# Cardinal-Hickory Creek Transmission Line Project Alternative Crossings Analysis Appendices


ITC Midwest LLC
American Transmission Company LLC
Dairyland Power Cooperative


Cardinal-Hickory CreekTransmission Line Project

April 2016

# APPENDIX A - ALTERNATIVE ANALYSIS DATA

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## Impact Summary Table

| Route Name | Total length (miles) | Number of angles greater than 30˚ | Length not Along Transmission Lines (miles) | Length of Mississippi River crossing (miles) | Airport, airstrip, or heliport within 1 mile (number) | Water towers within 1,000 feet (number) | Communication facilities within 1,000 feet (number) | Length through USACE Restricted Area (miles) | Length through floodplain (miles) | Length Through Terrain with Greater than 30% Slope (miles) | Total Wetland acres in ROW (acres) | Forested/ shrub wetland in ROW (acres) | Emergent wetland in ROW (acres) | Total Woodland acres in ROW (acres) | Number of streams/ waterways crossed | Length through state or local public lands (miles) | Length through private conservation easements (miles) | Length through USFWS Refuge (feet) | USFWS Refuge Land within ROW (acres) | Parks within 1,000 feet (number) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lock and Dam No. 10 | 25.6 | 15 | 22.8 | 1.4 | 1 | 0 | 9 | 0.0 | 1.4 | 0.2 | 3.9 | 3.9 | 0.0 | 156.6 | 37 | 0.3 | 0.0 | 6532.4 | 28.3 | 2 |
| Nelson Dewey | 14.6 | 13 | 12.7 | 0.3 | 0 | 0 | 18 | 0.0 | 0.8 | 0.1 | 9.5 | 7.5 | 2.0 | 61.8 | 15 | 0.0 | 0.5 | 3695.8 | 22.1 | 0 |
| Stoneman | 14.9 | 13 | 11.1 | 0.3 | 1 | 0 | 2 | 0.0 | 0.8 | 0.1 | 36.1 | 23.0 | 13.1 | 82.2 | 15 | 0.0 | 0.5 | 7712.8 | 46.0 | 2 |
| Lock and Dam No. 11 | 22.3 | 13 | 8.2 | 0.5 | 0 | 1 | 4 | 0.1 | 0.9 | 0.2 | 0.1 | 0.0 | 0.1 | 128.3 | 19 | 0.1 | 0.0 | 0 | 0 | 1 |
| Highway 151 Bridge | 23.1 | 18 | 8.0 | 0.5 | 0 | 1 | 4 | 0.2 | 1.2 | 0.2 | 5.5 | 4.1 | 1.4 | 131.8 | 20 | 0.1 | 0.0 | 0 | 0 | 4 |
| Galena 161kV | 23.7 | 18 | 7.2 | 0.4 | 0 | 1 | 8 | 0.2 | 1.7 | 0.2 | 4.3 | 4.1 | 0.2 | 131.0 | 20 | 0.1 | 0.0 | 0 | 0 | 5 |
| Julien Dubuque Bridge | 25.2 | 24 | 8.0 | 0.4 | 1 | 1 | 27 | 0.4 | 2.2 | 0.2 | 6.7 | 5.6 | 1.1 | 128.3 | 19 | 0.1 | 0.0 | 0 | 0 | 5 |

| Route Name | Total Length | Residences within 0-25 feet (number) | Residences within 26-50 feet (number) | Residences within 51-100 feet (number) | Residences within 101-300 feet (number) | Schools within 300 feet (number) | Daycares within 300 feet (number) | Hospitals within 300 feet (number) | Places of Worship within 300 feet (number) | Business/ Commercial structure within 300 feet (number) | Public Facilities within 300 feet (number) | Cemeteries within 300 feet (number) | Archaeological sites in ROW (number) | Historical resources within 1,000 feet (number) | Length not along actual fence row or property line (miles) | Length through developed space (miles) | Length through cultivated crops (miles) | Length through pasture/hayland (miles) | Length through prime farmland (miles) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lock and Dam No. 10 | 25.6 | 5 | 0 | 13 | 49 | 1 | 0 | 0 | 1 | 33 | 2 | 0 | 0 | 196 | 2.9 | 4.0 | 8.3 | 2.8 | 1.3 |
| Nelson Dewey | 14.6 | 0 | 1 | 1 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 2.7 | 3.3 | 5.1 | 0.5 | 2.1 |
| Stoneman | 14.9 | 4 | 1 | 4 | 13 | 2 | 1 | 0 | 1 | 4 | 0 | 0 | 1 | 1 | 2.6 | 3.6 | 5.0 | 0.5 | 2.3 |
| Lock and Dam No. 11 | 22.3 | 9 | 14 | 35 | 150 | 0 | 0 | 0 | 0 | 19 | 2 | 1 | 3 | 74 | 6.7 | 4.5 | 3.5 | 7.3 | 1.2 |
| Highway 151 Bridge | 23.1 | 9 | 14 | 35 | 138 | 0 | 0 | 0 | 0 | 20 | 0 | 1 | 3 | 68 | 7.6 | 5.3 | 3.5 | 7.3 | 1.6 |
| Galena 161kV | 23.7 | 9 | 15 | 37 | 148 | 0 | 0 | 0 | 0 | 20 | 0 | 1 | 3 | 68 | 8.1 | 5.6 | 3.6 | 7.3 | 1.6 |
| Julien Dubuque Bridge | 25.2 | 9 | 14 | 35 | 138 | 0 | 0 | 0 | 0 | 42 | 1 | 1 | 5 | 122 | 9.2 | 7.5 | 3.5 | 7.3 | 1.6 |

# APPENDIX B - AGENCY MEETING MINUTES AND OTHER MATERIALS

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ITC MIDWEST
123 Fifth Street SE
Cedar Rapids, IA 52401
phone: 319.297.6700
www.itctransco.com

February 17, 2015

**VIA EMAIL**

Paul F. St. Louis
U.S. Army Corps of Engineers
1500 Iowa Interstate Railroad
Rock Island, IL 61201

Nathan Wallerstedt
U.S. Army Corps of Engineers
180 5th Street East
St. Paul, MN 55101

**Re: Cardinal-Hickory Creek Transmission Project - Mississippi River Crossing Analysis - Lock and Dam No. 10 & Lock and Dam No. 11: Meeting Notes from January 7, 2014 Conference Call**

Dear Messrs. St. Louis and Wallerstedt:

Enclosed please find the final meeting notes of our January 7, 2014 call regarding the proposed lock and dam crossing locations for the Cardinal-Hickory Creek Transmission Line Project ("Project"). The notes include changes provided by the United States Army Corps of Engineers on February 3, 2015. I note that these notes take the place of the dual letter referenced at the end of the meeting notes which was initially identified as the means of documenting discussions between ITC Midwest and the Corps. relating to the Project.

Please contact me with any questions.

Sincerely,

Dan Hagan

Dan Hagan
Permit Policy Specialist
Local Government & Community Affairs
DH/rlr

Cardinal-Hickory Creek Transmission Project –
Mississippi River Crossing Analysis - Lock and Dam No. 10 & Lock and Dam No. 11:
Meeting Notes from January 7, 2014 Conference Call

Attendees:

| **ITC Midwest** | **USACE** | **Burns & McDonnell** |
|---|---|---|
| Dan Hagan | Paul St. Louis (Rock Island) | Jack Middleton |
| Mark Ryan | Nathan Wallerstedt (St. Paul) | Joe Pattison |
| Henry Wen | Henry DeHann | |
| Matt Carstens | Jim Piper | |
| | Robert Germann | |
| | Tom Heinold | |
| | Harland Shannon | |
| | Doug Crum (St. Paul) | |
| | Rick Hauck (St. Paul) | |

**Notes:**

1) Dan Hagan provided a brief project introduction and background of the previous consultation efforts with both the USACE and USFWS; USACE staff indicated their appreciation for the overview and continued consultation efforts by ITC.

2) Dan explained that this is a joint project with ATC and briefly explained the project division between the two companies and some of the outreach efforts underway in each state.

3) Dan explained the development of the study area as well as the rationale behind the size and extent of the study area, as well as relationship to the original project configuration under MISO. Dan indicated that a feasibility analysis was being developed for all seven potential crossing locations within the study area and that the data being requested during this meeting would be compiled into this document, which would then serve as the base for a river crossing application.

4) Additional background was provided to USACE staff on the IDOT consultations in relation to the use of the two bridges within Dubuque. Dan summarized IDOT's concerns and USACE staff understood the limitations and restrictions from IDOT"s point of view; ITC staff indicated to USACE that a letter was being drafted to IDOT that would summarize ITC's understanding of their position and restrictions for placement of HVTL's on these bridges. Dan indicated that this type of letter was something they would like to generate for the two lock and dam crossing locations.

5) Paul St. Louis indicated that the 1,200' distance indicated in his email was a length based on review by river crossing engineering staff for this particular lock and dam --- Paul indicated that the 1,200' estimate was not USACE policy, but

rather a condition related to this specific lock and dam. Dan indicated that this was one of the larger issues of clarification and enquired with Nathan Wallerstedt whether or not there were any similar conditions on Lock and Dam No. 10. Nathan indicated that they also did not have a specific USACE requirement for a setback from the dam or spillway, but agreed that 1,200' feet was "a pretty good number" for distance from the dam and associated facilities such as the spillway.

6) Nathan Wallerstedt indicated that he had the same concerns as indicated in the Rock Island letter and that the line would need to be moved off "a safe distance" from the dam; there was some internal USACE discussion about the specific setback distance, with some staff indicating that 1,000' may be acceptable; however, there was no consensus among the group and the discussion eventually gravitated back to the 1,200' figure as being appropriate for each location.

7) Nathan stated similar safety concerns regarding cranes operating from the earth embankment; any transmission lines would need to be located a safe distance away. USACE staff also indicated that ongoing maintenance activities could be impacted by a nearby line, as well as the ability to respond to future scour hole issues downstream of the dam.

8) Tom Heinold also stated that the USACE would have geotechnical concerns with any subsurface activities near the lock and dams; Tom indicated that the embankments hold back a significant weight and that construction near the lock and dams could shorten seepage paths, resulting in serious integrity concerns for the lock and dams.

9) Paul St. Louis indicated that their preference was also to not have anything located within 600' upstream of the lock and dams for safety concerns; Nate Wallerstedt indicated that this would apply at Lock and Dam No. 10 as well.

10) Dan Hagan and Henry Wen brought up the issue of conductor clearance over the river channel and enquired about the 90' clearance number. USACE staff indicated that it may be lower in specific areas along the river and that the specific clearance is also related to the water surface profile when the locks are closed (as opposed to open). USACE staff stated that the Dubuque-WI bridge was 64' above pool height, while some overhead wires were approximately 78-79' in some locations. USACE staff indicated that ITC should also check with the Coast Guard concerning potential navigations issues relating to construction and maintenance activities.

11) USACE St. Paul staff enquired about the potential undergrounding of the line at Dubuque; Dan indicated that they have not looked into this in detail as there are some fairly tight restrictions for putting a line through Dubuque which would prevent a potential segment from even reaching a potential underground crossing location. Dan also indicated that there were areas where underground construction is being evaluated, but this is currently limited to the Refuge area; Dan also explained some of the potential concerns and impacts with undergrounding HVTLs.

12) Rob Germann also indicated that the suspended wires near operating lock and dam locations was a safety concern in general.

13) Paul St. Louis also brought up the recent 'Sunfish' restoration efforts just north of Lock and Dam No. 11; Paul suggested that ITC look into this restoration effort to see if there were any conflicts with a potential HVTL in this area.

14) Nathan Wallerstedt stated that there may also be concerns regarding construction of a potential HVTL downstream of Lock and Dam No. 10 as a result of the braided channel and use of barges for construction. Potential construction issues in proximity to the lock and dam locations was good information to relate to USFWS staff.

15) USACE St. Paul District staff brought up the potential issues with HVTL in relation to Bald Eagle winter habitat in proximity to the dams; as a result of the limited freezing near these locations, the areas have become an important winter-feeding area for Bald Eagles.

16) Paul St. Louis indicated that the USACE is currently updating their master/comprehensive plan for the Upper Mississippi. In it, the USACE has provided 'dedicated corridors' for utility development. Paul cautioned that this information is still being developed, but that we should enquire with Paul Lundt, who is managing the updates to the plan.

17) Dan Hagan concluded the meeting with a roundtable discussion of any additional concerns or clarifications from USACE staff. No additional item of concern was brought up that wasn't previously discussed during the call. Dan indicated that they would like to summarize the results of this conference call as well as the previous discussions with USACE staff. USACE staff indicated that a dual letter to both districts would be acceptable.

Utility Section
800 Lincoln Way - Ames, Iowa 50010
515.239.1014 (TEL) 515.239.1891 (FAX)
www.iowadot.gov/iowaroadsigns

January 29, 2015

Attn: Henry Wen
ITC Midwest
123 Firth Street SE
Cedar Rapids, IA 52241

Henry, our bridge people have weighed in on allowing attachment of the transmission line to either one of our bridges. These bridges have fracture critical components that must be inspected 'hands-on' every 2 years and placing high voltage lines on the bridge would prevent access to the fracture critical members. Future maintenance and repairs would be impacted adversely and probably require significant down time for the power lines during those times. Those are just the top issues on their list. There are less serious ones that we did not get into because the first ones are beyond consideration.

After having a discussion with the State Bridge Maintenance and Inspection Engineer I must convey the state **will not** be in a position to grant a permit for attachment of high power electric transmission lines to any of our Mississippi River bridges. If you desire further explanation or discussion please let me know. Sorry we are not able to help you. I hope you haven't expended too much time exploring this possibility.

There is a future Highway 20 bridge that is planned to cross the Mississippi. That bridge will have the same issues as the existing ones and is not in the 5 year program so it will likely be at least 10 years before construction would start.

Sincerely,

Bryan S. Bradley

Bryan Bradley
State Utility Engineer
bryan.bradley@dot.iowa.gov

BB:sa

# APPENDIX C - CITY OF DUBUQUE RESOLUTION AND MATERIALS

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# RESOLUTION NO. 215-15

**PROVIDING THAT A PROPOSED PROJECT BY ITC MIDWEST LLC FOR A LICENSE TO ERECT, MAINTAIN AND OPERATE A PROPOSED ELECTRIC TRANSMISSION LINE FACILITY IN THE CITY OF DUBUQUE WOULD NOT BE PERMITTABLE UNDER THE CITY OF DUBUQUE CODE OF ORDINANCES AND WOULD NOT BE PERMITTED BY THE CITY COUNCIL AND THEREFORE AN APPLICATION FOR A LICENSE AND THE REQUIRED PROCESS FOR SUCH A LICENSE WOULD NOT BE IN THE PUBLIC INTEREST**

Whereas, City of Dubuque Code of Ordinances Chapter 11-6 establishes a process for licensing electric transmission line companies which requires an electric transmission line company to apply for a license to erect, maintain and operate a facility within the city; and

Whereas, the applicant must hold a public informational meeting prior to filing the petition; and

Whereas, Chapter 11-6 requires the City Council to hold a public hearing when considering whether to grant, amend, extend, or renew such a license; and

Whereas, ITC Midwest LLC (ITC) proposes to apply for a license for three (3) proposed route alternatives for a 345 kilovolt (KV) overhead electric transmission line as shown on the attached map; and

Whereas, the City Manager has met with representatives of ITC to gather information about the proposed project; and

Whereas, the City Manager and City staff have investigated the project, including material provided by ITC; and

Whereas, the City Manager has provided the City Council with the attached recommendation that the filing of a petition by ITC and a formal public hearing process would not be in the public interest; and

Whereas, the City Council, having reviewed the City Manager's recommendation, and material provided by ITC, finds that the City Council has adequate information to determine that the proposed project is not permittable and would not be permitted under Chapter 11-6, and that the recommendation of the City Manager should be approved.

**NOW, THEREFORE, BE IT RESOLVED BY THE CITY COUNCIL OF THE CITY OF DUBUQUE, IOWA:**

Section 1. The City Council hereby approves the recommendation of the City Manager that the filing of a petition by ITC for a license to erect, maintain and operate a facility within the city as proposed by ITC is not permittable and would not be permitted by the City Council, and that the filing of an application by ITC and proceeding with the process required by the City of Dubuque Code of Ordinances for such a license would not be in the public interest.

Passed, approved and adopted this 15th day of June, 2015.

Roy D. Buol, Mayor

Attest:

Kevin S. Firnstahl, City Clerk

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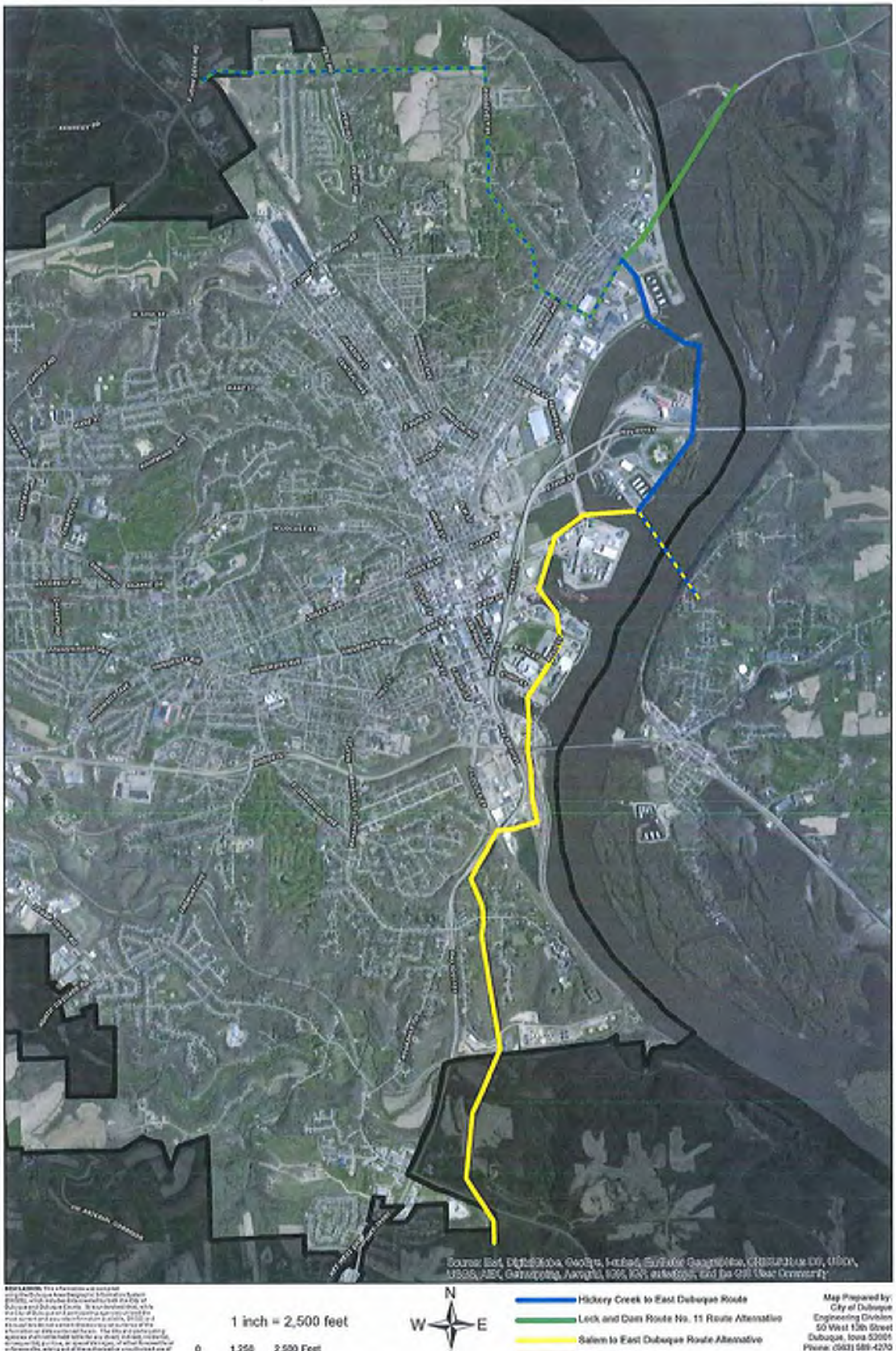
# ITC Proposed Routes





Map Prepared by:
City of Dubuque
Engineering Division
50 West 13th Street
Dubuque, Iowa 52001
Phone: (563) 589-4270
Fax: (563) 589-4205

THE CITY OF DUBUQUE
*Masterpiece on the Mississippi*

Dubuque
All-America City
2007 • 2012 • 2013

**MEMORANDUM**

**TO:** Michael C. Van Milligen, City Manager

**FROM:** Laura Carstens, Planning Services Manager
Gus Psihoyos, City Engineer

**SUBJECT: ITC Route Alternatives for Overhead Electric Transmission Facilities**

**DATE:** June 10, 2015

**INTRODUCTION**
This memorandum provides a recommendation on the route alternatives for overhead electric transmission facilities proposed by ITC through the city of Dubuque. Enclosed are a map of the route alternatives, City Code Chapter 11-6 Procedure for Licensing Electric Transmission Line Companies, and a resolution.

**BACKGROUND**
City Code Section 11-6-3 requires an electric transmission line company to apply, via petition, for a license to erect, maintain and operate a facility within the city. The applicant must hold a public informational meeting prior to filing the petition. Section 11-6-5 requires the City Council to hold a public hearing when considering whether to grant, amend, extend, or renew a license. Section 11-6-7 sets forth location criteria. This section requires a transmission line to be at least two hundred fifty feet (250') from any dwelling or other building, except by agreement or when the line crosses or passes along a public highway or is located along a railroad right-of-way.

**DISCUSSION**
ITC has proposed three (3) route alternatives for a 345 kilovolt (KV) overhead electric transmission line as shown on the enclosed map. The Hickory Creek-East Dubuque Route Alternative is ITC's preferred route. City staff had the following comments and concerns on potential impacts for each route alternative:

1. Hickory Creek-East Dubuque Route Alternative (blue line on map)
    a. This route is near a planned water tower site on Roosevelt Street.
    b. This route will affect the most wetland acres.
    c. This route will affect residential properties (125 residences within 250 feet).

2. Lock and Dam No. 11 Route Alternative (green line on map)
   a. Sutton Public Pool and Eagle Point Water Plant are within 200 feet and 250 feet of this route.
   b. This route is near a planned water tower site on Roosevelt Street.
   c. This route will affect the highest number of residential properties (133 residences within 250 feet).
   d. This route will affect the highest number of woodland acres.
   e. This route is the only one which includes areas that are not currently occupied by overhead transmission facilities.
   f. This route will have obvious negative visual impacts on Eagle Point Park, one of the Midwest's most outstanding parks. Each year, the park hosts approximately 240,000 visitors and more than 1,200 events.

3. Salem-East Dubuque Route Alternative (yellow line on map)
   a. The National Mississippi River Museum and Aquarium is within 200 feet and 250 feet of this route.
   b. This route will affect the highest number of communication facilities.
   c. This route will affect the highest number of commercial properties.
   d. This route includes the highest number of streams and waterways crossed.
   e. This route will affect residential properties (18 residences within 250 feet).

**RECOMMENDATION**
Based on the minimum 250-foot distance between transmission lines and buildings in City Code Section 11-6-7 and on the identified impacts described above, City staff recommends that the City Council adopt the enclosed resolution which states that the filing of a petition by ITC and a formal public hearing process would not be in the public interest.

**REQUESTED ACTION**
The requested action is for the City Council to concur with the staff recommendation and adopt the resolution.

