportunities and constraints analysis is shown in **Figure 7.5**. On this map, the shades of green indicate the highest convergence of fuel delivery and transmission opportunities based on closest distance to both. Areas with the darkest two shades of green areas indicate locations within 5 miles of potentially suitable fuel delivery and transmission connection locations and are not designated as an exclusion area. These two highest opportunity levels were carried forward to the Phase 2 analysis.

Much of the highest opportunity areas extend along the Mississippi River, branching into the uplands of Wisconsin toward Menomonie and Eau Claire, as well as Blair. In Minnesota, candidate siting areas include lands from Rochester to Albert Lea. Opportunity areas in Iowa include an east west rail corridor from Mason City to the Mississippi River as well as a 345kV transmission line corridor running north-south. Areas of greatest opportunity in Illinois are generally confined to the Mississippi River corridor.

The identification of these higher opportunity areas concluded the Phase 1 portion of the study and provided the starting point for a more refined level of study in Phase 2 to identify alternative sites within these areas.



LEGEND

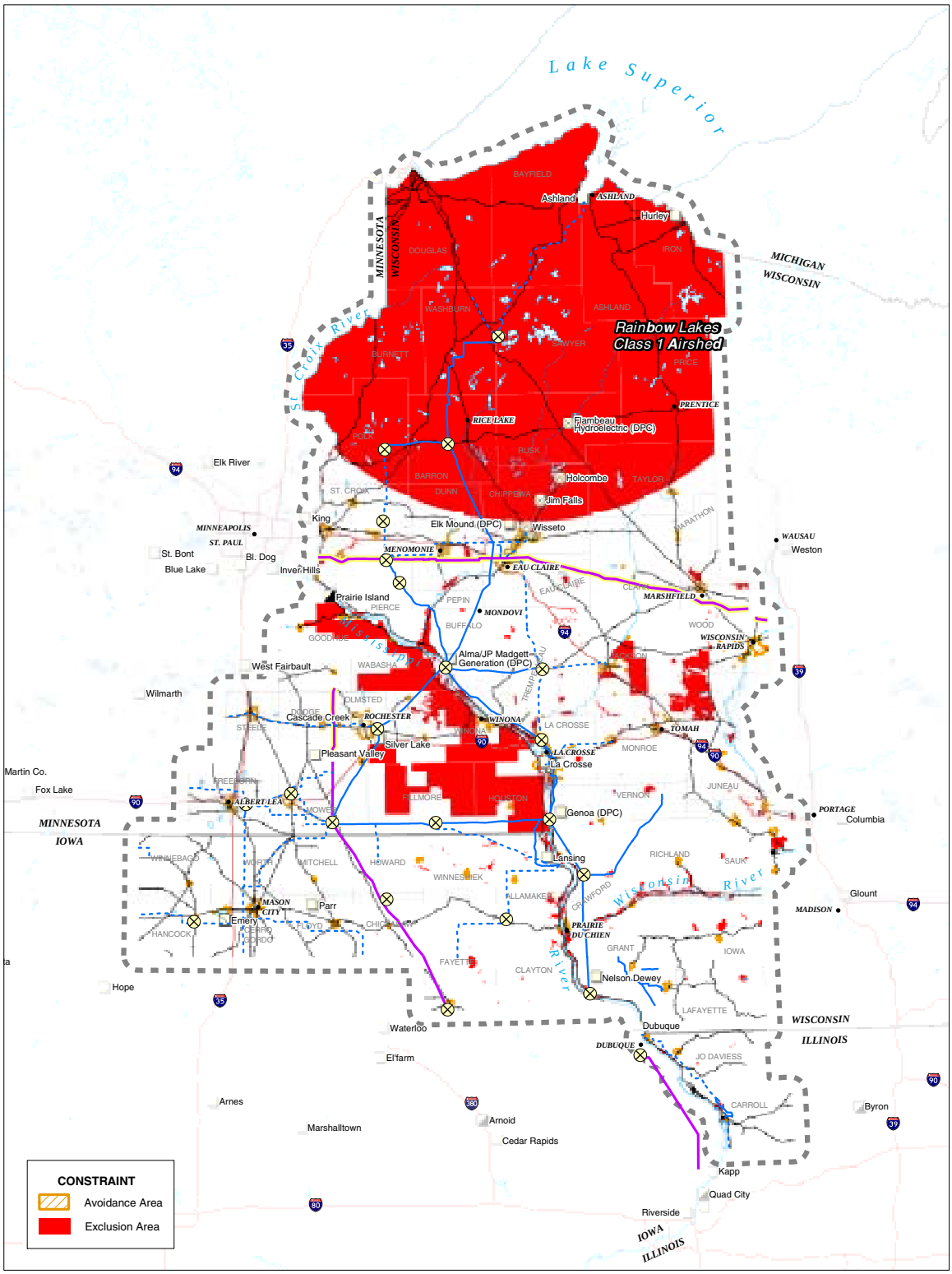
- 161 kV Foreign Transmission Line
- 161 kV DPC Transmission Line
- 345 kV Foreign Transmission Line
- Constrained Interface
- DPC Service Territory

Generation Facility

- Fossil Fuel
- Hydroelectric
- Nuclear
- Wind

- Injection Point
- Avoidance Area
- Exclusion Area

Figure 7.3
Opportunities - Transmission



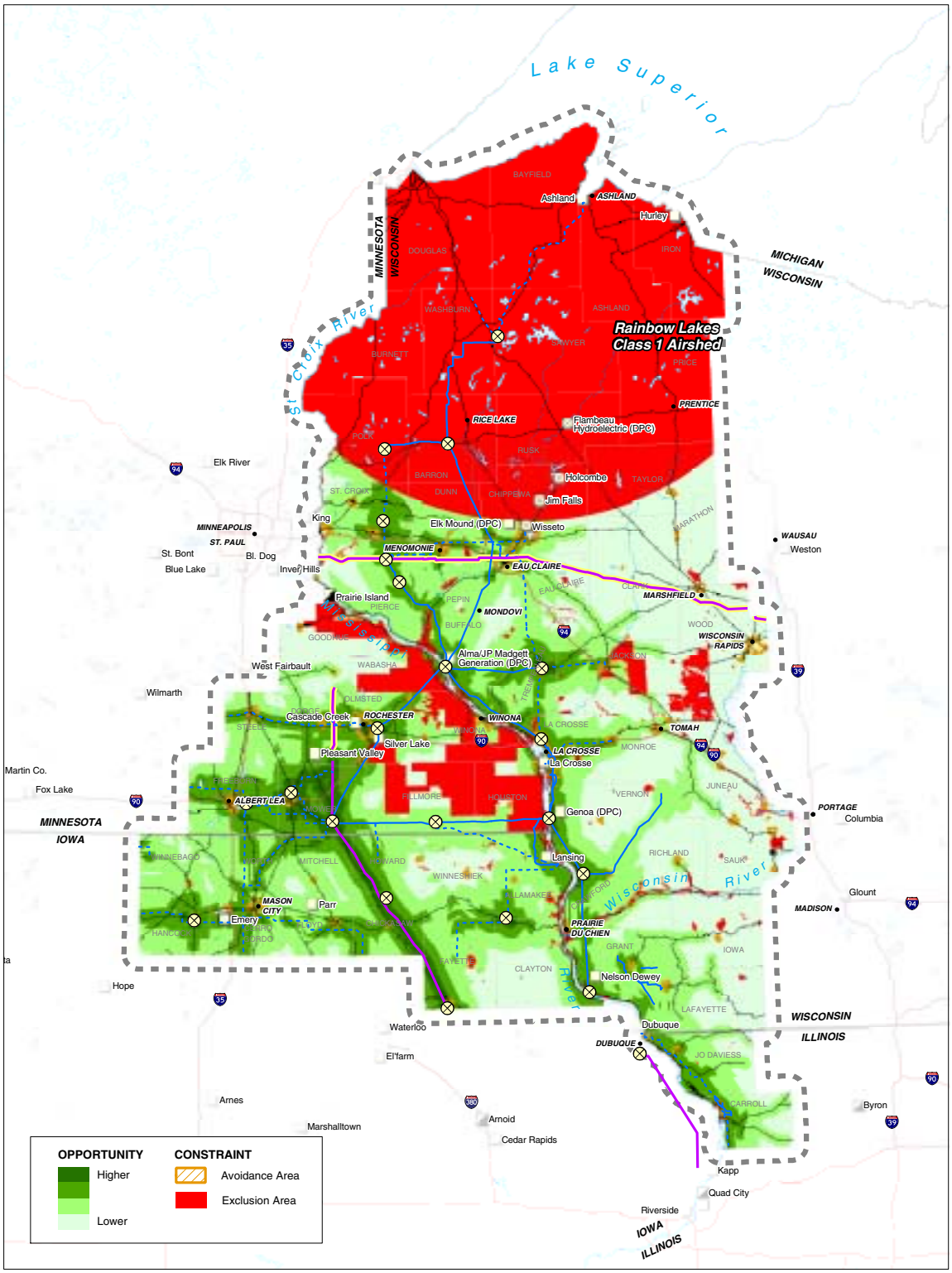
LEGEND

- Injection Point
- 161 kV Foreign Transmission Line
- 161 kV DPC Transmission Line
- 345 kV Foreign Transmission Line
- Constrained Interface
- DPC Service Territory

Generation Facility

- Fossil Fuel
- Hydroelectric
- Nuclear
- Wind

Figure 7.4
Constraints



LEGEND

- Injection Point
- 161 kV Foreign Transmission Line
- 161 kV DPC Transmission Line
- 345 kV Foreign Transmission Line
- Constrained Interface
- DPC Service Territory

Generation Facility

- Fossil Fuel
- Hydroelectric
- Nuclear
- Wind

Figure 7.5
Phase 1 Composite Map

8 Phase 2

The objective of Phase 2 was to identify specific power plant sites within the opportunity areas identified in Phase 1. In accomplishing this, a greater number of criteria conditions were inventoried and mapped. In all, seven criteria categories were used in the Phase 2 assessment. They include the following:

- transmission (a refinement of the transmission considerations used in phase 1)
- fuel delivery (a refinement of the rail and barge considerations used in phase 1)
- topography
- cultural and historic resources
- land use/land cover
- airports
- water source and discharge

Sources of data used in this phase of study came from an analysis of aerial photography, land parcel data, digital elevation models (DEMs), National Register of Historic Places, ground and surface water documentation, and local planning documents among others.

While Phase 1 identified opportunity areas, the combination of Phase 2 criteria was evaluated in terms of level of suitability within these areas of opportunity. For each criterion these were expressed as high, medium or low suitability, or as an exclusion area. These are listed in **Table 8.1**, while the suitability mapping process is shown in **Figure 8.1**.

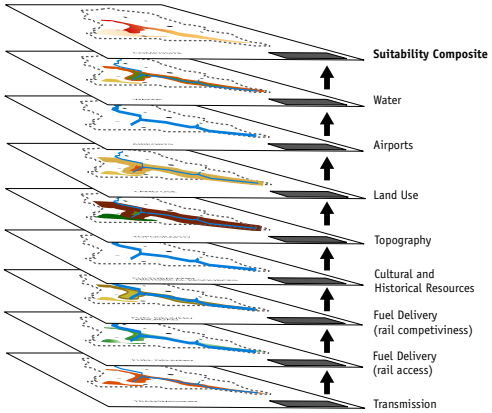


Figure 8.1

Phase 2 Suitability Mapping Process

Table 8.1
Phase 2 Suitability Values

Phase 2 Criterion	Suitability Value
Transmission	
within 5 miles of a best or good injection point	high
within 5 miles of a fair or marginal injection point	medium
Over 5 miles from an injection point	low
Fuel Delivery (rail access)	
within 5 miles of an active railroad	high
within 5 miles of an abandoned railroad	medium
beyond 5 miles of any railroad	low
Fuel Delivery (rail competitiveness)	
within 5 miles of a competitive rail junction	high
beyond 5 miles of a competitive rail junction	low
Cultural and Historic Resources	
within 0.5 miles of a site registered on the National Register of Historic Places	low
Topography	
under 10% slope	high
greater than 10% slope	low
Land Use	
brownfields, industrial	high
agricultural	medium
natural vegetation communities	low
commercial	exclusion
residential	exclusion
Airports	
within 2 miles of an airport	low
Water Supply	
within 1 mile of surface water of sufficient capacity	high
within area of *probably sufficient* groundwater	medium
within area of *probably insufficient* groundwater	low

A discussion of the rationale and application of each of the seven criteria follows.

Transmission

All of the opportunity areas carried forward to the Phase 2 analysis are in close proximity to a transmission line of potentially adequate capacity. To differentiate between these the focus of transmission as a Phase 2 criterion was on the proximity to potential injection points. These are the locations where a large injection of electrical voltage could be most efficiently added to the existing system with the least need for system upgrades, such as new or rebuilt transmission lines and substations.

In Phase 2 a distinction was made between injection points based on their quality (capacity to take on the electric load created by the new power plant with minimal system upgrades). Identified injection points were given a score based on a combination of subcriteria influencing quality, such as available capacity and number of transmission lines connected to the injection point. The total score for each injection point is the sum of a rating between 1 and 10 for each subcriteria. Total injection point scores were converted to a rating of best, good, fair or marginal. Five injection points that would only be suitable if the proposed Arrowhead to Westin 345kV transmission line is constructed in northern Wisconsin were eliminated from further consideration because of the uncertainties surrounding the construction of this transmission line.

Table 8.2 summarizes the injection point quality evaluation. The criteria used in Table 8.2 are described below. More detail is provided in **Appendix C**.

Table 8.2
Injection Point Rating

Injection Point	HV Line Score	Network Line Score	PTDF Score	MISO Queue Score	Ownership Score	Total Score	Rating
Genoa	7	10	10	10	10	47	best
Alma	7	9	10	10	10	46	best
Rochester	7	8	10	10	9	44	best
North La Crosse	6	5	10	10	9	40	best
Adams	10	7	10	5	7	39	good
Jerico	3	6	10	10	10	39	good
Tremval	6	7	7	10	9	39	good
Crystal Cave*	9	8	2	10	9	38	n/a*
Harmony	4	5	10	10	9	38	good
Seneca	4	5	8	10	10	37	good
Apple River*	3	10	2	10	9	34	n/a*
Austin	3	7	10	5	7	32	fair
Hayward	6	5	10	7	4	32	fair
Rock Elm	3	3	6	10	10	32	fair
Barron*	4	5	2	10	10	31	n/a*
Pine Lake*	6	6	2	10	7	31	n/a*
Hazelton	9	0	7	10	4	30	fair
Stone Lake*	4	5	2	10	9	30	n/a*
Postville	3	0	10	10	4	27	marginal
NED Cassville	6	0	6	10	4	26	marginal
Emery	6	0	8	3	4	21	marginal
Lore Dubuque	6	0	1	10	4	21	marginal

* Dependent upon construction of the Arrowhead-Weston 345 kV transmission line

HV Line Score
The number of high voltage (HV) lines above 115kV correlate to the actual or potential outlet capacity of a generator injection point. The outlet capacity of these sites can be increased, in general, by upgrading or rebuilding these existing lines rather than constructing additional lines.

Network Line Score
This is the sum of the network outlet capacity of the lines at a particular generator injection point. The outlet capacity provides an indication of the how much transmission upgrades are needed in order to make the site suitable as a generator injection point.

Lines within the Xcel Energy Northern States Power (NSP) network agreement avoid tariff charges and are from an economic standpoint more desirable than non NSP network lines.

Power Transfer Distribution Factor (PTDF) Score
PTDF violations occur when the output of a generator serving the Dairyland control area load accounts for greater than a 5% increase of flow on a MAPP constrained interface. This flow must also be greater than 1 MW to cause a violation to occur. Mitigation's must be made to correct the violation before the generator can be accredited by MAPP.

MISO Queue Score
The Midwest Independent System Operator (MISO) has a queue of planned generators. These generators will consume available transmission capacity and must be considered when evaluating the suitability of the generator injection point.

Ownership Score
If Dairyland owns the facility, capital investments become Dairyland assets. If Dairyland must spend money to upgrade the facilities of other utilities, it is considered not as advantageous.

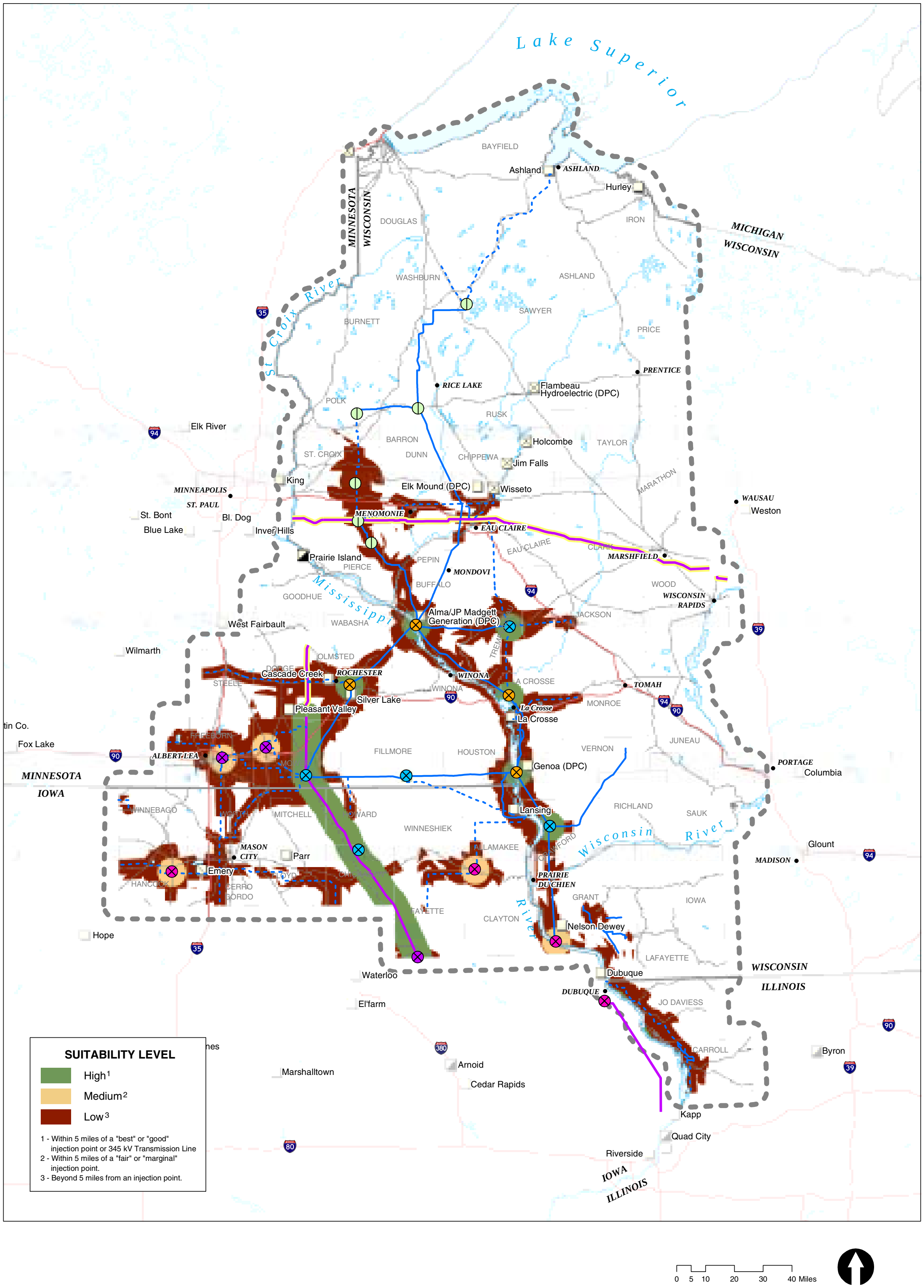
The 345kV transmission line in the study area was also regarded as a high quality injection point for the purposes of this analysis. Making a connection at any point along the length of this transmission line not identified as a constrained interface would be effective from an electric system perspective.

Areas within 5 miles of a *best or good* injection point were given a high suitability rating. Areas within 5 miles of a *fair or marginal* injection point were given a medium suitability rating. A low suitability rating was applied to areas beyond 5 miles of one of these injection points.

The transmission suitability analysis is shown in **Figure 8.2**. This reveals a pattern of high suitability around the injection points along the Mississippi River in the central portion of the study area, plus Tremval in Wisconsin and Rochester in Iowa. A large corridor of high transmission suitability also follows the 345kV transmission line in northern Iowa and southern Minnesota.

Fuel Delivery - Rail Access

Proximity to railroads for fuel (coal) delivery was one of the opportunity criteria in Phase 1. In Phase 2, a distinction was made between active and abandoned railroads. Proximity to an active railroad is considered



LEGEND

161 kV Foreign Transmission Line
161 kV DPC Transmission Line
345 kV Foreign Transmission Line
Constrained Interface
DPC Service Territory

Generation Facility
- Fossil Fuel
- Hydroelectric
- Nuclear
- Wind

Injection Point
- Best
- Good
- Fair
- Marginal
- Needs Proposed Arrowhead-Weston 345kV to be Built

Figure 8.2
SUITABILITY - TRANSMISSION

to be more advantageous than proximity to an abandoned railroad because of the expense and potential impacts of restoring an abandoned railroad to an operational level.

Areas within 5 miles of an active railroad are identified as high suitability, while areas within 5 miles of an abandoned railroad are medium suitability. All areas beyond 5 miles of any railroad were regarded as low suitability.

All potential barge access points along the Mississippi River are in close proximity to an active railroad and are therefore within the high suitability area for the fuel delivery criterion.

Figure 8.3 shows the results of the Phase 2 fuel delivery (rail access) suitability analysis. Areas of high suitability areas cover much of the Mississippi River corridor, following railroads that are located on both sides of the river. Active railroads in other parts of Wisconsin, create high suitability areas around Blair, Eau Claire and Menomonie. An extensive network of railroads in southern Minnesota and northern Iowa create large areas of high suitability in the western portion of the study area.

Fuel Delivery - Rail Competitiveness

A second fuel delivery criterion was introduced to the Phase 2 analysis. This was based on the proximity of an area to two or more railroads owned by different companies which are likely to provide more competitive prices for coal delivery. A competitive fuel delivery situation can result in extremely large cost savings to Dairyland, particularly when calculated over the life of a power plant.

Two locations were identified (**Figure 8.4**) where this high level of rail competition would occur. Locations within 5 miles of these two locations are given a high suitability rating, while areas beyond this radius are rated as low suitability under the fuel delivery competitiveness criterion.

The first location is at the junction of the Canadian National Railroad and the ICE railroad at Lyle, Minnesota adjacent to the Iowa border. The second is another intersection of railroads owned by these two companies at Charles City, Iowa. Nearby interchanges between these and other railroads add to the competitiveness of these two locations.

Topography

The consideration of topography was included in Phase 2 because of the environmental impacts and higher costs associated with constructing a coal-fired power plant in steep areas. Because of the size of the area needed, constructing in steep topography would likely require extensive earthwork, with both environmental and cost implications. A slope analysis of the Phase 2 siting area was conducted using a digital terrain model to identify areas greater than 10% slope. Lands with substantial areas of slope beyond this threshold were regarded as presenting a significant constraint and were given a low suitability rating. All other areas are given a high suitability. No medium suitability threshold was defined due to the coarseness of the analysis.

Figure 8.5 shows the result of this analysis. Much of the river bluff and hill country along the Mississippi River corridor exceeds 10% slope and were therefore assigned a low suitability designation. Low suitability lands are also concentrated in the Black River Valley north of Lacrosse, Wisconsin. With the exception of some scattered lands around Rochester and in northeast Iowa, the remainder of the Phase 2 study area has a high suitability based on considerations of topography, reflecting the plains of Iowa and Minnesota.

Cultural and Historic Resources

The potential impact to cultural and historic resources was considered to be an important consideration. The objective of this assessment was to identify significant resources so that they could be avoided, both from the perspective of direct physical impacts as well as protecting the integrity of their setting. A search of the National Register of Historic Places was conducted to locate any sites occurring on the register within the study area. Information on the significance of individual sites was not obtained for this Phase of the Site-Selection Study. Areas within 0.5 miles of sites listed on the register were given a low suitability rating for this criterion. Areas beyond this were given a high suitability rating.

The results of this analysis are shown on **Figure 8.6**. Sites of Low suitability are generally present as small and isolated features. Some clusters of sites listed on the register do occur, most notably in the south-western corner of the study area, west of Mason City.

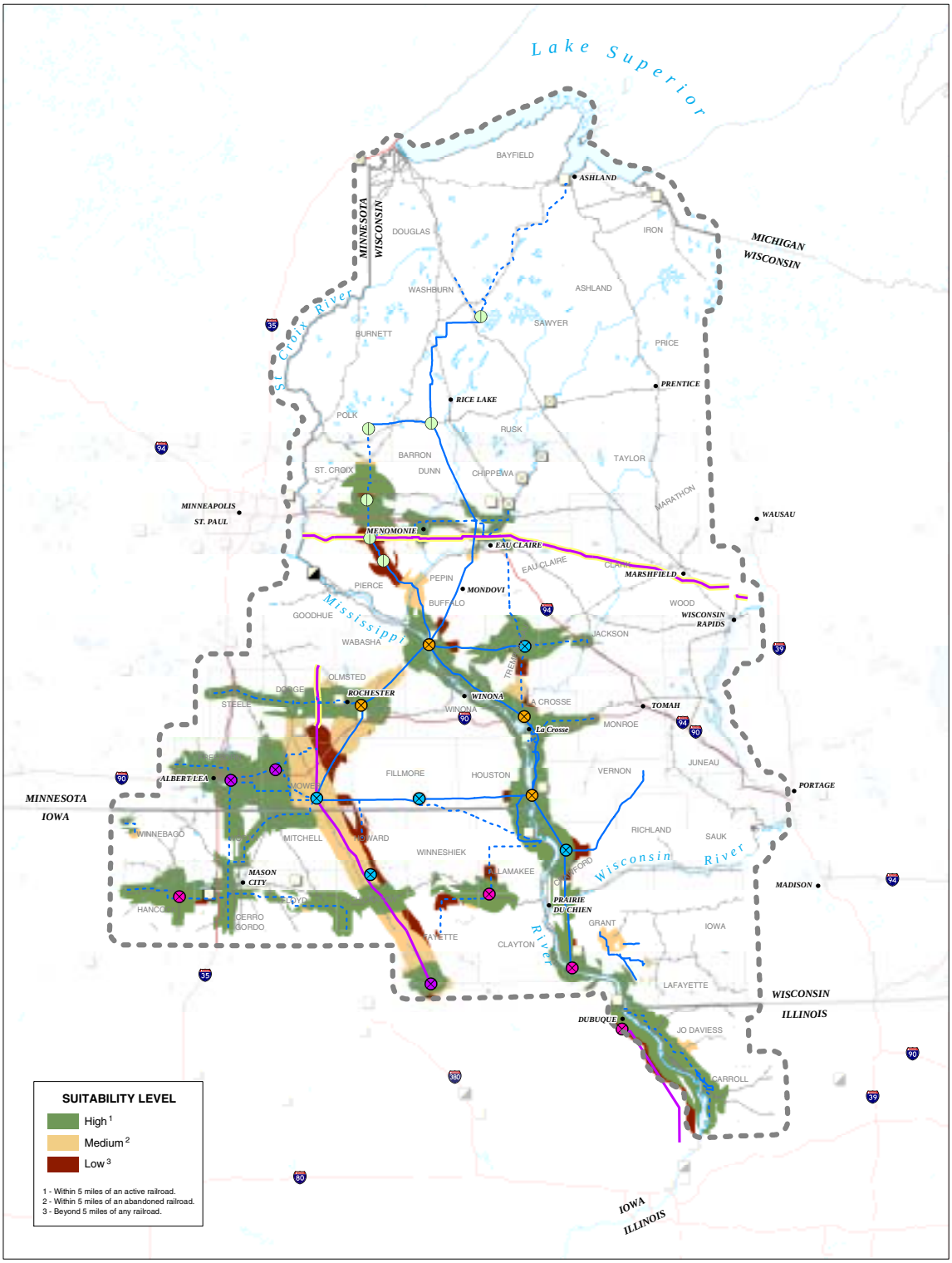
Land Use/Land Cover

Minimizing impacts to land use and sensitive types of land cover was also seen as an important objective.

National Land Cover Data (NLCD) from the United States Geological Survey (USGS) was the primary source of data used to determine land use and land cover in the Phase 2 siting area. This source was used because it is the most accurate data available that covers the entire Phase 2 siting area.

For this analysis several categories of land use and land cover were identified. These include residential, commercial, industrial, agricultural, and areas of natural vegetation. Residential land uses were given an Exclusion rating as there would be no foreseeable circumstances where a power plant of this type would be sited in a residential area. It was intended that commercial land uses would be classified as an exclusion and industrial land uses would be rated as a high suitability. However, the NLCD classification grouped these into one category. To address this, areas classified by the NLCD as commercial/industrial that were under 100 acres (minimum feasible sized parcel for siting the power plant) were classified as exclusion since they would not be suitable as a power plant site in any event. Commercial/industrial sites greater than 100 acres were conditionally classified as having a high suitability because of the likelihood that an area of this size would be industrial rather than commercial. If this assumption proved incorrect in any individual case, it would be corrected through a review of aerial photography that occurred later in Phase 2.

Separate investigations were carried out to identify brownfield sites, as these are potentially advantageous from a siting perspective and are not classified in the NLCD. Dairyland commissioned 3D Strategies Inc. to undertake a survey of local government and economic development organizations within the Phase 2 opportunity areas to identify potential brownfield and industrial sites that may be suitable for the development of a power plant. A summary of this survey is included as **Appendix D**. Several brownfield sites and other sites that local authorities had designated for future industrial use were identified and classified as high suitability.



LEGEND

- 161 kV Foreign Transmission Line
- 161 kV DPC Transmission Line
- 345 kV Foreign Transmission Line
- Constrained Interface
- DPC Service Territory

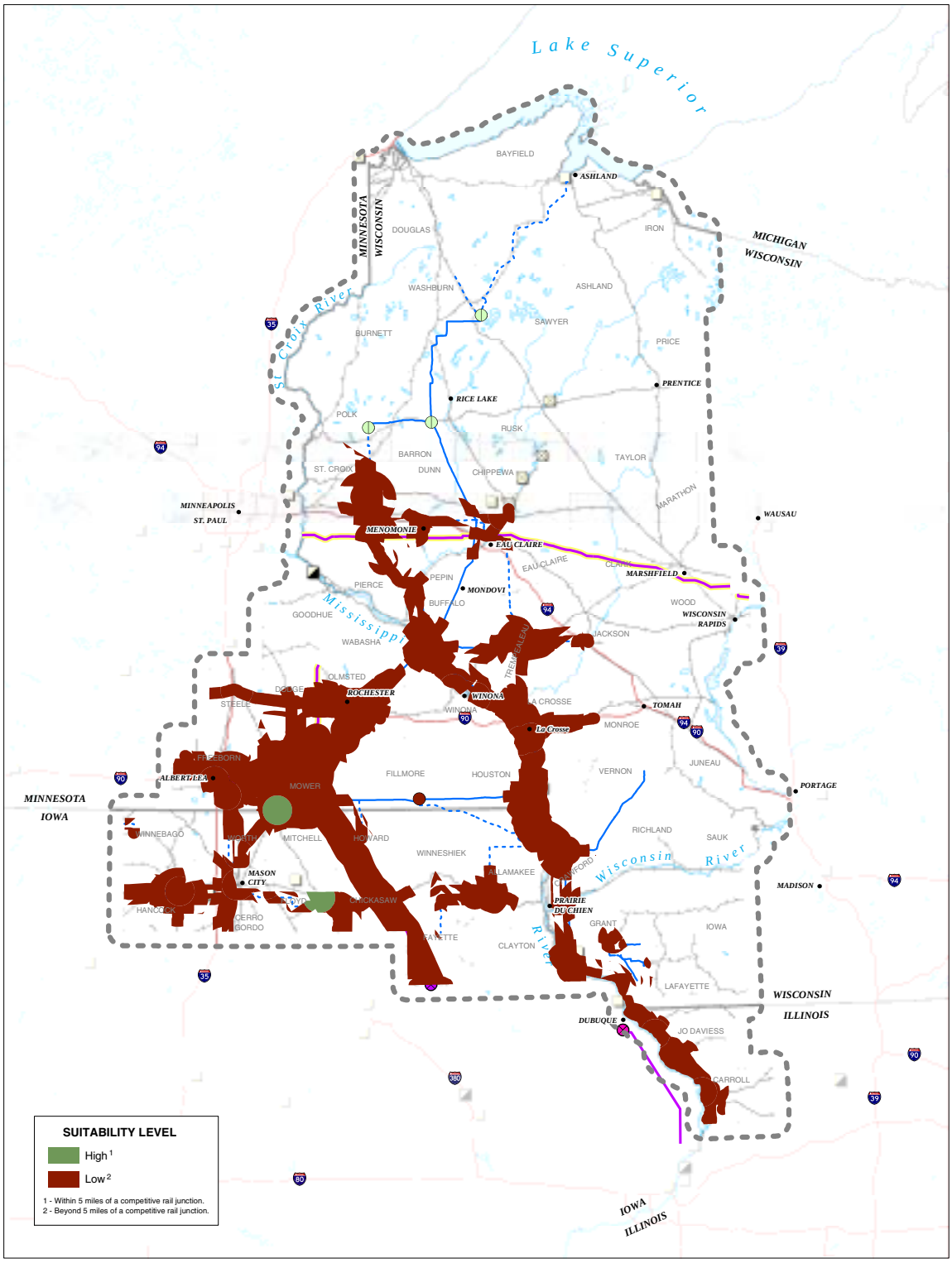
Generation Facility

- Fossil Fuel
- Hydroelectric
- Nuclear
- Wind

Injection Point

- Best
- Good
- Fair
- Marginal
- Needs Proposed Arrowhead-Weston 345kV to be Built

Figure 8.3
Suitability - Fuel Delivery (Rail Access)



LEGEND

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Generation Facility

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- Wind

Injection Point

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Figure 8.4
Suitability - Fuel Delivery (Rail Competitiveness)

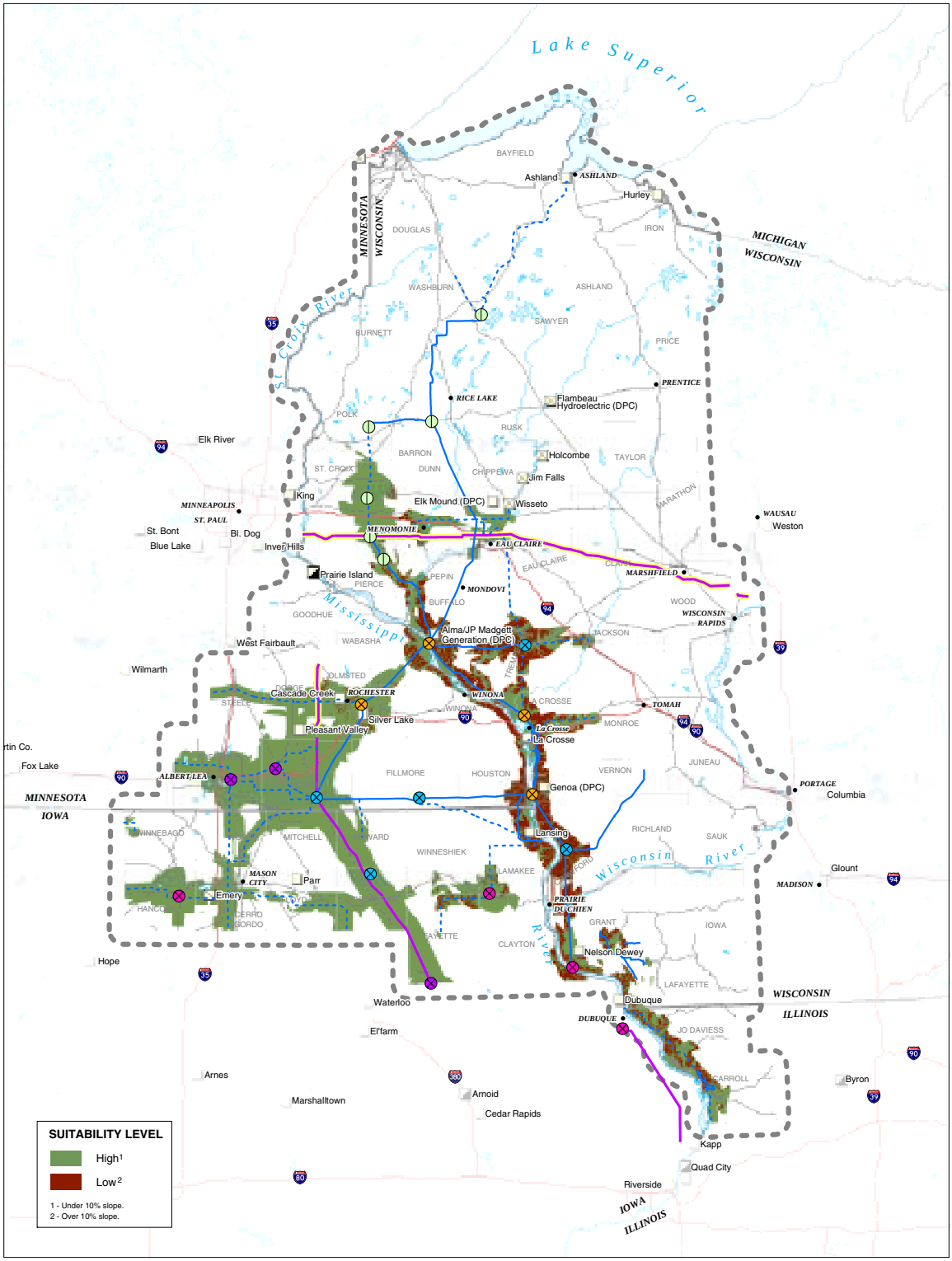

Figure 8.5
Suitability - Slope

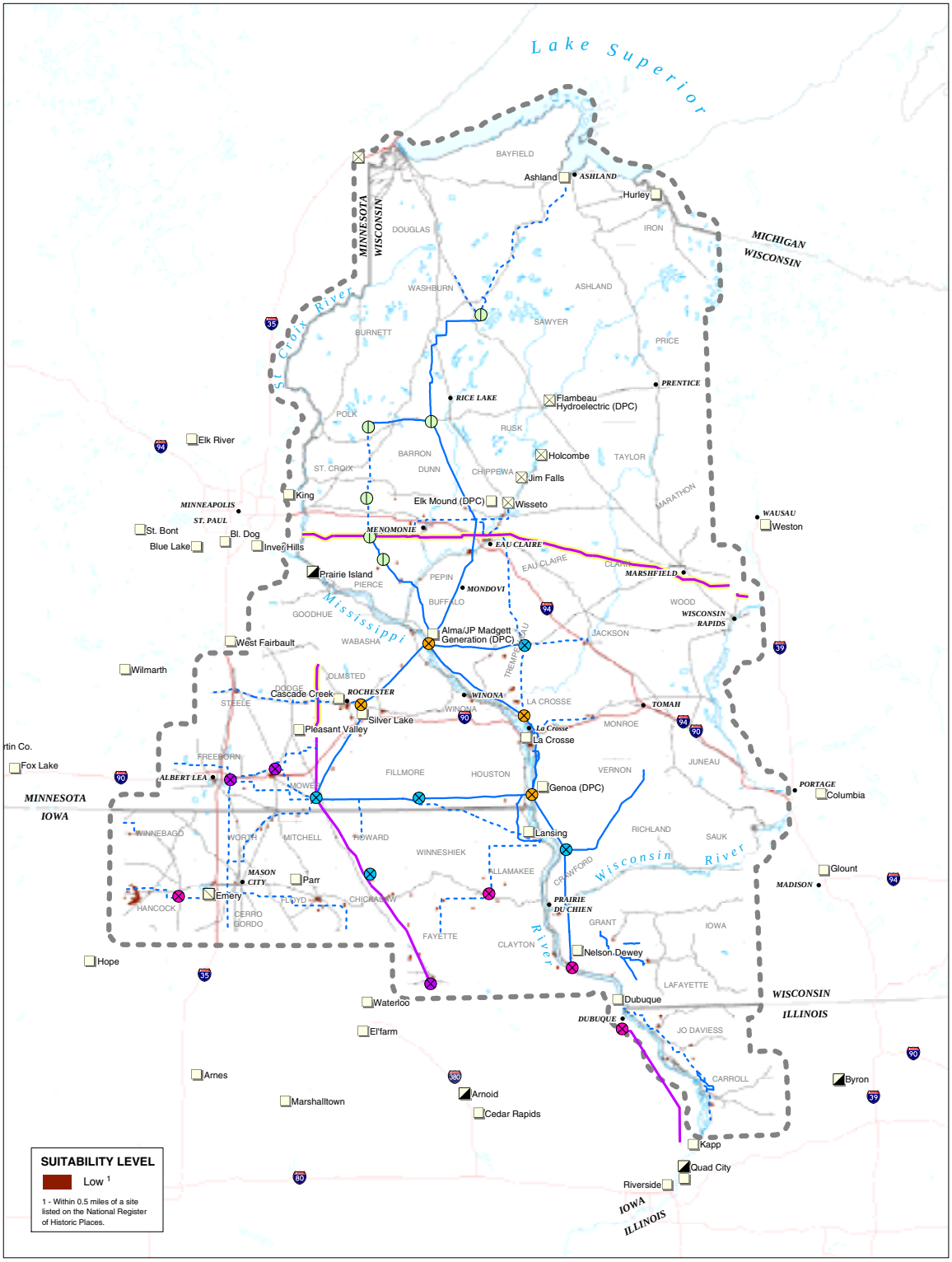

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Figure 8.6
Suitability - Cultural and Historic Resources

Agricultural land is rated as medium suitability. While siting a power plant on agricultural land will negate the production value of a substantial portion of that land, ecological impacts likely to be relatively low when compared to areas of extensive natural vegetation. Social impacts are likely to be low in terms of the number of people affected when compared to areas of higher population density.

Natural vegetation communities were rated as low suitability because of the inherent values and the potential to include important habitat for sensitive species. Habitat of Threatened and Endangered, or otherwise significant plant and animal species was not addressed directly in the Phase 2 analysis because of the lack of availability of consistent, detailed data across the Phase 2 siting area. It was decided that by designating natural vegetation communities as a low suitability, much of the potential and actual habitat of significant species would be eliminated from detailed consideration. Any potential ecological issues that remained in the alternative sites selected at the end of Phase 2, would be addressed with site specific data in the Phase 3 analysis.

Figure 8.7 shows the results of the Phase 2 land use/land cover mapping. High suitability areas, while present, are not highly visible at the scale of mapping shown. These site are however visible as higher suitability areas in the large scale Phase 2 composite maps (**Figures 8.11-8.15**). The high suitability areas include brownfield, industrial and proposed industrial areas at Alma, Wisconsin (within the existing Alma power plant site), Prairie du Chein, Wisconsin, Savannah, Illinois (the former Savanna Army Depot), Thomson, Illinois, Charles City, Iowa and Albert Lea, Minnesota.

Large areas of medium suitability follow the agricultural pattern in Minnesota and Iowa. Natural vegetation along the Mississippi River corridor create extensive areas of low suitability. Low suitability reflects the pattern of urban settlement in the study area.

Airports

Areas within two miles of airports were classified as being of low suitability. Two miles was determined to be an area within which the tall structures associated with a power plant are likely to have a higher probability of impact on aircraft safety. No distinction was made between the type of airport, as the specific characteristics of an airport if it did have a potential impact on the siting of the power plant, could be addressed in later stages of the Site-Selection Study. **Figure 8.8** shows the location of these airports with their two-mile buffers.

Water Supply

The availability of a reliable water source is a key siting criterion for all steam cycle power plants. A comprehensive screening of all potential water sources was conducted as part of the Phase 2 siting process. Specific characteristics of the potential water sources that were evaluated included the quantity of the source, reliability over the projected life of the project, seasonal variability, quality, and regulatory status. Based on these characteristics, a ranking was given to each potentially available water source.

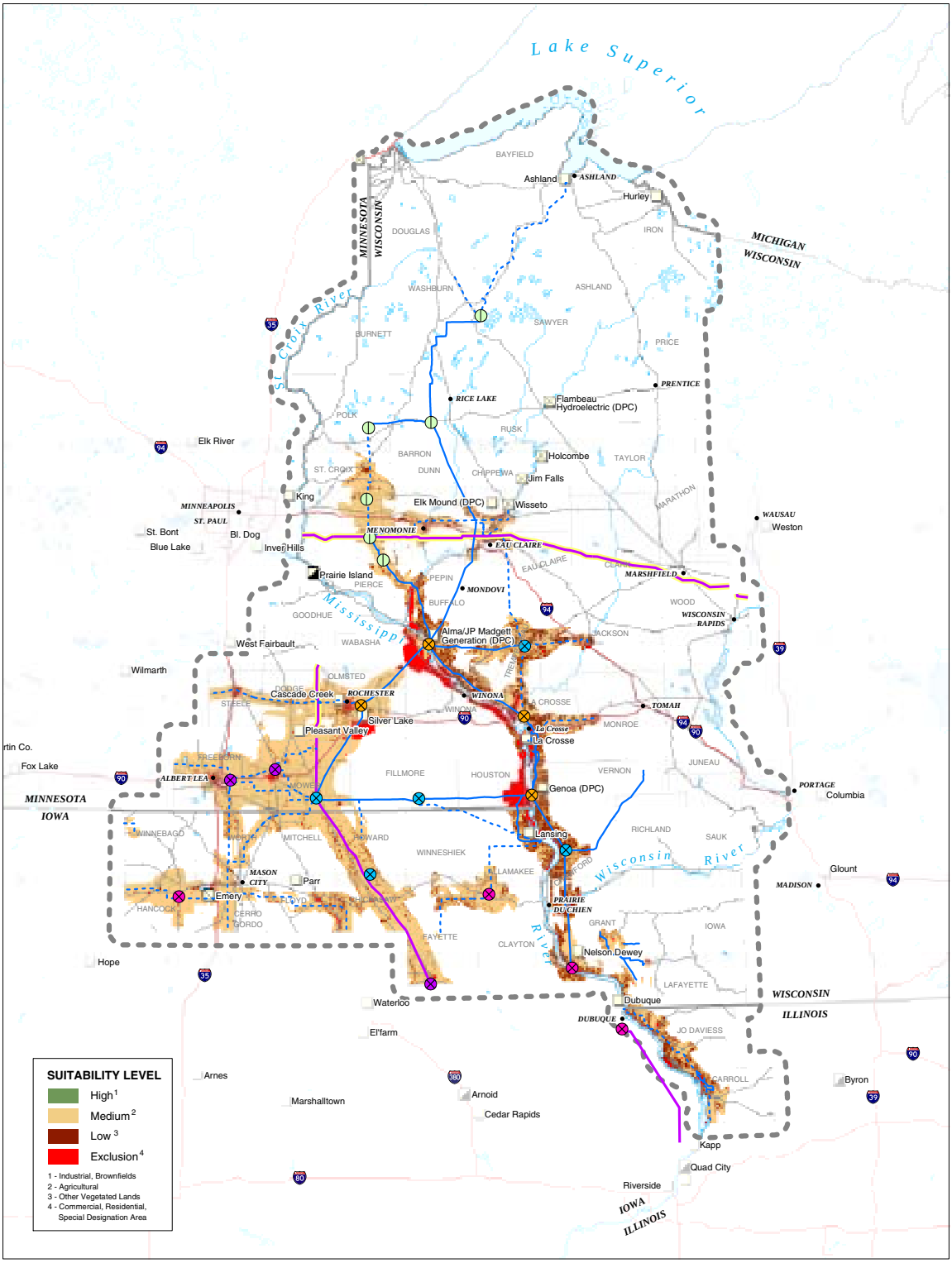
The majority of water used for the coal fired power plants is used for condenser cooling (cooling water), with other uses including steam cycle make up, potable water, and other incidental uses. Condenser cooling is accomplished through either the use of once through systems or through the use of cooling towers. In the case of once through cooling, water is drawn into the facility, typically from a large surface water source, and used for condenser cooling without the use of evaporative cooling. The resulting discharge has an increased temperature but with little or no change in quality. Cooling systems that utilize cooling towers typically recycle the water from three to ten times and thus use less overall water. However approximately three quarters of the cooling water is lost through evaporation, resulting in an increase of dissolved solids. Therefore, discharges from power plants using cooling towers typically have lower volumes and temperatures than once through systems but have higher concentrations of dissolved solids.

Major sources of surface water are regarded as highly desirable for the operation of a wet cooled coal fired power plant, while groundwater may also be effectively used provided it is available in sufficient quantities and of required quality. For this phase of the study all rivers and lakes within Dairyland's service area that were of sufficient size were identified and evaluated for water volume, quality and discharge acceptability.

An evaluation of the availability of groundwater including potential yields and quality information was conducted by reviewing data for each bedrock aquifer system as available from the United States Geological Survey (USGS) Hydrologic Investigations Atlas 730-J, Segments 9 and 10, 1992 and 1995, respectively.

An analysis of surface and groundwater resources within the study resulted in the identification of three classes water availability. These include:

- Areas of sufficient surface water availability (rated as high suitability). These areas were the major river systems that had a water supply sufficient for a plant that utilized cooling towers to achieve multiple cycles of cooling. The cooling water volume needed was estimated to be approximately 7.1 million gallons per day. The criteria was established for the purposes of the siting study, that the needed water volume be less than 10% of the 7 day minimum flow for the surface water body to be rated as high suitability. It was recognized that this criteria was set based on previous permitting and discharge experience and site specific analysis would be necessary to confirm that this supply could be used for the intended purpose. This analysis resulted in the following rivers being identified as high suitability. In Wisconsin, the Black River, Chippewa River, Flambeau River, Red Cedar River, Trempealeau River, Wisconsin River, and the St. Croix River. In Minnesota the Cannon River, Root River, and lower stretches of the Zumbro River all met this criteria. In Iowa the Turkey River and the lower stretches of the Wapsipinicon River both met the criteria. The Mississippi River which borders all states also met the criteria. Albert Lea lake was also considered as a possible water source of high suitability. Smaller Rivers and lakes were still considered as possible sources but were grouped with groundwater sources rated as medium suitability since it was unlikely that all the necessary water needed for cooling could be withdrawn from these types of sources and that groundwater may be necessary to supplement the surface water source.
- Areas of sufficient groundwater availability (rated as medium suitability). These are areas where it is likely that groundwater of sufficient quantity and quality will be available over the life of the facility. Two major aquifer systems cover the majority of Dairyland's service area and have the capacity to yield the required volume of water. They are as follows:
    - The Cambrian-Ordivician aquifer is a surficial bedrock aquifer that extends from western/southwestern Wisconsin and in the Minneapolis, St. Paul area in Minnesota southwestward through Iowa and Illinois. This is a multi-aquifer system (two sandstone aquifers and one dolomite/sandstone aquifer) with individual aquifers separated by leaky confining units.
    - The Upper Carbonate aquifer is a surficial bedrock aquifer consisting of limestone, dolomite, and dolomitic limestones. This aquifer occurs in the Minnesota portion of the study area and



LEGEND

- 161 kV Foreign Transmission Line
- 161 kV DPC Transmission Line
- 345 kV Foreign Transmission Line
- Constrained Interface
- DPC Service Territory

Generation Facility

- Fossil Fuel
- Hydroelectric
- Nuclear
- Wind

Injection Point

- Best
- Good
- Fair
- Marginal
- Needs Proposed Arrowhead-Weston 345kV to be Built

Figure 8.7
Suitability - Land Use/Land Cover

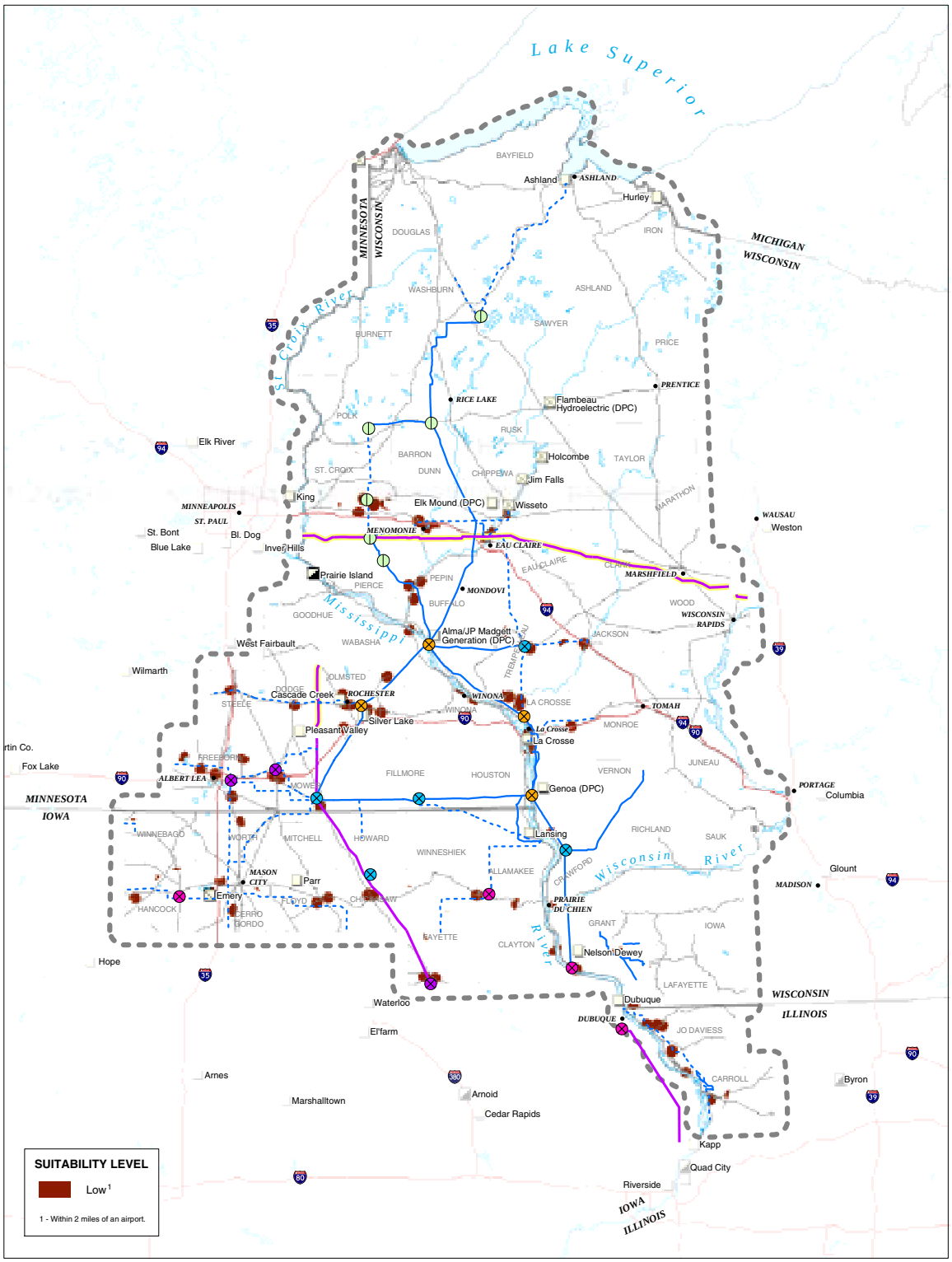


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Figure 8.8
Suitability - Airports

extends into Iowa although it is not very fractured in Iowa due to facies change and rocks are deeply buried. Thickness is very narrow around its edge to 650 feet in the center (southern portions of the Freeborn and Mower counties, Minnesota). Recharged through overlying surficial aquifer.