Enclosures

Prepared by Nate Kieffer and Laura Carstens

cc: Barry Lindahl, City Attorney
Steve Brown, Project Manager
Nate Kieffer, Land Surveyor, PLS

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# APPENDIX D - EVALUATION OF UNDERGROUND TRANSMISSION INSTALLATION

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BURNS McDONNELL

# Evaluation of Underground Transmission Installation

ITC

## ITC Midwest LLC

Cardinal to Hickory Creek
345 kV Transmission Line
Project No. 74417

Preliminary Report – October 2015

Revision 10/2015

7097606v2

# Evaluation of Underground Transmission Installation

prepared for

ITC Midwest LLC
Cardinal to Hickory Creek
345 kV Transmission Line
Cassville, Wisconsin

Project No. 74417

Preliminary Report – October 2015

Revision 10/2015

prepared by

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

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## EXECUTIVE SUMMARY

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# LIST OF ABBREVIATIONS

| Abbreviation | Term/Phrase/Name |
|---|---|
| ATC | American Transmission Company |
| BGEPA | Bald and Golden Eagle Protection Act |
| BMcD | Burns & McDonnell Engineering Company Inc. |
| CWA | Clean Water Act |
| ESA | Endangered Species Act |
| ESRI | Environmental Systems Research Institute |
| FEMA | Federal Emergency Management Agency |
| FPVC | Fusible Polyvinyl Chloride Pipe |
| GIS | Geographic Information System |
| HDD | Horizontal Directional Drilling |
| HDPE | High Density Polyethylene |
| HPFF | High Pressure Fluid Filled |
| IDNR | Iowa Department of Natural Resources |
| IDOT | Iowa Department of Transportation |
| ITC | ITC Midwest, LLC |
| kcmil | Thousands of circular mils (area measurement) |
| kV | kilovolt |
| MBTA | Migratory Bird Treaty Act |
| MISO | Midwest Independent Service Operator |
| MVP | Multi-Value Project |
| NEPA | National Environmental Policy Act |

| Abbreviation | Term/Phrase/Name |
|---|---|
| NERC | North American Electric Reliability Corporation |
| NESC | National Electric Safety Code |
| NHD | National Hydrography Dataset |
| NHPA | National Historic Preservation Act |
| NLCD | National Land Cover Dataset |
| NLEB | northern long-eared bat |
| NPDES | National Pollutant Discharge Elimination System |
| NRHP | National Registry of Historic Places |
| NWI | National Wetlands Inventory |
| PATON | Private Aids to Navigation |
| ROW | Right-of-Way |
| SHPO | State Historic Preservation Office |
| SWPPP | Storm Water Pollution Prevention Plan |
| UG | Underground |
| USACE | US Army Corps of Engineers |
| USFWS | United States Fish & Wildlife Service |
| XLPE | Cross Linked Polyethylene |

# 1.0 EXECUTIVE SUMMARY

ITC Midwest LLC (ITC) engaged Burns & McDonnell Engineering Company, Inc. (BMcD) to provide a feasibility study for two potential underground transmission line crossing locations of the Mississippi River and the abutting Upper Mississippi River National Wildlife and Fish Refuge (Refuge) managed by the United States Fish and Wildlife Service (USFWS). The evaluated underground crossing of the Refuge and River is part of the Cardinal to Hickory Creek 345 kV Transmission Line Project (the Project) and would contain both the newly-proposed 345 kV transmission line, as well as the existing 161 kV transmission line that is currently located within the Refuge and crosses the Mississippi River overhead. During ongoing consultations with USFWS, staff requested that an evaluation of underground alternatives be evaluated as part of the review and assessment of alternative crossing locations. USFWS staff requested that the analysis include options for undergrounding both the existing 161 kV line as well as the new proposed 345 kV line through the Refuge and underneath the Mississippi River. As such, preliminary costs and an overall assessment of an underground alternative is presented for a potential 161/345 kV configuration at two locations within the Refuge.

The routing scenario in this report assumes these transmission lines would originate at a new proposed Hickory Creek Substation in Dubuque County, south of the Turkey River Substation and would extend past either the Stoneman Substation (the Stoneman alternative) or the Nelson Dewey Substation (the Nelson Dewey alternative) near Cassville, Wisconsin.. The Project would continue farther into Wisconsin to an intermediate substation to be located near Montfort, Wisconsin, and onto the other project termini located at the Cardinal Substation just west of Madison, Wisconsin. This report summarizes the results of a preliminary evaluation of routing constraints, preliminary cable system design, construction considerations, and environmental impacts for a potential underground crossing of the Mississippi River and Refuge near Cassville, Wisconsin. As result of the location within the Refuge and the requirement to cross the Mississippi River, the Project must obtain Federal approvals from multiple Federal agencies which must complete environmental reviews under the National Environmental Policy Act (NEPA). The Project must also obtain state and local permits and approvals related to the Project.

## 1.1 Routes Evaluated

BMcD has identified two underground routes, identified as the Nelson Dewey and Stoneman crossing locations. These routes were identified as alternatives that would provide a direct underground route to Wisconsin. The Nelson Dewey underground crossing alternative would be placed in a new corridor. The Stoneman crossing alternative to the Stoneman Substation would utilize a portion of the existing overhead 161 kV corridor for placement of the underground alternative. The locations of the two routes were selected to minimize the impact on the environment and Refuge lands. These routes are shown below in Figure 1-1.

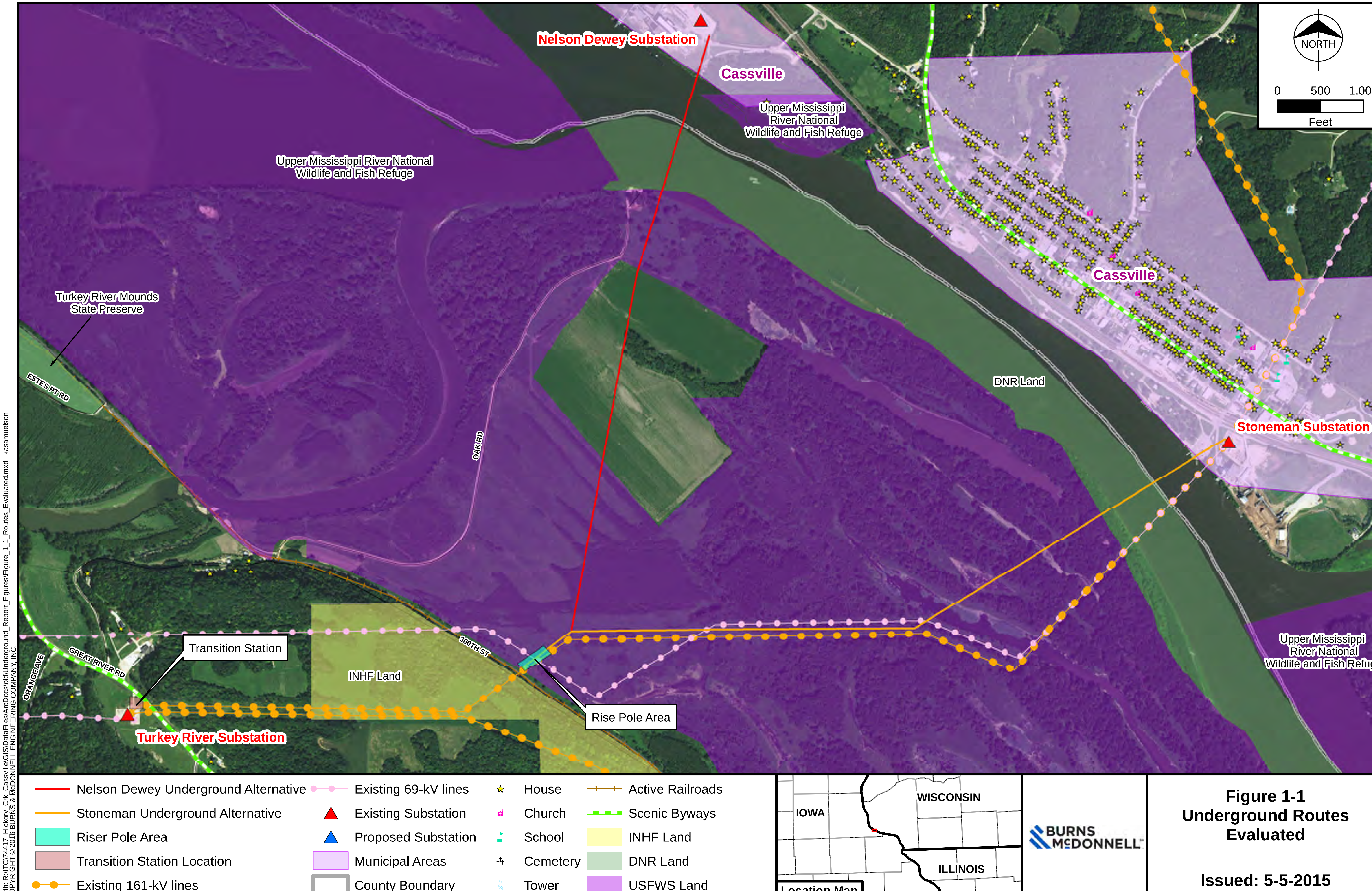



**Figure 1-1**
**Underground Routes Evaluated**

**Issued: 5-5-2015**

Path: R:\ITC\74417_Hickory_Crk_Cassville\GIS\DataFiles\ArcDocs\old\Underground_Report_Figures\Figure_1_1_Routes_Evaluated.mxd kasamuelson



Source: IDNR; Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community; Energy Velocity; Clayton County; INHF; USFWS; ITC Midwest; Burns & McDonnell.

## 1.2 Cable System Design and Construction

BMcD has determined that, for the proposed 345 kV circuit, a two cable-per-phase, 3000 thousands of circular mils (area measurement) (kcmil) copper conductor cross-linked polyethylene (XLPE) cable system would be required to achieve the requested 2,342-amp circuit capacity. For the 161 kV circuit it is anticipated that a single 4000-kcmil copper conductor XLPE cable system would be required to meet the requested 1,600-amp line ratings. These cables, both the 345 kV and 161 kV, would be installed in a duct bank and manhole system for the portion of the route within the Refuge, and then transition to a horizontal directional drill (HDD) to cross under the Mississippi River. Typical cross sections for both configurations are shown below in Section 4.0. These configurations were chosen based on evaluations completed in Section 3.0 of this report. The proposed installation includes the civil installation of a spare 345 kV circuit for future use, to minimize refuge impacts at a later date. Primary considerations in the evaluation included, but were not limited to, production rate, estimated cost, easement requirements, disturbance during and after construction, and constructability.

## 1.3 Environmental Review

BMcD performed a desktop environmental review of the potential environmental and land use impacts that may result from the construction of two potential underground transmission line crossings of the Mississippi River and Refuge. The overview of potential impacts to surrounding resources included a general analysis of the potential impacts to wetlands; threatened, endangered, and special concern species; cultural and archeological resources; terrestrial habitats; migratory avian species; floodplains; and, lastly, issues relating to existing and planned land uses and access considerations for the proposed Project.

## 1.4 Cable System Reliability

Advancing cable system technology has led to designs that have service life and reliability relatively equal to their traditional overhead counterparts. Cable systems in general exhibit excellent reliability due to their relative immunity to weather related events such as wind, ice, or lightning. If an outage were to occur, however, underground lines would typically take substantially longer to repair and may require duct bank repair and or replacement. Additionally, the unique flood conditions in the Refuge could result in prolonged durations of time where the cable system would be inaccessible, should a repair or maintenance be required.

## 1.5 Cost of Proposed Installations

BMcD has developed preliminary construction cost estimates based on the routes, installation methods, and cable system(s) evaluated in Sections 3.0 through 6.0 of this report. These cost estimates are based on

RSMeans Heavy Construction Cost Data as well as past projects, budgetary quotes provided by vendors, and professional experience and judgment.

- Total cost estimates for the 345/161 kV Nelson Dewey crossing- $82.0 MM
- Total cost estimate for the 345/161 kV Stoneman crossing- $97.6 MM

More detailed breakdowns of these costs can be seen in Section 9.0 and Appendix B.

# 2.0 INTRODUCTION

ITC is currently in the process of designing and permitting the Cardinal to Hickory Creek 345 kV Transmission Line Project. The Project was developed as one of 17 Multi-Value Projects (MVPs) by the Midcontinent Independent System Operator (MISO), a Regional Transmission Organization that manages the transmission system across all or part of 15 U.S. states, including Iowa and Wisconsin. Referred to as one half of the MVP5 project, this portion of the MVP5 project would connect a new Hickory Creek Substation in Dubuque County to an intermediate substation near Montfort, Wisconsin, and then continue to the Cardinal Substation just west of Madison, Wisconsin. The Project has been developed to addresses reliability issues on the regional bulk transmission system; cost-effectively increases transfer capacity to enable additional renewable generation needed to meet state renewable portfolio standards, and supports the nation's changing energy mix; alleviates congestion on the transmission grid to reduce the overall cost of delivering energy; and, responds to public policy objectives aimed at enhancing the nation's transmission system and mitigating global climate change.

As part of Cardinal to Hickory Creek 345 kV Transmission Project, BMcD has been asked to evaluate and provide cost estimates for the option of installing the transmission lines, both the proposed 345 kV and existing 161 kV circuits, underground for the portion of the route within the Refuge and across the Mississippi River.

This study was performed to analyze the location(s) for an underground utility at the Nelson Dewey and Stoneman crossing locations near Cassville, Wisconsin. Each crossing location analysis included the undergrounding of a single 345 kV and single 161 kV transmission line, as well as a spare 345 kV circuit for future use.

This report is intended to summarize the following aspects of the proposed Project:

- Identify underground routes to cross the Refuge and the Mississippi River,
- Describe the cable systems necessary to fulfill the electrical system operating criteria,
- Evaluate the feasibility of various trenchless installation methods along the identified routes,
- Evaluate the environmental impact of the proposed underground installation,
- Evaluate the various aspects of reliability in cable systems, and how they would compare to a comparable overhead installation, and
- Generate preliminary construction cost estimates for the recommended installations.

# 3.0 UNDERGROUND CABLE SYSTEM OPERATING REQUIREMENTS

This section of the report identifies the electrical parameters and operating requirements that have been used for the preliminary engineering of the cable system.

It is important to note that an overhead to underground transition point (transition station) for the 345 kV transmission line would be required on the east and west side of the Refuge for either crossing location (see Section 4.0 and Figure 4-4 for more detail on the proposed location of the western transition station). The transition stations, while a necessary portion of the Project, are only discussed at a high level in this report. This report identifies a potential location for the western equipment and riser poles but does not focus on any existing topography concerns, access issues, existing environmental concerns, reliability risks, and long term maintenance issues. Should an underground option be selected for further consideration as a project alternative, further analysis would be done to determine the optimal location for the riser poles, as well as the eastern transition station in Wisconsin. Estimated costs associated with the transition stations have been included in the construction estimate portion of this report.

## 3.1 Cable System Technology

Currently there are two predominant cable system technologies used for underground transmission in the U.S. market. These systems are XLPE, which is a solid-dielectric-insulated cable system; and, a high-pressure fluid-filled (HPFF), which is a fluid-dielectric-insulated cable system. While there are significant differences and histories to both technologies, this report is focused on the potential impacts to the Mississippi River and the Refuge. Therefore, this report will not go into depth on the cable system differences and comparison of the two technologies.

For the purposes of this report, all cable systems and installation scenarios provided will be based on the XLPE technology. This is the cable technology that BMcD would recommend for this potential installation. The XLPE cable offers several advantages over the HPFF cables which have led to the recommendation of this specific cable technology. A short comparison of the two cable technologies is shown below in Table 3-1.

**Table 3-1: Cable Technology Summary**

| Parameter | XLPE | HPFF |
|---|---|---|
| Available Conductor Size | 1000-5000 kcmil<br>(enameled conductor coating available for greater ampacity needs) | 1000-3500 kcmil |
| Maintenance Requirements | Regular monitoring and inspection only | Fluid sampling and testing, pumping plant maintenance, cathodic protection system monitoring and maintenance. |
| Required Ancillary Systems | None | Pumping plant<br>Cathodic protection |
| Cable Reel Lengths | 1,500-3,000+ feet each | 1,500-3,000 feet each |
| Environmental Concerns | Higher EMF than HPFF | Dielectric fluid release into Refuge or Mississippi River |

## 3.2 Cable System Requirements and Assumptions

In order to complete the preliminary design of the proposed underground cable installation BMcD has used the following data for inputs to the cable system calculations and design.

### 3.2.1 Electrical Criteria

The following electrical criteria and assumptions were used for the preliminary design on the XLPE cable system.

**Table 3-2: 345 kV Cable System Electrical Criteria**

| Parameter | Value | Notes |
|---|---|---|
| Nominal Voltage | 345 kV | |
| Required Ampacity | 2,342 Amps | Future civil installation to accommodate an additional circuit or increased ratings |
| Load Factor | 0.75 | Assumed |
| Max Conductor Temperature | 90°C | AEIC/ICEA standard |
| Bonding Scheme | Single Point | |

**Table 3-3: 161 kV Cable System Electrical Criteria**

| Parameter | Value | Notes |
|---|---|---|
| Nominal Voltage | 161 kV | |
| Required Ampacity | 1,600 Amps | |
| Load Factor | 0.75 | Assumed |
| Max Conductor Temperature | 90°C | AEIC/ICEA standard |
| Bonding Scheme | Single Point | |

### 3.2.2 Installation Criteria

The following installation criteria and assumptions were used for the preliminary design for both the 345 kV and 161 kV XLPE cable systems (Table 3-4).

**Table 3-4: Cable System Installation Criteria**

| Parameter | Value | Notes |
|---|---|---|
| Earth Thermal Resistivity | 0.90°C-m/W | Assumed |
| Earth Ambient Temperature | 20°C/15°C | Typical depth/max depth |
| Thermal Resistivity of Grout | 0.80°C-m/W | Specified value |
| Thermal Resistivity of Concrete | 0.65°C-m/W | Specified value |
| Maximum Anticipated Depth of Cover | 45 feet | Based on preliminary trenchless analysis |

# 4.0 PRELIMINARY CABLE SYSTEM DESIGN

In an effort to determine the installation size and installation scenarios, BMcD has completed preliminary cable system ampacity calculations and cable sizing. These calculations are based on the criteria and assumptions as listed in Section 3-2 above.

## 4.1 Cable and Duct Bank System

Utilizing Cymcap® ampacity software, BMcD has determined that a two cable-per-phase system (six total cables) would provide adequate capacity to meet the requested 345 kV ratings. However, in an effort to allow for future expandability and to avoid future impacts to the Refuge, it is recommended that the proposed installation include the civil portions (duct bank and manholes) for a third set of cables. This additional civil infrastructure provides additional redundancy and or expandability in the proposed system, allowing for additional cables that could be a separate circuit, or a third set of cables per phase to increase the capacity of the existing circuit at a later date.

For the undergrounding of the existing 161 kV circuit, BMcD determined that a single cable per phase system (three total cables) would provide adequate capacity to match the line rating of the overhead portion of the circuit. Unlike the 345 kV system, the 161 kV installation would not include provisions for future expansion. It is anticipated that any transmission expansion in this region would be at the 345 kV voltage class.

The proposed cable systems and installation conditions evaluated are listed below.

**Table 4-1: 345 kV Ampacity Calculation Summary**

| Scenario | Duct Bank/Bore Configuration | Separation between Bores/Duct Banks | Depth of Cover | Cables Size | Ampacity Achieved (Amps [MVA]) |
|---|---|---|---|---|---|
| River Crossing/Refuge HDD | 3 X 36" Bores | 20' | 45' | 2 X 3000 kcmil | 2,430 [1,452] |
| Refuge Duct Bank | Single Duct Dank | N/A | 5' | 2 X 3000 kcmil | 2,820 [1,685] |

Detailed ampacity reports for the 345 kV cable system can be found in Appendix A. The ampacity calculations provided above for the 345 kV cable system are based on the following installation cross sections.

**Figure 4-1: Typical 345 kV Duct Bank Cross Section**

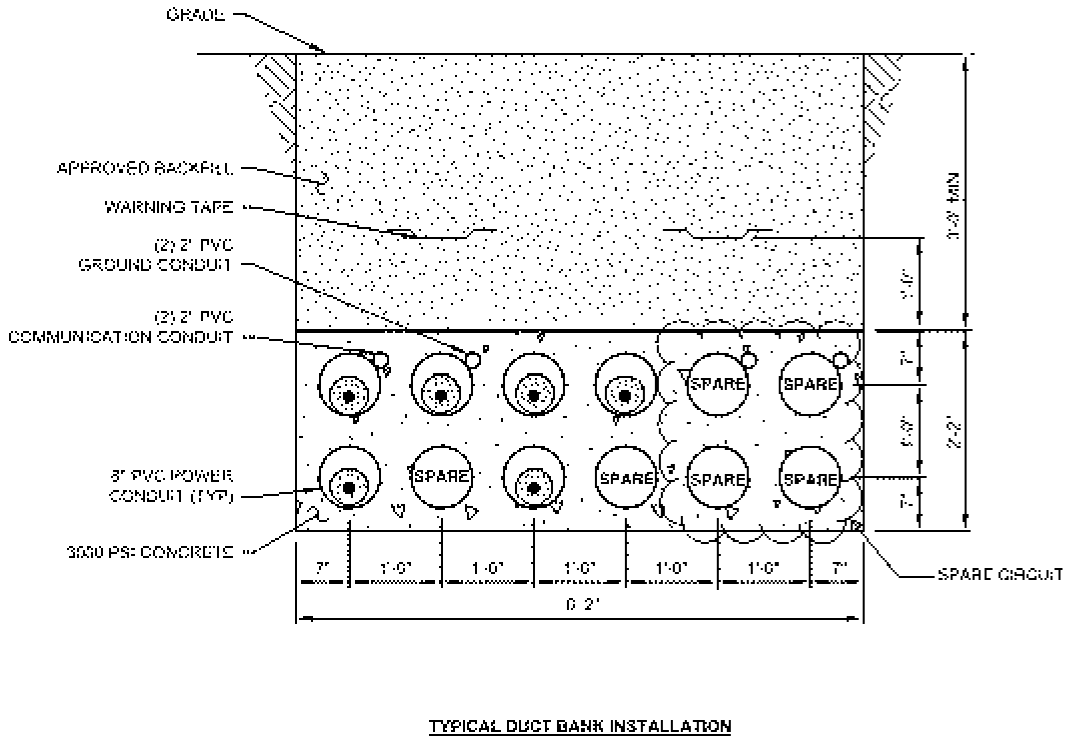



**Figure 4-2: Typical 345 kV HDD at River Crossing and Refuge Cross Section**

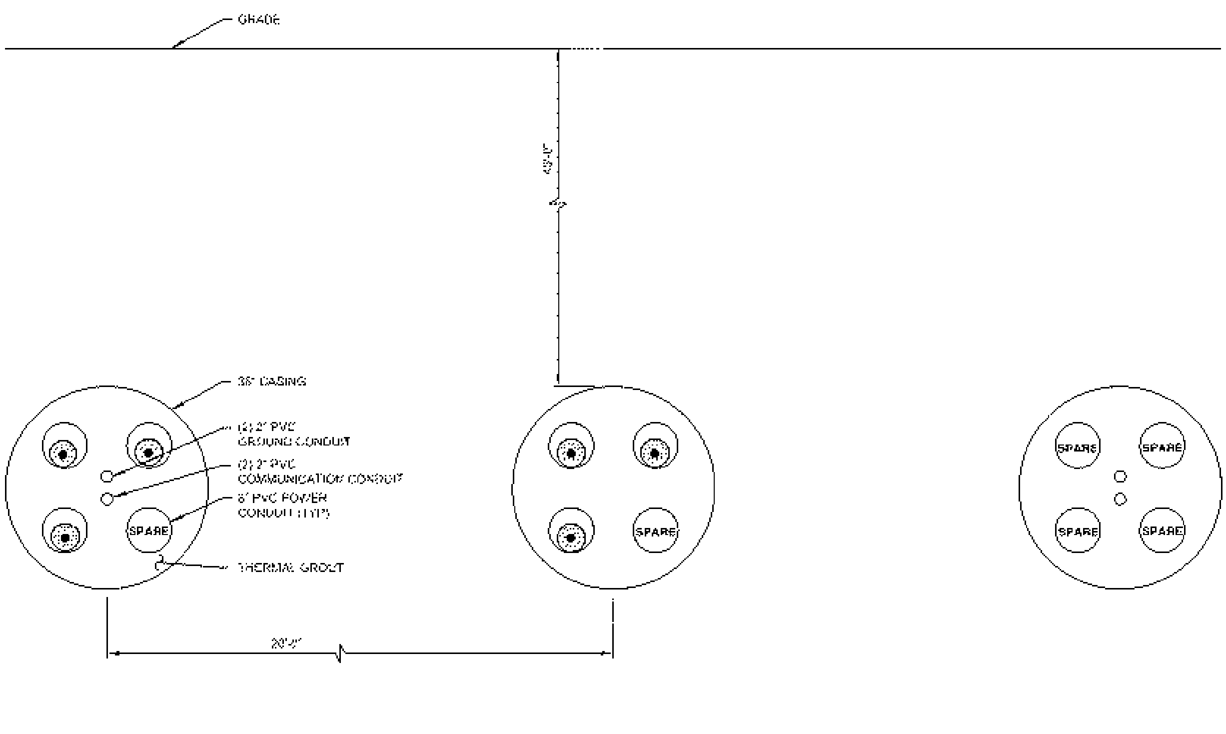


**Table 4-2: 161 kV Ampacity Calculation Summary**

| Scenario | Duct Bank/Bore Configuration | Separation between Bores/Duct Banks | Depth of Cover | Cables Size | Ampacity Achieved (Amps [MVA]) |
|---|---|---|---|---|---|
| River Crossing/Refuge HDD | 1 X 36" Bores | 20' | 45' | 1 X 4000 kcmil | 1,640 [457] |
| Refuge Duct Bank | Single Duct Dank | N/A | 5' | 1 X 4000 kcmil | 1,880 [524] |

Detailed ampacity reports for the 161 kV cable system can be found in Appendix A.