- Areas of insufficient groundwater availability (rated as low suitability). These are areas where the bedrock aquifers are mainly crystalline rock which have low permeability resulting in low yields insufficient for cooling water purposes. This aquifer is present in northern Wisconsin. Groundwater that is used locally in this area is typically from surficial, glacial or alluvial deposits. Surficial aquifers comprised of unconsolidated alluvium and/or glacially-deposited materials in these areas are available, but were considered too localized to be considered as viable options.

Figure 8.9 shows the classification of Phase 2 lands with regard to water availability. Surface water is available along the major rivers, namely the Mississippi River, the Wisconsin River, the Chippewa River and the Eau Claire River. Areas of low suitability are found in the northern reaches of the Phase 2 study area where groundwater becomes less available. Elsewhere, the lands are rated as moderate, meaning that there is *probably sufficient groundwater capacity*.

In addition to surface waters and groundwater, discharges from municipal Wastewater Treatment Plants (WWTPs) can be used for cooling water purposes. Tertiary treatment of this effluent would be necessary before it could be used. Municipal WWTPs with effluent discharges meeting the required volume (7.1 MGD) were identified, however, none of these WWTPs were located within an area of high suitability based on rail and transmission lines, so this option was not pursued further.

The results of overlaying the suitability values for each Phase 2 criterion is shown in the composite Phase 2 suitability map (**Figure 8.10**). Larger scale subunits of the Phase 2 composite map are shown in **Figures 8.11-8.15**.

To produce the composite map, numerical values were assigned to each suitability level for each criterion. Areas of high suitability received a score of 0, areas of moderate suitability a score of 1, areas of low suitability a score of 2, and exclusion areas a score of 999 (so that they were well beyond the high to low suitability scale). The scores of the seven criteria were digitally compiled (added) and the resulting totals presented in map form. Areas with the greatest suitability thus had the lowest scores and areas of poorest suitability had high scores.

This process resulted in twelve different levels of suitability, plus exclusion. Theoretically an area could score 0 if it had ratings of high suitability for all seven criteria. However, the lowest actual score was 2, meaning that every area had at least one low or two moderate ratings. Those areas falling within the first three levels were selected for more detailed examination. The third level of suitability was chosen as the cutoff point based on the predicted ability to identify an adequate number of alternative sites from within the 363 square miles of the study area that fell into these first three levels of suitability. This decision was based on the primary study objective, which was to identify the most suitable sites within the study area. It was also recognized that if this level of stringency did not result in the identification of an adequate range of suitable alternative sites, that lands in the less suitable categories could then be examined as well.

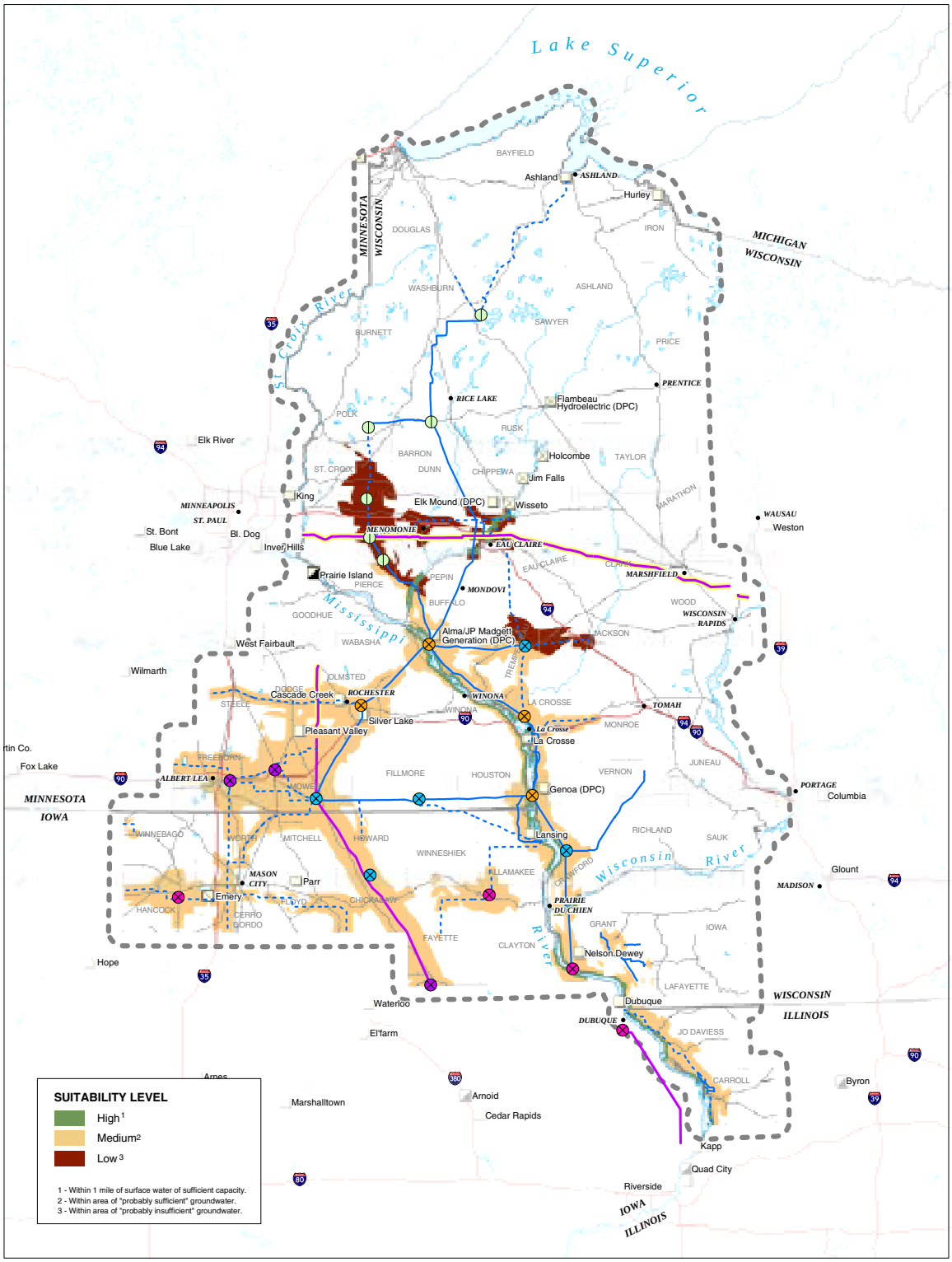
The top three suitability levels included areas around Blair Wisconsin, Alma Wisconsin, La Crosse Wisconsin, East Dubuque Wisconsin, Rochester Minnesota, Hayward Minnesota, Lyle Mn/Mona Iowa, Staceyville Iowa, Charles City Iowa, New Hampton Iowa, Arlington Iowa, Savanna Illinois and Thomson Illinois.

A more detailed examination of the lands included in the top three suitability levels was then conducted. This was done in part by reviewing large scale aerial photography. The aerial photography allowed a more precise identification of specific land uses than the broad scale land use data that had been used in developing the composite suitability map.

Within each of these areas, suitable locations were sought where a power station could be sited adjacent to or very close to both a transmission injection point and an active railroad. A number of such locations were subsequently identified that were free of residences and all other significant constraints. These sites were identified and delineated as candidate power plant sites.

In a few instances, sites were identified as having high suitability in all respects except for nearby proximity to a transmission injection point. When these conditions occurred at a brownfield site, the area was included as a candidate alternative site as well because of its very high land use compatibility. The rationale being that the land use displacement that would occur at a greenfield site would not occur at a brownfield site and thus could partially offset some transmission line construction or rebuilding.

Twelve alternative sites were identified (**Figure 8.16**). Three are located in Wisconsin: at the existing Alma plant; a site at Blair, east of Alma in Trempealeau County; and at Brice Prairie, north of La Crosse. Three sites are located in Minnesota: a site east of Rochester; a site near Kellogg, across the river from Alma; and the Hayward site, east of Albert Lea. Five sites are located in Iowa. They include the Otranto site near the Minnesota state line in Mitchell County, the Charles City and New Hampton sites in the central portion of Dairyland's Iowa service territory, and the Turkey River and Dubuque sites near the Mississippi River. The remaining two sites were in Illinois; Eagles Landing and Thomson, both located along the Mississippi River. The 12 sites were then carried into a more detailed comparative analysis in Phase 3.



LEGEND

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Generation Facility

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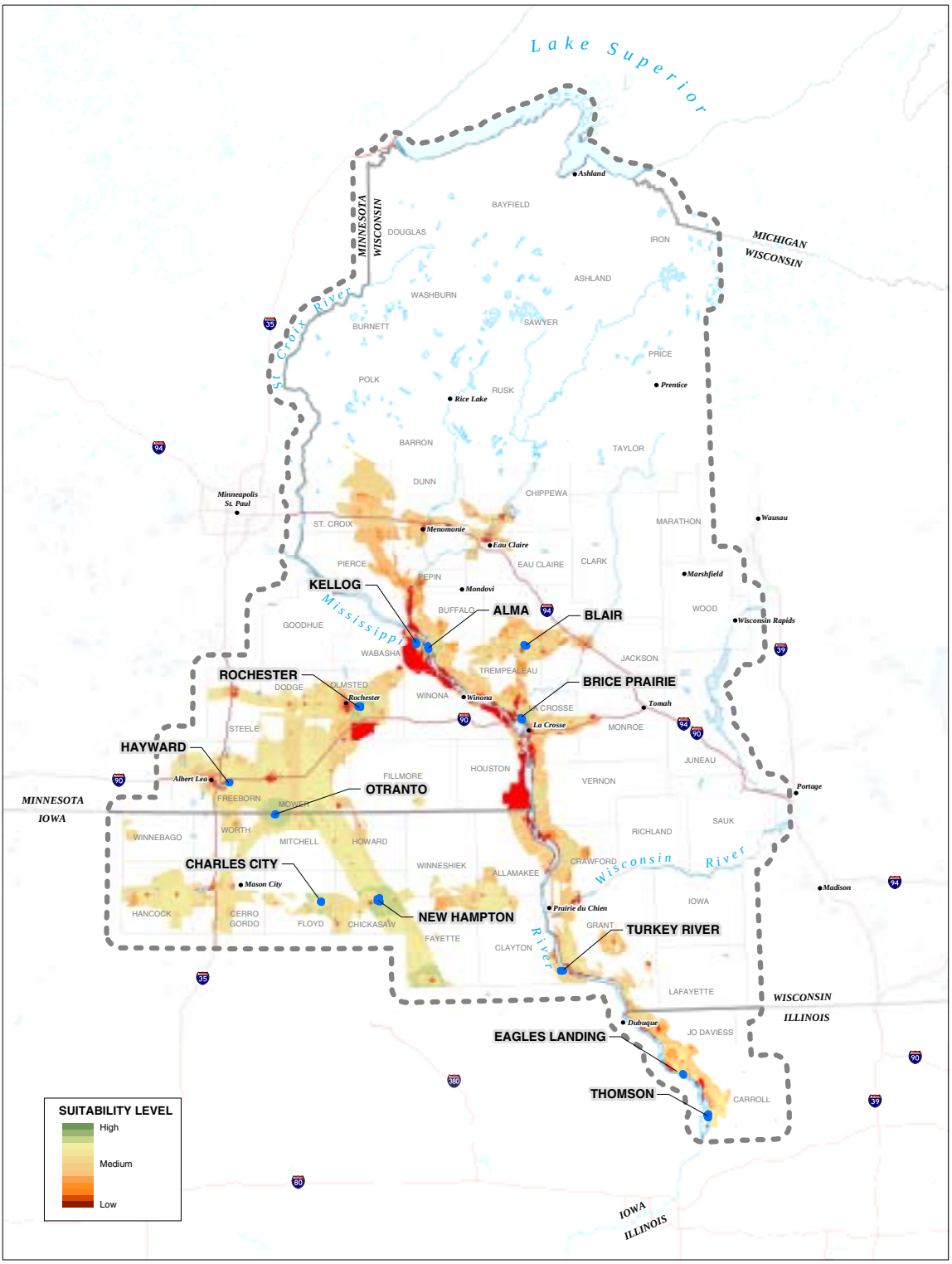
Injection Point

- Best
- Good
- Fair
- Marginal
- Needs Proposed Arrowhead-Weston 345kV to be Built

Figure 8.9
Suitability - Water Supply



LEGEND

- DPC Service Territory
- Exclusion
- Potential Site

Figure 8.10
Phase 2 Composite Suitability Map

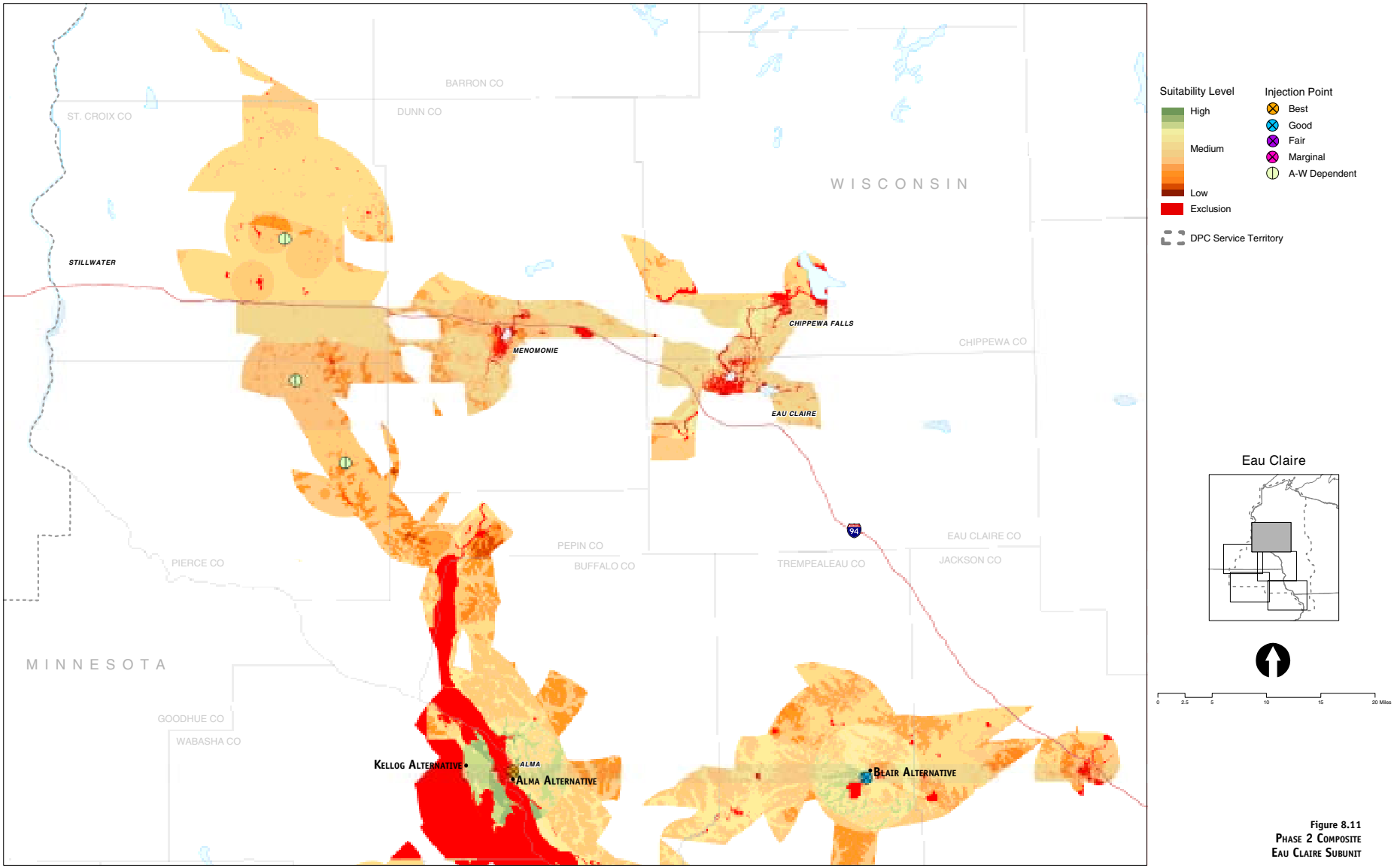


Figure 8.11
Phase 2 Composite
Eau Claire Subunit

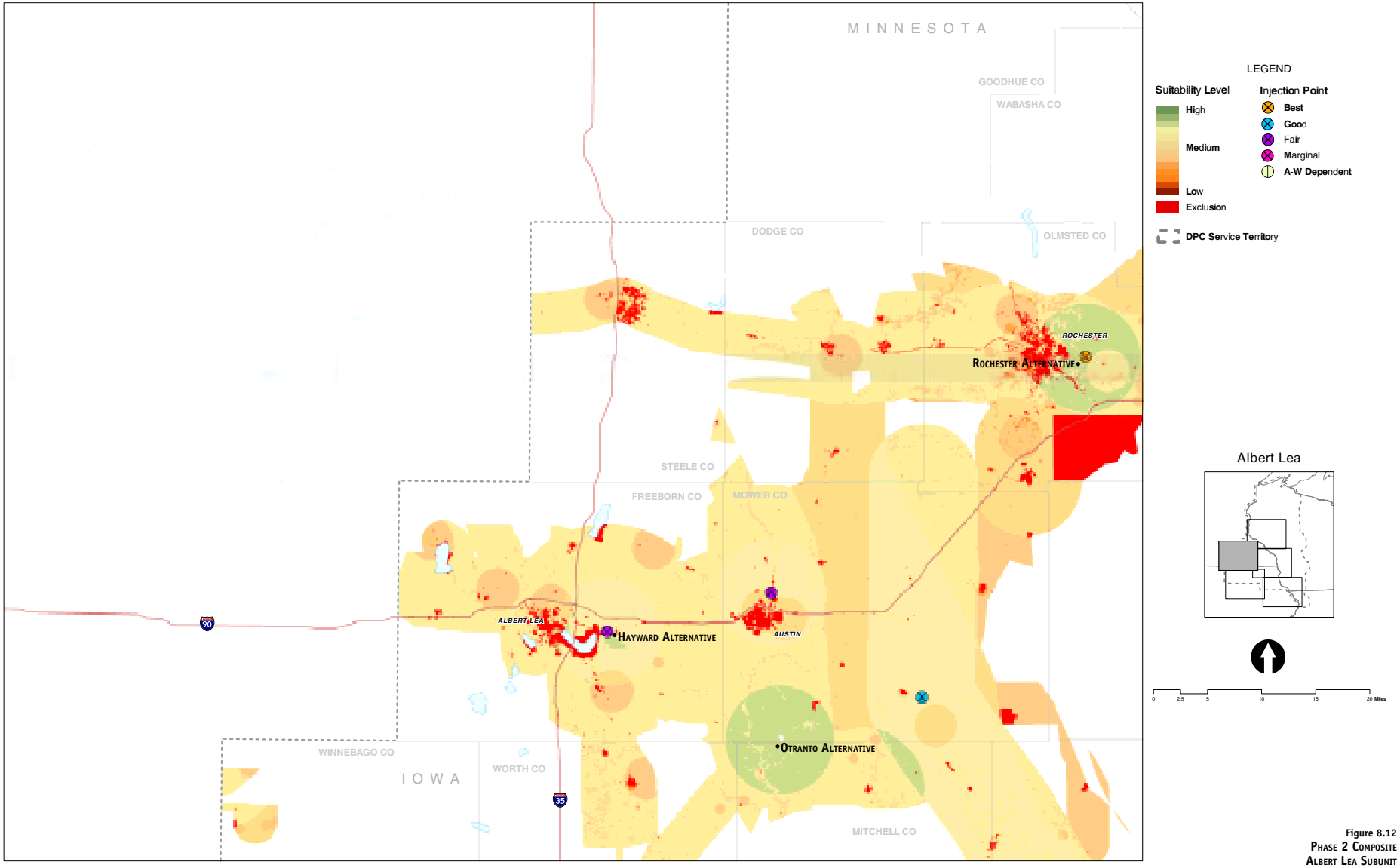


Figure 8.12
Phase 2 Composite
Albert Lea Subunit

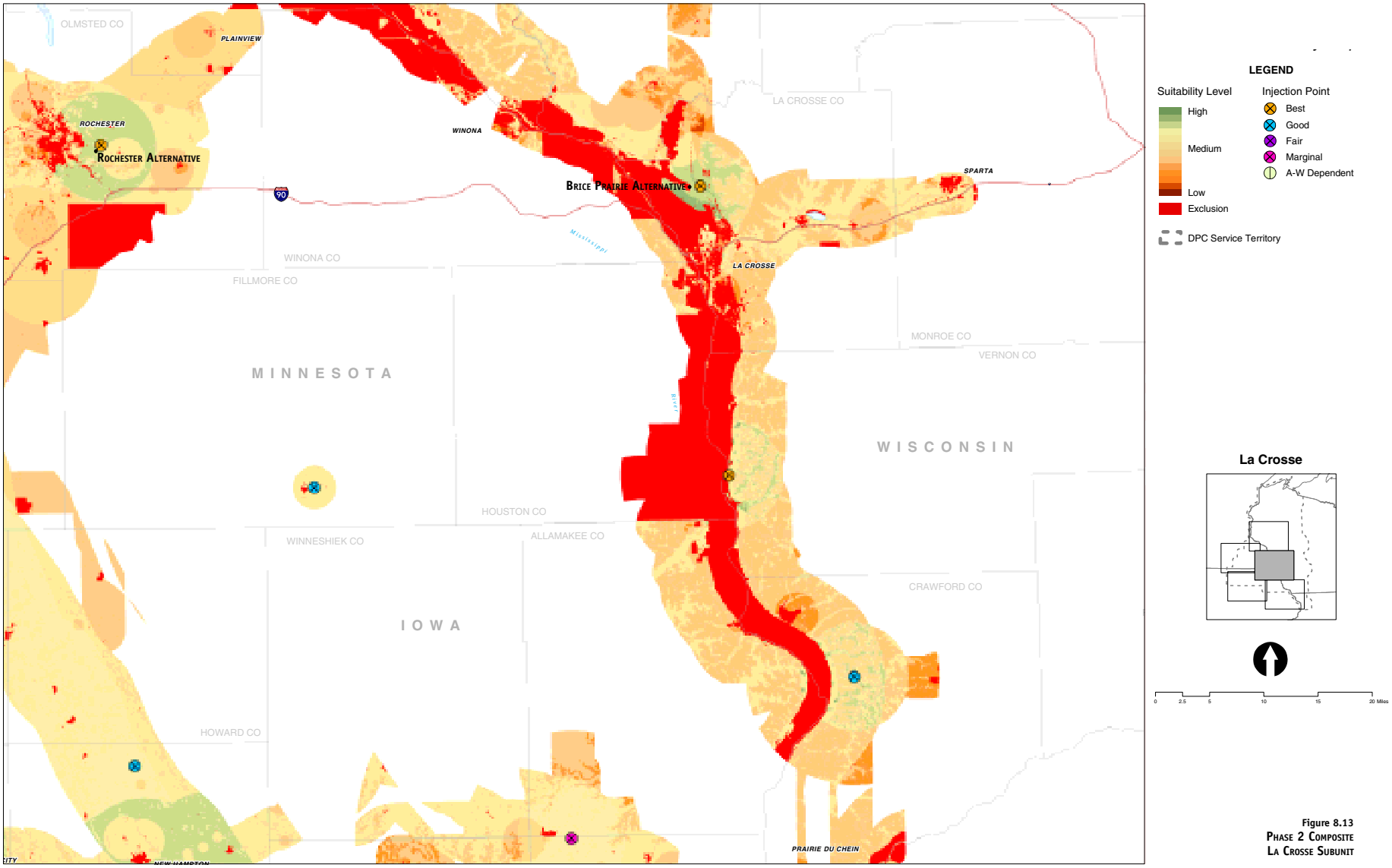


Figure 8.13
Phase 2 Composite
La Crosse Subunit

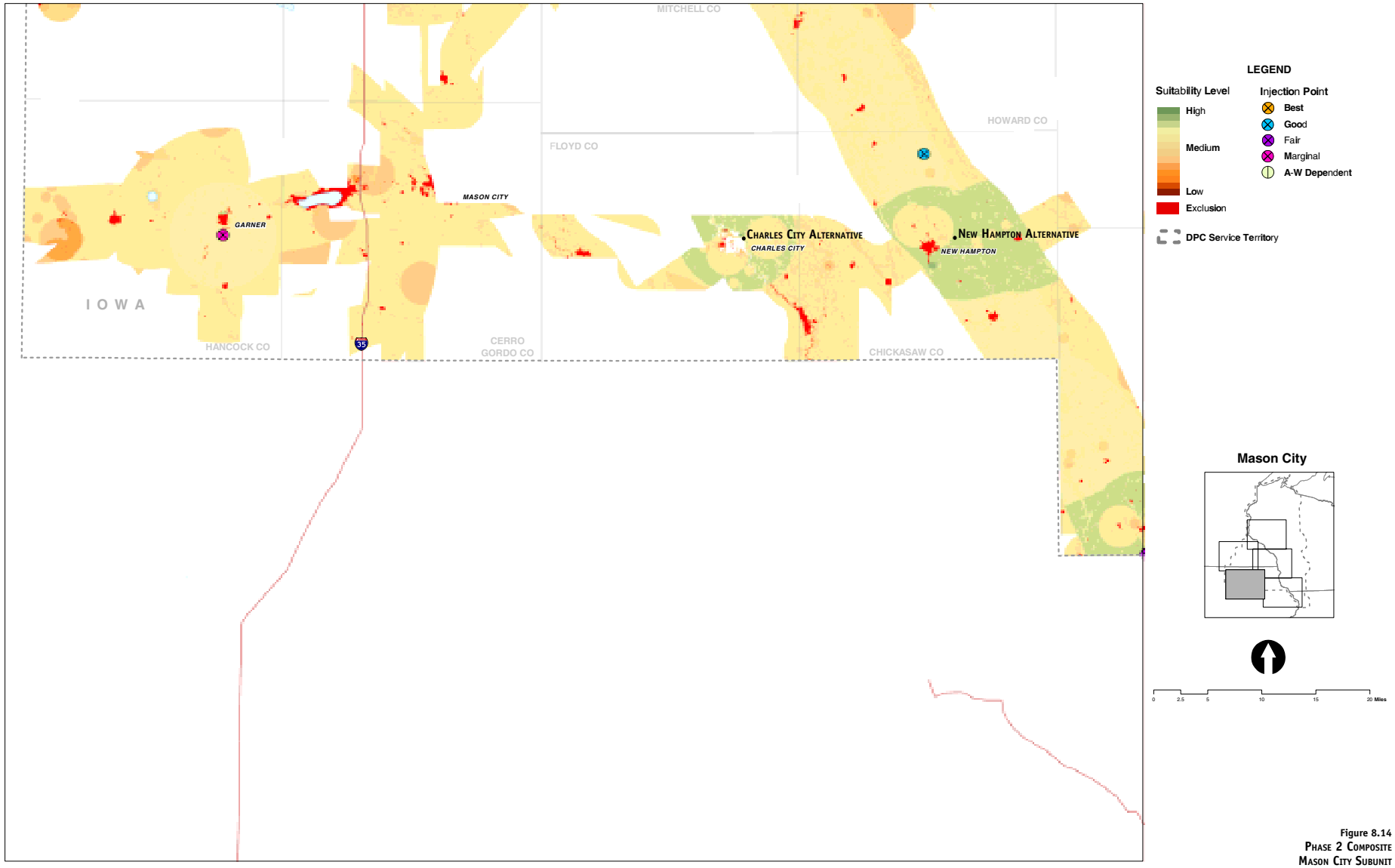


Figure 8.14
Phase 2 Composite
Mason City Subunit

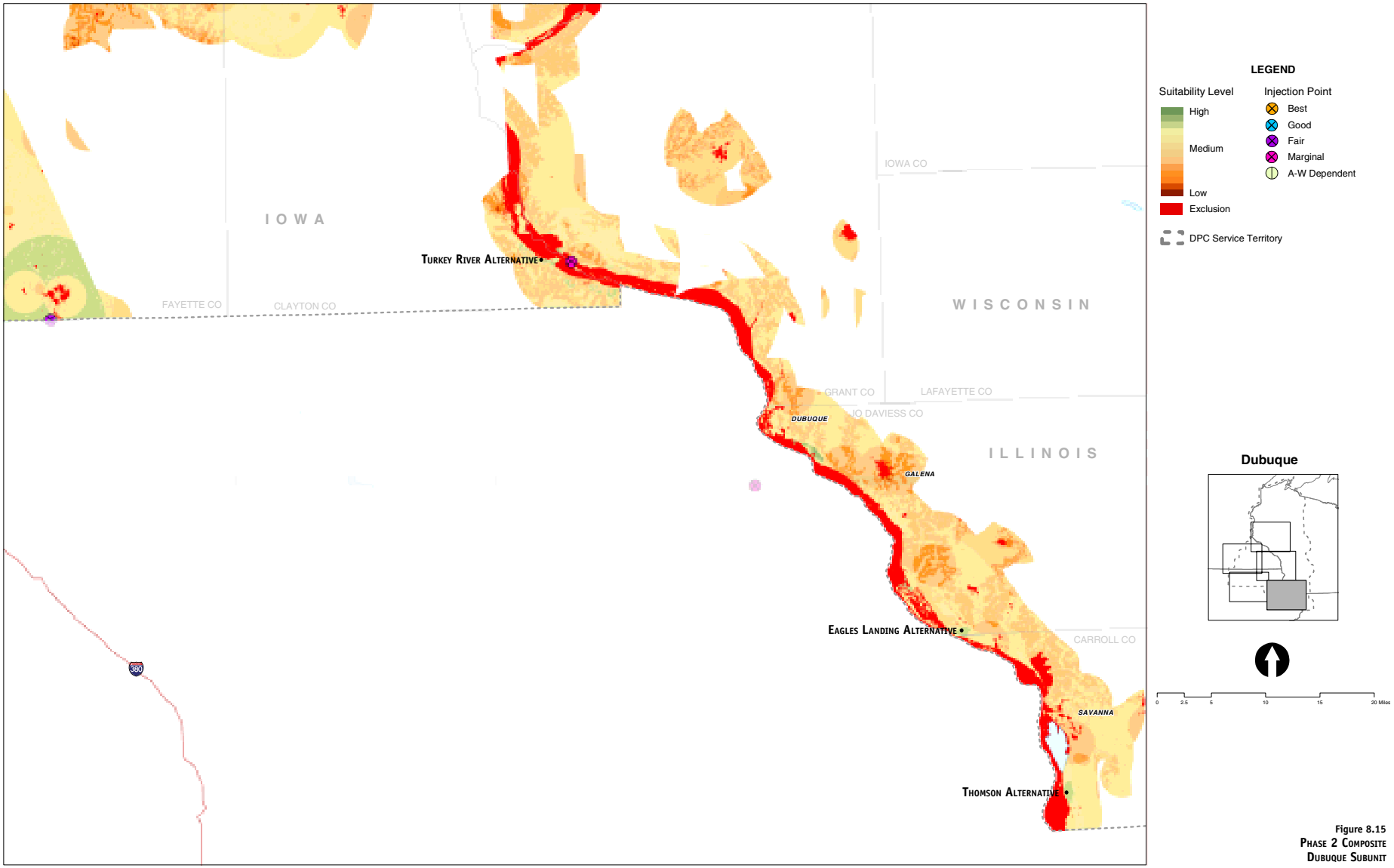
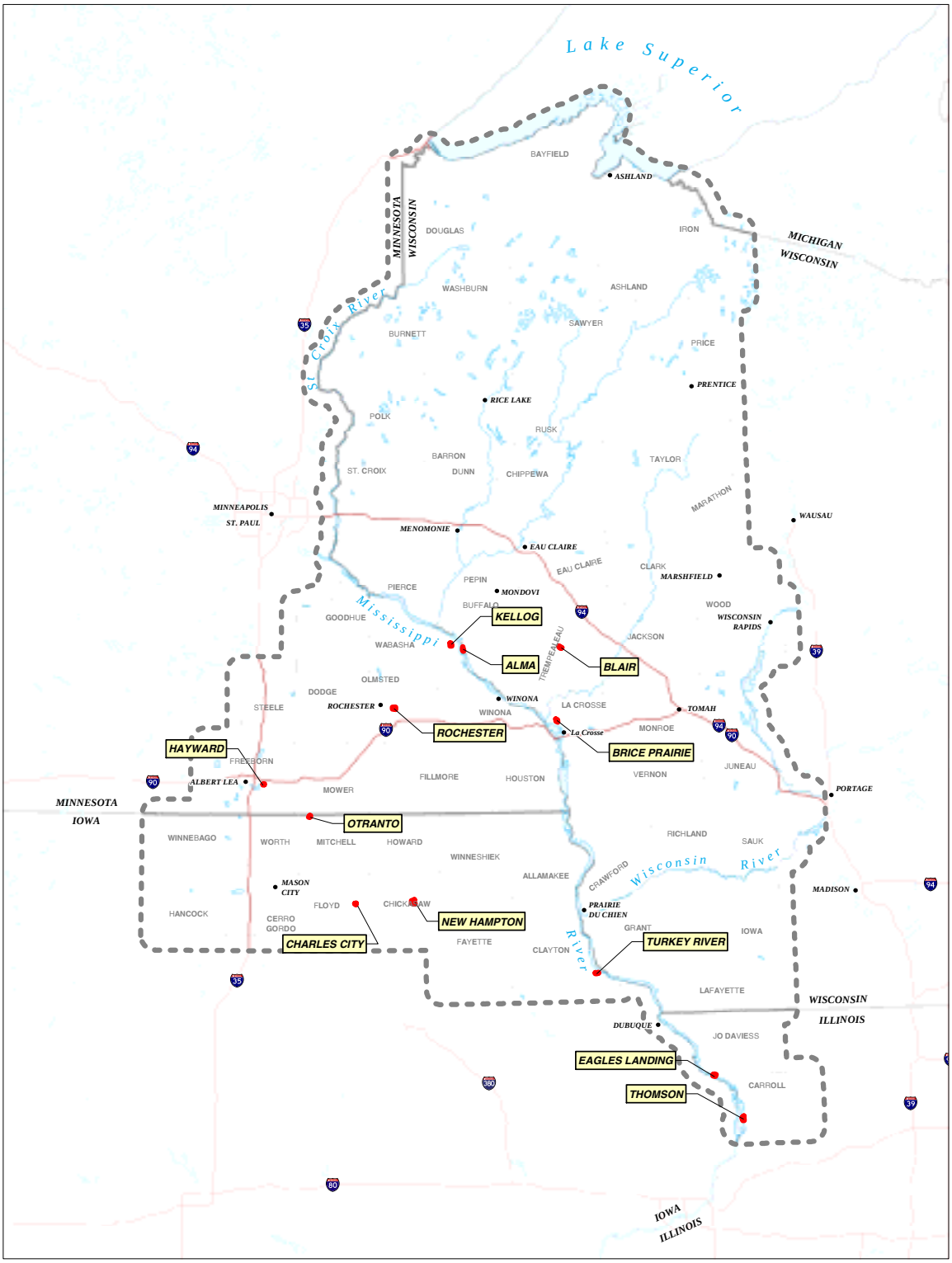


Figure 8.15
Phase 2 Composite
Dubuque Subunit



LEGEND

Potential Site

DPC Service Territory

Figure 8.16
Alternative Power Plant Sites

9 Phase 3

The 12 alternative sites resulting from the Phase 2 analysis were subjected to additional evaluation using more refined and detailed comparative criteria in Phase 3.

The comparative evaluation included eight criteria:

- area in floodplain
- ecological sensitivity
- visual sensitivity
- land use and planning compatibility
- residences within one-half mile
- transmission line impacts
- ash disposal
- cost

Engineering criteria (proposed cooling technology and on-site infrastructure requirements) where the only implication was cost, were not regarded as separate criteria. These were factored into the cost for each alternative site.

A range of conditions for each of these eight criteria from most suitable to least suitable were established and set to a uniform 1-5 scale with 5 being most suitable and 1 being least suitable. Scores for each criterion were added to produce a total score for each alternative site. The sites with the highest scores were regarded as the most suitable.

Initial scores were reviewed and in some cases modified at a project team (Dairyland, EDAW, and CH2M HILL) workshop on the September 10 and 11 , 2003. The final scores reflect an agreement between project team members as to the level of suitability presented by each criterion for each site.

Each criterion, for the purposes of this analysis, was regarded as equally important to the overall siting evaluation. Applying different weights to each criterion was considered but deemed to not be appropriate due to the subjectivity of applying weights and the fact that no single criterion was significantly more important than another.

The total score resulting from the Phase 3 scoring analysis was intended to be a way of efficiently summarizing data collected for each site and to be a guide in eliminating some sites from further analysis. The result was a measure of relative suitability between sites, not an absolute quantitative assessment of the suitability of any one site.

The Phase 3 scoring analysis lead to the identification of six sites that were to be evaluated through site reconnaissance. This in turn led to the identification of the two primary sites (Otranto and New Hampton) that are being taken to a public involvement and environmental regulatory process before a final site is selected.

The results of the Phase 3 scoring analysis are detailed below according to each assessment criterion.

Area in Floodplain

Aside from potential flooding damage, a power plant inundated by floodwaters would in most cases need to be shut down for safety reasons and the inability for operational staff to access the plant. A flood prone site would therefore need to be protected from floodwaters in some way, either through filling, or the construction of a levee. Flood mitigation works are likely to cause some environmental impact, may worsen downstream flooding and may be expensive. While not being a factor that would in itself prohibit the siting of a power plant, the presence of a floodplain on a site will make it less desirable.

Federal Emergency Management Agency (FEMA) floodplain maps were evaluated to determine the amount (if any) of each site that was within a 100 year floodplain. Additional flood height data (in draft form) was also obtained from recent modeling undertaken by the Army Corps of Engineers as part of the (uncompleted) Upper Mississippi River System Flow Frequency Study to verify FEMA mapped flood heights on the Mississippi River.

The entire Brice Prairie and Turkey River sites are within 100 year floodplains as mapped by FEMA. Significant portions of the Kellogg and Blair sites are within a 100 year floodplain, although there would be likely to be adequate land above the floodplain to locate the main power plant infrastructure. Other sites were either totally above the 100 year floodplain, had an insignificant portion affected by flooding, or according the FEMA mapping were subject to some form of existing protection from floodwaters (details of this protection were not included on the FEMA mapping).

Suitability scores (**Table 9.1**) reflect the extent to which floodplains are likely to impact on the feasibility of the project at each alternative site. Sites are completely within the 100 year floodplain received a score of 2 rather than 1 as this criterion was seen as only a moderate constraint to developing a power plant at a given site. A score of 5 was given to sites subject to little or no flooding. Sites partially impacted by flooding were given scores of 3 and 4.

The FEMA flood zones that occur within the 12 alternative sites are briefly summarized below:

- Zone A: Area of special flood hazard, without base flood elevations determined.
- Zones A1 through A30: Area of special flood hazard with base flood elevations determined.
- Zone AE: Area of special flood hazard, almost certainly within the floodway; this designation indicates that a detailed study was conducted to make this determination.
- Zones C and X: Area of minimal flood hazard.

Ecological Sensitivity

Minimizing impacts to ecologically sensitive areas and critical vegetation and wildlife habitats is another site selection study criterion. To evaluate the impact a power plant would have on each of the selected sites the following were examined.

- The likelihood that threatened and endangered (T&E) or special status species would be present on or adjacent to the site.
- The type of terrestrial vegetative habitat on or adjacent to the site.
- The type of habitat on or adjacent to the site that may be critical or of high value to wildlife.

Table 9.1
Suitability scores - area in floodplain

	Alma	Blair	Brice Prairie	Charles City	Eagles Landing	Hayward
Floodplain	227 Acres Zone A8 Flood Elevations 672-673 Feet	88 Acres Zone A, 110 Acres Zone C, 21 Acres Unknown	311 Acres Zone A	6 Acres Zone A, 118 Zone C	451 Acres Zone C	110 Acres Zone C
Score	4	3	2	5	5	5

	Kellog	New Hampton	Otranto	Rochester	Thomson	Turkey River
Floodplain	211 Acres Zone X, 112 Acres Zone AE	No Zoning specified	34 Acres Zone A	465 Acres Zone X	All Zone C	174 Acres Zone A
Score	3	5	5	5	5	2

To develop background data, a thorough computerized literature search was conducted. This research included evaluation of data from the following types of sources:

- federal, state, regional, and local government agency databases and geographic information management systems
- aerial photography
- environmental organizations
- scientific journals, publications and web sites

To determine the potential likelihood of impacting habitat critical to T&E or special status species the US Fish and Wildlife Service, each state department of natural resources and the National Marine Fisheries Service web sites and databases were reviewed to identify occurrences of listed species and there associated habitats within the vicinity for each of the selected sites.

If there was an known occurrence of a T&E or special status species on the site the site was rated as low suitability. If there was a known occurrence within a mile of the site, the site was rated as medium suitability. The site was rated as high suitability if there were no known occurrences of T&E or special status species within a mile of the site.

Land use data partially developed during Phase 2 was used as a basis for evaluating terrestrial vegetation. National wetland inventory maps, state wetland inventories and aerial photography were the primary data sets used to evaluate the type of terrestrial vegetation present on the site. By examining the landuse, it could be determined how suitable the area was for development. Each data set gives specific information on the commercial, industrial, residential, and other land types (i.e. forested, wetland areas, agricultural areas, etc.) surrounding the proposed sites in each of the specific states.

A ranking system was developed consistent with the land use assessment from Phase 2. When possible, the area of the site that is comprised of natural vegetation was determined. Natural vegetation was considered as low suitability, while agricultural land was considered medium suitability and brownfields or industrial land was considered as high suitability. From a habitat perspective natural vegetation provides more diversity of habitat and disturbing the least amount of this habitat type to construct the new power plant is preferable.

The sites were also evaluated and ranked based on the presence or absence of wetlands. Aerial photography and the national and state wetland inventories were the primary data used to determine the amount and type of any wetlands present on the sites. If there were no wetlands present then the site was deemed to be high suitability. Sites that had small areas of non-forested wetland (e.g. emergent or scrub-shrub wetland) that could likely be avoided during construction were classified as medium suitability, and sites that had extensive wetlands or forested wetlands were classified as low suitability. The presence or absence of wetlands resources cannot be completely verified or confirmed by aerial imagery or national wetland inventory maps. The presence of wetlands must be confirmed in the field in accordance with applicable state and federal guidelines.

State layers (more specific than general land use layers) for wetlands, and natural areas were also evaluated to determine the type and amount of land cover that may be critical wildlife habitat. The type and amount of each cover type present on the site was taken into consideration when ranking each site. Also if critical habitat was located in close proximity (within two miles) of the site that was also considered in the rankings. Natural vegetation and wetlands are of highest value for wildlife habitat so sites with significant amounts of these types of land covers were considered to have a high value as wildlife habitat. Agricultural land provides some food value for wildlife but provides little overall wildlife habitat value, so siting of a power plant on this land cover was determined to have a low impact. Industrial or urban land covers were also considered to have low impacts.

Sites where cooling water is discharged to the Mississippi River (Alma, Eagles Landing, Kellog, Thomson and Turkey River) were regarded as having a slightly higher ecological impact due to potential effects of cooling water discharge on the aquatic environment.

Sites with the highest overall suitability under the ecological sensitivity criterion were Charles City, Hayward and Rochester, where there was virtually no natural vegetation on the site and no proposed cooling water discharged. The site with the lowest suitability was Brice Prairie, which contains significant areas of natural vegetation. Middle levels of suitability were applied to sites with small amounts of natural vegetation/wildlife habitat or to sites that where there would be potential minor impacts to the aquatic environment through the discharge of cooling water. Suitability scores for ecological sensitivity are shown in **Table 9.2**.

Visual Sensitivity

The quality of the visual character surrounding each site was evaluated to gain a preliminary indication of the visual impact of the power plant. This evaluation was based on the assumption that a power plant will have a higher visual impact if it is located in an area of high visual quality. The numbers of viewers and the likely duration of views to the power plant at each site was not assessed.

Higher suitability values were given to sites located in industrial areas (or in the case of Eagles Landing an ex-army depot designated for future industrial use). Lower suitability values were given to sites that were within view of the Mississippi River or that had extensive natural areas nearby. Sites in agricultural areas were regarded as being moderately suitable. The area surrounding most sites had a combination of the above visual characteristics and scoring took this combination into account.

Visual sensitivity scores are shown in **Table 9.3**.

Land Use and Planning Compatibility

Existing land uses at each alternative site were identified. Where strategic and statutory planning documents identified likely future land uses or policies, the compatibility of a power plant with these was evaluated.

The highest suitability score was given to brownfield sites or sites located in an area otherwise designated for industrial development. A power plant is most compatible with an area of heavy industry. Eagles Landing, Charles City and Thomson are all designated for future industrial development. Eagles Landing can also be classified as a brownfield site because of its previous use as an army depot.

The Alma site also received the highest suitability score as there are already two power plants on the property. The only potential use for the Alma site is for a power plant or other uses ancillary to electricity generation.

Agricultural areas were regarded as being of moderate suitability. While the construction of a power plant on agricultural land will remove land from agricultural production, the generally low numbers of people living in agricultural areas is advantageous. The majority of alternative sites are currently used for agriculture, with six of these, Blair, Brice Prairie, Kellogg, New Hampton, Otranto and Turkey River not being subject to any current plans or proposals that would change this land use.

A lower suitability score was given to areas that were identified for future residential use and/or where policies were in place that were in conflict with a power plant being developed. This was the case for the Rochester site where the Olmsted County General Land Use Plan designated the site area as Suburban Development Area and Resource Protection Area, the objectives of both of which are incompatible with a power plant.

Land use and planning compatibility scores are show in **Table 9.4**.

Residences within 0.5 miles

The number of residences within 0.5 miles of each alternative site was used as an indicator of likely immediate impacts to the local community. Houses within this distance were counted using aerial photography.

Table 9.2
Suitability scores - ecological sensitivity

	Alma	Blair	Brice Prairie	Charles City	Eagles Landing	Hayward
Ecological Sensitivity	Medium	Low/Medium	Medium/High	Low	Low/Medium	Low
Score	3	4	2	5	4	5

	Kellog	New Hampton	Otranto	Rochester	Thomson	Turkey River
Ecological Sensitivity	Low/Medium	Low/Medium	Low/Medium	Low	Low/Medium	Low/Medium
Score	4	4	4	5	4	4

Table 9.3
Suitability scores - visual sensitivity

	Alma	Blair	Brice Prairie	Charles City	Eagles Landing	Hayward
Visual Sensitivity	Industrial/ near river	Near river and forest	Agricultural/some natural areas	Agricultural	Army depot/ near river	Agricultural/ near lake
Score	4	4	3	4	4	3

	Kellog	New Hampton	Otranto	Rochester	*Thomson*	*Turkey River*
Visual Sensitivity	Agricultural/some natural areas	Agricultural	Agricultural	Agricultural/ urbanizing	Agricultural/ near river	Agricultural/near river and natural areas
Score	3	4	4	3	3	1

Table 9.4
Suitability scores - land use and planning compatibility

	Alma	Blair	Brice Prairie	Charles City	Eagles Landing	Hayward
Land use and planning compatibility	Existing power plant site	Agriculture	Agriculture	Some agriculture - partly designated industrial	Identified for future industrial use	Agriculture/some conflict with local planning
Score	5	5	4	3	1	3

	Kellog	New Hampton	Otranto	Rochester	Thomson	Turkey River
Land use and planning compatibility	Agriculture	Agriculture	Agriculture	Agriculture/conflict with local strategic planning	Agriculture/ zoned industrial	Agriculture
Score	1	4	2	4	1	1

Scores of between 1 and 5 were applied, with the highest suitability values being applied to the sites with the lowest number of nearby houses (**Table 9.5**). In one case (Brice Prairie), residential development was known to occur since the aerial photography was taken. This was taken into account but did not alter the score.

The site with the highest number of nearby residences was Charles City, which is located on the edge of the town. Other sites with higher numbers of nearby residences included Blair, Rochester and Thomson due mainly to the site location close to small townships.

Eagles Landing, being a former army depot had no houses within 0.5 miles and received the maximum suitability score for this criterion. Turkey River also received a high suitability score due to its location in a sparsely populated rural area.

The remaining sites had surrounding residential densities consistent with cropping activities.

Transmission Impacts

Dairyland estimated the new infrastructure that would be required at each site to connect the new power plant into the electric system. New infrastructure can include new transmission lines, upgrading/ rebuilding of existing transmissions lines and the construction of new including new substations and switching stations.

The greatest potential for transmission impacts is the construction of extensive distances of new transmission lines. Situations where existing lines are being rebuilt to have greater capacity will generally have lower impacts due to there being an existing impact from the transmission lines.

Suitability values were applied to sites on the basis of the length of both new and rebuilt transmission lines that would be required. For the purposes of this analysis 1 mile of new transmission line is assumed to have double the impact of 1 mile of rebuilt transmission line. **Table 9.6** indicates the amount if new transmission line construction and rebuilt transmission line for each site along with its associated suitability score.

Solid Waste Disposal Suitability

Coal plants produce ash that can be either disposed of in a landfill or recycled as an additive to cement or other product. Dairyland aims to recycle as much of the ash produced at the new power plant as possible. However, some of the ash will still need to be placed in a landfill.

The landfilling of ash is a significant environmental consideration in the siting of a new coal fired power plant. Therefore, a siting criterion was developed to assess the distance from the various sites under consideration to the nearest existing landfill that accepts ash, whether there is adequate space for an on-site ash disposal facility and whether a site is close enough to the concrete manufacturing industry at Mason City for there to be potential for ash recycling to occur. It is estimated that approximately 108,000 tons of ash per year will be generated by the power plant.