The ampacity calculations provided above for the 161 kV cable system are based on the following installation cross sections.

**Figure 4-3: Typical 161 kV Duct Bank Cross Section**

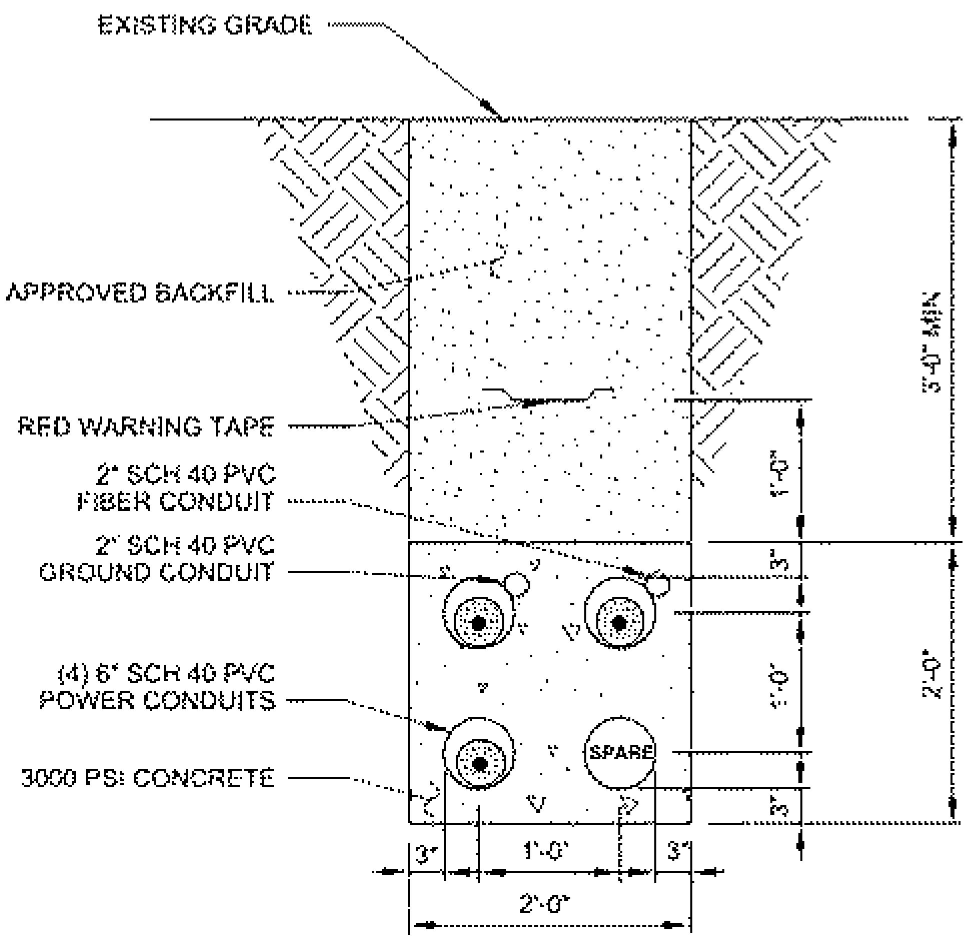
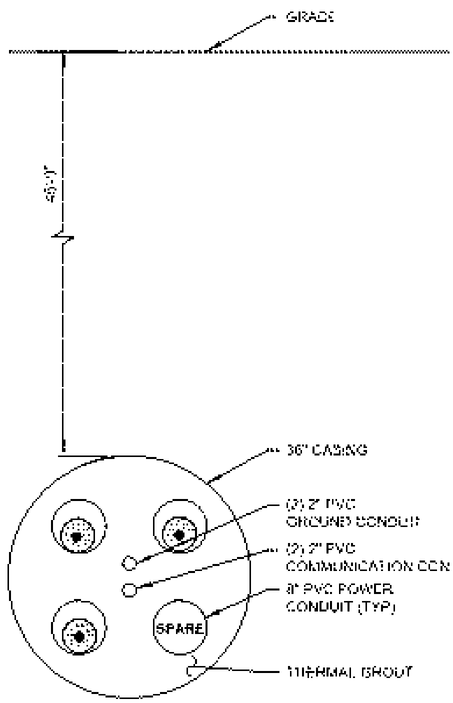


**Figure 4-4: Typical 161 kV HDD at River Crossing and Refuge Cross Section**

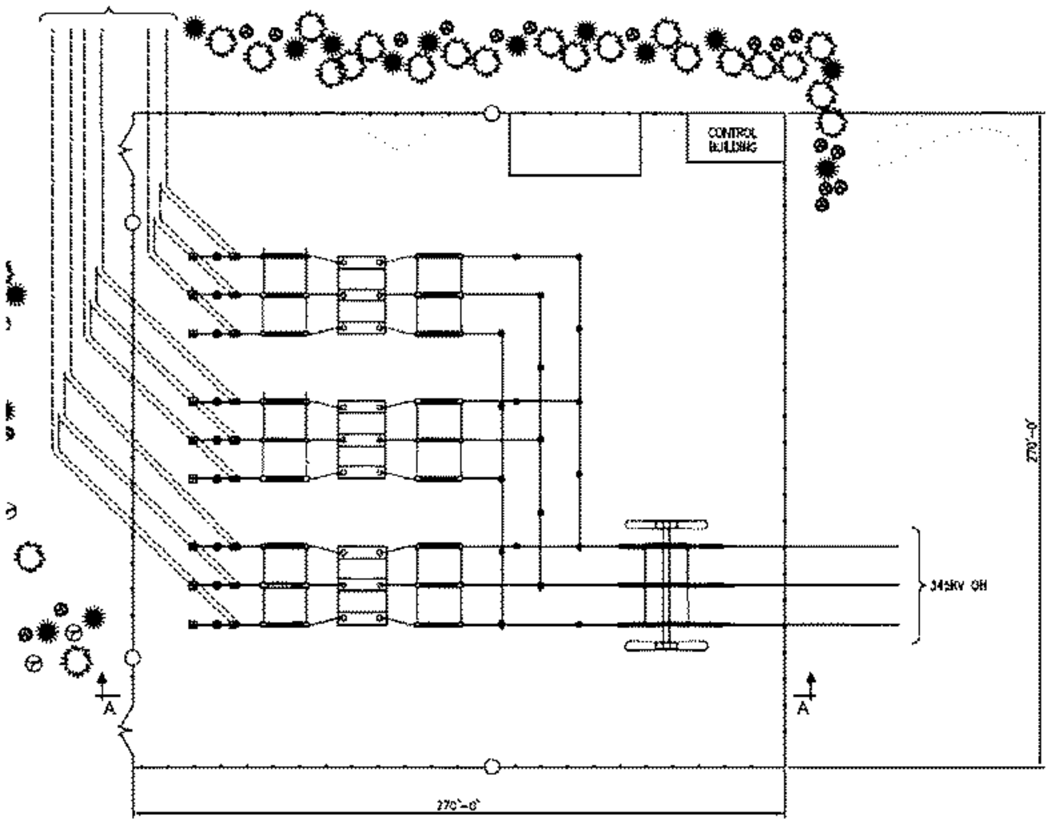



## 4.2 Transition Station

Due to the parameters of the Project, BMcD recommends the use of transition stations to increase reliability and operational flexibility of a large 345 kV transmission line comprised of both overhead and underground components. A 345 kV transmission line transition station is often utilized where a high capacity or critical bulk power underground transmission line is transitioned to an overhead transmission line. Generally, at the 161 kV voltage class, it is not necessary to utilize a transition station. The 161 kV circuit would simply utilize a transition structure (riser pole).

For purposes of this high-level study, it was estimated that a 345 kV collector bus transition station suitable for the proposed Project would have a general footprint of approximately 270 feet wide by 270 feet long, or approximately 1.7 acres (see Figure 4-5, below). However, based on the space requirements and proposed alignment of the transmission line for both the Nelson Dewey and Stoneman route options, BMcD recommends that a split location configuration of the transition station be used. In order to reduce the footprint on Refuge lands, the majority of the transition station equipment would be located off Refuge land near the existing Turkey River Substation, with only the riser poles being located on the western edge of the Refuge land.

**Figure 4-5: Assumed 345 kV (3 Cables/Phase) Transition Station Layout**




It is anticipated that for either route, the riser pole area will contain four riser poles consisting of the following:

- Three poles allocated for 345 kV (2 currently occupied with one spare pole for future expansion)
- A single pole for 161 kV

This general transition structure and configuration can be seen below in Figure 4-6 and Figure 4-7, respectively. Another transition station would be needed on the east bank of the Mississippi River; but the exact placement of that station has yet to be determined or evaluated.

**Figure 4-6: Typical 161kV Transition Structure**

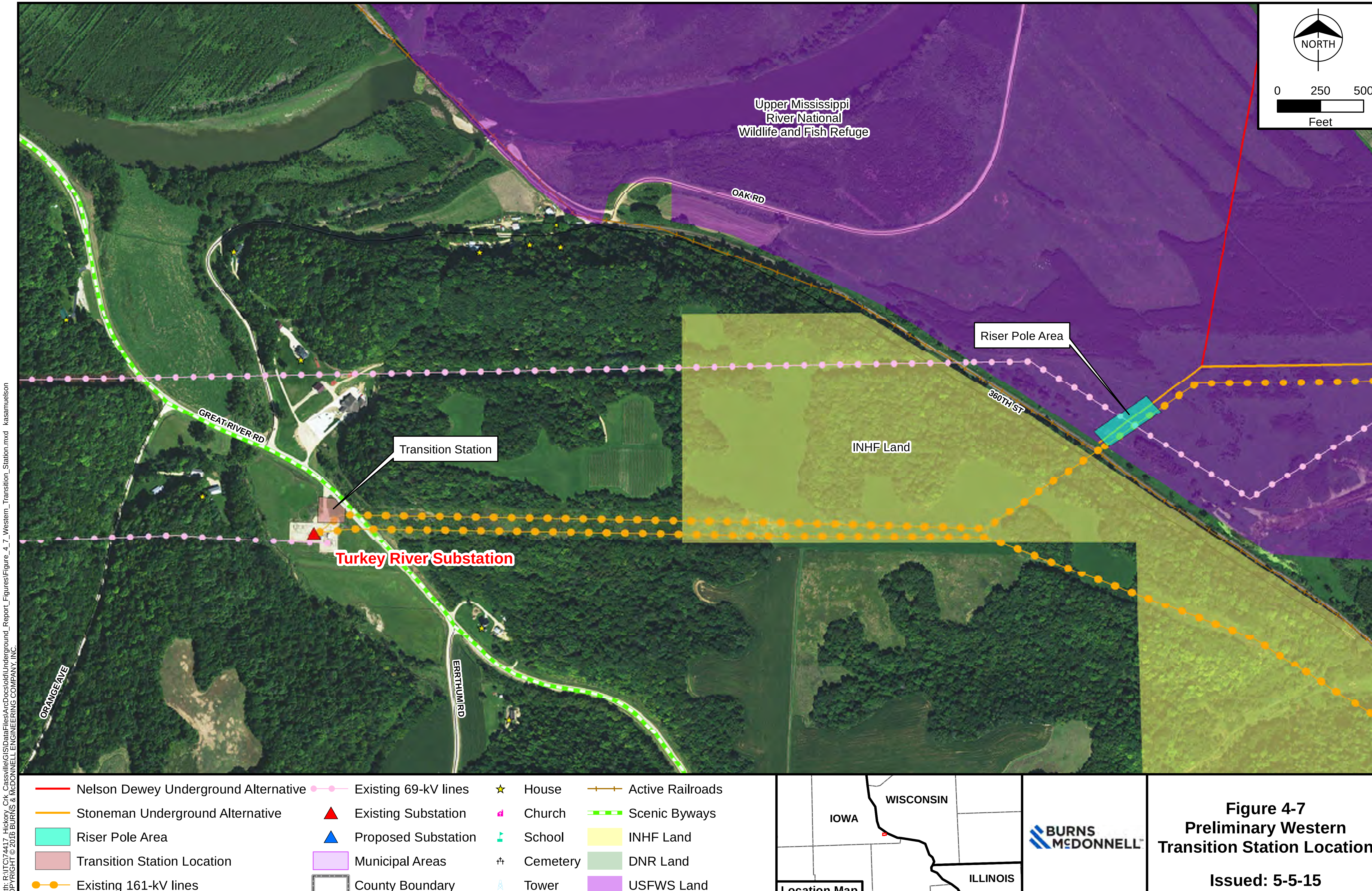



**Figure 4-7**
**Preliminary Western Transition Station Location**

**Issued: 5-5-15**

Path: R:\ITC\74417_Hickory_Crk_Cassville\GIS\DataFiles\ArcDocs\old\Underground_Report_Figures\Figure_4_7_Western_Transition_Station.mxd kasamuelson



Source: IDNR; Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community; Energy Velocity; Clayton County; INHF; USFWS; ITC Midwest; Burns & McDonnell.

Due to the required space within the Refuge, the steep grade to the west, and the presence of potential archeological sites near the bluff, the most practical preliminary western transition station location was determined to be a split arrangement with the breakers, relays, and other equipment located near the existing Turkey River Substation. The riser poles would be located on the western edge of the Refuge just east of the railroad tracks and within the existing 161 kV transmission line right-of-way (ROW). This approach would provide the increased reliability and operational flexibility of a transition station, while minimizing the impact to the Refuge by keeping the riser poles within the existing overhead ROW. Construction of the riser poles on this site would require approximately 1.0 acre. Land cover in the proposed riser pole area includes emergent wetlands; approximately 1.0 acre of emergent wetlands would be removed and permanently converted for construction of the riser pole area. Should an underground alternative be selected, the location of the western transition station would be reviewed further to verify the optimal location.

# 5.0 UNDERGROUND INSTALLATION REQUIREMENTS & ROUTING

As part of the feasibility study BMcD has evaluated various crossing installations and routing scenarios for both the Nelson Dewey and the Stoneman crossing options. This section of the report is intended to identify the installation requirements, routing constraints, and the final routes evaluated.

## 5.1 Installation Requirements

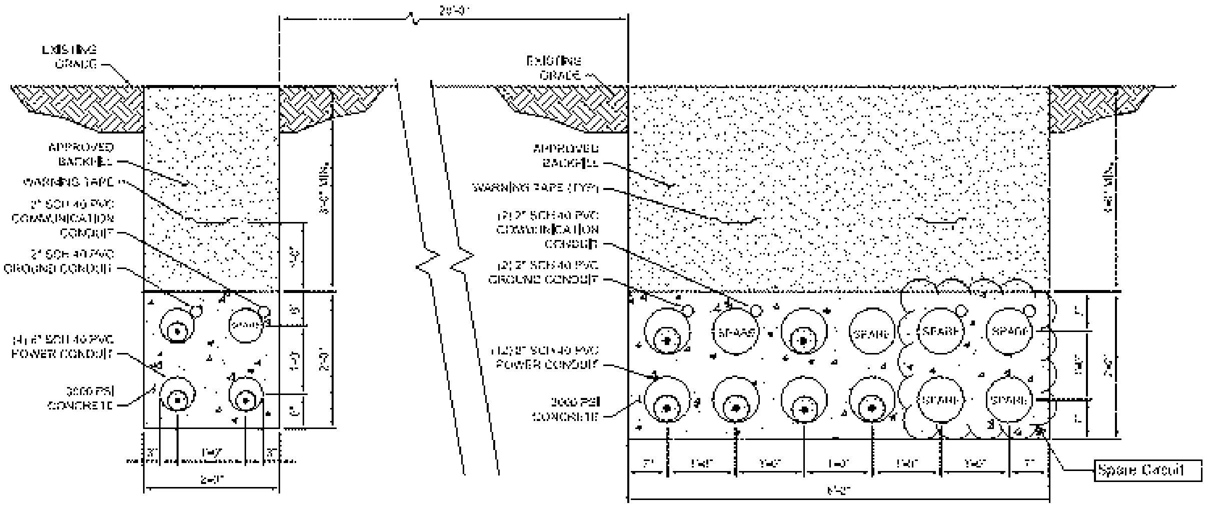
### 5.1.1 Refuge Installation

Outside the Mississippi River crossing itself, it is anticipated that the cables would be installed in either a duct-bank-and-manhole system or back-to-back HDD installations through the Refuge. Based on the requirements of the Project, it is anticipated that the necessary underground circuit can be carried in two different installation scenarios to the location of the potential Mississippi River crossing location. The first proposed configuration is a series of parallel HDD installations. These HDD installations would consist of three parallel 36-inch casings containing four 8-inch conduits each for the 345 kV circuit, with a fourth 36-inch casing containing four 8-inch conduits for the 161 kV circuit. Each casing would be spaced approximately 20 feet (on center) from one another with an anticipated maximum depth of approximately 45 feet. This is the configuration displayed above in Figure 4-2 and Figure 4-4..

The second installation configuration identified for the 345 kV cable system is a single duct bank consisting of twelve 8-inch Schedule 40 polyvinyl chloride (PVC) conduits, nine of which would have the ability to carry a three-cables-per-phase system. The remaining three 8-inch conduits would be used for spare conduits. In addition to the 8-inch conduits, four 2-inch conduits are required to carry the fiber optic cable for relaying and ground continuity conductor. This is the configuration displayed above in Figure 4-1.

The duct bank installation for the proposed 161 kV circuit is a single duct bank containing four 6-inch Schedule 40 polyvinyl chloride (PVC) conduits, three of which would have the ability to carry the single-cable-per-phase system. The remaining 6-inch conduit would be used for a spare conduit. In addition to the 6-inch conduits, two 2-inch conduits are required to carry the fiber optic cable for relaying and ground continuity conductor. This is the configuration displayed above in Figure 4-3. A composite of the 345 kV and 161 kV duct banks can be seen in Figure 5-1 below.

**Figure 5-1: Typical 345 kV & 161 kV Duct Bank Cross Section**



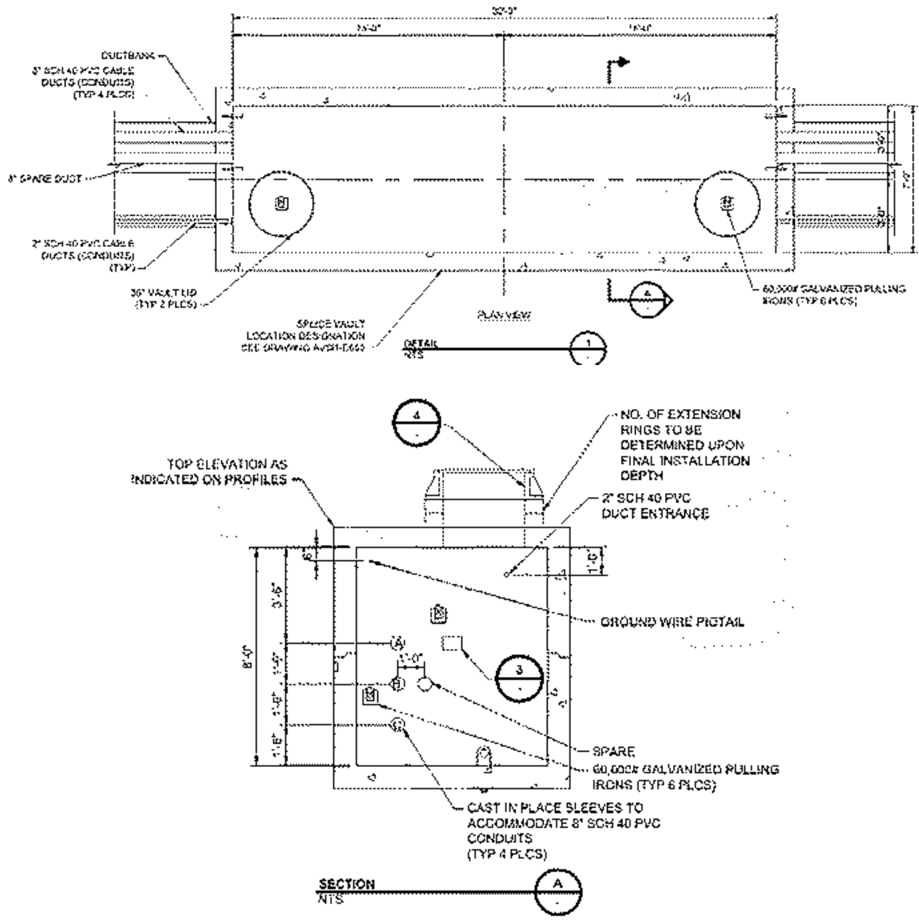

### 5.1.2 River Crossing

For the portion of the routes that are proposed to cross under the Mississippi River, the HDD (first) configuration outlined above in section 5.1.1 would be utilized. These HDD installations would consist of three parallel 36-inch casings containing four 8-inch conduits each for the 345 kV circuit, with a fourth 36-inch casing containing four 8-inch conduits for the 161 kV circuit. Each casing would be spaced approximately 20 feet (on center) from one another with an anticipated maximum depth of approximately 45 feet. This is the configuration displayed above in Figure 4-2 and Figure 4-4.

### 5.1.3 Splice Vaults

In addition to the duct bank or HDD installation(s), splice vaults would be required along each route, spaced at approximately 1,750 foot intervals. A typical 345 kV splice vault detail is shown below in Figure 5-2, with the 161 kV splice vault being equal, or slightly smaller in size. Each splice location will require a total of four splice vaults, three for the 345 kV system and one for the 161 kV system. This configuration allows for the maximum reliability and operational flexibility of the 345kV system. With the three separate splice vaults for the 345kV system, should a splice fail it will limit the potential damage to only the three cables located within that splice vault, allowing the system to maintain partial capacity on the remaining cables throughout the failure event and through the repair process. It is anticipated that the Nelson Dewey crossing alternative would require a total of five splice locations each containing four vaults (three for 345 kV and one for 161 kV) for a total of 20 vaults within the Refuge. For the Stoneman crossing alternative, the Project would also require five splice locations each containing four vaults (three for 345 kV and one for 161 kV) for a total of 20 vaults located within the existing overhead ROW (150 feet) within the Refuge.

**Figure 5-2: Typical Splice Vault Detail**




## 5.2 Routing Constraints

As part of this analysis, BMcD has been specifically asked to evaluate the feasibility and costs associated with undergrounding the new Cardinal to Hickory Creek 345 kV transmission line. In addition to this request, BMcD was asked to evaluate the relocation of the existing 161 kV overhead line to an underground installation. For the purposes of this report, it is assumed that the 345 kV and 161 kV underground installations would be in separate trenches, within the same corridor. This configuration does offer some operational diversity; should one circuit be impacted by an individual event, the other facility would likely remain relatively unaffected while avoiding two separate corridors through the Refuge.

Based on these parameters, BMcD reduced the routing options to those routes that utilize the existing 161 kV overhead corridor for the proposed 345 kV and 161 kV underground installations. This resulted in one routing option per crossing location.

For the Stoneman crossing option, the route is proposed to utilize the existing 161 kV overhead 150-foot ROW, with the exception where the route deviates from the existing 161 kV overhead transmission line at the point within the Refuge where the overhead line turns south. This was done because there are no suitable soils for boring equipment due to the presence of marshy wetlands around the existing line in that area. That location also lacked sufficient space to lay down the required drilling equipment.

## 5.3 Underground Routing Options

The preliminary routing options investigated as part of the feasibility study include:

**Stoneman Crossing Alternative:**

- Proposed 345 kV/161 kV underground crossing starting southeast of the town of Cassville and head west to the Stoneman Substation location then continuing west/southwest under the Mississippi River channel to the western river limits near the existing overhead alignment. From this location the route continues southwest slightly north of the current overhead alignment before rejoining the existing overhead alignment. From this location the route turns back west and extends within the overhead alignment to the limits of the Mississippi River Floodway at railroad tracks.
- Approximately 9,600 feet in total length.
- This route is shown in orange in Figure 1-1

**Nelson Dewey Crossing Alternative:**

- Proposed 345 kV/161 kV underground at southeast corner of Nelson Dewey Substation, head southwest to east bank of the Mississippi River and continue southwest under the channel to the existing western river limits near the Cassville Ferry Landing boat ramps. From this location the route continues to the southwest, in a straight alignment to the existing overhead transmission line corridor at the western limits of the Mississippi River Floodway at railroad tracks.
- Approximately 7,900 feet in total length
- This route is shown in red in Figure 1-1.

# 6.0 UNDERGROUND CONSTRUCTION AND INSTALLATION

This portion of the report discusses the various installation methodologies that could be utilized for each portion of the proposed underground route. This section has been subdivided into the land based (Refuge) portions of the route and those involving water crossings (Mississippi River).

## 6.1 Construction Methodology – Refuge Segments(s)

For the portion of the proposed route that is within Refuge lands and does not involve any water crossings, there are various methods of construction that could be used to install the proposed cable system. The two most common installation methods are outlined below. It is important to note that due to the close proximity of the Project to the Mississippi River, there is significant risk of flood/water related delays during construction. Since the Refuge area is within the floodplain, access for both construction and maintenance activities may be severely impacted during flood events.

### 6.1.1 Open Trench Construction

The most traditional and time/cost effective method of installing underground cable systems is the open-trench installation method. This method is also commonly referred to as the “cut and cover” or “open cut” construction. In this type of construction, a continuous trench of sufficient size to place and assemble the duct bank (cross section shown in Figure 5-1) is excavated along the entire route. The typical installation depth for open trench construction is approximately three to five feet of cover over the duct bank package. Following the excavation crew is a duct bank assembly crew that assembles the conduit package, places the conduit package in the trench, and encases the conduits in concrete. Once the concrete has cured, the trench is then backfilled with native soil or other approved materials. Following these activities, the electrical contractor would pull the cable into the conduits from the manhole locations.

This method of installation is the most efficient from a cost and time perspective, but also requires a construction alignment with continuous access for heavy construction equipment. This would result in a permanent access path or clearing area, approximately 35 to 50 feet wide, for the entirety of the cable system route. Additional area of approximately 50 by 150 feet would also be needed at the splice vault locations.

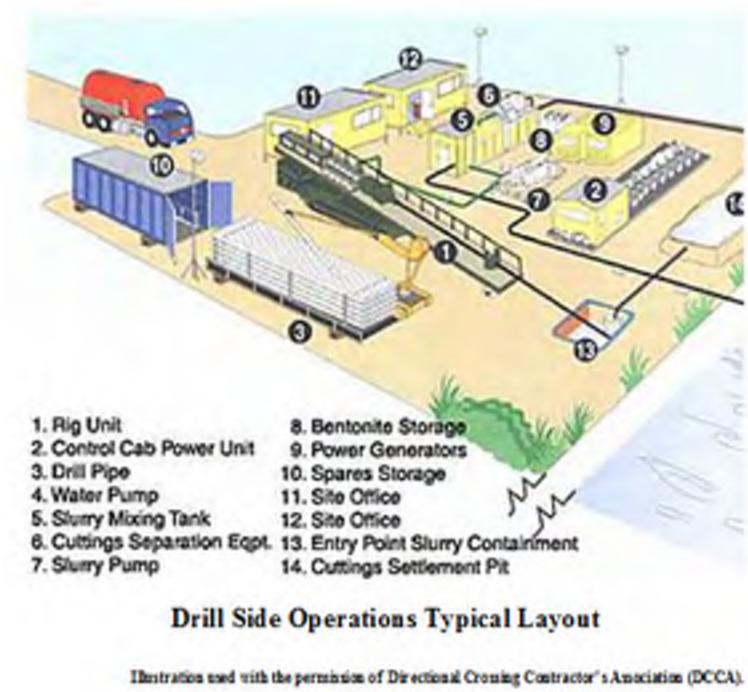
After installation and backfill of the trench, above grade maintenance may be necessary to prevent growth of large plants and/or trees with intrusive root systems that could damage the duct bank over time. Should an underground alternative be selected for further consideration, proposed re-vegetation activities would be developed in consultation with USFWS staff.

### 6.1.2 Trenchless Construction

The second identified method of installing underground cable systems is the HDD installation method. This method would employ back-to-back trenchless operations along the route with entry and exit sites coordinated with the manhole locations. This results in more of a point-to-point construction, with minimal at grade disturbance between the points.

In contrast to the open trench method where the construction space at the manholes is marginally larger than manhole footprint, the HDD construction method would require substantially larger staging areas at the manhole locations. In general, these staging locations would need to accommodate all of the drilling equipment and materials. A typical HDD staging area for both the sending and receiving ends can be seen in Figure 6-1.

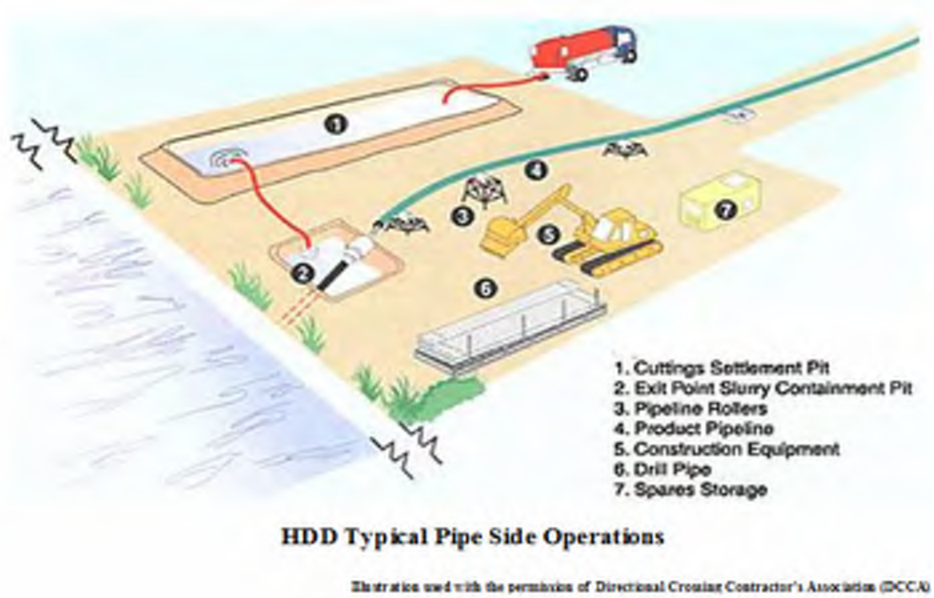
**Figure 6-1: Typical HDD Drill Side Work Space**




Based on the preliminary sizing of the drill equipment, it is anticipated that a large drill rig would be required to complete the proposed HDD installations. This size drill rig would typically require a 150 foot by 250 foot workspace on the drilling side.

The receiving side of a HDD operation is generally much smaller. Normally, a small crane or tracked excavator is required to remove and/or add drill stem as required for reaming operations. Reaming operations is a step in the HDD process to increase borehole size. Figure 6-2 below is a typical HDD receiving side set up. In some instances a smaller rig may be set up in this area to assist in reaming operations. Note in Figure 6-2 below the product pipe running out to right. In general practice, the product pipe is preassembled to reduce stopping of pull back operations. This is especially required when geologic conditions are unstable, or in squeezing clay to prevent pipe or drill stem failure during pull back operations. For example, for a 1,000-foot drill, 1,000 feet of pipe should ideally be assembled and ready for pull back when required. This requires a space 1,100 feet long by approximately 20 feet wide. If this space is not available, a substantial space should still be available to reduce the number of times required to stop and add pipe to a minimum.

**Figure 6-2: Typical HDD Receiving Side Work Space**




While this method of installation results in less at grade restoration, there still needs to be an access path to each manhole/drilling location for the delivery of equipment and materials, as well as maintenance activities. This would result in an access path or clearing area that would be approximately 25 to 40 feet wide for the entirety of the cable system route, with additional permanent area of approximately 50 by 150 feet at the splice vault locations. While similar to the open trench option for space requirements during construction, the major advantage of HDD is that the areas outside of the splice vault locations have a much smaller disturbance. Additionally, future vegetation control and maintenance are potentially reduced to an access road after construction activities have been completed. This is partially because repairs on HDD installations are typically too costly and difficult to attempt from the surface.

After installation, above grade maintenance may be necessary to prevent growth of large plants and/or trees with large or intrusive root systems that could damage the duct bank over time, similar to the open trench construction. However, with the additional depth of the installation, there may be more leniencies on the species of plants that would be allowed in the easement area when compared to open trench construction. Areas that are close to the splice vault locations (where the cable system is closer to the surface) would require more strict vegetative management to prevent root intrusion into the cables. Areas outside of these vaults would be constructed at a depth-to-cover of approximately 45 feet.

### 6.1.3 Construction Method Summary

Based on the two construction methodologies discussed above, BMcD has compiled a comparison table to highlight the differences in installation methods.

**Table 6-1: Construction Method Comparison**

| Open Trench | Parameter | HDD |
|---|---|---|
| 100-200 feet per day | **Production Rate** | 50-75 feet per day |
| $$ | **Installation Cost** | $$$$ |
| Full length trench and construction vehicle access | **At Grade Installation Disturbance** | Access road and minimal excavation areas at vault locations |
| Limited use, access road maintenance and vegetation control | **After Construction Disturbance** | Limited use, access road maintenance and vegetation control |
| ~80’ along duct bank & 50 x 150’ areas at vault locations | **Approximate Width of Easement During Construction** | ~100’ along HDD & 100 x 200’ areas at vault locations |
| ~45’ along duct bank & 50 x 150’ areas at splice vault locations | **Approximate Width of Easement After Construction** | ~100’ along HDD & 50 x 150’ areas at splice vault locations |

Based on the above discussed construction methodologies, BMcD recommends the use of the open-trench installations method where possible. The open-trench method allows for the fastest production rate, lower cost, and better future maintenance and or repair access. Although the open trench method would have a larger impact during the construction of the cable system, it would ultimately result in a smaller and less costly easement though the Refuge.

## 6.2 Construction Methodology – River Crossing Segment(s)

Several installation methods exist for crossing the Mississippi River, including the following:

- HDD, as discussed in Section 6.1.2;
- Microtunneling;
- Direct Pipe Method; and

- Laying or plow-type installation of the cable system on or immediately beneath the river bottom.

The installation method utilized will need to reduce construction impacts to the river and to allow the cable system to be installed below the zone of potential river scour (or dredging). Although each of the above installation methods is technically viable, we believe that HDD currently presents the most feasible solution, from the standpoint of anticipated construction risk, cost, the probable subsurface conditions (sand and gravel), and long-term operations and maintenance of the cable system.

The approximate duct configuration for the Mississippi River crossing by means of HDD is shown in Figure 4-2 and Figure 4-4. This involves four (4) separate duct bundles, each installed in an outer carrier casing. For thermal purposes, the casing would need to consist of either high density polyethylene (HDPE), or fusible polyvinyl chloride (FPVC). The casing wall thickness and material requirements would ultimately depend on the length of the bore, the bore depth, and the bore geometry. To minimize construction risk, the side-to-side spacing between the casings would need to be at least 20 feet.

The approximate HDD bore depth below the river would need to be at least 45 feet. Maintaining this minimum depth would help reduce risk of inadvertent drill fluid loss (i.e., “frac-out”) to the Mississippi River and adjacent Refuge during construction. Note that this minimum depth would need to be evaluated during HDD design, following acquisition of site-specific geotechnical data. For each casing, a pilot hole would be drilled from a designated entry area below the Mississippi River to an exit area. The drill equipment and drill materials would be located at the entry area and the casing and duct at the exit area. For all of the identified options, the most viable entry area is probably located to the northeast of the Mississippi River. This would enable use of the open space located to the southwest of the river for casing and duct assembly and storage.

Once completed, the pilot hole would be enlarged by successive reaming passes to a diameter sufficient to accept the casing. At this stage, it is estimated that the reamed borehole diameter in each case would be approximately 48 inches. Following borehole preparation, the casing would be pulled into place. Note that all stages of HDD construction require circulation of drill fluid (water, bentonite, and polymer) through the borehole to cool the drill tools, remove drill cuttings, stabilize the hole, and lubricate the casing.

The approximate HDD alignment for the Nelson Dewey route Mississippi River crossing is shown in Figure 6-3. The plan length for this alignment is approximately 2,900 feet. BMcD anticipates that the installation forces involved with a bore of this length may permit either FPVC or HDPE be used for duct casing.

The approximate HDD alignment for the Stoneman crossing alternative is shown in Figure 6-4. The plan length for this alignment is approximately 4,200 feet. The installation forces involved with a bore of this length may require that FPVC be used for the duct casing rather than HDPE.

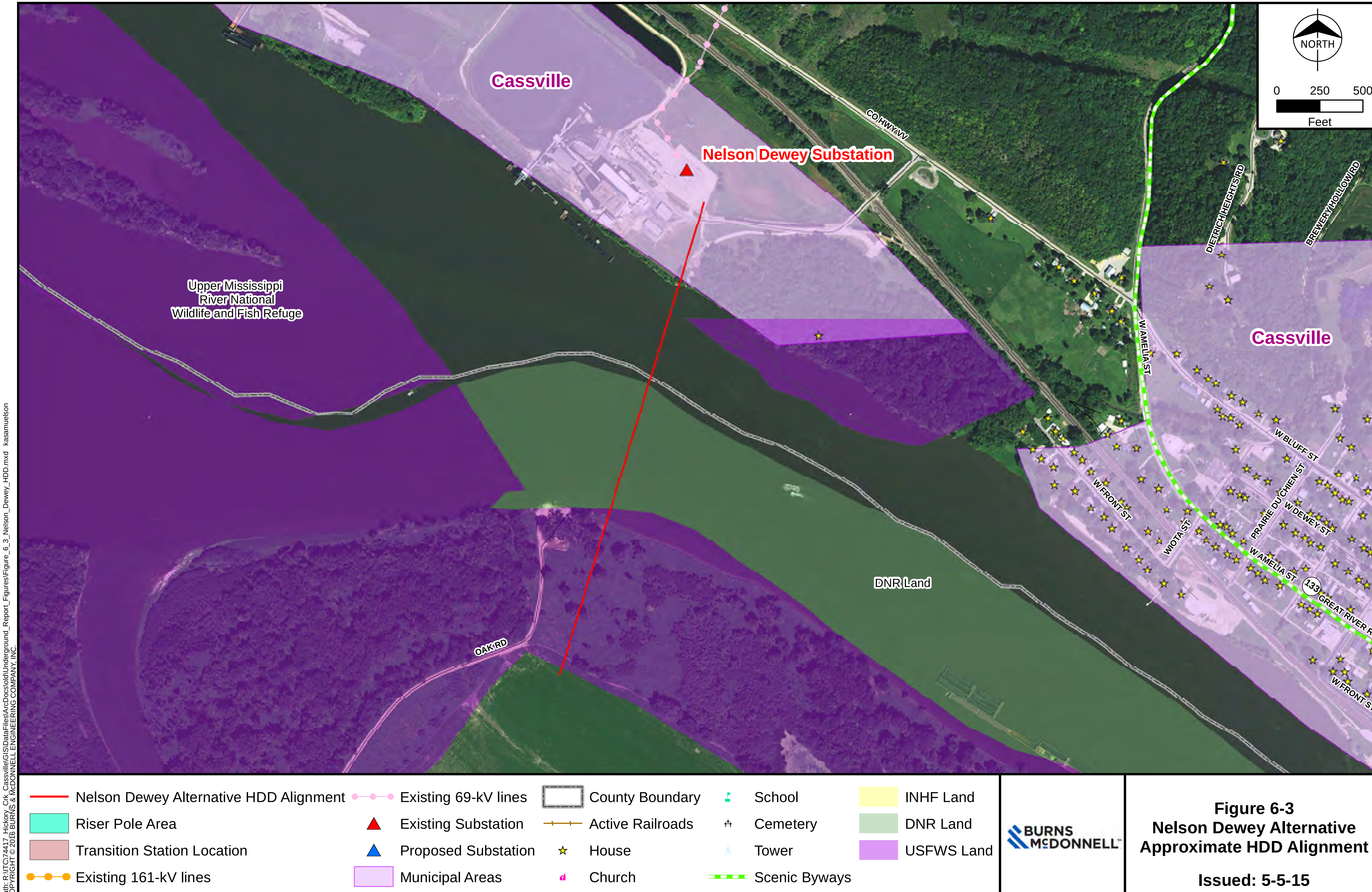



**Figure 6-3**
**Nelson Dewey Alternative Approximate HDD Alignment**

**Issued: 5-5-15**

Source: IDNR; Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community; Energy Velocity; Clayton County; INHF; USFWS; ITC Midwest; Burns & McDonnell.


| | | | | |
|---|---|---|---|---|
| Stoneman Alternative HDD Alignment | Existing 69-kV lines | County Boundary | School | INHF Land |
| Riser Pole Area | Existing Substation | Active Railroads | Cemetery | DNR Land |
| Transition Station Location | Proposed Substation | House | Tower | USFWS Land |
| Existing 161-kV lines | Municipal Areas | Church | Scenic Byways | |

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**Figure 6-4**
**Stoneman Alternative Approximate HDD Alignment**

**Issued: 5-5-15**

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Source: IDNR; Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community; Energy Velocity; Clayton County; INHF; USFWS; ITC Midwest; Burns & McDonnell.

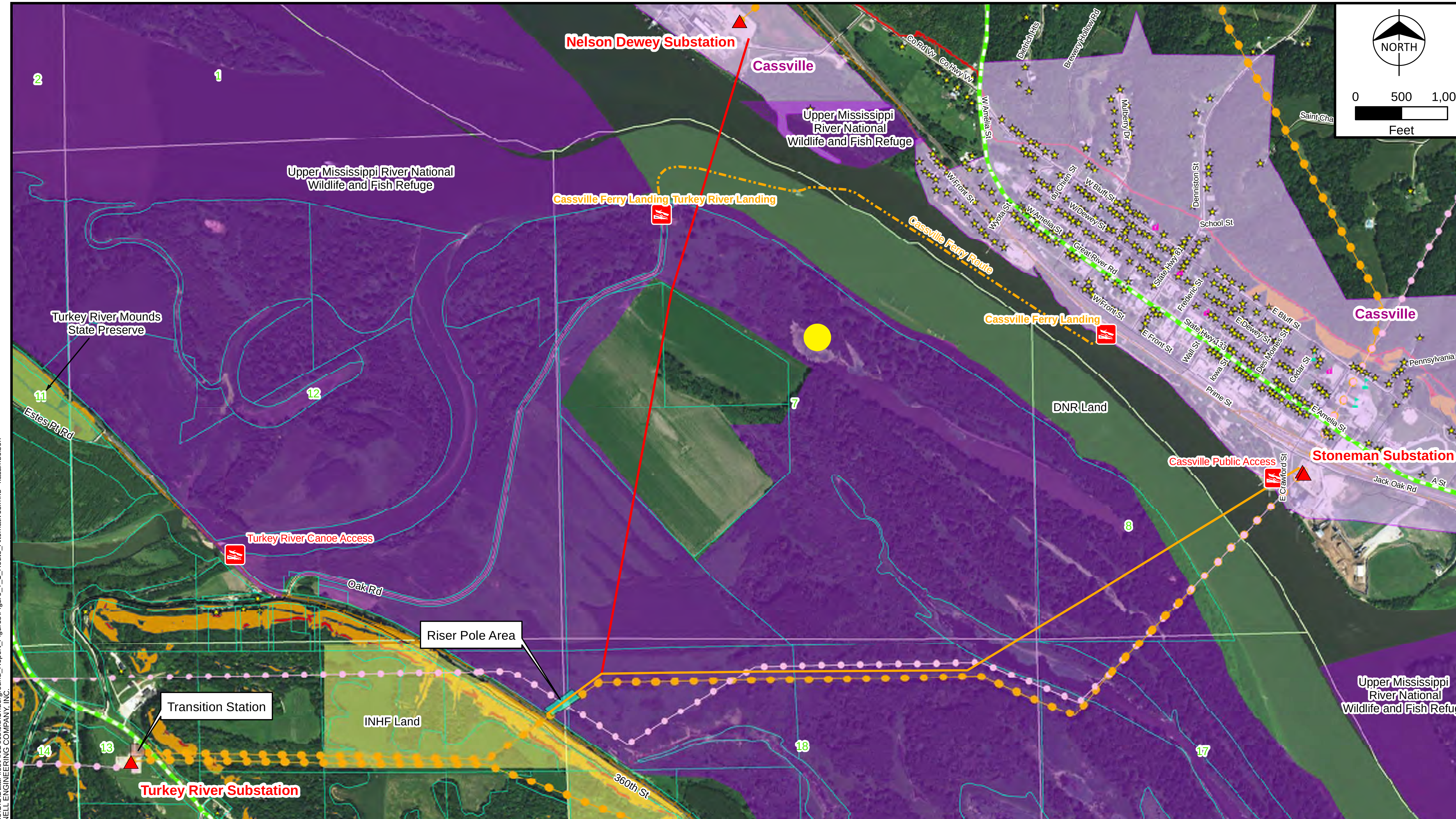
# 7.0 ENVIRONMENTAL REVIEW

BMcD completed a desktop environmental review of the potential impacts to natural resources in the vicinity of the proposed underground transmission alternatives. The proposed Project consists of the evaluation of two alternative underground transmission line crossing locations in Clayton County, Iowa, and Grant County, Wisconsin. Both alternative crossing locations would extend across the Refuge from Cassville, Wisconsin, and continue west to the Turkey River Substation in Clayton County, Iowa. The proposed Project would connect a new 345 kV transmission line from the proposed Hickory Creek Substation to the new American Transmission Company (ATC) Cardinal Substation near Madison, Wisconsin. Potential resources analyzed as part of this review included wetlands, threatened and endangered species, migratory birds, existing land uses, floodplains, as well as archeological and cultural resources. Although the Project will be in Iowa and Wisconsin, this report only investigated potential impacts in Iowa from the Turkey River Substation to the Wisconsin state line. Additional supplemental environmental impact data will be collected and analyzed for Wisconsin should the UG alternative be selected for additional analysis. Geographic Information System (GIS) data was collected from a variety of sources, including Environmental Systems Research Institute (ESRI), Iowa Department of Natural Resources (IDNR), National Hydrography Dataset (NHD), National Wetland Inventory, USFWS, National Land Cover Dataset (NLCD), the Iowa State Historic Preservation Office, Dubuque and Clayton counties, ITC, and BMcD.

The following review includes an analysis of resources found in proximity to the Mississippi River at the two proposed underground crossing locations (Figure 7-1). The Stoneman crossing alternative to the Stoneman Substation would extend approximately 9,600 feet from the eastern edge of the Town of Cassville on the east bank of the Mississippi River, to the west bank of Mississippi River in Iowa, and extending to an existing railroad crossing where the circuit would transition to an overhead configuration at the western edge of the Refuge. The north crossing to the Nelson Dewey Substation would be approximately 7,900 feet from the northwest section of the Nelson Dewey substation, to the east bank of Mississippi River and further onto the west bank of Mississippi River channel. The route then continues through Refuge land and a private parcel of land within the Refuge to an existing railroad crossing where the circuit would transition to an overhead configuration. Both crossing alternatives would utilize the same proposed location for the riser pole (Figure 4-4).

Post-construction ROW widths proposed for this Project would be approximately 45 feet for open trench and approximately 100 feet for HDD. For the Stoneman crossing alternative, this ROW width would be located within the existing 161 kV overhead line ROW mentioned in Section 6.0. The ROW of the existing overhead 161 kV line is 150 feet. Based on these estimates, up to approximately 10.7 acres of ROW within the Refuge would be necessary for the Stoneman crossing alternative if open trenching were utilized with HDD for the Mississippi River crossing; up to approximately 16.6 acres of ROW in the Refuge would be necessary if the HDD option were selected for the entire length of the underground line through the Refuge. The majority of the land proposed for ROW would be woody and emergent wetlands, as well as open water. For the Nelson Dewey crossing alternative, approximately 5.1 acres of Refuge land would be necessary for ROW use with the open trenching method with the HDD method for the Mississippi River crossing within the Refuge. If the HDD alternative were selected for the entire length of the Nelson Dewey crossing alternative, approximately 8.6 acres of Refuge land would be necessary for ROW. The potentially affected acres along the Nelson Dewey crossing alternative within the Refuge are mainly woody and emergent wetlands, open water, and a small area of cultivated lands. Hence, less ROW will be required for the Nelson Dewey Crossing alternative regardless of construction technique.