Scores of between 1 and 5 were applied, with the highest suitability values being applied to the sites that had both adequate space for an ash disposal city and were in reasonable proximity to Mason City. Lower values were given to sites a long distance from Mason City and where ash would need to be transported to an off-site landfill (**Table 9.7**).

Cost

An analysis was prepared for each of the 12 sites to evaluate the capital and operational costs of constructing and operating a 400MW coal-fired power plant. The cost analysis was based on characteristics of the sites including cost of fuel delivery and transmission line upgrades. The objective of the cost analysis was to identify the relative differences in both the capital costs and net present value for each of the 12 sites. A description of the approach used for the cost analysis and the results is provided below.

The annual average net power output, net plant heat rate and fuel consumption for a nominal 400MW unit burning Powder River Basin (PRB) coal was obtained by averaging the corresponding values for a nominal 300MW and 500MW plant burning PRB coal evaluated by Sargent & Lundy in the *New Coal Plant Technology Assessment Study*, dated 9 October, 2002. This same method was used to obtain the annual average net power output, net plant heat rate and fuel consumption for a nominal 400MW unit burning Illinois coal. A slightly reduced (1.25% lower) net plant heat rate was used for the Alma site based on once-through cooling instead of a cooling tower. An annual average plant capacity factor of 80% was assumed for the evaluation.

Fuel Costs

A mine mouth coal price of $6.12/ton was used based on a 8,350 Btu/Lb heating value for PRB coal. The basis for this price was the 31 August, 2003 *Coal News and Markets* bulletin from the DOE Energy Information Administration (EIA) website. The cost of transporting the PRB coal from the mine mouth to the potential plant sites was obtained from Dairyland's fuel delivery cost calculations.

A delivered cost of $35.62/Ton for Illinois coal delivered to the Eagles Landing site was obtained from Dairyland Power.

Non-Fuel Operating & Maintenance Costs

The annual fixed and non-fuel variable operating and maintenance (O&M) costs for a nominal 400MW unit burning PRB coal were obtained by averaging the corresponding values for a nominal 300MW and 500MW plant burning PRB coal evaluated in the Sargent & Lundy study referenced above. This same methodology was used to obtain the annual fixed and non-fuel variable O&M costs for a nominal 400MW unit burning Illinois coal.

An annual cost of $5.0 Million to purchase NOx emission credits was included for the Illinois plant sites based on anticipated future NOx emission credit trading requirements. An additional O&M power cost was included for sites requiring Zero Liquid Discharge (ZLD) for the brine concentrator and crystallizer energy requirements.

Debt Service

The annual debt service cost was calculated based on financing 100 percent of the plant capital cost at a 5.0 percent annual interest rate.

Net Present Value

The Net Present Value (NPV) for each plant site was calculated based on a 7.0 percent discount rate and annual cash flows for a plant economic life of 20 years.

Results

The results of the cost analysis are presented in **Table 9.8**. The Charles City site was found to have the lowest overall cost on a NPV basis. The top six sites in increasing NPV order are Charles City, Otranto, Rochester, New Hampton, Kellog, and Turkey River. The most expensive site on a NPV basis was found to be Brice Prairie.

The impact of using Illinois Coal versus Powder River Basin Coal was calculated for the two sites in Illinois, to determine if Illinois coal might be a more economical fuel source. The pollution control equipment costs were substantially higher for Illinois coal, requiring a wet versus dry flue gas desulfurization system, a wet electrostatic precipitator and mercury control. This negated any cost advantages from the Enterprise Coal Credit available from the state of Illinois.

The costs for transmission, landfill and zero liquid discharge requirements were the most dominant capital cost drivers. The Alma site was given a substantial credit for existing facilities (coal handling and rail delivery system) at $62 million, although this was offset somewhat by the requirement for a pile foundation system and a stack height requirement of 700 feet due to nearby terrain.

Least significant was the impact of rail access on the sites. Using an average cost of $1.1 million per mile for track extensions, this did not result in a significant cost for any of the sites due to relatively close proximity of existing rail service.

Table 9.5
Suitability scores - residence within 0.5 miles

	Alma	Blair	Brice Prairie	Charles City	Eagles Landing	Hayward
Residences within 0.5mi of Site	79	162	76	236	0	89
Score	4	2	2	1	5	4

	Kellog	New Hampton	Otranto	Rochester	Thomson	Turkey River
Residences Within 0.5mi of Site	78	40	43	122	164	7
Score	4	4	4	3	3	5

Table 9.6
Suitability scores - transmission impacts

	Alma	**Blair**	**Brice Prairie**	**Charles City**	**Eagles Landing**	**Hayward**
Transmission Impacts	70mi rebuild	70mi rebuild	70mi rebuild	42.5mi new line	32mi rebuild 30mi new line	73mi rebuild
Score	4	4	4	3	3	4

	Kellog	**New Hampton**	**Otranto**	**Rochester**	**Thomson**	**Turkey River**
Transmission Impacts	70mi rebuild	50mi new line	114mi rebuild	37mi rebuild	59mi rebuild 18mi new line	54mi new line
Score	4	3	3	5	3	3

Table 9.7
Suitability scores - solid waste disposal

	Alma	Blair	Brice Prairie	Charles City	Eagles Landing	Hayward
Solid Waste Disposal Suitability	Moderate	Moderate	Low/Moderate	High	Moderate	Moderate/High
Score	3	3	2	5	3	4

	Kellog	New Hampton	Otranto	Rochester	Thomson	Turkey River
Solid Waste Disposal	Low/Moderate	High	High	Low	Moderate	Moderate
Score	2	5	5	1	3	3

Table 9.8
Suitability scores - cost

	Alma	Blair	Brice Prairie	Charles City	Eagles Landing	Hayward
Cost (NPV over 20 years)	$1347.03M	$1222.42M	$1397.60M	$1138.14M	$1259.46M	$1225.30M
Score	1	4	1	5	3	4

	Kellog	New Hampton	Otranto	Rochester	Thomson	Turkey River
Cost (NPV over 20 years)	$1200.52M	$1176.15M	$1150.15M	$1163.54M	$1253.68M	$1201.72M
Score	4	5	5	5	3	4

The NPV for each plant site was calculated based on a 7.0% discount rate and annual cash flows for a plant economic life of 20 years. The largest single life cycle cost driver was the debt service for the capital cost of the plant at approximately 45% of the total NPV. The annual debt service cost was calculated based on financing 100 percent of the plant capital cost at a 5.0% annual interest rate. While the debt service for the capital cost was the single largest cost driver on a NPV basis, this factor was relatively consistent between sites.

The next largest life cycle cost component was the delivered fuel cost at approximately 35% of the total NPV, based on PRB coal. The rail transportation cost was approximately 60% of the delivered fuel cost for plant sites in Iowa, or equivalent to approximately 20% of the total NPV. The rail transportation cost was the single most significant factor in differentiating the NPV costs for the twelve sites.

The non-fuel O&M cost was the smallest life cycle cost component at approximately 20% of the total NPV. Similar to the debt service, the O&M component of the NPV analysis did not result in a significant cost differential between the various sites.

More detail is provided in **Appendix E**.

Shortlisting of Sites

Based on the total score for each Phase 3 criterion (**Table 9.9**), the six highest scoring sites were selected for further evaluation. Six sites were selected because this provided an adequate range of characteristics for the project team to be confident that the best site could be selected after further evaluation. The six sites that were not shortlisted, while all potentially feasible, were regarded as not having a reasonable likelihood of emerging as the preferred site.

The six shortlisted sites were:

- Alma, Wisconsin
- Charles City, Iowa
- Eagles Landing, Illinois
- Hayward, Minnesota
- New Hampton, Iowa
- Otranto, Iowa

Site reconnaissance for each of these sites was conducted in September 2003, with the aim of identifying the most appropriate sites that could be taken through a public involvement and EIS process. The results of the site reconnaissance and the overall evaluation of each of the shortlisted sites are described below.

Alma, Wisconsin

Land for a new power plant has been reserved on Dairyland's Alma property since the 1970's. The property, where both the Alma and J.P. Madgett coal-fired power plants are located, is adjacent to the Mississippi River, on the southern edge of the town of Alma.

The main advantage of the Alma site is the use of this property for coal-fired power for several decades. The additional impacts of another power plant on this site could be regarded in general terms as less than the construction of a power plant at a new site.

A power plant at Alma however, would require water discharge to the Mississippi River and would have some level of impact to the aquatic environment. In these terms Alma is at a disadvantage to sites described below that would have a ZLD system.

Alma is the third most expensive site of the twelve that were initially evaluated. Cost savings from shared infrastructure with the two existing facilities are more than offset by the single railroad that accesses the site and the resulting inability for Dairyland to obtain competitive fuel delivery contracts. A new plant at Alma was estimated to cost around $121M more than the cheapest alternative over twenty years in net present value terms.

Locating a third power plant at Alma would have the disadvantage of concentrating a large proportion of Dairyland's generation resources in one location. This increases the potential severity of a major system fault, if it occurs at one of the power plants or in the nearby transmission network.

Charles City, Iowa

Charles City was the least cost alternative at $1138.14M because of its location at a highly competitive rail junction between the Iowa, Chicago and Western (ICE) and Canadian National (CN) Railroads.

The identified site located mostly on a developing industrial subdivision on the eastern edge of Charles City. Charles City received a maximum score in the Phase 3 suitability scoring evaluation for this reason. Site reconnaissance however, suggested that the proximity of this site to residential areas in Charles City was enough to make it less suitable than originally thought.

Additional reconnaissance was undertaken around Charles City to attempt to identify a suitable site in the area that could still take advantage of the rail access of the original site. No suitable sites were found due to incompatible land uses (primarily residential and small lot rural subdivisions) in reasonable proximity to the two railroads.

Table 9.9
Suitability scores - summary

	Area in Floodplain	Ecological Sensitivity	Visual Sensitivity	Land Use and Planning Compatibility	Residences Within 0.5mi of Site	Transmission Impacts	Ash Disposal	Cost	Total Score
Alma	4	3	4	5	4	4	3	1	**28**
Blair	3	4	4	3	2	4	3	4	**27**
Brice Prairie	2	2	3	3	2	4	2	1	**19**
Charles City	5	5	4	4	1	3	5	5	**32**
Eagles Landing	5	4	4	5	5	3	3	3	**32**
Hayward	5	5	3	2	4	4	4	4	**31**
Kellog	3	4	3	3	4	4	2	4	**27**
New Hampton	5	4	4	3	4	3	5	5	**33**
Otranto	5	4	4	3	4	3	5	5	**33**
Rochester	5	5	3	1	3	5	1	5	**28**
Thomson	5	4	3	4	3	3	3	3	**28**
Turkey River	2	4	1	3	5	3	3	4	**25**

Eagles Landing, Illinois

The former Savanna Army Depot in northern Illinois, now known as *Eagles Landing*, was initially identified because of its brownfield status and location adjacent to the Mississippi River (which would ensure a reliable supply of water). The current designation of the site and the absence of surrounding residential areas made the Eagles Landing site the most advantageous from a land use perspective.

Like Alma, however Eagles Landing has access to only one rail line. The resulting lack of rail competition and high fuel delivery cost is the main factor in making Eagles Landing the ninth most expensive alternative at $1,259.46M.

The discharge of cooling water into the Mississippi River creates some disadvantages for Eagles Landing when compared to sites where a ZLD system is proposed.

Eagles Landing is not close to an identified injection point and is therefore not one of the more suitable sites in terms of the efficiency of connecting a power plant with Dairyland's electric system.

Hayward, Minnesota

The site identified at Hayward is located on agricultural land west of the Hayward township. The site is adjacent to both the Hayward Substation (rated as a *fair* injection point in Phase 2) and the ICE Railroad.

Hayward's advantages lie primarily in the ability to locate a site immediately adjacent to both an injection point and a railroad line and the few constraints to site planning occurring on the site. Adjacent land uses are mainly agricultural, with few nearby residents. Environmental impacts would also be relatively low, with no significant natural vegetation occurring and a ZLD system being employed.

The ICE railroad is however the only railroad that can be accessed from the site. This creates a high

ongoing fuel delivery cost that places Hayward eighth in cost when assessed in terms of Net Present Value over twenty years.

New Hampton, Iowa

New Hampton was identified as a site because of the intersection of the 345kV transmission line and the ICE Railroad east of the township of New Hampton. The site is located on crop land, with several farm residences occurring on its perimeter.

The physical setting of New Hampton is similar to that of Hayward, with the dominant land use on and adjacent to the site being agriculture. New Hampton is therefore also likely to also have relatively low impacts. There is, however, a vegetated drainage running through the site from north to south.

The ICE railroad accesses the New Hampton site. The proximity of rail interchanges to the west however creates a more competitive environment for fuel delivery and is the main reason that New Hampton is the fourth cheapest site at $1176.15M.

The ability to connect directly to the 345kV transmission line gives New Hampton a significant advantage from an electric system point of view. This is the highest capacity transmission line in the Dairyland service area. A power plant at New Hampton would therefore require the least amount of new electric infrastructure to connect into the electric system. Once connected, electricity coming from a plant at New Hampton could be transmitted through the network more efficiently than at any other site.

Otranto

The Otranto is located close to one of the two highly competitive rail junctions that occur in the study area that were identified in Phase 2. It is in a similar setting to both New Hampton and Hayward and as such would result in relatively low impacts. Agricultural land uses dominate, although a cemetery does occur on the edge of the site and would need to be conserved as part of any power plant development here.

The ability of the site to access both the ICE and CN railroads makes Otranto highly advantageous from a fuel delivery competitiveness point of view and the second cheapest site at $1150.15M when operational costs are taken into account. This is despite the site not being close to an identified injection point and requiring the most expensive infrastructure to connect it to Dairyland's electric system.

Aerial photographs of the six shortlisted sites are shown in **Figures 9.1-9.6**.

Selection of Primary Alternatives

New Hampton and Otranto were selected as primary alternative sites after the field reconnaissance and further evaluation. These sites were regarded as better than the remaining four sites because of a combination of relatively low environmental impacts and low cost.

Hayward is regarded as the third preference if issues arise that would preclude a power plant being sited at either New Hampton or Otranto. The level of impact at Hayward is similar to that at New Hampton and Otranto, with the additional cost being the reason these two sites were favored over Hayward.

Alma and Eagles Landing are both sites where a power plant could be feasibly sited. They do not provide any significant advantage in terms of impacts over the primary alternatives. Again, a significant cost difference led to these sites not being regarded as the most favorable.

Charles City, was the cheapest site in terms of NPV over 20 years, but on the basis of its proximity to the city would have an unacceptable level of impact. As no other site with lower impacts was found in the Charles City area, this alternative was eliminated from further consideration.

The New Hampton and Otranto sites, as the primary alternatives, will now be subject to a detailed public involvement and environmental assessment process under NEPA. A preferred site will be selected upon completion of this process.

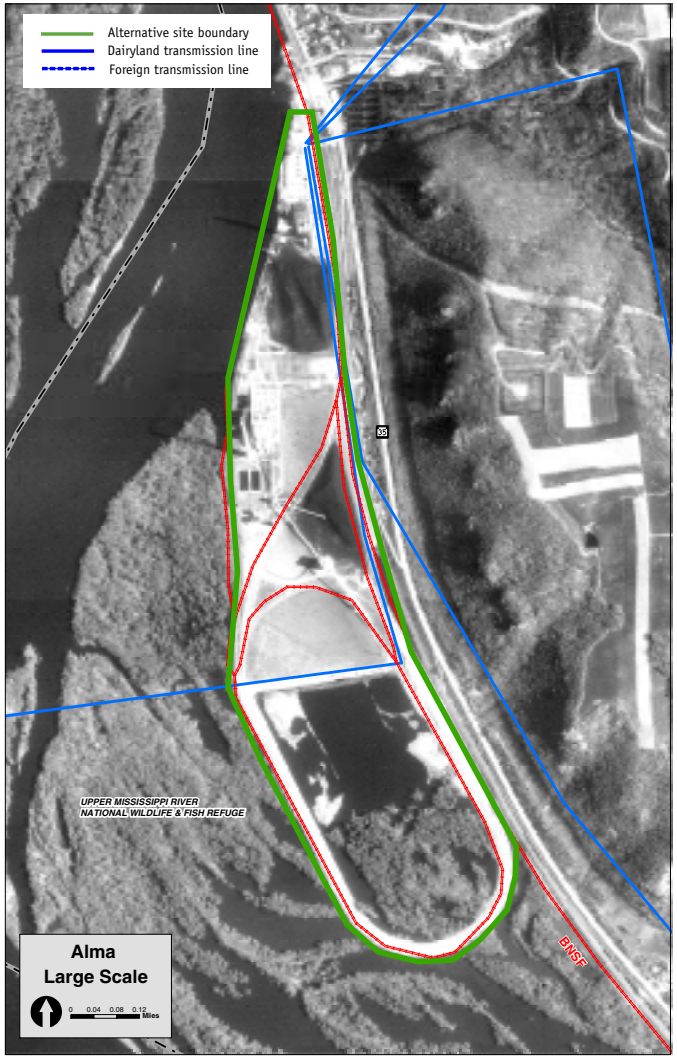


Figure 9.1
Alternative Site - Alma

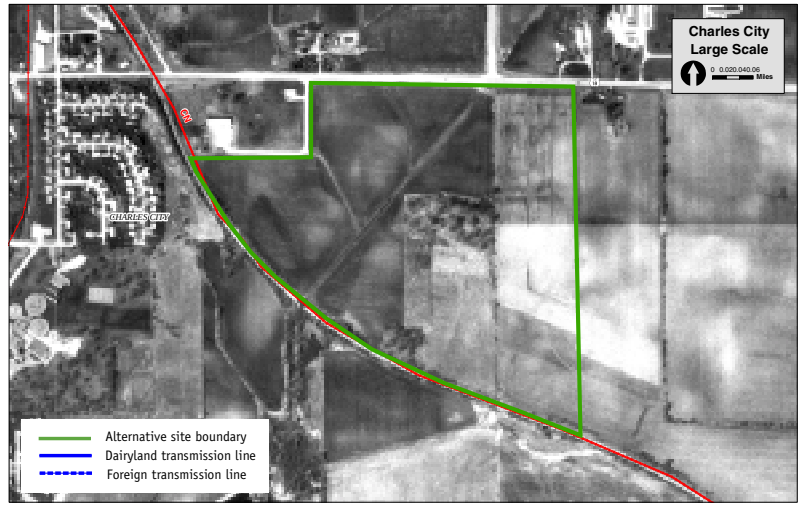


Figure 9.2
Alternative Site - Charles City

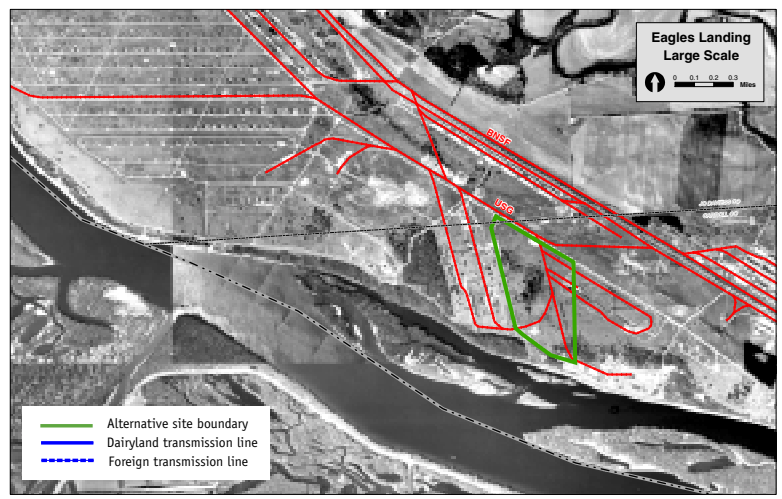


Figure 9.3
Alternative Site - Eagles Landing

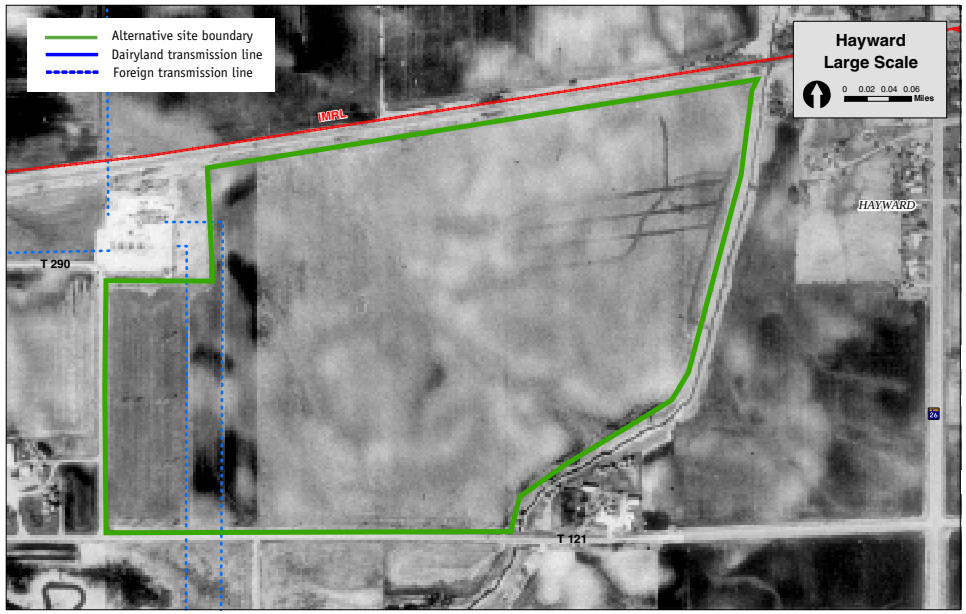


Figure 9.4
Alternative Site - Hayward

Figure 9.5
Alternative Site - New Hampton

Figure 9.6
Alternative Site - Otranto

10 Macro Corridor Study

A Macro Corridor Study was conducted to identify potential corridors for the transmission line connections required for the Otranto and New Hampton alternative coal-fired power plant sites. The transmission line connections required at each alternative site consist of the following:

Otranto Site

- Double circuit in-and-out connection to the existing Adams-Lime Creek 161kV transmission line on-site.
- Rebuild the existing Otranto-Adams 161kV transmission line.
- Rebuild the existing Otranto-Lime Creek 161kV transmission line.
- Rebuild the existing Adams-Rochester 161kV transmission line.
- Rebuild the existing Adams-Harmony 161kV transmission line.

New Hampton Site

- Connection to the existing 345kV transmission line on-site.
- Construction of New Hampton-Floyd 161kV transmission line.
- Construction of New Hampton-Rice 161kV transmission line.

For the Otranto site alternative, the double circuit in-and-out connection would be on-site and the rebuild requirements would occur on or adjacent to existing rights-of-way. The corridors for these transmission line improvements are shown on **Figure 10.1**. These corridors have been identified for further refinement and evaluation in subsequent environmental documentation that will be prepared to identify and analyze specific routes. In general, the corridors shown are approximately ¼ mile wide.

Opportunity, avoidance and exclusion areas were used to identify the alternative corridors shown on **Figure 10.2**. These corridors have been identified for further refinement and evaluation in subsequent environmental documentation that will be prepared to identify and analyze specific routes. In general, the corridors shown are approximately ¼ mile wide.

The identification of corridors was strongly influenced by the electric system interconnection requirements, following existing utility rights-of-way and other linear features such as roads. The corridors shown on **Figure 10.2** are intended to minimize impacts on avoidance and exclusion areas. The relative sensitivity of different resources classified as opportunities or constraints (avoidance and exclusion areas) was determined to assist in identifying the alternative corridors.

Different resources have varying degrees of sensitivity to the construction, operation and maintenance of a transmission line. Certain resources may be moderately sensitive (e.g., cropland, floodplains, surface water) and other resource areas may be highly sensitive (e.g., airports, national or state parks) and should be excluded from consideration if there are other reasonable alternatives. Still other areas may provide opportunities for siting transmission lines (e.g., existing utility lines, roads, railroads). The basis for these classifications was compiled from project team experience and the RUS Environmental Guide, The Borrower's Report for Environmental Assessment Projects, RUS Bulletin 1794A-601, April 1995.

Opportunity, avoidance and exclusion area criteria are shown on **Table 10.1**. The resource sensitivity was then linked to routing objectives shown on **Table 10.2**.