As mentioned is Section 4.0, riser poles are proposed to be located within Refuge boundaries. This would permanently convert approximately 1.0 acres of Refuge land for the base of the structures. In addition to these conversions, both crossing alternatives would require five splice locations each. Each of these facilities is 7,500 square feet in size. This would equate to an additional 0.86 acres permanently converted for the each crossing alternatives.




- Nelson Dewey Underground Alternative
- Stoneman Underground Alternative
- Existing 161-kV lines
- Existing 69-kV lines
- Existing Substation
- Municipal Areas
- Parcels
- PLSS Sections
- Riser Pole Area
- Transition Station Location
- House
- Church
- School
- Cemetery
- Tower
- Active Railroads
- Cassville Ferry Route
- Scenic Byways
- Historic Eagle Nest Location
- INHF Land
- DNR Land
- USFWS Land
- Ferry Landing
- Boat Landing or Canoe Access

**Percent Slope**

- 30 - 50
- > 50

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**Figure 7-1**
**Route Alternatives Overview - Iowa**

**Issued: 5-5-15**

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Source: IDNR; Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community; Energy Velocity; Clayton County; INHF; USFWS; ITC Midwest; Burns & McDonnell.

## 7.1 Potential Environmental Impacts of New Underground Installation

### 7.1.1 Wetlands

Wetlands are federally protected under Section 404 of the Clean Water Act (CWA). A wetland permit from the United States Army Corps of Engineers (USACE) is required when discharging dredged or fill material into jurisdictional waters of the United States, including wetlands. A permit and/or notification may also be required by the Clayton County Soil and Water Commission depending upon the location, size, and type of impact. Should the underground alternative be selected for further study, all applicable Wisconsin DNR (WDNR) permit and approvals will be obtained.

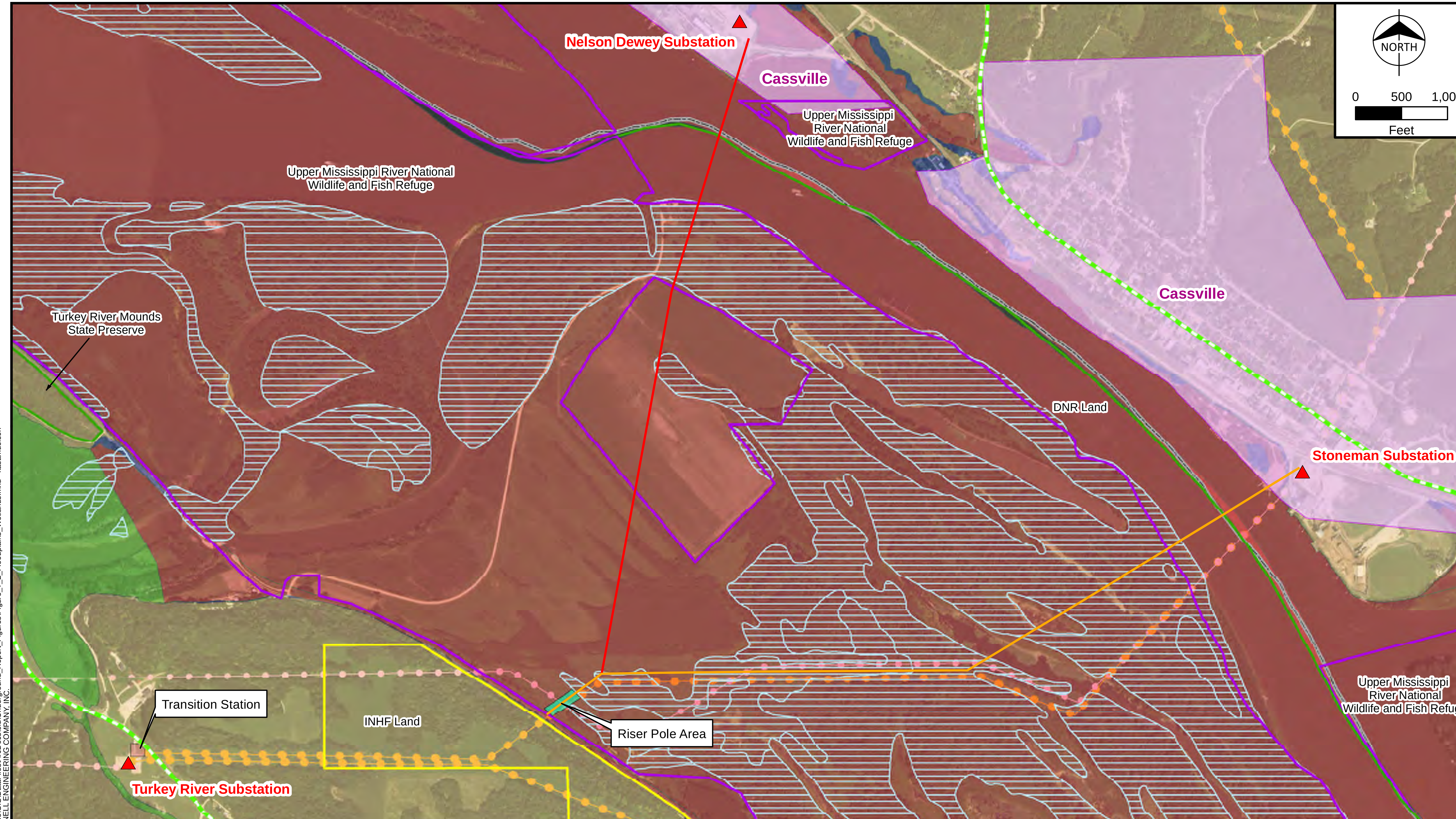
The USACE defines wetlands as those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Generally, all three indicators (wetland vegetation, hydric soil, and wetland hydrology) must be present for an area to meet the definition of a wetland.

National Wetland Inventory (NWI) maps, produced by USFWS, are based on aerial photographs and Natural Resource Conservation Service (NRCS) soil surveys. These maps are the best available source of wetland data prior to completing field-verified wetland and waterbody surveys. According to the NWI maps, there are freshwater emergent wetlands and freshwater forested/shrub wetlands located throughout the Refuge area. While many of these wetlands occur on USFWS property and within the Refuge boundaries, a small portion of a wetland is located on private property (Figure 7-2).

Each of the two route options has wetlands within their respective evaluation corridors. The wetlands potentially impacted by the route options are primarily designated as freshwater forested/shrub wetlands and freshwater emergent wetlands. Riser poles would be required for both crossing scenarios and underground construction types. The riser poles would require the conversion of approximately 1.0 acre of land. The currently proposed riser poles are located within the Refuge on land classified as emergent wetland and a very small area of woody wetland. If an underground option were selected for this Project, further analysis would be done to determine the optimal location for the riser poles, as well as the eastern transition station in Wisconsin. The proposed eastern and western transition stations would be located outside of Refuge boundaries on the eastern side of the Mississippi River and at the Turkey River Substation, respectively. The land use in these areas would be permanently converted from their current use to accommodate the transition station and its associated facilities.

Both underground construction options would require splice vaults every 1,750 feet with a minimum cleared area of 7,500 square feet per vault location. Each vault location would be approximately 50 by 150 feet. It is anticipated that both alternatives would require a total of five splice locations each containing four vaults (three for 345 kV and one for 161 kV) for a total of 20 vaults within the Refuge. Although the actual location of these vaults are not known at this time, due to the presence of wetlands (Figure 7-2) in this area, it is likely a majority of the acreage required for vault constructions would occur in designated wetlands. These splice vaults would be required under both underground construction options. In addition, vegetation management areas would be required near these splice vault locations so that root incursion into the underground cable systems would be prohibited. ITC Midwest would work in conjunction with the USFWS to determine the appropriate re-vegetation plan for these areas. Due to the general depth of the proposed HDD option, it is likely that this underground construction option would require less vegetation management than the open trench construction method.

In comparing the two types of underground construction, the open trench method would require the excavation of a utility corridor through the entire Refuge, including wetland areas. Measures to avoid wetlands in the final alignment for construction would be employed; however, as a result of the extensive wetlands in this area, permanent wetland impacts would occur where vegetation removal is required. The open trench method would cross approximately 1,100 feet of wetlands under Nelson Dewey crossing alternative and approximately 7,000 feet of wetlands utilizing the Stoneman crossing alternative. The proposed HDD option would also require a new utility corridor through both the entire Refuge and wetland areas, but impacts to wetlands would be minor outside of the staging areas, as the HDD method would extend underneath wetland areas through the Refuge. However, vegetation management would be required in and around the riser pole and the splice vaults to allow for safe operation of the cable systems. In these areas, existing woody wetland vegetation, if present, would be permanently removed.




Nelson Dewey Underground Alternative
Stoneman Underground Alternative
Riser Pole Area
Transition Station Location
Existing 161-kV lines
Existing 69-kV lines
Existing Substation
Active Railroads
Municipal Areas
Scenic Byways
NWI Wetland
INHF Land
DNR Land
USFWS Land

**FEMA Flood Zones**

0.2 Percent Annual Chance Flood Hazard
A
AE
AH
Area Not Included
X
X Protected by Levee

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**Figure 7-2**
**Wetlands and Floodplains**

**Issued: 5-5-15**

Path: R:\ITC\74417_Hickory_Crk_Cassville\GIS\DataFiles\ArcDocs\old\Underground_Report_Figures\Figure_7_2_Floodplains_Wetlands.mxd kasamuelson



Source: IDNR; Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community; Energy Velocity; NWI; INHF; USFWS; ITC Midwest; Burns & McDonnell.

Wetlands impacted by construction would be restored as required by the USACE and Wetlands Conservation Act; in addition, specific improvements would be discussed and reviewed by Refuge staff as part of the USFWS internal federal compliance requirements, including any required National Environmental Policy Act (NEPA) review.

The USACE may require wetland mitigation for conversion of forested wetlands to non-forested wetlands. Any required mitigation would be determined through consultation with USACE and the USFWS. ITC Midwest would obtain all appropriate permits and approvals from the USACE, IDNR, local government unit(s), and watershed districts (when necessary) for any actions determined to occur in wetlands.

### 7.1.2 Threatened and Endangered Species

Species listed as threatened and endangered in Iowa are protected under the Endangered Species Act (ESA) of 1973 and Chapter 481B of the Code of Iowa (Endangered Plants and Wildlife, enacted in 1975). Both the ESA and Chapter 481B of the Code of Iowa afford legal protection to those species and their habitats determined to meet the specified criteria for listing as either threatened or endangered. Additionally, the USFWS has oversight and jurisdiction of the Bald and Golden Eagle Protection Act (BGEPA) and Migratory Bird Treaty Act (MBTA).

There are a total of four federally-listed endangered species, three federally-listed threatened species, and one federally-listed proposed endangered species in Clayton County (Table 7-1). There are 27 state-listed endangered species and 42 state-listed threatened species in Clayton County (Table 7-2). Additionally, there are 38 special concern species within Clayton County (Table 7-3). Bald eagles and bald eagle habitat are located within the Project area and protected by the BGEPA and MBTA. Avian species protected by the MBTA use the Project area throughout the year.

**Table 7-1: Federally-Listed Species in Clayton County, Iowa**

| Common Name | Scientific Name | Class | Federal Status | State Status |
|---|---|---|---|---|
| Higgin's-eye pearly mussel | *Lampsilis higginsii* | Freshwater Mussels | Endangered | Endangered |
| Iowa Pleistocene snail | *Discus macclintocki* | Snails | Endangered | Endangered |
| sheepnose mussel | *Plethobasus cyphyus* | Freshwater Mussels | Endangered | Endangered |
| spectaclecase | *Cumberlandia monodonta* | Freshwater Mussels | Endangered | Endangered |

| Common Name | Scientific Name | Class | Federal Status | State Status |
|---|---|---|---|---|
| northern wild monkshood | *Aconitum noveboracense* | Plants (Dicots) | Threatened | Threatened |
| prairie bush-clover | *Lespedeza leptostachya* | Plants (Dicots) | Threatened | Threatened |
| western prairie fringed orchid | *Platanthera praeclara* | Plants (Monocots) | Threatened | Threatened |
| northern long-eared bat | *Myotis septentrionalis* | Mammals | Threatened (effective May 4, 2015) | — |

Avoidance of habitat utilized by these species is recommended to limit potential impacts. ITC Midwest would coordinate with IDNR, WDNR, and USFWS, as appropriate, to identify locations for endangered species and other rare and unique natural resources along the proposed alignment and concerning any recommendations to minimize, mitigate, or avoid impacts to protected species. As a result of the depth-to-cover of the proposed HDD alternative underlying the Mississippi River (the only option being considered for extending under the river channel), the Project is not likely to adversely affect the Higgin's-eye pearly mussel, the sheepnose mussle, the specteclecase, or the Iowa Pleistocene snail. Staging areas would be set back from the river and determined, in consultation with the USFWS, to limit potential impacts to resources in the immediate area. Appropriate sedimentation and erosion control measures would be determined as part of the required permitting compliance with Section 401 and 404 of the CWA in consultation with Refuge staff.

Habitat for the northern long-eared bat (NLEB) is found in proximity to the Project. Under each routing scenario, removal of vegetation is proposed for the necessary construction of Project facilities. In order to determine the potential likelihood for presence of this species, it is recommended that ITC Midwest conduct a habitat assessment to determine species presence within the Project vicinity. The habitat assessments would be conducted in conjunction with the USFWS and would follow the NLEB Guidance (USFWS 2014b)[1] and Appendix A provided in the Indiana bat Guidance (USFWS 2013, 2014a).[2,3]

[1] U.S. Fish and Wildlife Service (USFWS). 2014b. Northern Long-Eared Bat Interim Conference and Planning Guidance, USFWS Regions 2, 3, 4, 5, & 6, January 2014. 67 p.

[2] U.S. Fish and Wildlife Service (USFWS). 2013. 2013 Revised Range-Wide Indiana Bat Summer Survey Guidelines. May 2013. 40 p.

[3] U.S. Fish and Wildlife Service (USFWS). 2014a. 2014 Range-Wide Indiana Bat Summer Survey Guidelines, January 2014. 41 p.

The northern wild monkshood and western prairie fringed orchid are considered to be extremely rare plant species. Therefore, consultation with the USFWS would be recommended to determine the potential for habitat or presence within and adjacent to the proposed route alternatives through the Refuge. ITC Midwest would coordinate with IDNR and USFWS, as appropriate, to identify locations for threatened species and other rare and unique natural resources along the proposed alignment and concerning any recommendations to minimize, mitigate, or avoid impacts to protected species. Should an underground alignment be selected for further consideration, habitat assessments for protected species would be recommended to determine potential impacts to protected species and habitat in proximity to all the proposed alternative routes for the Project.

In general, the open trench method of construction would require additional conversion of lands compared to the HDD option. However, until the presence of these threatened species is determined, the specific impacts of each alternative on the species are unknown at this time.

**Table 7-2: State-Listed Species in Clayton County, Iowa**

| Common Name | Scientific Name | Class | State Status | Federal Status |
|---|---|---|---|---|
| barn owl | *Tyto alba* | Birds | Endangered | — |
| blue giant hyssop | *Agastache foeniculum* | Plants (Dicots) | Endangered | — |
| bluff vertigo | *Vertigo meramecensis* | Snails | Endangered | — |
| bluntnose darter | *Etheostoma chlorosoma* | Fish | Endangered | — |
| bog bedstraw | *Galium labradoricum* | Plants (Dicots) | Endangered | — |
| Briarton Pleistoscene vertigo | *Vertigo brierensis* | Snails | Endangered | — |
| Canada plum | *Prunus nigra* | Plants (Dicots) | Endangered | — |
| cinnamon fern | *Osmunda cinnamomea* | Plants (Pteriodophytes) | Endangered | — |
| false mermaid-weed | *Floerkea proserpinacoides* | Plants (Dicots) | Endangered | — |
| frigid ambersnail | *Catinella gelida* | Snails | Endangered | — |
| Iowa Pleistocene vertigo | *Vertigo iowaensis* | Snails | Endangered | — |
| lake sturgeon | *Acipenser fulvescens* | Fish | Endangered | — |
| least darter | *Etheostoma microperca* | Fish | Endangered | — |

| Common Name | Scientific Name | Class | State Status | Federal Status |
|---|---|---|---|---|
| northern lungwort | *Mertensia paniculata* | Plants (Dicots) | Endangered | — |
| northern panic-grass | *Dichanthelium boreale* | Plants (Monocots) | Endangered | — |
| pistolgrip | *Tritogonia verrucosa* | Freshwater Mussels | Endangered | — |
| prickly rose | *Rosa acicularis* | Plants (Dicots) | Endangered | — |
| purple cliff-brake fern | *Pellaea atropurpurea* | Plants (Pteriodophytes) | Endangered | — |
| red-shouldered hawk | *Buteo lineatus* | Birds | Endangered | — |
| round pigtoe | *Pleurobema sintoxia* | Freshwater Mussels | Endangered | — |
| slender mountain-ricegrass | *Oryzopsis pungens* | Plants (Monocots) | Endangered | — |
| spotted skunk | *Spilogale putorius* | Mammals | Endangered | — |
| weed shiner | *Notropis texanus* | Fish | Endangered | — |
| yellow sandshell | *Lampsilis teres* | Freshwater Mussels | Endangered | — |
| American brook lamprey | *Lampetra appendix* | Fish | Threatened | — |
| black redhorse | *Moxostoma duquesnei* | Fish | Threatened | — |
| Blanding's turtle | *Emydoidea blandingii* | Reptiles | Threatened | — |
| bog birch | *Betula pumila* | Plants (Dicots) | Threatened | — |
| bog willow | *Salix pedicellaris* | Plants (Dicots) | Threatened | — |
| bunchberry | *Cornus canadensis* | Plants (Dicots) | Threatened | — |
| burbot | *Lota lota* | Fish | Threatened | — |
| butterfly | *Ellipsaria lineolata* | Freshwater Mussels | Threatened | — |
| common musk turtle | *Sternotherus odoratus* | Reptiles | Threatened | — |
| creeper | *Strophitus undulatus* | Freshwater Mussels | Threatened | — |
| glandular wood fern | *Dryopteris intermedia* | Plants (Pteriodophytes) | Threatened | — |

| Common Name | Scientific Name | Class | State Status | Federal Status |
|---|---|---|---|---|
| golden saxifrage | *Chrysosplenium iowense* | Plants (Dicots) | Threatened | — |
| grass pickerel | *Esox americanus* | Fish | Threatened | — |
| green violet | *Hybanthus concolor* | Plants (Dicots) | Threatened | — |
| Henslow's sparrow | *Ammodramus henslowii* | Birds | Threatened | — |
| Hooker's orchid | *Platanthera hookeri* | Plants (Monocots) | Threatened | — |
| Hubricht's vertigo | *Vertigo hubrichti* | Snails | Threatened | — |
| jeweled shooting star | *Dodecatheon amethystinum* | Plants (Dicots) | Threatened | — |
| kidney-leaf white violet | *Viola renifolia* | Plants (Dicots) | Threatened | — |
| leathery grape fern | *Botrychium multifidum* | Plants (Pteriodophytes) | Threatened | — |
| low sweet blueberry | *Vaccinium angustifolium* | Plants (Dicots) | Threatened | — |
| Midwest Pleistocene vertigo | *Vertigo hubrichti hubrichti* | Snails | Threatened | — |
| mudpuppy | *Necturus maculosus* | Amphibians | Threatened | — |
| nodding onion | *Allium cernuum* | Plants (Monocots) | Threatened | — |
| northern black currant | *Ribes hudsonianum* | Plants (Dicots) | Threatened | — |
| oak fern | *Gymnocarpium dryopteris* | Plants (Pteriodophytes) | Threatened | — |
| ornate box turtle | *Terrapene ornata* | Reptiles | Threatened | — |
| pinesap | *Monotropa hypopithys* | Plants (Dicots) | Threatened | — |
| purple wartyback | *Cyclonaias tuberculata* | Freshwater Mussels | Threatened | — |
| rock clubmoss | *Lycopodium porophilum* | Plants (Pteriodophytes) | Threatened | — |
| rosy twisted stalk | *Streptopus roseus* | Plants (Monocots) | Threatened | — |
| showy lady's slipper | *Cypripedium reginae* | Plants (Monocots) | Threatened | — |
| spotted coralroot | *Corallorhiza maculata* | Plants (Monocots) | Threatened | — |
| tree clubmoss | *Lycopodium dendroideum* | Plants (Pteriodophytes) | Threatened | — |
| twinflower | *Linnaea borealis* | Plants (Dicots) | Threatened | — |

| Common Name | Scientific Name | Class | State Status | Federal Status |
|---|---|---|---|---|
| twinleaf | *Jeffersonia diphylla* | Plants (Dicots) | Threatened | — |
| variable Pleistocene vertigo | *Vertigo hubrichti variabilis* | Snails | Threatened | — |
| velvet leaf blueberry | *Vaccinium myrtilloides* | Plants (Dicots) | Threatened | — |
| western sand darter | *Ammocrypta clara* | Fish | Threatened | — |
| yellow trout-lily | *Erythronium americanum* | Plants (Monocots) | Threatened | — |

#### 7.1.2.1 Special Concern Species

There are 38 concern species within Clayton County (Table 7-3). Special concern species are species that have suspected issues of status or distribution, but where such concerns have not been documented. These species are not protected by the state laws for the protection of endangered species. Some special concern species are protected under other state and federal laws, however. Measures to limit potential impacts to special concern species, if applicable, would be discussed and coordinated with the IDNR and USFWS as part of the required environmental review for the Project, should an underground alternative be selected for further consideration.

**Table 7-3: Species of Concern in Clayton County, Iowa**

| Common Name | Scientific Name | Class | State Status | Federal Status |
|---|---|---|---|---|
| alderleaf buckthorn | *Rhamnus alnifolia* | Plants (Dicots) | Special Concern | — |
| bald eagle | *Haliaeetus leucocephalus* | Birds | Special Concern | — |
| balsam fir | *Abies balsamea* | Plants (Gymnosperms) | Special Concern | — |
| bog bluegrass | *Poa paludigena* | Plants (Monocots) | Special Concern | — |
| carey sedge | *Carex careyana* | Plants (Monocots) | Special Concern | — |
| Columbine dusky wing | *Erynnis lucilius* | Insects | Special Concern | — |
| crowfoot clubmoss | *Lycopodium digitatum* | Plants (Pteriodophytes) | Special Concern | — |
| drooping bluegrass | *Poa languida* | Plants (Monocots) | Special Concern | — |
| dwarf scouring-rush | *Equisetum scirpoides* | Plants (Pteriodophytes) | Special Concern | — |
| earleaf foxglove | *Tomanthera auriculata* | Plants (Dicots) | Special Concern | — |

| Common Name | Scientific Name | Class | State Status | Federal Status |
|---|---|---|---|---|
| flat top white aster | *Aster pubentior* | Plants (Dicots) | Special Concern | — |
| frost grape | *Vitis vulpina* | Plants (Dicots) | Special Concern | — |
| grape-stemmed clematis | *Clematis occidentalis* | Plants (Dicots) | Special Concern | — |
| grass pink | *Calopogon tuberosus* | Plants (Monocots) | Special Concern | — |
| hedge nettle | *Stachys aspera* | Plants (Dicots) | Special Concern | — |
| ledge spikemoss | *Selaginella rupestris* | Plants (Pteriodophytes) | Special Concern | — |
| limestone oak fern | *Gymnocarpium robertianum* | Plants (Pteriodophytes) | Special Concern | — |
| low bindweed | *Calystegia spithamaea* | Plants (Dicots) | Special Concern | — |
| meadow bluegrass | *Poa wolfii* | Plants (Monocots) | Special Concern | — |
| mountain maple | *Acer spicatum* | Plants (Dicots) | Special Concern | — |
| mountain ricegrass | *Oryzopsis asperifolia* | Plants (Monocots) | Special Concern | — |
| muskroot | *Adoxa moschatellina* | Plants (Dicots) | Special Concern | — |
| northern adder's-tongue | *Ophioglossum pusillum* | Plants (Pteriodophytes) | Special Concern | — |
| ovate spikerush | *Eleocharis ovata* | Plants (Monocots) | Special Concern | — |
| pearly everlasting | *Anaphalis margaritacea* | Plants (Dicots) | Special Concern | — |
| pugnose minnow | *Opsopoeodus emiliae* | Fish | Special Concern | — |
| rough bedstraw | *Galium asprellum* | Plants (Dicots) | Special Concern | — |
| sage willow | *Salix candida* | Plants (Dicots) | Special Concern | — |
| Saskatoon service-berry | *Amelanchier alnifolia* | Plants (Dicots) | Special Concern | — |
| sedge | *Carex cephalantha* | Plants (Monocots) | Special Concern | — |
| shadbush | *Amelanchier sanguinea* | Plants (Dicots) | Special Concern | — |
| snowberry | *Symphoricarpos albus* | Plants (Dicots) | Special Concern | — |
| Solomon's seal | *Polygonatum pubescens* | Plants (Monocots) | Special Concern | — |
| spurge | *Euphorbia commutate* | Plants (Dicots) | Special Concern | — |
| summer grape | *Vitis aestivalis* | Plants (Dicots) | Special Concern | — |

| Common Name | Scientific Name | Class | State Status | Federal Status |
|---|---|---|---|---|
| tall cotton grass | *Eriophorum angustifolium* | Plants (Monocots) | Special Concern | — |
| upland boneset | *Eupatorium sessilifolium* | Plants (Dicots) | Special Concern | — |
| valerian | *Valeriana edulis* | Plants (Dicots) | Special Concern | — |

#### 7.1.2.2 Unique Habitats

The Project area includes several areas that included the presence of known algific slopes. This landform, also known as a cold air slope, is very rare and is only found in the 'Driftless Area' of Iowa, Wisconsin, Illinois, and Minnesota. In Iowa, this area, also known as the Paleozoic Plateau, occurs in the extreme northeast portion of the state. Algific slopes stay cool on hot summer days as a result of their geologic and topographical formation. This unique habitat is home to a number of unique species found nowhere else in Iowa (Iowa Natural Heritage Foundation 2014).[4] During consultation efforts undertaken for the Project, correspondence with the USFWS was initiated to determine the potential for this resource near the proposed Project facilities. Based on a review of USFWS data, the results indicated that there were no known algific slopes within a potential 200 foot evaluation corridor of any proposed alternative segment through the Refuge. The closest area to the underground alternatives that includes algific talus slopes is located approximately 4,000 feet to the southeast of the Stoneman crossing alternative.

The areas where the proposed Mississippi River crossing locations are located are within Pool 11 of the Mississippi River; this pool is recognized by the USFWS as having excellent mussel bed habitat. This pool, among others in the Refuge, is crucial habitat for the Higgins-eye pearly mussel as well as other mussel species (USFWS 2006). However, as indicated above in Section 7.1.2.1, the Project is not likely to adversely affect Higgins-eye pearly mussel habitat as a result of locating the HDD cable system at a depth of approximately 45 feet under the river channel. In addition, the staging area for the HDD cable system extending under the Mississippi River would be set back to allow for sufficient depth to avoid this habitat. The potential for erosion and sedimentation would be limited through compliance with Section 401 and 404 of the CWA in consultation with Refuge staff.

[4] Iowa Natural Heritage Foundation 2014. An ecosystem frozen in time. Available: http://www.inhf.org/ec13-algific-slopes.cfm. Accessed May 2014.

#### 7.1.2.3 Migratory Birds

The Refuge is utilized by many different species of migratory bird species throughout the year. The Refuge is part of the Mississippi Flyway, a main corridor or path for migrating birds traveling north or south during migration seasons. This flyway is composed of the states of Alabama, Arkansas, Indiana, Illinois, Iowa, Kentucky, Louisiana, Michigan, Minnesota, Mississippi, Missouri, Ohio, Tennessee, and Wisconsin, as well as the Canadian provinces of Saskatchewan, Manitoba, and Ontario. It is estimated that 40 percent of North American waterfowl use the Mississippi Flyway during their migration (USFWS 2006[5]). The USFWS has established closed areas to provide waterfowl opportunities to feed and to rest without disturbance from human activities. This seclusion allows waterfowl an opportunity to molt, preen, pair bond, and store fat, all of which help to build healthier populations of waterfowl (2006).

There is a variety of migratory waterfowl that utilize the Refuge. There are seven species that use the Mississippi Flyway that are on the USFWS Region 3 Resource Conservation Priority List: lesser snow geese, Canada geese, wood ducks, mallards, blue-winged teals, canvasbacks, and the lesser scaup (USFWS 2006). In addition to these species, the area is a critical migration corridor for tundra swans, ring-necked duck, and hooded merganser. There is also a variety of songbirds (including numerous species of landbirds and passerines), colonial nesting birds (such as black terns and great blue herons), marsh birds (such as rails and bitterns), and raptors (such as eagles and vultures) that utilize habitats within the Refuge (2006).

Waterfowl populations can fluctuate from year to year in the Refuge due to a variety of factors such as food scarcity and weather. Biologists have been conducting waterfowl population surveys within the Refuge since the 1920s to estimate both the number of birds as well as overall species diversity. In order to achieve optimal bird distribution, the Refuge aims to provide food resources in areas where birds are not disturbed. The challenges facing management of the Refuge today include the need to provide this secure resting and feeding habitat for migratory waterfowl, as well as hunting opportunities for the waterfowl within the Refuge. In the Upper Mississippi River National Wildlife and Fish Refuge Comprehensive Plan the USFWS notes that disturbance can have a detrimental impact on the development of young birds. Things such as power boats, low-flying airplanes, helicopters, canoes, swimming visitors, hiking, and car traffic and the associated noise can cause this disturbance (USFWS 2006).

[5] USFWS. 2006. Upper Mississippi River National Wildlife and Fish Refuge Comprehensive Plan. http://www.fws.gov/midwest/planning/uppermiss/CCP/CCP.pdf. Accessed May 2014.

During construction activities under both options, there would be short-term impacts to migratory avian species that utilize areas of the flyway that are being proposed for construction. The presence of cranes and other heavy equipment would emit noise, fugitive dust, and exhaust pollutants that may result in the temporary avoidance of the area by avian and terrestrial species that currently utilize these habitats. Potential impacts to avian species could also be limited through construction timing, where applicable and/or required. If feasible, major construction activities could be planned to occur outside of peak migration periods. Additional measures to reduce the potential for additional avian impacts would be discussed in continued consultation with USFWS.

### 7.1.3 Land Cover and Land Use

The majority of this portion of the Project is managed by the USFWS and is part of the Refuge. In the vicinity of the Refuge, there are areas of open water, developed open space, low intensity development, deciduous forest, grassland/herbaceous area, pasture/hay fields, cultivated crops, woody wetlands, and emergent herbaceous wetlands. There are several residences near an active vineyard operation close to the Turkey River Substation location. The Promiseland Winery and Vineyard is the only known commercial business near the alternative routes. There is a small private parcel that is located within (and enclosed by) the Refuge boundaries which is currently crossed by the Nelson Dewey crossing alternative; this area is currently used for cultivated crops. In addition, there is another smaller private parcel that parallels the rail line on the western edge of the Refuge just north of the Nelson Dewey alignment. There is also a parcel of land managed by the Iowa Natural Heritage Foundation that would be crossed by the Stoneman crossing alternative.

To minimize any undue impacts to land cover in the vicinity of the Refuge, alteration of land cover would be limited to that necessary for safe operation of the line or as part of necessary construction activities. ITC Midwest would coordinate with USFWS and other applicable agencies to identify measures to avoid disturbance to the areas within the Refuge. Further additional measures would be developed with the USFWS to avoid migration of invasive species into any Refuge lands prior to clearing. Any disturbed areas would be restored. ITC Midwest would limit vehicle traffic to the extent practical to roads and pathways along the ROW.

In the agricultural areas and private parcels along the route, ITC Midwest would inform landowners of the timing of clearing and construction activities. Depending on the timing of construction and the alternative selected, some crop damage may occur. Areas that are currently utilized for agricultural purposes would not be able to be farmed after construction of the underground transmission line.

The scenic views of the Refuge attract hundreds of visitors each year for a variety of activities, such as hiking and boating. As a result of the topography of the area, some construction activities would likely be visible from vantage points around the Refuge, but would be limited to major construction activities. Visual evidence of underground transmission infrastructure through the Refuge would include the splice vault locations along the buried cable corridor, as well as the riser pole area, access roads to reach both the vault locations and the riser pole area. The transition station itself would also be visible, but would be located at the Turkey River Substation. Permanent vegetation removal would be required at these locations and would be evident from elevated views surrounding the Refuge.

It is anticipated that both crossing alternatives would require a total of five splice locations each containing four vaults (three for 345 kV and one for 161 kV) for a total of 20 vaults within the Refuge for either crossing alternative. At each of these locations, the transmission line would need to be slightly closer to the surface grade. This proximity may affect soil composition and seed germination in the surrounding vegetation due to possible heat transfer when the conductors are a shorter distance away. A proposed re-vegetation plan to address this issue would be developed in consultation with the USFWS.

### 7.1.4 Floodways/Floodplains

The Federal Emergency Management Agency (FEMA) designates areas that are likely to experience flooding in a 100-year storm event. Since the Project is in such close proximity to the Mississippi River, much of the segments are in Zone AE or X. Zone AE includes areas subject to inundation of floodwater by the 1-percent annual chance flood event, also known as a 100-year floodplain (FEMA 2014). [6]

The segments in Zone X have moderate risk within the 0.2-percent-annual-chance (or 500-year) floodplain. Zone X also includes areas of 1-percent-annual-chance flooding where average depths are less than 1 foot and areas of 1-percent-annual-chance flooding where the contributing drainage area is less than 1 square mile, both of which present a moderate risk of flood. Outside of the 100-year and 500-year floodplains, there is minimal risk of floods. The segments through Zone X are those that are on the bluffs above the Mississippi. This area is over 200 feet higher in elevation than those areas in the 100-year floodplain closer to the river. There may be fewer impacts to floodplain areas if the HDD method is utilized compared to the open trench option depending on differences in the amount and location of staging areas in relation to the specific route alignment. In general, the open trench would potentially

[6] FEMA. 2014. Definition of FEMA Flood Zones. https://msc.fema.gov/webapp/wcs/stores/servlet/info?storeId=10001&catalogId=10001&langId=-1&content=floodZones&title=FEMA%2520Flood%2520Zone%2520Designations. Accessed May 2014.

require more of a construction footprint within the floodplain during construction, but may result in a reduced permanent impact in terms of permanent ROW compared to the HDD method.

Approximately half of the route would need to be placed within FEMA-designated 100-year floodplains. ITC Midwest would file a joint floodplain permit application with the IDNR floodplain development program, the IDNR sovereign lands program, and the USACE. The proposed Project is not anticipated to cause a potential reduction in floodflows or reduction in flood storage volumes in the vicinity of the Refuge. The infrastructure required to operate the underground 161 and 345 kV cable systems within the floodplain would be limited in size, but would result in the permanent conversion of land designated as floodplain within the different prescribed rights-of-way for each construction method.

### 7.1.5 Cultural Resources

An assessment of cultural and archeological resources in the surrounding area was done in order to incorporate the potential impact on these existing resources into the route analysis. These sites include archaeological sites listed on the National Register of Historic Places (NRHP) as well as other recorded sites. Data was obtained from the Iowa State Historic Preservation Office (SHPO). This initial investigation was based on the area in which alternative routes would be developed. The Nelson Dewey crossing alternative would cross in proximity to one mound group, thought to be from the Woodland period. This mound group has only been investigated through archival research and thus its integrity is unknown. If an underground alternative were chosen, the location would need to be verified and its integrity investigated with SHPO consultation prior to start of construction activities. This site has not been evaluated to determine its National Register Eligibility Recommendation. The Stoneman crossing alternative would have two archeological resources within the projected ROW width. According to data obtained from the Iowa SHPO, these two resources were burial mounds that were previously destroyed. There were no known historical structures identified within 1,000 feet of any alternative route. Overall, within the Refuge, there have been 108 archaeological, geomorphological, history, and research investigations which have produced over 129,000 artifacts (USFWS 2006).

During construction, avoidance would be the primary mitigation approach to these resources. Avoidance of resources, historic or prehistoric, may include minor adjustments to Project design and designation of environmentally sensitive areas to be left undisturbed by the Project. BMcD recommends archeological monitoring during construction of the transmission line or the development of an unanticipated discoveries plan be put in place, which would outline the specific steps ITC Midwest would take if cultural resources were to be found, particularly human remains. If cultural resources are discovered during construction, any construction activity would be halted in that location. The SHPO should be notified and appropriate measures would be implemented to protect any discovered resources. Additionally, if any unmarked burials, human remains, or grave goods are discovered during construction, they should be reported to the County Coroner and local law enforcement and construction activities would cease in that area. If these burials, human remains, or grave goods are determined to not be a recent case, the State Archaeologist should be notified and mitigation measures would be developed between ITC Midwest and the State Archaeologist to assist in protecting the resource while determining appropriate options for the Project. Additionally, ITC Midwest and the other Project owners will conduct tribal consultation efforts the overall Cardinal-Hickory Creek Project and will eventually include future discussions and/or meetings with Native American tribes who have an historical interest in this area of the Mississippi River.

### 7.1.6 Existing or Planned Development

There are several areas with existing or planned development in the general vicinity of the proposed route alternatives. The Nelson Dewey crossing alternative would be near the launch for the Cassville Car Ferry, a passenger ferry between Cassville, Wisconsin, and Oak Road in Clayton County, Iowa. Construction of the Nelson Dewey crossing alternative may disrupt the ferry service as temporary closures of Oak Road might be required during trenching and installation of the underground transmission line. Also, depending on the crossing location selected, required construction activities near the Mississippi River may disrupt normal operations of the ferry. Should this location be selected, ITC Midwest would work with the ferry operators to identify feasible construction timing that would assist in limiting potential impacts to this transportation resource.

There is an active Canadian Pacific railroad that extends northwest to southeast along the Mississippi River that would need to be crossed under by either alternative. Potential boring activities at the site may require disruption of normal rail traffic through the area. Coordination with the Iowa Department of Transportation (IDOT) would be required to obtain and to submit all applicable permits associated with crossing railroad rights-of-way in addition to coordination with Canadian Pacific Railroad.

Both routes would be in close proximity to the aforementioned existing winery and vineyard near the Turkey River Substation (Section 6.1.3). The Promiseland Winery offers wine tastings, music, and bottles of wine for purchase. The winery also hosts community events in their facility. Construction noise from the underground transmission line and associated facilities may impact visitor experience at the winery, especially outdoor activities that occur on the site. There may also be a disruption of normal traffic flow along the Great River Road due to construction activities.

The Great River Road, a National Scenic Byway, would also be crossed by both route alternatives. ITC Midwest would coordinate with the IDOT to determine any applicable conditions required for transmission infrastructure near and across a scenic byway.

### 7.1.7 Navigation Considerations

There are a number of barges, boats, and other river vessels that utilize the Mississippi River channel near the potential underground transmission crossing. Construction timing would be coordinated with the U.S. Coast Guard to avoid potential impacts to Private Aids to Navigation (PATON) in this portion of the Mississippi River. Closures of the Mississippi River channel near the crossing may be required during construction activities. These closures would need to be coordinated by ITC Midwest, the USFWS, the USACE, and the United States Coast Guard in terms of the planned duration and extent of the navigation considerations on the river.

Periodic maintenance of all transmission facilities would be required. Maintenance of the overhead lines could result in potential short-term adjustments to maritime navigation in the immediate vicinity of the required maintenance activities. Impacts to navigation aids on the Mississippi River are not anticipated as a result of operation of either underground construction scenario or crossing location. Significant delays to maritime traffic on the Mississippi River are not anticipated to result from either construction activities or ongoing maintenance. USACE has authority under Section 10 of River and Harbors Act of 1899 for a potential underground crossing of the Mississippi River.

### 7.1.8 Access Considerations

ITC Midwest would evaluate construction access opportunities by identifying existing transmission line rights-of-way, roads, or trails that run parallel or perpendicular to the transmission line. Where feasible, ITC Midwest intends to traverse the ROW acquired for the Project to access construction areas. This method of access would minimize impacts to landowners and adjacent properties. In some situations, private field roads, trails, or fields must be used to gain access to areas for construction. Where no current access is available or existing access is inadequate to cross roadway ditches or other features, new access roads may be constructed. Permission from landowners and/or land managers would be obtained prior to using any of these areas to access the ROW for construction. Where necessary to accommodate heavy construction equipment, including cranes, cement trucks, and hole-drilling equipment, existing roads may be upgraded or new roads may be constructed. If new roads must be constructed, in addition to permission from landowners, ITC Midwest would also obtain permissions necessary from the local road authority. During construction activities, ITC Midwest would work with appropriate road authorities to utilize proper maintenance procedures of roadways traversed by construction equipment.

Some soil conditions will require that construction mats be placed along the ROW or at trenching/boring location to minimize soil disturbances. These mats can also be used to provide access across sensitive areas to minimize impacts including soil compaction, rutting, or damage to plant species. Crews would attempt to minimize ground disturbance whenever feasible during ROW and substation site clearing for, and construction of, the Project. Although attempts to minimize potential impacts would be made, areas would be disturbed during the normal course of work. Once construction is completed in an area, disturbed areas would be restored in consultation with the USFWS to their original condition to the maximum extent feasible.

On private parcels, after construction activities have been completed, a representative of ITC Midwest would contact the property owner to discuss any damage that has occurred as a result of the Project. This contact may not occur until after ITC Midwest has started restoration activities. If, during the course of construction of the Project, crops, fences, or drain tile have been damaged, ITC Midwest would repair damages or reimburse the landowner to repair the damages. Measures to limit the potential impact to Refuge lands would be developed in conjunction with the USFWS as part of the ongoing consultation for this Project.

Ground-level vegetation disturbed or removed from the ROW during construction of the Project would naturally reestablish to pre-construction conditions. Areas where significant soil compaction or other disturbance from construction activities occur would require additional assistance in reestablishing the vegetation stratum and controlling soil erosion. Various best management practices to be used during the construction of the Project would be identified in the Storm Water Pollution Prevention Plan (SWPPP) that would be prepared when ITC Midwest applies for an National Pollutant Discharge Elimination System (NPDES) permit, but some commonly-used methods to control soil erosion are erosion control blankets with embedded seeds, including those with biodegradable netting, where feasible; silt fences; and, straw bales.

Another aspect of restoration relates to the roads used to access staging areas, construction sites, splice vault locations, and the riser poles. These access roads would vary in width from 25 to 40 feet for HDD access and 35 to 50 feet for open trench access. The roads used for maintaining the splice vault location could be narrower, while those used during construction and to access the riser poles would be closer to 35 feet. After construction activities have completed, ITC Midwest would work with township, city, and county transportation agencies in order that roads used for purposes of access during construction would be returned to either the condition they were in, or better, before ROW clearing began. ITC Midwest would meet with township road supervisors, city road personnel, or county highway departments to address any issues that arise during construction to work to restore roadways, if necessary, after construction is completed.

### 7.1.9 Federal and State Permits and Approvals

ITC Midwest would coordinate with various agencies that have jurisdiction over the lands and waters within the Project area, including the US Coast Guard, the USFWS, IDNR, WDNR, and the USACE, throughout the permitting and construction process. Additional Wisconsin state approvals would be required for an underground alternative at this location. Should an underground alternative be further investigated as an option for this Project, additional detailed information would be provided regarding applicable Wisconsin permits and approvals for such a Project.

The Proposed Project would require action from applicable federal and IA agencies with jurisdiction under the following:

- National Environmental Policy Act
- U.S. Fish and Wildlife Service - Special Use Permit, Endangered Species Act, Bald and Golden Eagle Protection Act, Migratory Bird Treaty Act
- U.S. Army Corps of Engineers - Section 404 and 401, Clean Water Act
- U.S. Environmental Protection Agency – Spill Prevention, Control, and Countermeasure Plan (SPCC)
- Section 106 of the National Historic Preservation Act (NHPA)
- U.S. Department of Agriculture Rural Utility Service Compliance (lead federal agency yet to be determined)
- U.S. Army Corps of Engineers - Section 10, Rivers And Harbors Act
- U.S. Federal Aviation Administration – Part 7460 Review
- IDNR Sovereign Lands and Rivers Permit
- IDOT Utility Accommodation Permit

### 7.1.10 Continuing Maintenance Requirements

ITC Midwest and other utilities design transmission lines and substations to operate for decades while requiring minimal maintenance, particularly in the first few years of operation. Substantial work on an existing transmission line is typically only required after it has been exposed to the elements for a long period of time (55, or more, years) or after a storm event has caused damage to the transmission line.

A typical transmission line last approximately 50 years, depending on the design and materials used. For this Project, future utility plans would be developed to include a potential repair or rebuild at this specific location, rather than retiring or abandoning the line. Transmission infrastructure has very few mechanical elements and is designed and constructed to withstand weather extremes typical for the region. With the exception of severe weather, transmission lines rarely fail. Protective relaying equipment would automatically take these facilities out of service when a fault is sensed on the system, and these interruptions are usually only momentary. Outages necessary for scheduled maintenance are also infrequent. Because of these general operational characteristics, the average annual availability of transmission infrastructure is in excess of 99 percent.

The primary cost associated with the operation and maintenance of a transmission line is the cost of inspections, usually done semi-annually by helicopter with a forester, vegetation planner, and line inspector; annually by ground with a forester; and once every four years by ground with a line inspector. Annual operating and maintenance costs for transmission lines in Iowa and the surrounding states vary depending upon the setting, the amount of vegetation management necessary, storm damage occurrences, structure types, materials used, and the transmission line's age.

Substations also require a certain amount of maintenance to keep them functioning in accordance with accepted operating parameters, ITC Midwest procedures, North American Reliability Corporation (NERC) reliability standard requirements, and the National Electric Safety Code (NESC). Transformers, circuit breakers, control buildings, batteries, relay equipment, and other substation equipment need to be serviced periodically to maintain operability. The fenced area must also be kept free of vegetation and proper drainage must be maintained.

# 8.0 CABLE SYSTEM RELIABILITY

This section is intended to briefly discuss and outline various aspects of reliability in cable systems and how they would compare to a comparable overhead installation. This section includes discussion on items such as weather impacts, potential for damage due to human activities in the area, and estimated repair times for both underground and overhead options.

## 8.1 Outage Events

Generally underground transmission systems are a reliable method of power transmission. Due to the cables being placed underground, they are impervious to many weather related events such as high winds, ice accumulation, lightning damage, or other debris (i.e., tree limbs) damaging the circuit. Outages on underground transmission cables are primarily caused by dig-ins (i.e., cable damage and fault due to excavation in the vicinity of the underground line). Due to this particular Project being located in a Refuge, that risk should be significantly lower than many other areas where excavations occur more regularly, such as streets or within public ROW.

Most failure events that do not involve a dig-in would not require any replacement of duct bank conduit or manholes; therefore, there would typically be no excavation or damage to the refuge land during the repair. For the majority of instances, these cable failure events that do not involve a dig in would be attributed to the failure of accessories such as terminations and splices. To repair a failure of this type, the cable and/or splice would be removed and replaced and the conduit inspected with a remote video device. If there were a failure that required conduit and/or manhole repairs, it would likely be caused by a dig-in event. In this case Refuge lands would already be disturbed.

Should the failure occur within a trenchless (HDD) installation, the cable would be removed and re-pulled after a video inspection of the conduit to verify the conduit integrity. Should there be significant damage to the conduit this conduit would be abandoned and the replacement cable would utilize the spare conduit within the proposed HDD installation.

One additional concern for an underground cable installation in a flood prone area such as the Refuge would be a washout or destabilization of the supporting soils. Unlike an overhead transmission structure that has a deep foundation or piles to support it, duct banks are traditionally an unreinforced concrete structure that relies on the earth below it for support. While various things (such as a reinforced mud mat supported on piles) can be done to create a structural member under the duct bank to resist differential settlement and other issues associated with a washout, they can be very costly and time consuming during construction. This scenario involving a large scale washout or soil destabilization would be the only type of event that could potentially result in a common mode failure between the 161 kV and 345 kV circuits. Again, due to the very low probability of this type of event, and the physical separation between the 161 kV and 345 kV circuits the likelihood of a single event common mode failure should be considered very low.

## 8.2 Outage Durations

The main reliability concern with underground cable system compared to overhead cable systems is the length of the outage in the event of a cable failure. With overhead transmission, the line can generally be placed back into service in a relatively short amount of time, typically less than a day or even a matter of seconds in a re-close situation, thus increasing the line's availability for transmitting load. When there is a fault on an underground line, the line may be out of service for a significant amount of time, more than two weeks and up to six months, depending on the type of failure and how quickly it can be located and repaired. Due to the Refuge's semi-regular flooding, this duration could be extended significantly due to access limitations. Additionally, it is not typical to re-close on a circuit that contains a section of underground cable.

The main reason for very long repair times on underground installations is due to the manufacture of new cable and accessories and the time it would take to get such necessary material and qualified personnel to perform the repair work. Because of these longer outage times, an underground cable system has a lower circuit availability compared to an overhead line. This could be managed by keeping lengths of cable and spare equipment on hand, however this poses a potential budgetary impact.