Table 10.1
Macro corridor criteria

Opportunities	Existing transmission line rights-of-way Road rights-of-way Railroad rights-of-way
Avoidance	Potential locations of federally and state listed endangered species Existing buildings (within 50 feet) Riparian areas 100 year floodplains
Exclusion	Known habitat of federally and state listed endangered species Placement of a new transmission line over existing residences or other occupied buildings (within ¼ mile) Airports Subdivided lands and densely populated areas

Table 10.2
Resource sensitivity

Resource Sensitivity	Corridor Selection Objective
opportunity areas or low sensitivity	maximize percent of corridor
avoidance areas or moderate sensitivity	minimize percent of corridor
exclusion areas or high sensitivity	avoid when there are other alternatives

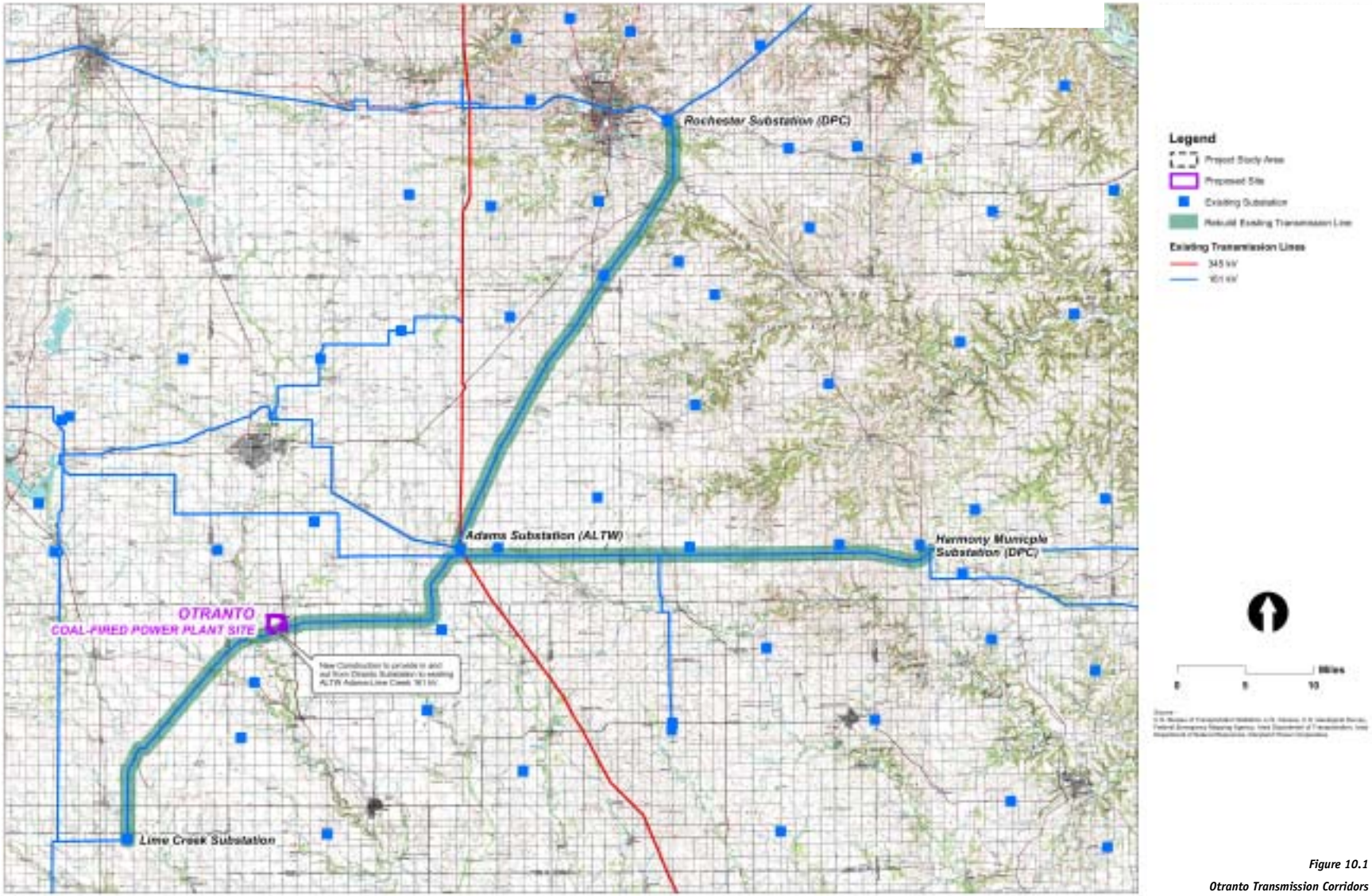


Figure 10.1

Otranto Transmission Corridors

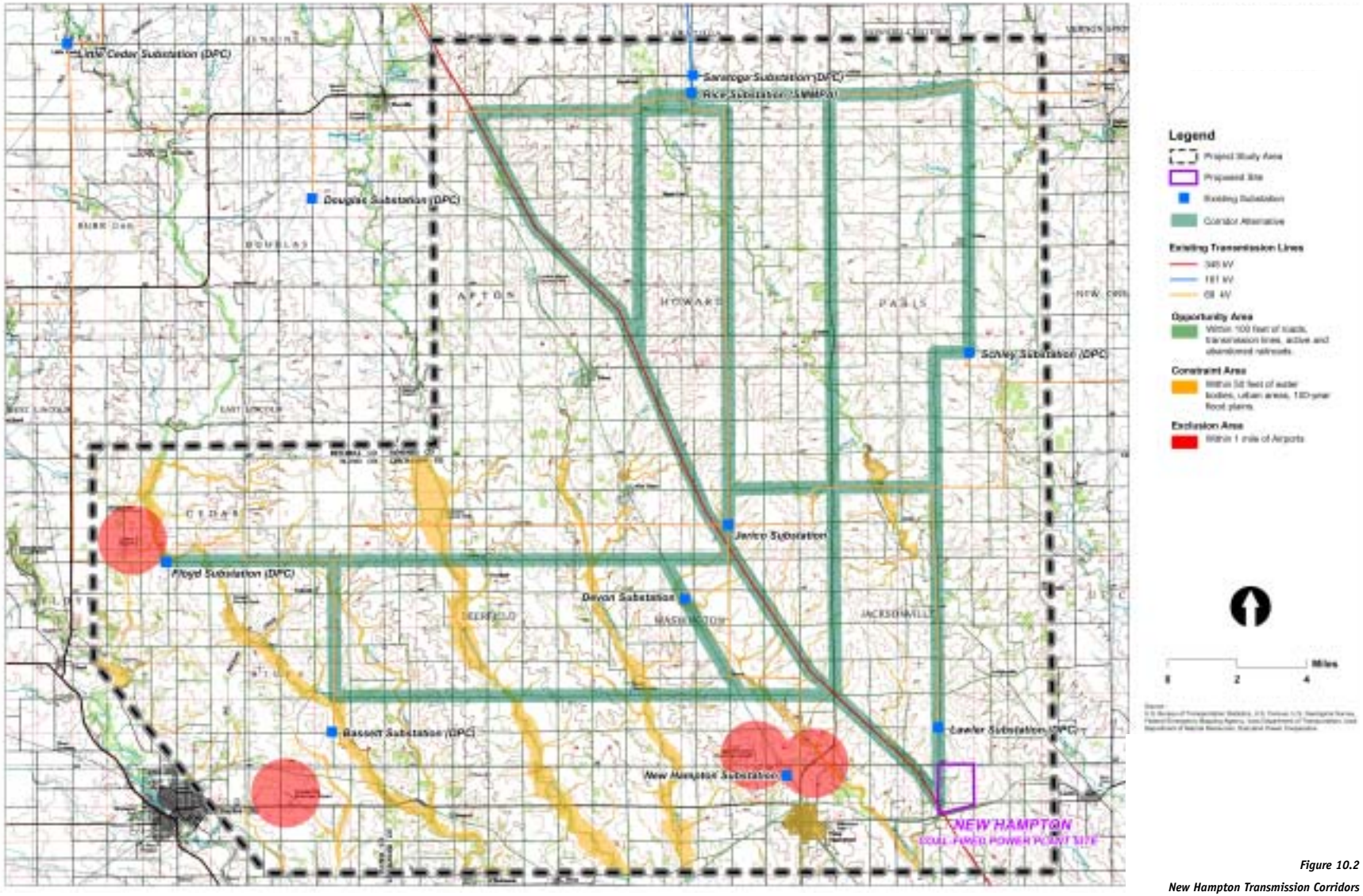
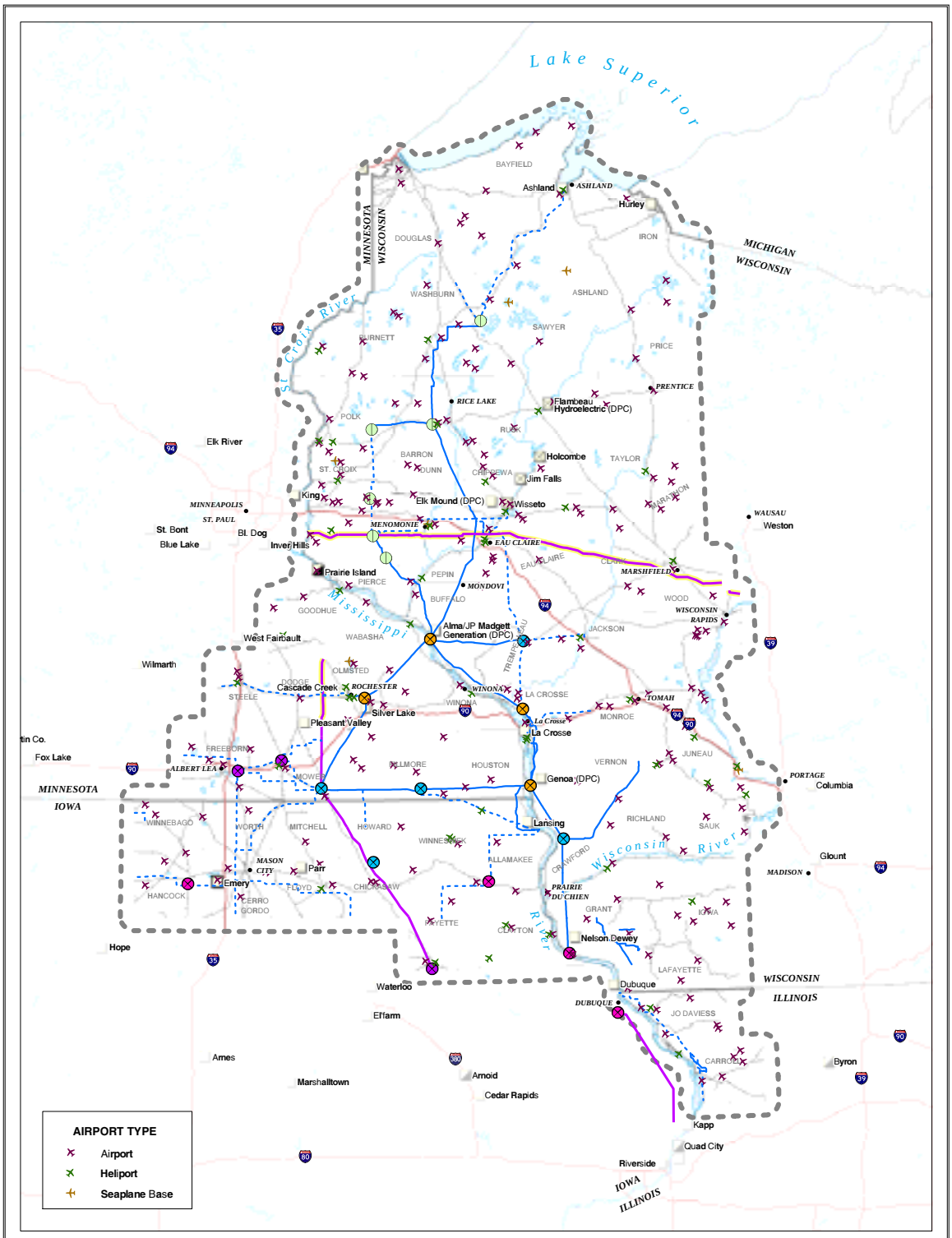


Figure 10.2

New Hampton Transmission Corridors

Appendix A
Study Area Resource Maps



Airports

Resource Map

LEGEND

- 161 kV Foreign Transmission Line
- 161 kV DPC Transmission Line
- 345 kV Foreign Transmission Line
- Constrained Interface
- DPC Service Territory

Generation Facility

- Fossil Fuel
- Hydroelectric
- Nuclear
- Wind

Injection Point

- Best
- Good
- Fair
- Marginal
- Needs Proposed Arrowhead-Weston 345kV to be Built

0 5 10 20 30 40 Miles

DAIRYLAND POWER COOPERATIVE

NEW COAL-FIRED POWER PLANT

EDAW

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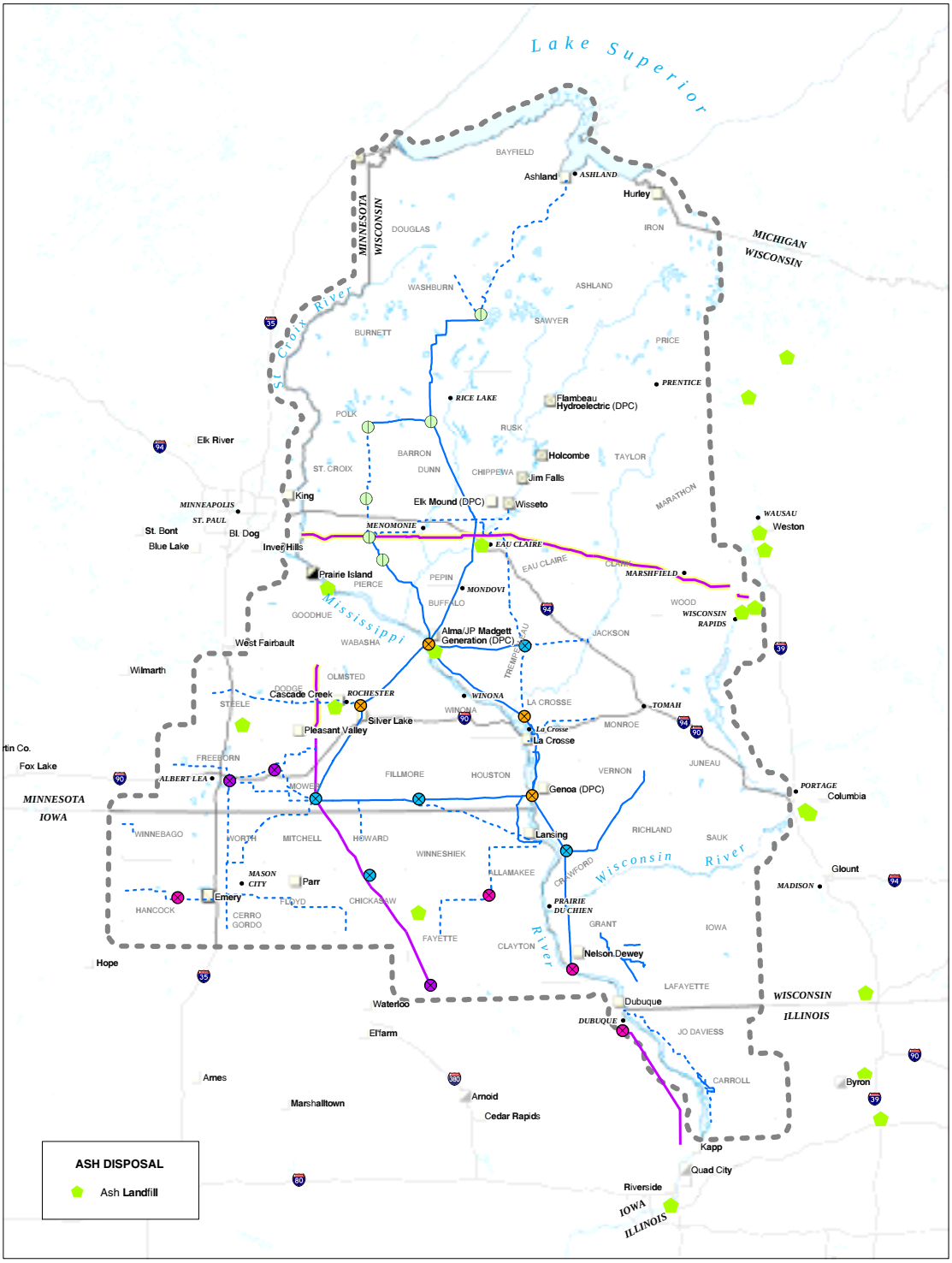

Ash Disposal

Resource Map

LEGEND

- 161 kV Foreign Transmission Line
- 161 kV DPC Transmission Line
- 345 kV Foreign Transmission Line
- Constrained Interface
- DPC Service Territory

Generation Facility

- Fossil Fuel
- Hydroelectric
- Nuclear
- Wind

Injection Point

- Best
- Good
- Fair
- Marginal
- Needs Proposed Arrowhead-Weston 345kV to be Built

0 5 10 20 30 40 Miles

DAIRYLAND POWER COOPERATIVE

NEW COAL-FIRED POWER PLANT

EDAW

September 8, 2003

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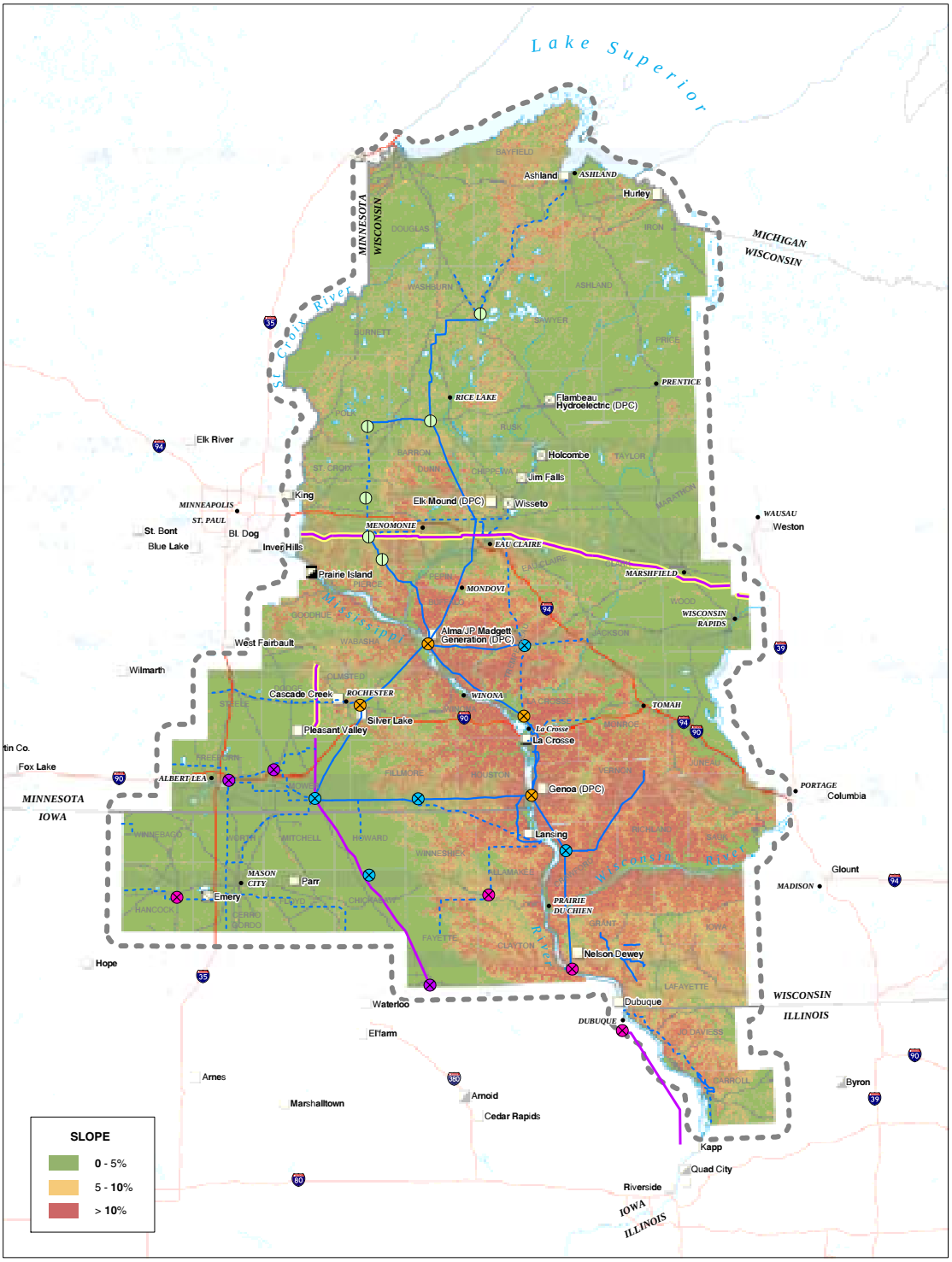

Slope
Resource Map

0 5 10 20 30 40 Miles

LEGEND

- 161 kV Foreign Transmission Line
- 161 kV DPC Transmission Line
- 345 kV Foreign Transmission Line
- Constrained Interface
- DPC Service Territory

Generation Facility

- Fossil Fuel
- Hydroelectric
- Nuclear
- Wind

Injection Point

- Best
- Good
- Fair
- Marginal
- Needs Proposed Arrowhead-Weston 345kV to be Built

DAIRYLAND POWER COOPERATIVE

NEW COAL-FIRED POWER PLANT

EDAW

September 4, 2003
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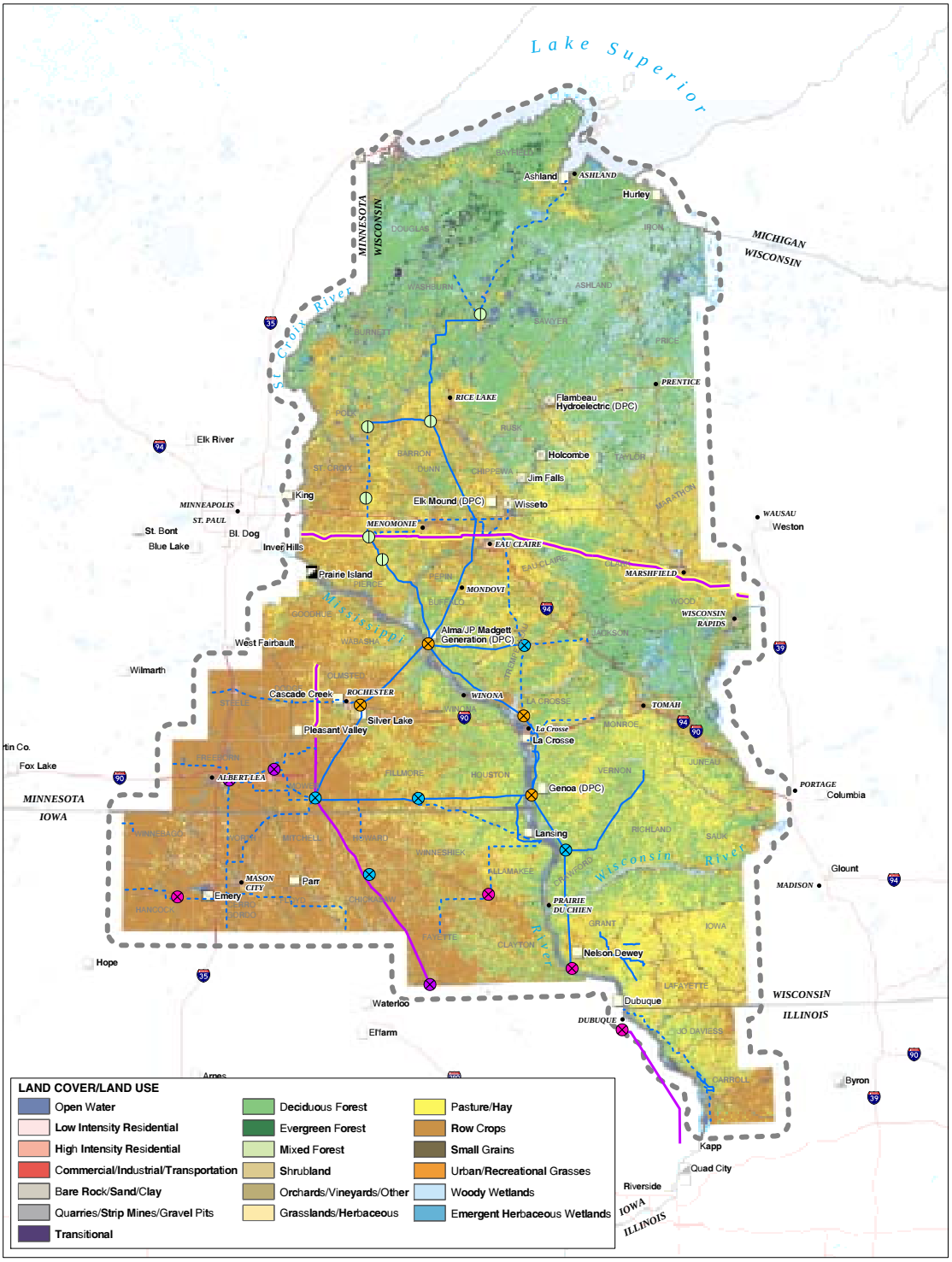

Land Cover - All Classes

Resource Map

LEGEND

- 161 kV Foreign Transmission Line
- 161 kV DPC Transmission Line
- 345 kV Foreign Transmission Line
- Constrained Interface
- DPC Service Territory

Generation Facility

- Fossil Fuel
- Hydroelectric
- Nuclear
- Wind

Injection Point

- Best
- Good
- Fair
- Marginal
- Needs Proposed Arrowhead-Weston 345kV to be Built

0 5 10 20 30 40 Miles

DAIRYLAND POWER COOPERATIVE

NEW COAL-FIRED POWER PLANT

EDAW

June 26, 2003

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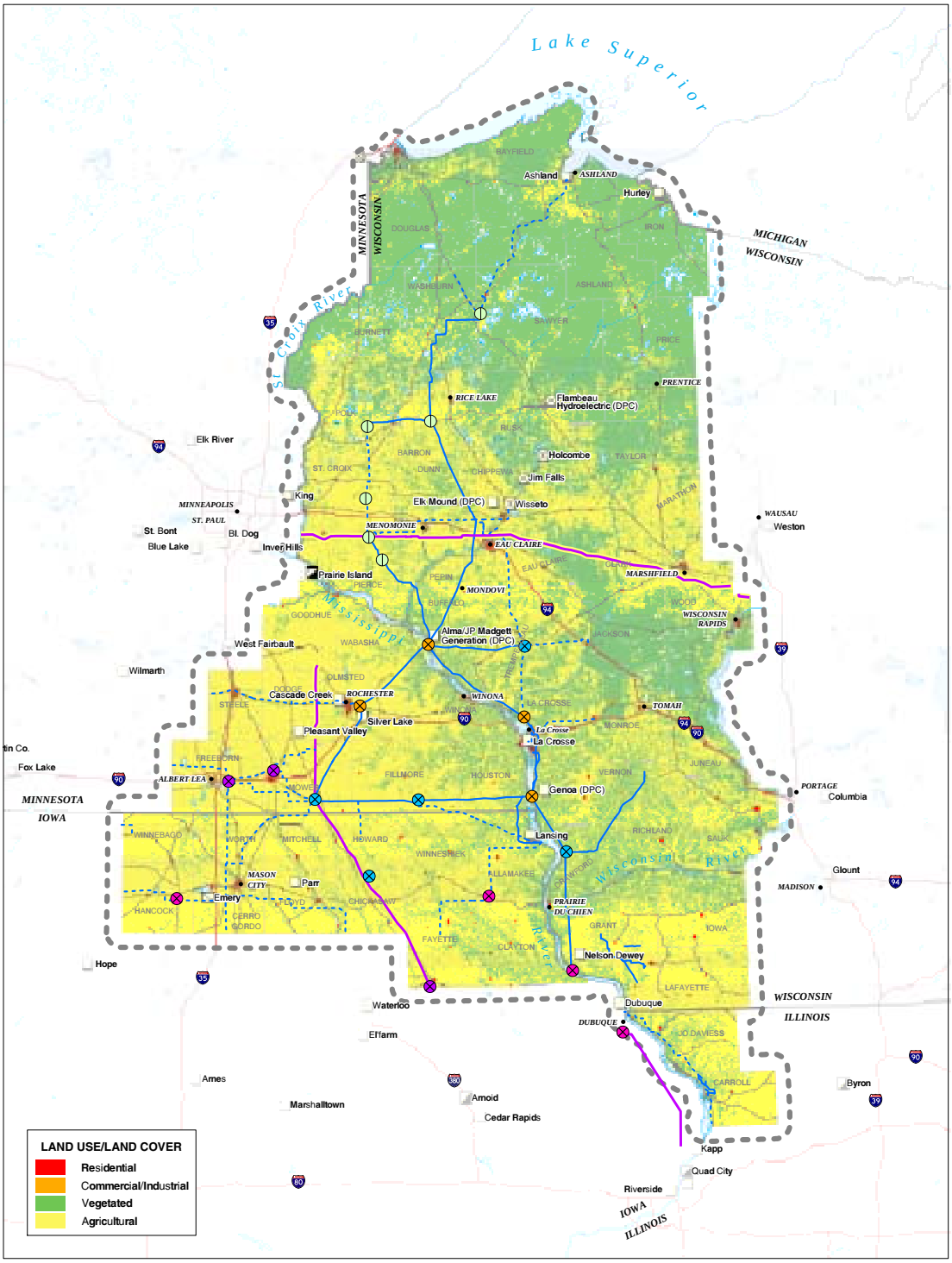