## 8.3 Cable Technology Reliability

While XLPE cables systems have a low intrinsic failure rate because of stringent factory quality control and testing, splices and terminations are susceptible to failure because of their field assembly. Most utilities in North America rely on the cable system manufacturer to provide skilled workers and special tools to perform splices, terminations, and repairs on XLPE transmission cables.

As XLPE systems are becoming more prevalent and more installations are completed throughout the world, manufacturers are improving the material quality and installation practices continually. This has led to the latest generation of XLPE cable systems being much more reliable than past generations. XLPE cable systems are now designed to have a service life of 40 years or greater, much like other transmission infrastructure components.

The manufacturing process for extruded cables is of critical importance in ensuring a reliable end product. Manufacturers minimize insulation contamination by using super clean insulation compounds, transporting and storing the compounds in sealed facilities, and screening out contaminants at the extruder head.

The three basic cable accessories for extruded dielectric cables are splices, terminations, and sheath bonding materials. Pre-fabricated or pre-molded splices are commonly used to join extruded dielectric cables. During the splicing operation, the insulation and shields are removed from the conductor and the insulation is penciled. The conductor ends are then joined by a compression splice or exothermic welding. Once the conductors have been joined, the pre-molded or prefabricated joint is slid over the connection into its final resting location and covered with watertight shrink wraps and/or membranes. An advantage of these types of splices is that many of the parts can be factory tested prior to field installation.

Terminations are available for extruded dielectric cable to allow transitions to overhead lines or above ground equipment. Termination bodies are typically made of porcelain or polymer and include skirts to minimize the probability of external flashovers due to contamination. For the 345 kV and 161 kV voltage class the terminations would be a wet-type, or oil-filled termination. This means that after the cable insulation and the terminations, interior walls would be filled with high dielectric strength oil to aid in electric field dissipation within the termination.

Another important component of a XLPE cable system is the grounding/bonding of the cable shield/sheath. An underground distribution system typically has the shield grounded at each splice and termination. Grounding at each splice and terminations, while effective at reducing standing sheath voltages, causes circulating currents to be developed on the cable shield resulting in additional heating in the cable and lower ampacity. The way to maximize the ampacity of an underground cable is to eliminate the circulating currents. This is accomplished with underground transmission cables by using special bonding methods such as single-point and cross-bonding. These methods eliminate or reduce the amount of current which would flow on the cable shield, resulting in no additional, or limited additional, heating and ultimately a higher ampacity.

Maintenance should be performed regularly so the cables will operate with uninterrupted service. Inspections are recommended to occur every six to eighteen months. Typical major components to be checked for XLPE cable systems are terminators, vaults, arresters, and link boxes. Although there are various methods of checking the condition and maintenance of the above items, the primary method of inspection is visual. Vault inspections, where worker entry is required, should only be performed when an outage is taken on the circuit for safety reasons.

## 8.4 Cable System Operation & Maintenance

Underground line is relatively easy to operate and maintain although it can be more difficult to troubleshoot and repair under certain failure conditions. Maintenance procedures for XLPE systems include various items such as visual and/or operational inspections of the cable terminations, manholes, and temperature monitoring system inspection and testing.

With proper maintenance, the design life of an underground line is approximately 40 years. Underground lines are susceptible to outages resulting from dig in's and cable, splice or equipment failure.

XLPE cable requires little maintenance since it is usually installed in a duct bank. Duct inspections are performed in conjunction with routine manhole inspections. Furthermore, ducts are seldom cleaned unless a new circuit or grounding is being installed. Unless environmental conditions dictate more frequent inspections, a yearly manhole inspection is generally sufficient to examine cable sheaths, protective jackets, joint casings, cable neutrals, and general physical condition of the manhole. Terminations should also be visually checked on a yearly basis to determine if the system is operating properly.

# 9.0 UNDERGROUND CONSTRUCTION COST ESTIMATE

BMcD has developed preliminary construction cost estimates bases on the routes, installation methods, and cable system(s) determined in Sections 3 through 6 of this report. These cost estimates are based on RSMeans Heavy Construction Cost Data as well as past projects, budgetary quotes provided by vendors, and professional experience and judgment.

These estimates are based on the following assumptions:

- Costs are provided in 2014 dollars, escalated to 2020
- No costs for contaminated soils disposal included
- No costs for existing utility relocation included
- No traffic control costs included
- No state, local, federal, or import taxes included
- No permitting costs included
- Civil costs based on average production rate of 100 feet per day (duct bank portion)
- Civil costs based on average depth of cover of 3.9 feet (duct bank portion)
- Civil costs based on an assumed HDD length of 2900/4200 feet
- No rock removal costs included
- Transition Station Costs
    - Property Acquisition
    - Soil Investigation
    - Site Work
    - Structural Foundations
    - Termination Structures
    - Raceway
    - Grounding
    - Bus/Conductor (4000 Amp Capacity)
    - Switching/Breakers (4000 Amp Capacity)
    - Capacitor/Reactor Banks ($5MM per ITC request)
    - Engineering (material & labor)
    - Construction (material & labor)
    - Testing (material & labor)
- Costs adjusted to Lancaster, WI city cost index (CCI)

**Table 9-1: Nelson Dewey Crossing Alternative 345 kV Cost Summary**

| SUMMARY OF COSTS | UNIT | MATERIAL COST | LABOR COST | TOTAL COST |
|---|---|---|---|---|
| UNDERGROUND CABLE SYSTEM & ACCESSORIES | LOT | $ 25,000,000.00 | $ 6,800,000.00 | $ 31,800,000.00 |
| CIVIL WORKS | LOT | $ 12,900,000.00 | $ 14,100,000.00 | $ 27,000,000.00 |
| ENGINEERING | LOT | $ - | $ 1,700,000.00 | $ 1,700,000.00 |
| **PROJECT TOTAL** | **LOT** | **$ 37,900,000.00** | **$ 22,600,000.00** | **$ 60,500,000.00** |
| PROJECT TOTAL | COST / MILE | $ 25,330,632.91 | $ 15,104,810.13 | $ 40,435,443.04 |

**Table 9-2: Stoneman Crossing Alternative 345 kV Cost Summary**

| SUMMARY OF COSTS | UNIT | MATERIAL COST | LABOR COST | TOTAL COST |
|---|---|---|---|---|
| UNDERGROUND CABLE SYSTEM & ACCESSORIES | LOT | $ 26,200,000.00 | $ 7,000,000.00 | $ 33,200,000.00 |
| CIVIL WORKS | LOT | $ 17,600,000.00 | $ 18,400,000.00 | $ 36,000,000.00 |
| ENGINEERING | LOT | $ - | $ 2,000,000.00 | $ 2,000,000.00 |
| **PROJECT TOTAL** | **LOT** | **$ 43,800,000.00** | **$ 27,400,000.00** | **$ 71,200,000.00** |
| PROJECT TOTAL | COST / MILE | $ 25,984,719.10 | $ 16,255,280.90 | $ 42,240,000.00 |

**Table 9-3: Nelson Dewey Crossing Alternative 161 kV Cost Summary**

| SUMMARY OF COSTS | UNIT | MATERIAL COST | LABOR COST | TOTAL COST |
|---|---|---|---|---|
| UNDERGROUND CABLE SYSTEM & ACCESSORIES | LOT | $ 7,700,000.00 | $ 1,300,000.00 | $ 9,000,000.00 |
| CIVIL WORKS | LOT | $ 5,600,000.00 | $ 7,000,000.00 | $ 12,600,000.00 |
| ENGINEERING | LOT | $ - | $ 700,000.00 | $ 700,000.00 |
| **PROJECT TOTAL** | **LOT** | **$ 13,300,000.00** | **$ 9,000,000.00** | **$ 22,300,000.00** |
| PROJECT TOTAL | COST / MILE | $ 8,889,113.92 | $ 6,015,189.87 | $ 14,904,303.80 |

**Table 9-4: Stoneman Crossing Alternative 161 kV Cost Summary**

| SUMMARY OF COSTS | UNIT | MATERIAL COST | LABOR COST | TOTAL COST |
|---|---|---|---|---|
| UNDERGROUND CABLE SYSTEM & ACCESSORIES | LOT | $ 8,700,000.00 | $ 1,600,000.00 | $ 10,300,000.00 |
| CIVIL WORKS | LOT | $ 7,100,000.00 | $ 8,200,000.00 | $ 15,300,000.00 |
| ENGINEERING | LOT | $ - | $ 800,000.00 | $ 800,000.00 |
| **PROJECT TOTAL** | **LOT** | **$ 15,800,000.00** | **$ 10,600,000.00** | **$ 26,400,000.00** |
| PROJECT TOTAL | COST / MILE | $ 9,373,483.15 | $ 6,288,539.33 | $ 15,662,022.47 |

Detailed cost breakdowns can be seen in Appendix B.

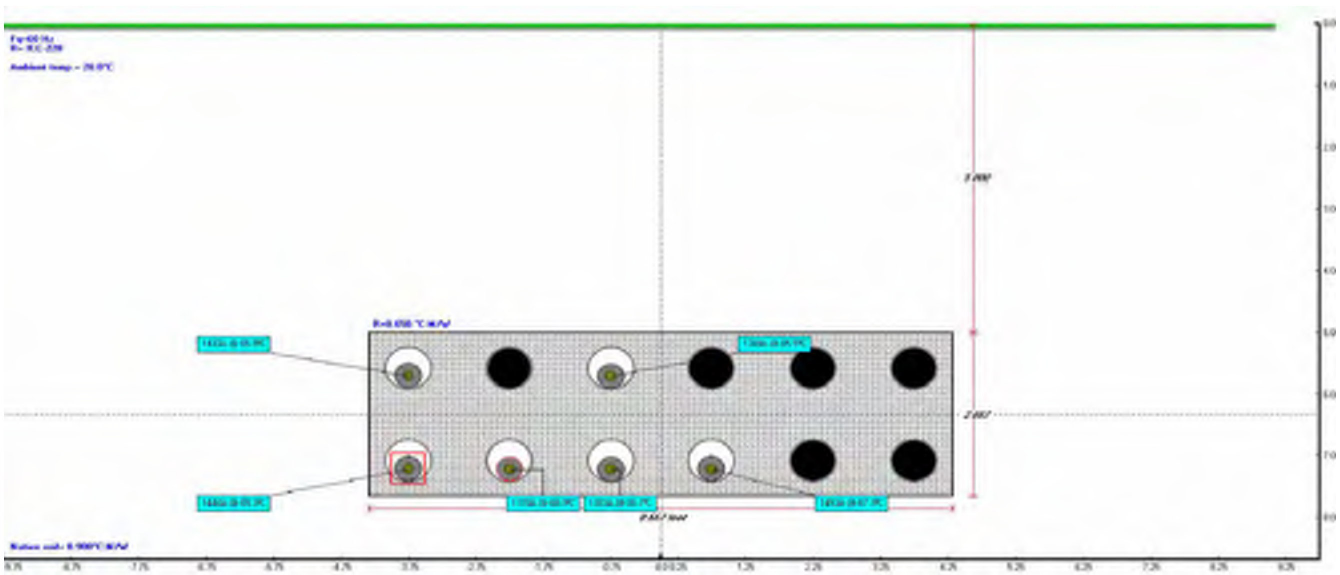
# APPENDIX A - AMPACITY CALCULATIONS

**Summary Results**

**CYMCAP 6.2 rev. 5.3**

**Study:** Temporary
**Execution:** ITC Mississippi 2
**Date:** 5/19/2014
**Frequency:** 60 Hz
**Conductor Resistances:** IEC-228
**Fraction of conductor current returning through sheath for single phase cables:** 0

| **Installation Type: Duct Bank** | | |
|---|---|---|
| **Parameter** | **Unit** | **Value** |
| Ambient Soil Temperature at Installation Depth | °C | 20 |
| Thermal Resistivity of Native Soil | °C.m/W | 0.9 |
| Duct Bank Width | ft | 8.667 |
| Duct Bank Height | ft | 2.667 |
| Duct Bank X Center | ft | 0 |
| Duct Bank Y Center | ft | 6.333 |
| Thermal Resistivity of Duct Bank | °C.m/W | 0.65 |



**Summary Results**

**Solution converged**

| Cable No. | Cable Type | Circuit No. | Feeder ID | Phase | Location | | Load Factor | Temperature | Ampacity |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | X[ft] | Y[ft] | [p.u.] | [°C] | [A] |
| 1 | 1 | 1 | <Undefined> | A | -3.75 | 5.713 | 0.75 | 85.9 | 1433.3 |
| 2 | 1 | 1 | <Undefined> | B | -3.75 | 7.213 | 0.75 | 89.3 | 1439.5 |
| 3 | 1 | 1 | <Undefined> | C | -2.25 | 7.213 | 0.75 | 88 | 1369.6 |
| 4 | 1 | 1 | <Undefined> | A | -0.75 | 5.713 | 0.75 | 85.5 | 1389.4 |
| 5 | 1 | 1 | <Undefined> | B | -0.75 | 7.213 | 0.75 | 88.7 | 1383.2 |
| 6 | 1 | 1 | <Undefined> | C | 0.75 | 7.213 | 0.75 | 87.3 | 1453 |

**Summary Results**

**CYMCAP 6.2 rev. 5.3**

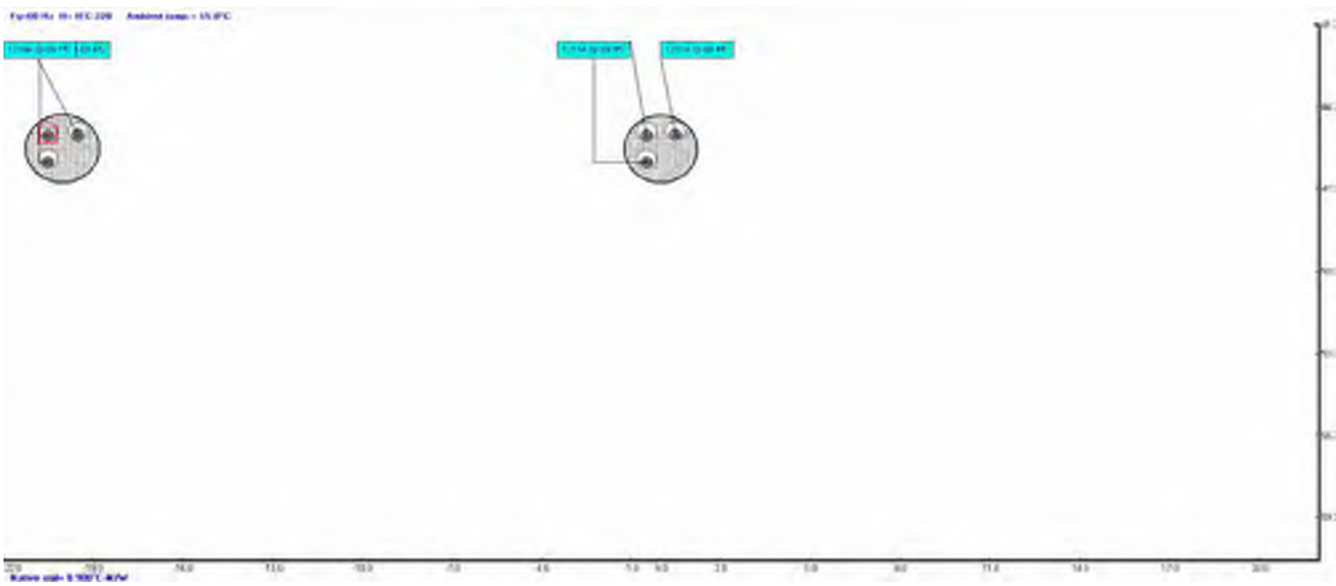
**Study:** Temporary
**Execution:** ITC Mississippi
**Date:** 4/28/2014
**Frequency:** 60 Hz
**Conductor Resistances:** IEC-228

**Fraction of conductor current returning through sheath for single phase cables:** 0

**Installation Type: Multiple Duct Banks Backfills**

| Parameter | Unit | Value |
|---|---|---|
| Ambient Soil Temperature at Installation Depth | °C | 15 |
| Thermal Resistivity of Native Soil | °C.m/W | 0.9 |

| Layers | | Dimensions [ft] | | | | Type | Thermal Resistivity [°C.m/W] |
|---|---|---|---|---|---|---|---|
| No. | Name | X Center | Y Center | Width | Height | | |
| 1 | NSTD DB2 | 0 | 46.25 | 2.5 | 2.5 | Casing | 0.8 |
| 2 | NSTD DB3 | -20 | 46.25 | 2.5 | 2.5 | Casing | 0.8 |



**Summary Results**

**Solution converged**

| Cable No. | Cable Type | Circuit No. | Feeder ID | Phase | Location | | Load Factor | Temperature | Ampacity |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | X[ft] | Y[ft] | [p.u.] | [°C] | [A] |
| 1 | 1 | 1 | <Undefined> | A | -20.5 | 45.75 | 0.75 | 90 | 1218.5 |
| 2 | 1 | 1 | <Undefined> | B | -19.5 | 45.75 | 0.75 | 89.4 | 1218.5 |
| 3 | 1 | 1 | <Undefined> | C | -20.5 | 46.75 | 0.75 | 89.1 | 1218.5 |
| 4 | 1 | 2 | <Undefined> | A | -0.5 | 45.75 | 0.75 | 89.9 | 1211.4 |
| 5 | 1 | 2 | <Undefined> | B | 0.5 | 45.75 | 0.75 | 88.4 | 1211.4 |
| 6 | 1 | 2 | <Undefined> | C | -0.5 | 46.75 | 0.75 | 89 | 1211.4 |

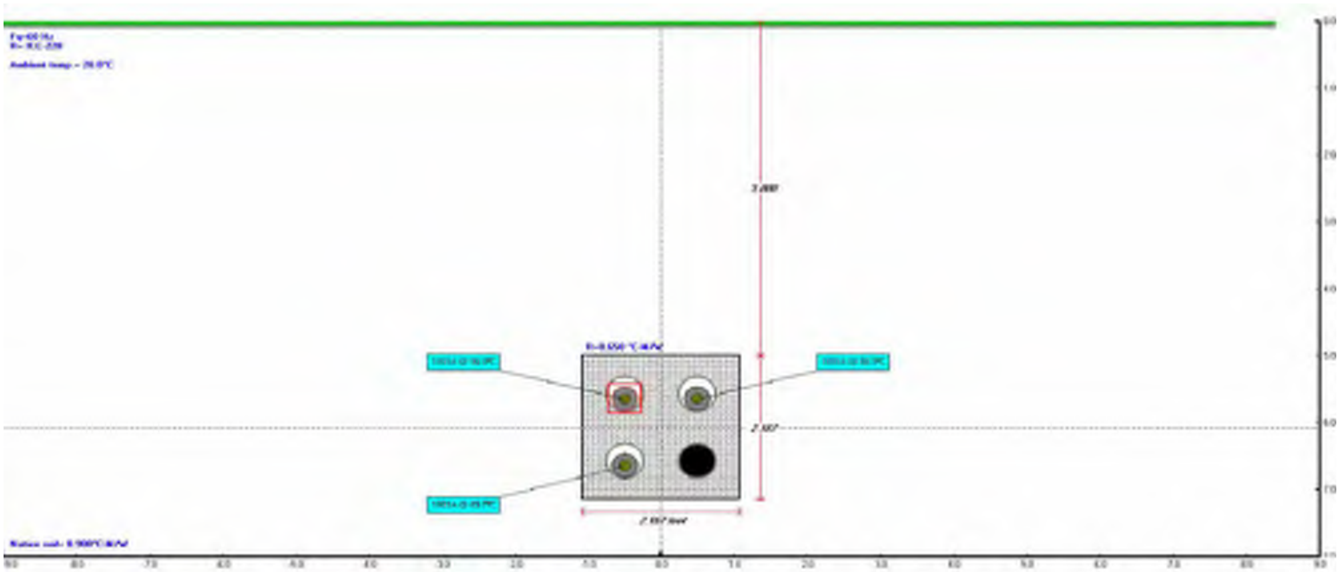
2429.9

**Summary Results**

**CYMCAP 6.2 rev. 5.3**

**Study:** Temporary
**Execution:** ITC Mississippi 4
**Date:** 1/6/2015
**Frequency:** 60 Hz
**Conductor Resistances:** IEC-228
**Fraction of conductor current returning through sheath for single phase cables:** 0

| Installation Type: Duct Bank | | |
|---|---|---|
| **Parameter** | **Unit** | **Value** |
| Ambient Soil Temperature at Installation Depth | °C | 20 |
| Thermal Resistivity of Native Soil | °C.m/W | 0.9 |
| Duct Bank Width | ft | 2.167 |
| Duct Bank Height | ft | 2.167 |
| Duct Bank X Center | ft | 0 |
| Duct Bank Y Center | ft | 6.083 |
| Thermal Resistivity of Duct Bank | °C.m/W | 0.65 |



**Summary Results**

**Solution converged**

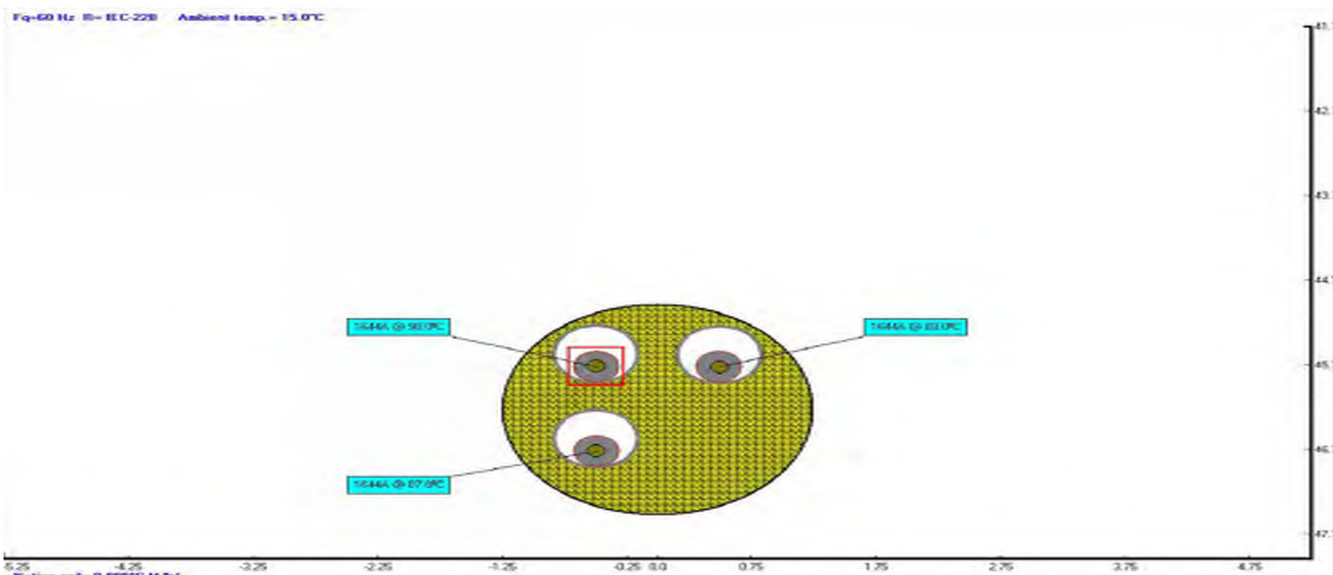
| Cable No. | Cable Type | Circuit No. | Feeder ID | Phase | Location | | Load Factor | Temperature | Ampacity |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | X[ft] | Y[ft] | [p.u.] | [°C] | [A] |
| 1 | 1 | 1 | <Undefined> | A | -0.5 | 5.647 | 0.75 | 90 | 1881.2 |
| 2 | 1 | 1 | <Undefined> | B | 0.5 | 5.647 | 0.75 | 88.9 | 1881.2 |
| 3 | 1 | 1 | <Undefined> | C | -0.5 | 6.647 | 0.75 | 89.7 | 1881.2 |