Land Cover - Grouped

Resource Map

LEGEND

161 kV Foreign Transmission Line
161 kV DPC Transmission Line
345 kV Foreign Transmission Line
Constrained Interface
DPC Service Territory

Generation Facility

Fossil Fuel
Hydroelectric
Nuclear
Wind

Injection Point

Best
Good
Fair
Marginal
Needs Proposed Arrowhead-Weston 345kV to be Built

0 5 10 20 30 40 Miles

DAIRYLAND POWER COOPERATIVE

NEW COAL-FIRED POWER PLANT

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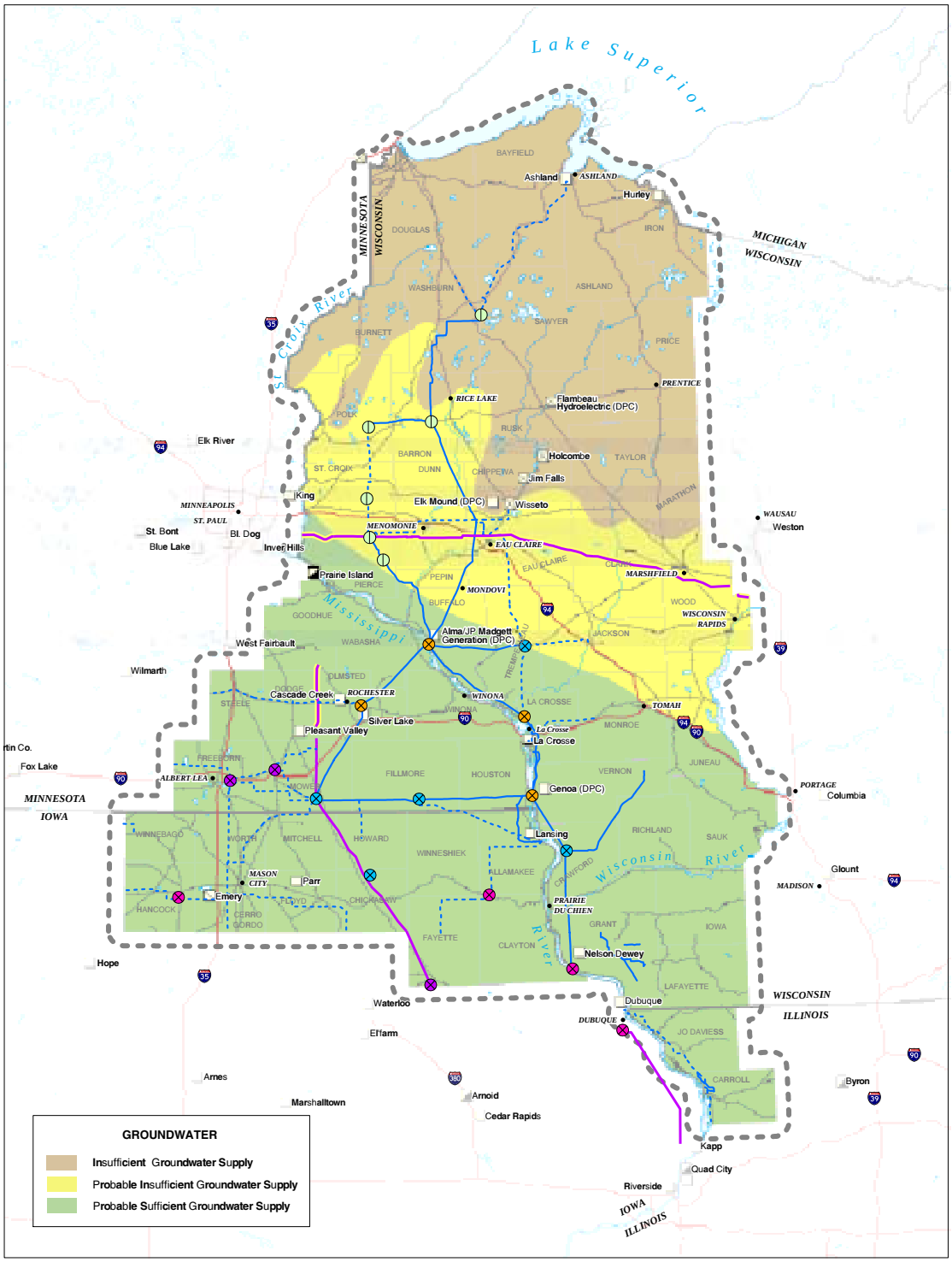

Groundwater Availability

Resource Map

LEGEND

- 161 kV Foreign Transmission Line
- 161 kV DPC Transmission Line
- 345 kV Foreign Transmission Line
- Constrained Interface
- DPC Service Territory

Generation Facility

- Fossil Fuel
- Hydroelectric
- Nuclear
- Wind

Injection Point

- Best
- Good
- Fair
- Marginal
- Needs Proposed Arrowhead-Weston 345kV to be Built

0 5 10 20 30 40 Miles

DAIRYLAND POWER COOPERATIVE

NEW COAL-FIRED POWER PLANT

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September 4, 2003

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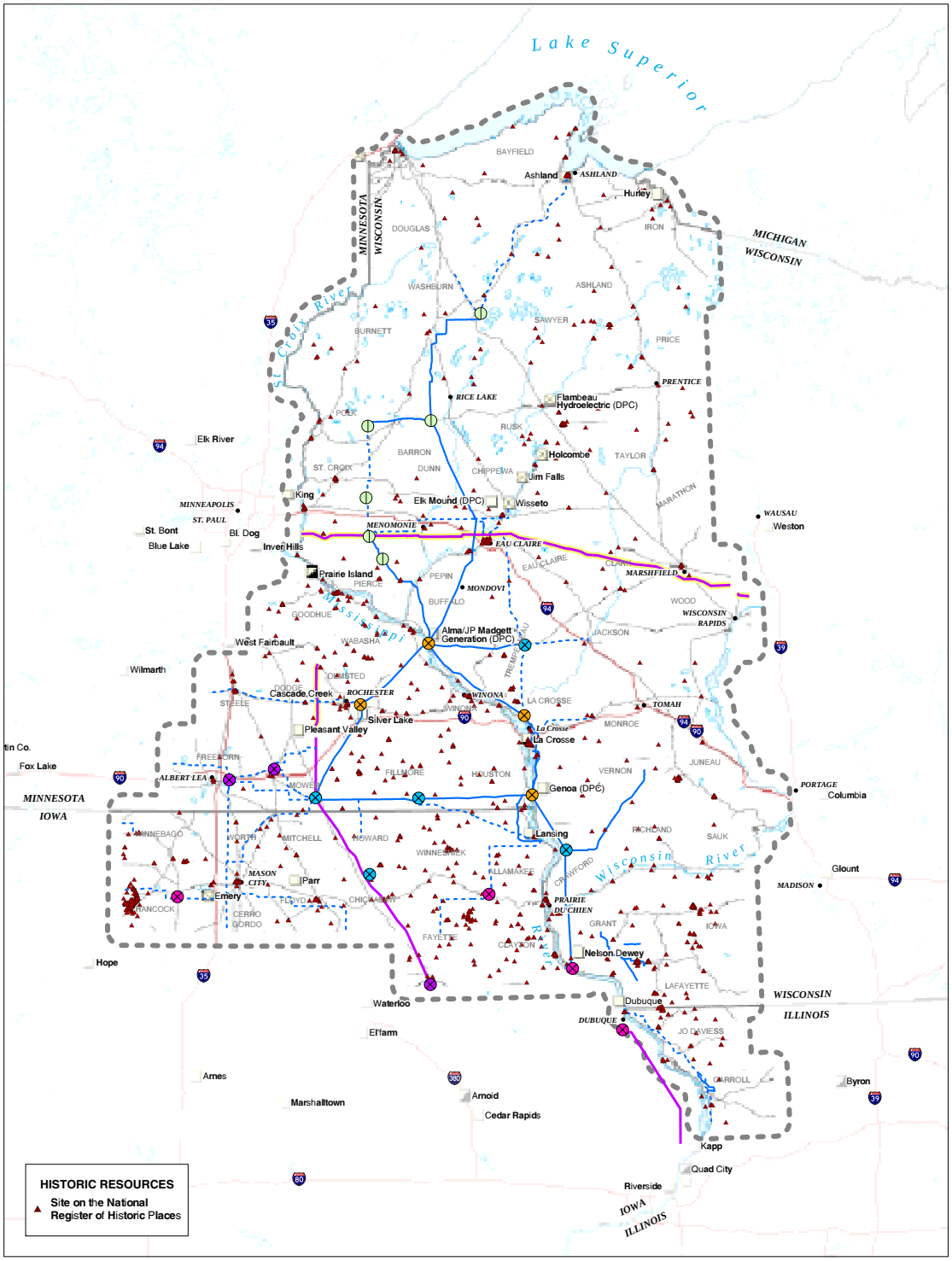

Historic Sites

Resource Map

0 5 10 20 30 40 Miles

LEGEND

- 161 kV Foreign Transmission Line
- 161 kV DPC Transmission Line
- 345 kV Foreign Transmission Line
- Constrained Interface
- DPC Service Territory

Generation Facility

- Fossil Fuel
- Hydroelectric
- Nuclear
- Wind

Injection Point

- Best
- Good
- Fair
- Marginal
- Needs Proposed Arrowhead-Weston 345kV to be Built

DAIRYLAND POWER COOPERATIVE

NEW COAL-FIRED POWER PLANT

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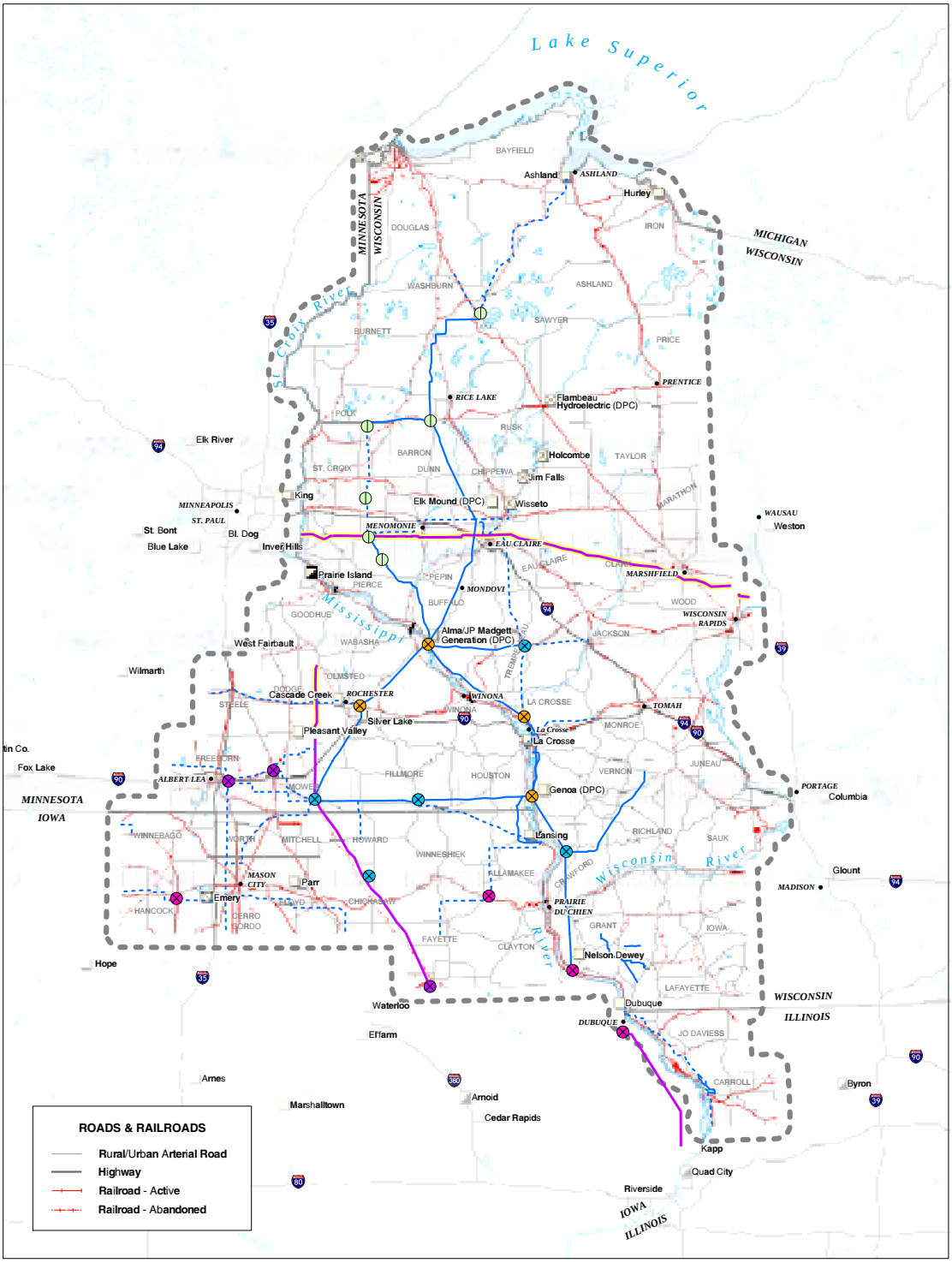


Transportation Network

Resource Map

0 5 10 20 30 40 Miles

LEGEND

161 kV Foreign Transmission Line
161 kV DPC Transmission Line
345 kV Foreign Transmission Line
Constrained Interface
DPC Service Territory

Generation Facility

Fossil Fuel
Hydroelectric
Nuclear
Wind

Injection Point

Best
Good
Fair
Marginal
Needs Proposed Arrowhead-Weston 345kV to be Built

DAIRYLAND POWER COOPERATIVE

NEW COAL-FIRED POWER PLANT

EDAW

September 4, 2003

Appendix B
Technical Memorandum - CALPUFF Screening Model

TECHNICAL MEMORANDUM CH2MHILL

CALPUFF Screen Modeling for Dairyland

PREPARED FOR: Randy Schulze/CH2M HILL/DEN

PREPARED BY: Josh Nall/CH2M HILL/DEN

DATE: June 16, 2003

The siting of a new 300 to 400 MW coal-fired power plant in the Dairyland service area must take into consideration the distance from candidate sites to air quality protected areas commonly referred to as Class I air quality areas. The Rainbow Lake Wilderness Area (RLWA) in northern Wisconsin is such a protected area. The federal land manager (FLM) for Rainbow Lake is the U.S. Forest Service. For the PSD air quality permitting of the plant, the Forest Service will have the right of providing comment on the protection of air quality related values (AQRV) in the wilderness. In addition, the state permitting agency (Wisconsin DNR if the plant is sited in Wisconsin) must assure that the operation of the power plant will not result in concentrations of criteria pollutants that exceed the allowable Class I increments.

The best way to meet these requirements is to site the plant beyond an acceptable minimum distance from the Class I area. CH2M HILL applied the EPA guideline model CALPUFF in a screening mode to arrive at conservative estimates of the potential impacts from the Dairyland Project on the RLWA. The analysis used the recommended approaches and CALPUFF technical options that are provided in the EPA document *Interagency Workgroup on Air Quality Modeling (IWAQM) Phase 2 Summary Report and Recommendations for Modeling Long Range Transport Impacts* (December 1998) and the *Federal Land Managers' Air Quality Related Values Workgroup* document (FLAG, 2000).

Modeling Receptors

Ordinarily, the CALPUFF screening technique must be conducted with rings of modeling receptors that surround the source in question. The use of receptor rings for the screening can introduce a great deal of conservatism because impacts anywhere along a ring must be treated as if they occur within the Class I area. To reduce this conservatism, CH2M HILL only considered the receptors that fall near the leading edge of RLWA.

Since the location of the plant site is unknown, the potential impacts from the plant were estimated by modeling the proposed unit at several points on a north-south line at various distances from RLWA. The closest modeled point was 50 kilometers (km) south of the RLWA and the farthest point was 250 km south (see Figure 1). A single arc of modeling receptors was created for each modeled point that represented the leading edge of the RLWA. For the RLWA receptors, CH2M HILL determined the highest elevation along the southern boundary of the RLWA, and this elevation was assigned to all receptors along the arc.

Meteorological Input

Meteorological input to the CALPUFF screening was assembled from surface data collected at the NWS station in Eau Claire, Wisconsin. Concurrent upper-air data were taken from the NWS station at St. Cloud, Minnesota. The period of record for the meteorological input included five years of data from 1986 through 1990. The data set included hourly solar radiation and relative humidity from the Eau Claire, Wisconsin station. The EPA PCRAMMET processor was used to combine the data into model-ready files suitable for computation of wet and dry deposition. Figure 2 presents a windrose for the Eau Claire surface data.

Source Parameters

Stack exit conditions for the plant were based on stack height, stack diameter, exit velocity, and exit temperature that are typical for units of the size proposed for the project. We selected a stack height of 500 feet. This height is based on our experience with other coal-fired units, and represents an approximate Good Engineering Practice (GEP) height for the stack as based on a boiler structure height of 200 feet. EPA modeling guidance states that a stack can be modeled at a height no higher than GEP, but a stack is not required to be as high as GEP (i.e. it can be lower). As stated in the EPA Guideline on Air Quality Models (Appendix W of 40 CFR Part 51), "The use of stack height credit in excess of Good Engineering Practice (GEP) stack height or credit resulting from any other dispersion technique is prohibited in the development of emission limitations by 40 CFR 51.118 and 40 CFR 51.164".

Emissions from the plant were estimated based on the current best available control technology (BACT) emission levels for coal-fired power plants or the emissions levels that are being required for new coal-fired plants due to Class I impact concerns. Specifically, the SOx emission rate was based on 0.12 lb/MMBtu and a heat input of 3,200 MMBtu/hr. This emission rate was required for a recent coal-fired unit to represent worst-case 24-hour emissions for purposes of CALPUFF modeling. This averaging period (24-hour) is key because the visibility calculations within the CALPUFF model are based on 24-hour periods. The emission rate for NOx (0.08 lb/MMBtu) is based on a recent BACT determination for a new coal-fired unit in the Midwest with SCR control. Table 1 summarizes the input parameters for the 300 MW and 400 MW options.

Table 1 - Stack Parameters and Emission Rates

Option	Emission Rate for Composite Stack (lb/hr)				Stack Parameters			
	NOx	SOx	SO_4	PM_{10}	Stack Height (feet)	Stack Diameter (feet)	Temperature (°F)	Velocity (feet per second)
300 MW	256	384	12.8	80	500	20	145	52.3
400 MW	320	480	16.0	100	500	23	145	52.3

Model Options and Results

For background concentrations of ozone and ammonia for chemical transformation within the CALPUFF model, we used the values recommended as defaults for CALPUFF screening in the IWAQM document. Background values for aerosol concentrations and seasonal relative humidity were taken from the FLAG document. Because the FLAG document does not list specific background values for RLWA, we used the values from the nearest listed Class I area, the Boundary Waters Canoe Area in Minnesota. Table 2 presents the results of the analysis. We evaluated the potential impacts on visibility and the impacts of the criteria pollutant (SO_2) that would most likely exceed the EPA-proposed Class I modeling significance levels. Visibility impacts are presented in terms of the percentage "extinction" that is attributable to the proposed project as compared to natural background conditions. Impacts of SO_2 are compared to the modeling significance levels and allowable increments.

Table 2 – Predicted Impacts to RLWA

Point/Option	3-Hour SO_2 (µg/m³)	24-Hour SO_2 (µg/m³)	Annual SO_2 (µg/m³)	Visibility (Maximum % Change)	# Days > 5%	# Days > 10%
300 MW Option						
Point 1 (50 km from RLWA)	2.2	0.72	0.049	14.0	46	3
Point 2 (75 km from RLWA)	1.6	0.47	0.031	10.6	31	2
Point 3 (100 km from RLWA)	1.2	0.37	0.025	8.2	19	0
Point 4 (125 km from RLWA)	1.5	0.32	0.020	7.1	13	0
Point 5 (150 km from RLWA)	0.9	0.28	0.015	7.0	12	0
Point 6 (200 km from RLWA)	0.7	0.197	0.011	8.0	8	0
Point 7 (250 km from RLWA)	0.6	0.18	0.008	6.1	4	0
400 MW Option						
Point 5 (150 km from RLWA)	1.0	0.34	0.019	8.5	21	0
Point 6 (200 km from RLWA)	0.8	0.24	0.013	9.5	15	0

Point 7 (250 km from RLWA)	0.7	0.22	0.009	7.5	8	0
Criteria						
Class I Modeling Significance Level	1	0.2	0.1	—	—	—
Class I PSD Increment	25	5	2	—	—	—
Visibility % Change in Extinction	—	—	—	5%	—	—

Conclusions

We applied the CALPUFF model to estimate the potential impacts from the proposed project because CALPUFF is the EPA-recommended model for long-range (>50 km) transport. Because CALPUFF is very labor intensive to apply in a refined mode, the model was applied in a screening mode to allow for a conservative estimate of impacts and to allow us to arrive at more timely results. The CALPUFF screening method can allow one (with relative ease) to identify projects that will yield impacts below the AQRV thresholds that have been established by the FLMs.

All of the modeled points in this case, including the point at a distance of 250 km from RLWA, yield visibility screening results that exceed the FLM threshold (5%) for a single project. All but the most distant points for the 300 MW option yield impacts of SO_2 that exceed the EPA-proposed Class I modeling significance level for 24-hour impacts. These results point out the conservative nature of the CALPUFF screening. Several aspects of the screening contribute to the conservatism, including the use of a single meteorological station. Any single station may exhibit periods of stagnation (calm winds). By using a single meteorological station within CALPUFF, all emission "puffs" may be subject to periods of stagnation across the entire domain, which is unreasonable over such a large area. Prolonged stagnation with the CALPUFF screening can lead to elevated impacts, and many of the episodes that yield higher visibility impacts included significant periods of stagnation.

Based on the results of this analysis, our experience with CALPUFF analyses for other coal-fired units, and the expected reduction in conservatism in going from CALPUFF screening to refined CALPUFF modeling, a reasonable "exclusion zone" for the 300 MW project could be set at the distance to Point 4 (125 km) and for the 400 MW project, the exclusion zone could be set at Point 5 (150 km). At these minimum distances, the project's impacts could likely be modeled with refined CALPUFF to a level that would be acceptable to the FLM. Siting at distances less than those specified above would likely present potential problems with the modeled Class I impacts.

A refined application of CALPUFF would make use of a 3-dimensional windfield with a unique set of meteorological parameters at each modeled grid point. This contrasts with CALPUFF in the screening mode, which uses data from a single meteorological station. For CALPUFF screening, the meteorology is assumed to extend throughout the modeling

domain for each hour, and this can lead to higher short-term impacts because of the uniform transport toward a particular area. Our determination of "exclusion" zones for the proposed Dairyland units is based on recent modeling experience including an exercise in Utah for a proposed 950 MW coal-fired. This analysis demonstrated that acceptable 24-hour visibility impacts could be achieved at a distance of approximately 200 km. Based on the modeling results for the proposed DPC units obtained using CALPUFF screening, and since the proposed unit for Dairyland is less than half of this size but the terrain in northern Wisconsin is generally flat allowing for longer unobstructed plume transport distances as compared to southern Utah, an exclusion distance of 125 km for a 300 MW unit and 150 km for a 400 MW unit is appropriate.

Figure 1 – Relative Locations of RLWA and Modeled Points

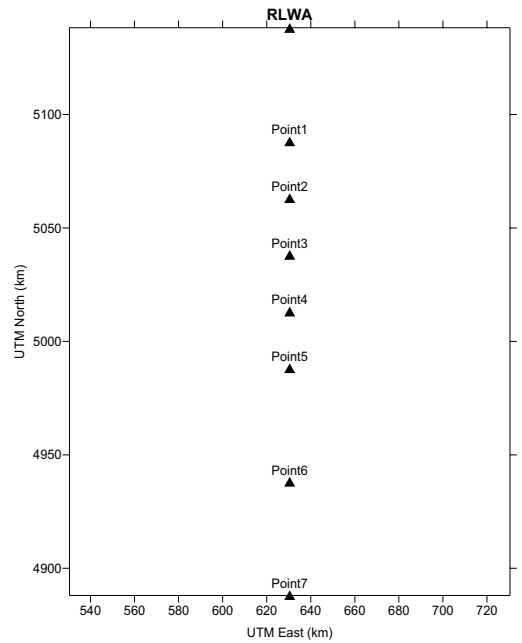
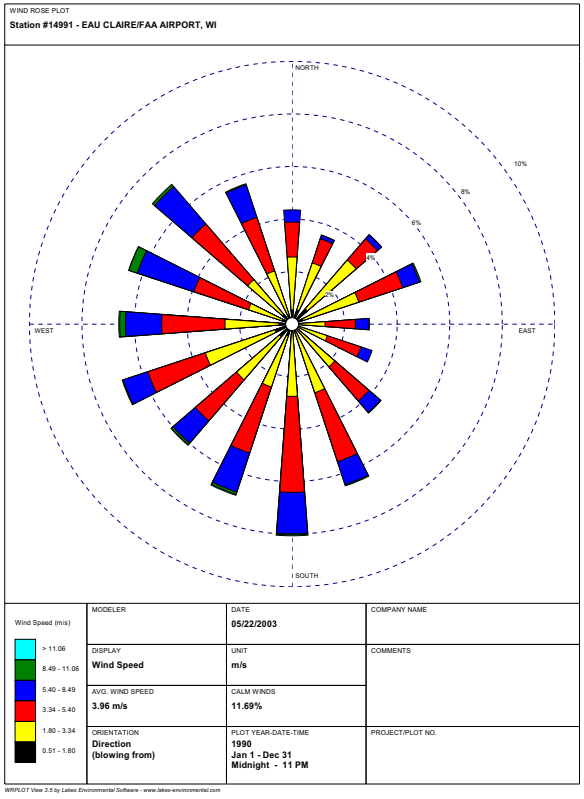


Figure 2: Windrose for Eau Claire, Wisconsin



Appendix C
Injection Point Scoring Methodology

Generation Injection Criteria Methodology and Assumptions

Jerry Iverson
Dairyland Power Cooperative
Facility Planning, Transmission Services Department
August 20, 2003

Site Selection: DPC's Transmission Services Department has determined 22 candidate sites for siting 250 MW or 400 MW of base load generation based upon the transmission grid's ability to accept this amount of generation with a minimum of transmission infrastructure upgrades. These candidate sites were selected by known system performance and engineering judgement. Factors considered were system topology, known transmission constraints, and the congruence of high voltage transmission lines. Also critical to these candidate sites is the ability to deliver this power to DPC's control area based upon these know transmission constraints or bottlenecks of the bulk transmission grid. These candidates were chosen strictly from an electrical aspect and were not prejudiced by the other two critical elements of the site selection process, fuel delivery and a water source for cooling.

In order to verify the validity of these 22 candidates sites a verification process was undertaken looking at their electrical attributes. These attributes were quantified and weighted in order to identify an order of merit based solely on their electrical characteristics. The following site attributes were considered:

Attribute/Considerations

Number of lines > 115 kV. – The number of high voltage lines above 115 kV correlate to the actual or potential outlet capacity of a generator injection point. The outlet capacity of these sites can be increased, in general, by upgrading or rebuilding these existing lines rather than constructing additional lines.

Summation of line ratings in MVA. – This is the sum of the MVA outlet capacity of the lines at a particular generator injection point. The outlet capacity provides an indication of the how much transmission upgrades are needed in order to make the site suitable as a generator injection point.

Summation of network line ratings in MVA. – Lines within the NSP network agreement avoid tariff charges and are from an economic standpoint more desirable than non NSP network lines.

Summation of Power Transfer Distribution Factor (PTDF) Violations in percent. – PTDF violations occur when the output of a generator serving the Dairyland control area load accounts for greater than a 5% increase of flow on a MAPP constrained interface. This flow must also be greater than 1 MW to cause a violation to occur. Mitigation's must be made to correct the violation before the generator can be accredited by MAPP.

Planned generation affecting sites found in MISO Generation Queue in MW. – MISO has a queue of planned generators. These generators will consume available transmission capacity and must be considered when evaluating the suitability of the generator injection point.

Line and substation ownership of site. – If DPC owns the facility capital investments become DPC assets. If DPC must spend money to upgrade the facilities of other utilities it is considered not as advantageous.

These attributes were then given weighting between 10 and 1 with 10 being the most desirable.

Results: The DPC Generation Injection Matrix found below identifies the ranking of each these 22 sites. The matrix gives a general idea of the amount of transmission infrastructure required to make the site suitable to deliver generation to the DPC service territory. All sites can be made to work if enough transmission infrastructure is constructed. Of these 22 sites, the five sites in DPC's northern service territory are believed to be viable only if the Arrowhead to Weston 345 kV line (or similar project) is constructed and operated with a 345/161 kV mid-point substation in the Stone Lake area. Without the Arrowhead-Weston line generation at theses sites significantly violate the Prairie Island-Byron Constrained Interface. These five sites are:

Apple River Barron Crystal Cave Pine Lake Stone Lake

The sites which ranked good or above are found below with a brief description of each:

Site **Ranking**

Genoa **47**
Genoa has five 161 kV lines with a NSP network capacity of 1325 MVA. All of these facilities are owned by DPC. Genoa violates no transmission constraints.

Alma **46**
Alma has five 161 kV lines with a NSP network capacity of 1209 MVA. Four of these lines are owned by DPC. Alma violates no transmission constraints.

Rochester **44**
Rochester has five 161 kV lines with a NSP network capacity of 1054 MVA. Two of these lines are owned by DPC. Rochester violates no transmission constraints.

North La Crosse 40
North La Crosse is located close to two 161 kV transmission lines. These lines would be configured with an in and out so this site would have four 161 kV lines. This would provide a NSP network capacity of 718 MVA. North La Crosse violates no transmission constraints.

Adams **39**
Adams is located along the Byron-Hazelton 345 kV line and five 161 kV transmission lines. This would provide a NSP network capacity of 948 MVA. Adams violates no transmission constraints. The MISO generation queue contains 200 MW of planned generation in the vicinity of Adams which would effect transmission capacity of the is site.

Jerico **39**
Jerico is located adjacent to the ALTW Adams-Hazelton 345 kV line. Since a generator at Jerico would provide benefit to ALTW negotiation for use of the line would be pursued. Additionally 161 kV outlets to Rice and Floyd or Postville would need to be constructed. Jerico violates no transmission constraints.

Tremval **39**
Tremval is located along four 161 kV transmission lines. This would provide a NSP network capacity of 885 MVA. Tremval violates the Prairie Island-Byron transmission constraint.

Harmony **38**
Harmony is located along a DPC 161 kV line. This line would need to be configured with an in and out so the NSP network capacity would be 648 MVA. Harmony violates no transmission constraints.

Site	Ranking
Seneca	**37**

Seneca is located along three DPC 161 kV transmission lines. This has a capacity of 694 MVA. Seneca violates the Quad City West transmission constraint.

Austin **32**
Austin is located along two 161 kV transmission lines. This has a NSP network capacity of 891 MVA. Austin violates no transmission constraints. The MISO generation queue contains 200 MW of planned generation in the vicinity of Austin which would effect transmission capacity of the is site.

Hayward **32**
Hayward is located along four 161 kV transmission lines. This has a NSP network capacity of 648 MVA. Hayward violates no transmission constraints. The MISO generation queue contains 100 MW of planned generation in the vicinity of Hayward which would effect transmission capacity of the is site.

Rock Elm **32**
Rock Elm is located along two DPC 161 kV transmission lines. This has a capacity of 457 MVA. Rock Elm violates the Prairie Island-Byron and MWSI transmission constraints.

Hazelton **30**
Hazelton is located along six 161 kV transmission lines in addition to being a 345 kV source. Hazelton has no NSP network capacity. Hazelton violates no transmission constraints.

Postville **27**
Postville is located along two 161 kV transmission lines. Postville has no NSP network capacity. Postville violates no transmission constraints.

Cassville **26**
Nelson Dewey (Cassville) is located along four 161 kV transmission lines. Cassville has no NSP network capacity. Cassville violates Montezuma-Bondurant, Arnold-Hazelton, and the Quad City West transmission constraints.

Emery **21**
Emery is located along four 161 kV transmission lines. Emery has no NSP network capacity. Emery violates the Spencer-Triboji transmission constraint.

Lore **21**
Dubuque (Lore) is located along four 161 kV transmission lines. Lore has no NSP network capacity. Lore violates Montezuma-Bondurant, Arnold-Hazelton, Quad City West, and the Lore-Turkey River transmission constraints.

Appendix D
Summary of Brownfields Survey

Response Summary

Sites with barge and rail access:

Dubuque, Iowa
- 80+ acre site five miles north of Dubuque
- Adjacent to Mississippi River with site access to both barge and rail.
- Zoning is heaving industrial
- Price is negotiable
- Site is owned by John Deere Dubuque Works

Thompson, Illinois
- 800 total acres
- Zoned industrial
- Burlington Northern-Santa Fe rail adjacent to property
- Barge potential as site has direct access to the Mississippi River, but would require permitting and some dredging
- Originally purchased for future power plant, so extensive site evaluation done
- Owned by Alliant Energy

Savanna, Illinois
- 2,958 acre development located on former Savanna Army Depot site
- Zoned Industrial
- Owned by the US Dept of Army and leased to Jo-Carroll Depot Local Redevelopment Authority and will be deeded to the Authority in phases as the scheduled remediation activities are completed
- Served by the Burlington Northern Santa Fe Railroad main line and on-site switching is provided by Riverport Railroad
- The main channel of the Mississippi River is located 2,500 feet west of the proposed power plant site.
- Pricing of the proposed site land would be nominal if job creation is sufficient

Prairie du Chien, Wisconsin, two suitable sites
Bloyer Business Park
- 90 acre site zoned industrial
- Adjacent to both Burlington Northern Santa Fe and Wisconsin Southern Railroad
- Privately owned, but available
- Pricing approximately $15,000 per acre
- Mississippi River borders site on west edge

Dillman Industrial Park
- Parcel from 80 to 150 acres
- Partially zoned industrial, partially zoned agricultural
- Adjacent to Burlington Northern Santa Fe Railroad on east
- Adjacent to Dillman Harbor on the south
- Owned by two different private parties, City can facilitate acquisition of parcels

Pierce County, Wisconsin
- Privately owned parcels in Diamond Bluff township, Pierce County
- Rail access
- Adjacent to St. Croix River

Bellevue, Iowa
- 43.35 acres
- Heavy Industrial Zoning, designated brownfield
- Barge and rail access
- Former anhydrous ammonia terminal
- Currently listed with real estate agent

Allamakee County, Iowa
- 1,200 acres total, privately owned
- Rail near property
- Mississippi River near property

Sites with Rail:

Charles City Area, Iowa
Four Sites Available
Former White Farm Equipment Site
- 80 acres
- Located on both Canadian National/Illinois Central and Illinois Chicago and Eastern Railways
- Brownfield Site, owner in bankruptcy, low or no remediation costs anticipated
- Zoned for general manufacturing and no zoning changes would be required

Charles City East Development Park
- 154 acres
- Canadian National Railroad available
- Zoned for general manufacturing and no zoning changes would be required
- Privately owned but advertised as an industrial park

Floyd Crossing
- Rural 221 acre site
- Illinois Central and Eastern Rail located on south portion of parcel
- Southern 103.09 acres within Enterprise Zone and designated Industrial
- Electric service by Butler County Rural Electric Cooperative
- Zoned suburban residential
- Owned by Floyd County

Erb Site
- Rural 149 acres
- Served by Illinois Central and Eastern Railroad (bisects parcel)
- Electric service by Butler County Rural Electric Cooperative
- Zoned agricultural
- Privately owned by the Mayor of Charles City

Mason City, Iowa
- 240 acre site, adjacent to planned Ethanol Plant (2004 construction)

- Land cost estimate $8,000 per acre
- Rail on site provided by Union Pacific
- Four rail lines serve Charles City: Union Pacific, ITRC, IC&E and North Central Railway

Dunn County, Wisconsin
- Six sites available adjacent to current industrial park
- Access to Union Pacific Rail
- Proximity to Red Cedar River should a continuous and significant supply of non-contact cooling water be required
- Pricing undetermined but ag land typically sells for $2,000 to $2,500 per acre
- Zoning currently agricultural and parcels privately owned

Chippewa County, Wisconsin
- Two sites available, 116 acres and 200 acres
- Both sites are on rail, Wisconsin Central
- Chippewa County Gravel pit site likely nominal or no fee
- Other lands may be acquired for less than $5,000 per acre

Eau Claire, Wisconsin
- 150 acre site
- Privately owned and zoned agricultural
- Land price anticipated $20,000 to $35,000 per acre
- Union Pacific Rail runs along southern border of this site

Hancock County, Iowa
- Rail provided by Iowa, Chicago and Eastern Railroad which intersects with Union Pacific at Garner, Iowa
- All sites privately owned and zoned agricultural

Winnebago County, Iowa
- Four potential sites ranging from 105 to 307 acres in Lincoln and Norway townships
- Chicago and Northwestern is the rail carrier for all sites
- All sites zoned agricultural
- All sites privately owned

Worth County, Iowa
- Five potential sites ranging from 185 to 302 acres in Bristol, Danville, Kensett, Lincoln and Union Townships
- Chicago & Northwestern serves sites in Bristol, Danville and Kensett Townships
- Site in Lincoln Township served by Iowa Northern Railway Company
- Site in Union Township served by Soo Line Railroad
- All lands privately owned and zoned agricultural

Forest City, Iowa
- 140 acre parcel zoned agricultural adjacent to Heavy Industrial
- Site served by Union Pacific Railroad

- Partially privately owned, Forest City Economic Development could facilitate acquisition

Lake Mills, Iowa
- 160 acres available
- Rail provided by Union Pacific
- Current zoning Agricultural
- Farmland is currently selling for $2,000 to $2,800 per acre

New Hampton, Iowa
- 154 acres available
- Served by Iowa, Chicago & Eastern Railroad three miles from site
- Zoned M-P (multi-purpose) which allows for a mix of commercial and industrial development
- Land price of $25,000 per acre with incentives available.

Glenville, Minnesota
- 80+ acres available
- Served by Union Pacific
- Utilities by Freeborn Mower Cooperative
- Zoned industrial

Sites that responded but could not meet search criteria:

- Allamakee County, Iowa
- Grant County, Wisconsin
- Sparta, Wisconsin
- Howard County, Iowa
- Clear Lake, Iowa
- Zumbrota, Minnesota
- Fayette County, Iowa
- St. Croix County, Wisconsin
- Trempealeau County, Wisconsin

Sites that did not respond in any way:

3D Strategies, Inc. called all recipients of the information request that had not responded by August 4, 2003. These areas did not respond to the fax, mail, or phone call.

- Clayton County, Iowa
- Fredericksburg, Iowa
- Maquoketa, Iowa
- Winneshiek County Development, Iowa
- Austin and Mower Counties, Minnesota
- Dodge County, Minnesota
- Rochester (Olmsted County), Minnesota
- Southeastern MN Dev. Corp (Fillmore and Houston Counties), Minnesota
- Steele County, Minnesota
- Wabasha, Minnesota
- Winona, Minnesota

- Buffalo County, Wisconsin
- Jackson County, Wisconsin
- LaCrosse County, Wisconsin
- Pepin County, Wisconsin
- Vernon County, Wisconsin

Appendix E
Economic Calculations

New Coal Plant Economic Comparison

Dairyland Power Cooperative - PRB Coal Analysis

Coal Plant Site		Total Capital Cost	Zero Liquid Discharge (ZLD)	NOx Credits to be Purchased?	PRB Coal		Net Present Value (NPV)			First Year Power Generation Cost			First Year Power Generation Cost ($/MW-Hr)			
City	State	($/Million)	0 = No, 1 = Yes	0 = No, 1 = Yes	Rail Rate ($/Ton)	Delivered Coal Cost ($/Ton)	($/Million)	Difference ($/Million)	% Diff.	$/MW-Hr	Difference ($/MW-Hr)	% Diff.	Non-Fuel O&M Cost	Fuel Cost	Debt Service	Total
Charles City	Iowa	640.2	1	0	7.99	14.11	(1,138.14)	Base	Base	(35.37)	Base	Base	6.36	10.85	18.17	35.37
Otronto	Iowa	651.9	1	0	8.07	14.19	(1,150.15)	(12.01)	1.06%	(35.77)	(0.39)	1.11%	6.36	10.91	18.50	35.77
Rochester	Minnesota	634.0	1	0	9.18	15.30	(1,163.54)	(25.40)	2.23%	(36.11)	(0.74)	2.09%	6.36	11.76	17.99	36.11
New Hampton	Iowa	636.1	1	0	9.60	15.72	(1,176.15)	(38.01)	3.34%	(36.50)	(1.12)	3.17%	6.36	12.09	18.05	36.50
Kellogg	Minnesota	636.6	0	0	11.12	17.24	(1,200.52)	(62.38)	5.48%	(37.26)	(1.88)	5.33%	5.94	13.26	18.07	37.26
Turkey River	Iowa	628.0	0	0	11.45	17.57	(1,201.72)	(63.58)	5.59%	(37.27)	(1.89)	5.35%	5.94	13.51	17.82	37.27
Blair	Wisconsin	639.3	1	0	11.29	17.41	(1,222.42)	(84.28)	7.41%	(37.89)	(2.51)	7.10%	6.36	13.39	18.14	37.89
Hayward	Minnesota	653.9	1	0	10.92	17.04	(1,225.30)	(87.16)	7.66%	(38.02)	(2.64)	7.47%	6.36	13.10	18.56	38.02
Thomson	Illinois	623.6	0	1	11.00	17.22	(1,253.68)	(115.54)	10.15%	(38.66)	(3.28)	9.28%	7.79	13.16	17.70	38.66
Eagles Landing	Illinois	630.4	0	1	11.00	17.12	(1,259.46)	(121.32)	10.66%	(38.85)	(3.47)	9.82%	7.79	13.16	17.89	38.85
Alma	Wisconsin	589.8	1	0	18.06	24.18	(1,347.03)	(208.89)	18.35%	(41.45)	(6.08)	17.19%	6.36	18.36	16.74	41.45
Brice Prairie	Wisconsin	635.6	0	0	18.80	24.92	(1,397.60)	(259.46)	22.80%	(43.14)	(7.76)	21.94%	5.94	19.16	18.04	43.14
Dubuque	Iowa	626.3	0	0												

Basis:

403.47	MW Net Output
9,996	Btu/kW-Hr Net Plant Heat Rate (1.25% lower or 9,871 Btu/kW-Hr for Alma Site w/Once-Through Cooling)
0.80	Annual Plant Capacity Factor
2,110,413	Tons/Year of PRB Coal
6.12	$/Ton Mine Mouth Coal Cost
$5,000,000	Annual NOx Credit Purchase Requirement for Illinois Sites
5.0%	Interest Rate on Capital
7.0%	Discount Rate for NPV Calculations
2.5%	Annual Non-Fuel O&M Cost Escalation Rate
1.5%	Annual Coal Rail Transportation Cost Escalation Rate
20	Years Plant Economic Life

Transmission Costing Detail

The following planning estimates assume no out of control area tariff costs. These estimates have not been verified with power flows.

400 MW Gen Site	State	2003$ Cost $M	Description
Alma	WI	**21.62**	161 kV rebuilts on existing ROW and North La Crosse phase shifter. See Alma Study Draft for details
Blair	WI	**20.72**	Similar to Alma Study with 161 kV rebuilts on existing ROW and North La Crosse phase shifter. See Alma Study Draft for details. Differs from the Alma Study with the following: Alma-Elk Mound rebuild exchanged for Tremval-Eau Claire, Alma substation upgrades transferred to Xcel Tremval.
Brice Prairie	WI	**17.62**	Similar to Alma Study with 161 kV rebuilts on existing ROW. Does not need North La Crosse phase shifter. See Alma Study Draft for details.
Hayward	MN	1.21	Hayward Generation Substation 400'X400'
		2.50	Hayward Generation GSU 161/13.8 kV 448 MVA Tx
		0.36	Hayward Generation Generation Substation GSU 161 kV Circuit Breaker with bay
		8.29	Rebuild ALTW Hayward-Adams-954 MCM 36.5 miles @ $227k/mi
		2.50	Add 2nd Adams 345/161 kV 448 MVA Tx
		8.40	Rebuild Adams-Rochester 954 MCM 37 miles @ $227k/mi
		23.26	**Total**
Kellog	MN	**23.62**	Similar to Alma Study with 161 kV rebuilts on existing ROW and North La Crosse phase shifter. See Alma Study Draft for details. Differs from the Alma Study with the following: Requires161 kV 954 MCM River Crossing from the Kellog Generator to the Alma substation for $2M
Rochester	MN	1.21	Rochester Generation Substation 400'X400'
		2.50	Rochester Generation GSU 161/13.8 kV 448 MVA Tx
		0.36	Rochester Generation GSU 161 kV Circuit Breaker with bay
		8.40	Rebuild Adams-Rochester 954 MCM 37 miles @ $227k/mi
		2.50	Add 2nd Adams 345/161 kV 448 MVA Tx
		14.97	**Total**
Dubuque	IA	1.21	Dubuque Generation Substation 400'X400'
		2.50	Dubuque Generation Substation GSU 161/13.8 kV 448 MVA Tx
		0.36	Dubuque Generation Substation GSU 161 kV Circuit Breaker with bay
		9.08	New Construction Dundee-Postville 161 kV 954 MCM 40 miles @ $227K/mi
		2.00	ROW for 40 miles new construction @ $5K/mi
		0.36	Postville 161 kV Circuit Breaker with bay
		0.36	Dundee 161 kV Circuit Breaker with bay
		15.87	**Total**
Charles City	IA	1.21	Charles City Generation Substation 400'X400'
		2.50	Charles City GSU 161/13.8 kV 448 MVA Tx
		1.07	Charles City (3) 161 kV Circuit Breakers with bay $358 each (two line breakers and one on high side GSU)
		1.02	New Construction Charles City-Rice 161 kV 954 MCM 4.5 miles @ $227K/mi along new ROW)
		0.23	ROW for 4.5 miles new construction @ $5K/mi
		4.95	New Construction Charles City-Rice 161 kV 954 MCM 17 miles @ $291K/mi (along N-90 & N-91 ROW)
		1.21	Jerico 345 kV Substation 400'X400'
		2.13	Jerico 345/161 kV 336 MVA Tx
		1.84	Jerico Terminate (2) 345 kV lines with Circuit Breakers
		4.07	New Construction Jerico-Rice 161 kV 954 MCM 14 miles @ $291/mi (along SMMPA N-81 ROW)
		1.59	New Construction Charles City-Floyd 161 kV 954 MCM 7 miles @ $227K/mi
		0.35	ROW for 7 miles new construction @ $5K/mi
		0.36	Floyd 161 kV Circuit Breaker with bay
		22.53	**Total**
New Hampton	IA	1.21	New Hampton Generation Substation 400'X400'
		2.50	New Hampton GSU 161/13.8 kV 448 MVA Tx
		1.07	New Hampton (3) 161 kV Circuit Breakers with bay $358 each (two line breakers and one on high side GSU)
		1.21	New Hampton 345 kV Substation 400'X400'
		2.13	New Hampton 345/161 kV 336 MVA Tx
		1.84	New Hampton Terminate (2) 345 kV lines with Circuit Breakers
		5.68	New Construction New Hampton-Floyd 161 kV 954 MCM 25 miles @ $227K/mi
		1.21	ROW for 25 miles new construction @ $5K/mi
		0.36	Floyd 161 kV Circuit Breaker with bay
		17.21	**Total**
Otranto	IA	1.21	Otranto Generation Substation 400' X 400'
		2.50	Otranto GSU 161/13.8 kV 448 MVA Tx
		1.07	Otranto (3) 161 kV Circuit Breakers with bay $358 each (two line breakers and one on high side GSU)
		4.09	Rebuild ALTW Otranto-Adams 954 MCM 18 miles @ $227k/mi
		5.22	Rebuild ALTW Otranto-Lime Creek 954 MCM 23 miles @ $227k/mi
		0.30	New Construction Provide in and out from Oranto substation to ALTW Adams-Lime Creek 161 kV
		8.40	Rebuild Adams-Rochester 954 MCM 37 miles @ $227k/mi
		2.50	Add 2nd Adams 345/161 kV 448 MVA Tx
		8.17	Rebuild Adams-Harmony 954 MCM 36 miles @ $227k/mi
		33.46	**Total**
Turkey River	IA	1.21	Turkey River Generation Substation 400'X400'
		2.50	Turkey River Generation Substation GSU 161/13.8 kV 448 MVA Tx
		0.36	Turkey River Generation Substation GSU 161 kV Circuit Breaker with bay
		1.43	Turkey River Generation Substation (4) 161 kV Circuit Breakers with bay
		0.30	New Construction Provide in and out from Turkey River Generation Substation to ALTW Stoneman-Turkey River 161 kV 954 MCM 1 mile double circuit @ $300K/mi
		0.05	ROW for 1 mile new construction @ $5K/mi
		2.27	New Construction Turkey River Generation Substation-Liberty 161 kV 954 MCM 10 miles @ $227K/mi
		0.50	ROW for 10 miles new construction @ $5K/mi
		12.22	New Construction Turkey River Generation Substation-Postville 161 kV 954 MCM 42 miles @ $291K/mi (along ALTW 69 ROW or N-9 ROW)
		0.36	Postville 161 kV Circuit Breaker with bay
		0.36	Liberty 161 kV Circuit Breaker with bay
		21.56	**Total**
Eagles Landing	IL	1.21	Eagles Landing Generation Substation 400'X400'
		2.50	Eagles Landing Generation Substation GSU 161/13.8 kV 448 MVA Tx
		1.07	Eagles Landing (3) 161 kV Circuit Breakers with bay $358 each (two line breakers and one on high side GSU)
		3.86	New Construction Eagles Landing to Galena 161 kV 954 MCM 17 miles @ $227K/mi
		0.85	ROW for 17 miles new construction @ $5K/mi
		0.36	Galena 161 kV Circuit Breaker with bay
		3.41	New Construction Eagles Landing to ALTW Savanna 161 kV 954 MCM 15 miles @ $227K/mi
		0.75	ROW for 15 miles new construction @ $5K/mi
		0.36	Savanna 161 kV Circuit Breaker with bay
		6.81	Rebuild Galena-ALTW Lore 954 MCM 30 miles @ $227k/mi
		21.18	**Total**
Thomson	IL	1.21	Thomson Generation Substation 400'X400'
		2.50	Thomson Generation Substation GSU 161/13.8 kV 448 MVA Tx
		1.07	Thomson (3) 161 kV Circuit Breakers with bay $358 each (two line breakers and one on high side GSU)
		1.82	New Construction Thomson to Savanna 161 kV 954 MCM 8 miles @ $227K/mi
		0.40	ROW for 8 miles new construction @ $5K/mi
		2.27	New Construction Thomson Landing to Albany 161 kV 954 MCM 10 miles @ $227K/mi
		0.50	ROW for 10 miles new construction @ $5K/mi
		6.58	Rebuild ALTW Savanna-Galena 954 MCM 29 miles @ $227k/mi
		6.81	Rebuild Galena-ALTW Lore 954 MCM 30 miles @ $227k/mi
		23.16	**Total**