## Summary Results

**CYMCAP 6.2 rev. 5.3**

**Study:** Temporary
**Execution:** ITC Mississippi 3
**Date:** 1/6/2015
**Frequency:** 60 Hz
**Conductor Resistances:** IEC-228
**Fraction of conductor current returning through sheath for single phase cables:** 0

| Installation Type: Multiple Duct Banks Backfills | | | | | | | |
|---|---|---|---|---|---|---|---|
| Parameter | | | | | | Unit | Value |
| Ambient Soil Temperature at Installation Depth | | | | | | °C | 15 |
| Thermal Resistivity of Native Soil | | | | | | °C.m/W | 0.9 |
| Layers | | Dimensions [ft] | | | | Type | Thermal Resistivity [°C.m/W] |
| No. | Name | X Center | Y Center | Width | Height | | |
| 1 | NSTD DB2 | 0 | 46.25 | 2.5 | 2.5 | Casing | 0.8 |




| Summary Results | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Solution converged | | | | | | | | | |
| Cable No. | Cable Type | Circuit No. | Feeder ID | Phase | Location X[ft] | Location Y[ft] | Load Factor [p.u.] | Temperature [°C] | Ampacity [A] |
| 1 | 1 | 1 | <Undefined> | A | -0.5 | 45.75 | 0.75 | 90 | 1644.1 |
| 2 | 1 | 1 | <Undefined> | B | 0.5 | 45.75 | 0.75 | 88 | 1644.1 |
| 3 | 1 | 1 | <Undefined> | C | -0.5 | 46.75 | 0.75 | 87.8 | 1644.1 |

## APPENDIX B - COST ESTIMATES

PROJECTED ESTMIATE OF PROJECT COST

CLIENT NAME: ITC
PROJECT NAME: Nelson - Dewey UG Route
ROUTE LENGTH (ft): 7,900
ROUTE LENGTH (mile): 1.50

VOLTAGE CLASS: 161 kV
CABLE SIZE/TYPE: 4000 kcmil XLPE
NUMBER OF CIRCUITS: 1
NUMBER OF CABLES PER 1

PREPARED BY N. Rochel 1/6/2015
CHECKED BY N. Scott 1/6/2015

Burns & McDonnell SINCE 1898

**UNDERGROUND CABLE SYSTEM & ACCESSORIES**

| ITEM NO. | ITEM | UNIT | QUANTITY | MATERIAL UNIT PRICE | MATERIAL COST | LABOR UNIT PRICE | LABOR COST | TOTAL COST |
|---|---|---|---|---|---|---|---|---|
| U01 | 161 kV 4000 kcmil XLPE Cable | L.F. | 24,570 | $ 191.40 | $ 4,702,698.00 | $ 13.92 | $ 342,014.40 | $ 5,044,712.40 |
| U02 | Spare 161 kV 4000 kcmil XLPE Cable | L.F. | 2,000 | $ 191.40 | $ 382,800.00 | $ - | $ - | $ 382,800.00 |
| U03 | 161 kV Open Air Terminators | Ea. | 5 | $ 11,600.00 | $ 58,000.00 | $ 17,400.00 | $ 87,000.00 | $ 145,000.00 |
| U04 | Spare 161 kV Open Air Terminators | Ea. | 2 | $ 11,600.00 | $ 23,200.00 | $ - | $ - | $ 23,200.00 |
| U05 | 161 kV GIS Terminators | Ea. | 0 | $ - | $ - | $ - | $ - | $ - |
| U06 | Spare 161 kV GIS Terminators | Ea. | 0 | $ - | $ - | $ - | $ - | $ - |
| U07 | Cable Splice | Ea. | 15 | $ 10,440.00 | $ 156,600.00 | $ 17,400.00 | $ 261,000.00 | $ 417,600.00 |
| U08 | Spare Cable Splice | Ea. | 1 | $ 10,440.00 | $ 10,440.00 | $ - | $ - | $ 10,440.00 |
| U09 | Lightning Arrester | Ea. | 5 | $ 1,160.00 | $ 5,800.00 | $ 580.00 | $ 2,900.00 | $ 8,700.00 |
| U10 | Spare Lightning Arrester | Ea. | 1 | $ 1,160.00 | $ 1,160.00 | $ - | $ - | $ 1,160.00 |
| U11 | Ground Continuity Conductor | L.F. | 8,190 | $ 5.01 | $ 41,054.83 | $ 4.83 | $ 39,521.66 | $ 80,576.50 |
| U12 | Link Box Without SVL's | Ea. | 6 | $ 4,176.00 | $ 25,056.00 | $ 8,120.00 | $ 48,720.00 | $ 73,776.00 |
| U13 | Link Box With SVL's | Ea. | 6 | $ 5,568.00 | $ 33,408.00 | $ 7,656.00 | $ 45,936.00 | $ 79,344.00 |
| U14 | Fiber Optic/Communications System | L.F. | 8,190 | $ 5.69 | $ 46,635.56 | $ 4.27 | $ 34,976.67 | $ 81,612.24 |
| U15 | Temperature Monitoring System | L.S. | 0 | $ - | $ - | $ - | $ - | $ - |
| U16 | Traffic Control | L.S. | 1 | $ - | $ - | $ - | $ - | $ - |
| U17 | Transition Station | Ea. | 0 | $ - | $ - | $ - | $ - | $ - |
| U18 | Other (Provide a Description) | Ea. | 0 | $ - | $ - | $ - | $ - | $ - |
| U19 | Admin / Mob / De-Mob by Contractor (Electrical) | L.S. | 1 | $ - | $ - | $ 63,489.21 | $ 63,489.21 | $ 63,489.21 |
| | | | | **SUBTOTAL** | **$ 5,486,852.40** | | **$ 925,557.95** | **$ 6,412,410.34** |
| | | | **CONTINGENCY** | 40.00% | **$ 2,194,740.96** | | **$ 370,223.18** | **$ 2,564,964.14** |
| | | | | **TOTAL** | **$ 7,681,593.35** | | **$ 1,295,781.13** | **$ 8,977,374.48** |

POWER CABLE DUCT SIZE: 6
NUMBER OF POWER CABLE DUCTS: 4
NUMBER OF OTHER DUCTS: 4
TYPICAL DUCT BANK DIMENSIONS: 24 in Wide X 24 in High

**CIVIL WORKS**

| ITEM NO. | ITEM | UNIT | QUANTITY | MATERIAL UNIT PRICE | MATERIAL COST | LABOR UNIT PRICE | LABOR COST | TOTAL COST |
|---|---|---|---|---|---|---|---|---|
| C01 | Trench Excavation | L.F. | 4,860 | $ 27.11 | $ 131,770.27 | $ 100.53 | $ 488,575.80 | $ 620,346.07 |
| C02 | Rock Excavation (Trench) | L.F. | 4,860 | $ - | $ - | $ - | $ - | $ - |
| C03 | Duct Bank | L.F. | 4,860 | $ 46.15 | $ 224,289.00 | $ 100.62 | $ 489,013.20 | $ 713,302.20 |
| C04 | Fluidized Thermal Backfill (FTB) | L.F. | 4,860 | $ - | $ - | $ - | $ - | $ - |
| C05 | Native Soil Backfill | L.F. | 4,860 | $ - | $ - | $ 19.87 | $ 96,568.20 | $ 96,568.20 |
| C06 | Pavement Restoration | L.F. | 0 | $ - | $ - | $ - | $ - | $ - |
| C07 | Steel Plating | L.F. | 0 | $ - | $ - | $ - | $ - | $ - |
| C08 | Traffic Signal Loop Detector Repair | Ea. | 0 | $ - | $ - | $ - | $ - | $ - |
| C09 | Splice Vaults | Ea. | 5 | $ 37,882.91 | $ 189,414.55 | $ - | $ - | $ 189,414.55 |
| C10 | Splice Vault Excavation | Ea. | 5 | $ 14,223.09 | $ 71,115.45 | $ 33,022.14 | $ 165,110.70 | $ 236,226.15 |
| C11 | Rock Excavation (Vault) | Ea. | 5 | $ - | $ - | $ - | $ - | $ - |
| C12 | Grounding System (civil) | L.S. | 1 | $ 29,566.08 | $ 29,566.08 | $ 29,566.08 | $ 29,566.08 | $ 59,132.16 |
| C13 | Communication Handholes | Ea. | 5 | $ 4,380.16 | $ 21,900.80 | $ 6,570.24 | $ 32,851.20 | $ 54,752.00 |
| C14 | Conduit Proofing (Civil) | L.S. | 1 | $ 23,652.87 | $ 23,652.87 | $ 165,570.05 | $ 165,570.05 | $ 189,222.92 |
| C15 | Substation Termination Structures | Ea. | 3 | $ 10,619.08 | $ 31,857.24 | $ 12,277.74 | $ 36,833.22 | $ 68,690.46 |
| C16 | OH to UG Termination Structures | Ea. | 2 | $ 137,975.04 | $ 275,950.08 | $ 102,933.76 | $ 205,867.52 | $ 481,817.60 |
| C17 | Clearing and Grubbing | L.F. | 3,500 | $ 13.66 | $ 47,810.00 | $ 16.03 | $ 56,105.00 | $ 103,915.00 |
| C18 | Loam and Seed | S.F. | 175,000 | $ 0.28 | $ 49,000.00 | $ 0.28 | $ 49,000.00 | $ 98,000.00 |
| C19 | Horizontal Directional Drill | L.F. | 2,900 | $ 801.79 | $ 2,325,191.00 | $ 658.83 | $ 1,910,607.00 | $ 4,235,798.00 |
| C20 | Jack & Bore | L.F. | 0 | $ - | $ - | $ - | $ - | $ - |
| C21 | Traffic Control, Flagger & Police (Civil) | L.S. | 0 | $ - | $ - | $ - | $ - | $ - |
| C22 | Construction Staking | L.F. | 7,900 | $ - | $ - | $ 1.63 | $ 12,877.00 | $ 12,877.00 |
| C23 | Contaminated Material Testing | L.F. | 7,900 | $ 2.19 | $ 17,301.00 | $ 19.72 | $ 155,788.00 | $ 173,089.00 |
| C24 | Contaminated Material Disposal | L.S. | 0 | $ - | $ - | $ - | $ - | $ - |
| C25 | Utility Relocation (known and unknown) | L.S. | 0 | $ - | $ - | $ - | $ - | $ - |
| C26 | Dewatering | L.S. | 1 | $ 532,351.17 | $ 532,351.17 | $ 982,736.26 | $ 982,736.26 | $ 1,515,087.42 |
| C27 | Other (Provide a Description) | Ea. | 0 | $ - | $ - | $ - | $ - | $ - |
| C28 | Other (Provide a Description) | Ea. | 0 | $ - | $ - | $ - | $ - | $ - |
| C29 | Admin/Mob/De-Mob by Contractor (Civil) | L.S. | 1 | $ - | $ - | $ 88,482.39 | $ 88,482.39 | $ 88,482.39 |
| | | | | **SUBTOTAL** | **$ 3,971,169.50** | | **$ 4,965,551.61** | **$ 8,936,721.12** |
| | | | **CONTINGENCY** | **40.00%** | **$ 1,588,467.80** | | **$ 1,986,220.65** | **$ 3,574,688.45** |
| | | | | **TOTAL** | **$ 5,559,637.31** | | **$ 6,951,772.26** | **$ 12,511,409.56** |

| SUMMARY OF COSTS | UNIT | MATERIAL COST | LABOR COST | TOTAL COST |
|---|---|---|---|---|
| UNDERGROUND CABLE SYSTEM & ACCESSORIES | LOT | $ 7,700,000.00 | $ 1,300,000.00 | $ 9,000,000.00 |
| CIVIL WORKS | LOT | $ 5,600,000.00 | $ 7,000,000.00 | $ 12,600,000.00 |
| ENGINEERING | LOT | $ - | $ 700,000.00 | $ 700,000.00 |
| **PROJECT TOTAL** | **LOT** | **$ 13,300,000.00** | **$ 9,000,000.00** | **$ 22,300,000.00** |
| **PROJECT TOTAL** | **COST / MILE** | **$ 8,889,113.92** | **$ 6,015,189.87** | **$ 14,904,303.80** |

Note: The individual unit rates provide a preliminary estimate of the associated costs prior to design. The unit rates may vary in construction bids and during construction due to placement of the contractors profit and contingency. The unit rates have been increased in an effort to anticipate unforeseen conditions and unknown market fluctuations. Although the unit rates may vary, the overall cost per mile is within the industry standard level of accuracy.

PROJECTED ESTMIATE OF PROJECT COST

| | | | | | |
|---|---|---|---|---|---|
| CLIENT NAME: | ITC | VOLTAGE CLASS: | 161 kV | | |
| PROJECT NAME: | Nelson - Dewey UG Route | CABLE SIZE/TYPE: | 4000 kcmil XLPE | | |
| ROUTE LENGTH (ft): | 7,900 | NUMBER OF CIRCUITS: | 1 | PREPARED BY N. Rochel | 1/6/2015 |
| ROUTE LENGTH (mile): | 1.5 | NUMBER OF CABLES PER PHASE: | 1 | CHECKED BY N. Scott | 1/6/2015 |

| | | | |
|---|---|---|---|
| POWER CABLE DUCT SIZE: | 6 | NUMBER OF OTHER DUCTS: | 4 |
| NUMBER OF POWER CABLE DUCTS: | 4 | TYPICAL DUCT BANK DIMENSIONS: | 24 in Wide X 24 in High |

**MAJOR ASSUMPTIONS**

1) Unit Costs Based Upon 3% Escalation, Per Year from 2015 to 2020 for a Total of 16% Escalation
2) Contaminated Material Disposal based upon 0% of Total Civil Cost
3) Utility Relocations based upon 0% of Total Civil Cost
4) Traffic Control based upon assumed 0% of Route Length
5) Unit Costs based upon CCI (Combined) = 0.944
6) Unit Costs based upon Tax = 0%
7) Civil Costs based upon an average trenching excavation of 100 feet per day
8) Civil Costs based upon an average duct bank depth of cover of 3.9 feet
9) Civil Costs based upon an assumed Horizontal Directional Drill Length of 2900 feet
10) Civil Costs based upon an assumed Jack and Bore Length of 0 feet
11) Rock Removal based upon 0% of Civil Excavation Length

PROJECTED ESTMIATE OF PROJECT COST

CLIENT NAME: ITC
PROJECT NAME: Nelson Dewey Route
ROUTE LENGTH (ft): 7,900
ROUTE LENGTH (mile): 1.50

VOLTAGE CLASS: 345 kV
CABLE SIZE/TYPE: 3000 kcmil XLPE
NUMBER OF CIRCUITS: 1
NUMBER OF CABLES PER 2

PREPARED BY N. Rochel 10/10/2014
CHECKED BY N. Scott 10/10/2014

Burns & McDonnell
SINCE 1898

**UNDERGROUND CABLE SYSTEM & ACCESSORIES**

| ITEM NO. | ITEM | UNIT | QUANTITY | MATERIAL UNIT PRICE | MATERIAL COST | LABOR UNIT PRICE | LABOR COST | TOTAL COST |
|---|---|---|---|---|---|---|---|---|
| U01 | 345 kV 3000 kcmil XLPE Cable | L.F. | 49,140 | $ 110.20 | $ 5,415,228.00 | $ 13.92 | $ 684,028.80 | $ 6,099,256.80 |
| U02 | Spare 345 kV 3000 kcmil XLPE Cable | L.F. | 2,000 | $ 110.20 | $ 220,400.00 | $ - | $ - | $ 220,400.00 |
| U03 | 345 kV Open Air Terminators | Ea. | 12 | $ 20,880.00 | $ 250,560.00 | $ 11,600.00 | $ 139,200.00 | $ 389,760.00 |
| U04 | Spare 345 kV Open Air Terminators | Ea. | 2 | $ 20,880.00 | $ 41,760.00 | $ - | $ - | $ 41,760.00 |
| U05 | 345 kV GIS Terminators | Ea. | 0 | $ - | $ - | $ - | $ - | $ - |
| U06 | Spare 345 kV GIS Terminators | Ea. | 0 | $ - | $ - | $ - | $ - | $ - |
| U07 | Cable Splice | Ea. | 30 | $ 17,400.00 | $ 522,000.00 | $ 11,600.00 | $ 348,000.00 | $ 870,000.00 |
| U08 | Spare Cable Splice | Ea. | 1 | $ 17,400.00 | $ 17,400.00 | $ - | $ - | $ 17,400.00 |
| U09 | Lightning Arrester | Ea. | 12 | $ 1,740.00 | $ 20,880.00 | $ 580.00 | $ 6,960.00 | $ 27,840.00 |
| U10 | Spare Lightning Arrester | Ea. | 1 | $ 1,740.00 | $ 1,740.00 | $ - | $ - | $ 1,740.00 |
| U11 | Ground Continuity Conductor | L.F. | 16,380 | $ 10.03 | $ 164,219.33 | $ 9.65 | $ 158,086.66 | $ 322,305.98 |
| U12 | Link Box Without SVL's | Ea. | 13 | $ 4,176.00 | $ 54,288.00 | $ 8,120.00 | $ 105,560.00 | $ 159,848.00 |
| U13 | Link Box With SVL's | Ea. | 13 | $ 5,568.00 | $ 72,384.00 | $ 7,656.00 | $ 99,528.00 | $ 171,912.00 |
| U14 | Fiber Optic/Communications System | L.F. | 8,190 | $ 5.69 | $ 46,635.56 | $ 4.27 | $ 34,976.67 | $ 81,612.24 |
| U15 | Temperature Monitoring System | L.S. | 0 | $ - | $ - | $ - | $ - | $ - |
| U16 | Traffic Control | L.S. | 1 | $ - | $ - | $ - | $ - | $ - |
| U17 | Transition station | Ea. | 2 | $ 3,500,000.00 | $ 7,000,000.00 | $ 1,000,000.00 | $ 2,000,000.00 | $ 9,000,000.00 |
| U18 | Reactive Compensation | Ea. | 1 | $ 4,000,000.00 | $ 4,000,000.00 | $ 1,000,000.00 | $ 1,000,000.00 | $ 5,000,000.00 |
| U19 | Admin / Mob / De-Mob by Contractor (Electrical) | L.S. | 1 | $ - | $ - | $ 224,038.35 | $ 224,038.35 | $ 224,038.35 |
| | | | | **SUBTOTAL** | **$ 17,827,494.89** | | **$ 4,800,378.48** | **$ 22,627,873.37** |
| | | | **CONTINGENCY** | 40.00% | **$ 7,130,997.96** | | **$ 1,920,151.39** | **$ 9,051,149.35** |
| | | | | **TOTAL** | **$ 24,958,492.85** | | **$ 6,720,529.87** | **$ 31,679,022.72** |

POWER CABLE DUCT SIZE: 8
NUMBER OF POWER CABLE DUCTS: 12
NUMBER OF OTHER DUCTS: 4
TYPICAL DUCT BANK DIMENSIONS: 105 in Wide X 33 in High

**CIVIL WORKS**

| ITEM NO. | ITEM | UNIT | QUANTITY | MATERIAL UNIT PRICE | MATERIAL COST | LABOR UNIT PRICE | LABOR COST | TOTAL COST |
|---|---|---|---|---|---|---|---|---|
| C01 | Trench Excavation | L.F. | 4,860 | $ 27.16 | $ 132,001.58 | $ 139.94 | $ 680,108.40 | $ 812,109.98 |
| C02 | Rock Excavation (Trench) | L.F. | 4,860 | $ - | $ - | $ - | $ - | $ - |
| C03 | Duct Bank | L.F. | 4,860 | $ 213.96 | $ 1,039,845.60 | $ 345.36 | $ 1,678,449.60 | $ 2,718,295.20 |
| C04 | Fluidized Thermal Backfill (FTB) | L.F. | 4,860 | $ - | $ - | $ - | $ - | $ - |
| C05 | Native Soil Backfill | L.F. | 4,860 | $ - | $ - | $ 64.57 | $ 313,810.20 | $ 313,810.20 |
| C06 | Pavement Restoration | L.F. | 0 | $ - | $ - | $ - | $ - | $ - |
| C07 | Steel Plating | L.F. | 0 | $ - | $ - | $ - | $ - | $ - |
| C08 | Traffic Signal Loop Detector Repair | Ea. | 0 | $ - | $ - | $ - | $ - | $ - |
| C09 | Splice Vaults | Ea. | 15 | $ 37,882.91 | $ 568,243.65 | $ - | $ - | $ 568,243.65 |
| C10 | Splice Vault Excavation | Ea. | 15 | $ 14,223.09 | $ 213,346.35 | $ 33,022.14 | $ 495,332.10 | $ 708,678.45 |
| C11 | Rock Excavation (Vault) | Ea. | 15 | $ - | $ - | $ - | $ - | $ - |
| C12 | Grounding System (civil) | L.S. | 1 | $ 88,698.24 | $ 88,698.24 | $ 88,698.24 | $ 88,698.24 | $ 177,396.48 |
| C13 | Communication Handholes | Ea. | 5 | $ 4,380.16 | $ 21,900.80 | $ 6,570.24 | $ 32,851.20 | $ 54,752.00 |
| C14 | Conduit Proofing (Civil) | L.S. | 1 | $ 47,305.73 | $ 47,305.73 | $ 331,140.10 | $ 331,140.10 | $ 378,445.83 |
| C15 | Substation Termination Structures | Ea. | 3 | $ 10,619.08 | $ 31,857.24 | $ 12,277.74 | $ 36,833.22 | $ 68,690.46 |
| C16 | OH to UG Termination Structures | Ea. | 0 | $ - | $ - | $ - | $ - | $ - |
| C17 | Clearing and Grubbing | L.F. | 3,500 | $ 13.66 | $ 47,810.00 | $ 16.03 | $ 56,105.00 | $ 103,915.00 |
| C18 | Loam and Seed | S.F. | 175,000 | $ 0.28 | $ 49,000.00 | $ 0.28 | $ 49,000.00 | $ 98,000.00 |
| C19 | Horizontal Directional Drill | L.F. | 2,900 | $ 2,310.18 | $ 6,699,522.00 | $ 1,905.10 | $ 5,524,790.00 | $ 12,224,312.00 |
| C20 | Jack & Bore | L.F. | 0 | $ - | $ - | $ - | $ - | $ - |
| C21 | Traffic Control, Flagger & Police (Civil) | L.S. | 0 | $ - | $ - | $ - | $ - | $ - |
| C22 | Construction Staking | L.F. | 7,900 | $ - | $ - | $ 1.63 | $ 12,877.00 | $ 12,877.00 |
| C23 | Contaminated Material Testing | L.F. | 7,900 | $ 2.19 | $ 17,301.00 | $ 19.72 | $ 155,788.00 | $ 173,089.00 |
| C24 | Contaminated Material Disposal | L.S. | 0 | $ - | $ - | $ - | $ - | $ - |
| C25 | Utility Relocation (known and unknown) | L.S. | 0 | $ - | $ - | $ - | $ - | $ - |
| C26 | Dewatering | L.S. | 1 | $ 208,540.00 | $ 208,540.00 | $ 379,682.40 | $ 379,682.40 | $ 588,222.40 |
| C27 | Other (Provide a Description) | Ea. | 0 | $ - | $ - | $ - | $ - | $ - |
| C28 | Other (Provide a Description) | Ea. | 0 | $ - | $ - | $ - | $ - | $ - |
| C29 | Admin/Mob/De-Mob by Contractor (Civil) | L.S. | 1 | $ - | $ - | $ 190,008.38 | $ 190,008.38 | $ 190,008.38 |
| | | | | **SUBTOTAL** | **$ 9,165,372.19** | | **$ 10,025,473.83** | **$ 19,190,846.02** |
| | | | **CONTINGENCY** | **40.00%** | **$ 3,666,148.88** | | **$ 4,010,189.53** | **$ 7,676,338.41** |
| | | | | **TOTAL** | **$ 12,831,521.06** | | **$ 14,035,663.37** | **$ 26,867,184.43** |

| SUMMARY OF COSTS | UNIT | MATERIAL COST | LABOR COST | TOTAL COST |
|---|---|---|---|---|
| UNDERGROUND CABLE SYSTEM & ACCESSORIES | LOT | $ 25,000,000.00 | $ 6,800,000.00 | $ 31,800,000.00 |
| CIVIL WORKS | LOT | $ 12,900,000.00 | $ 14,100,000.00 | $ 27,000,000.00 |
| ENGINEERING | LOT | $ - | $ 1,700,000.00 | $ 1,700,000.00 |
| **PROJECT TOTAL** | **LOT** | **$ 37,900,000.00** | **$ 22,600,000.00** | **$ 60,500,000.00** |
| **PROJECT TOTAL** | **COST / MILE** | **$ 25,330,632.91** | **$ 15,104,810.13** | **$ 40,435,443.04** |

Note: The individual unit rates provide a preliminary estimate of the associated costs prior to design. The unit rates may vary in construction bids and during construction due to placement of the contractors profit and contingency. The unit rates have been increased in an effort to anticipate unforeseen conditions and unknown market fluctuations. Although the unit rates may vary, the overall cost per mile is within the industry standard level of accuracy.

PROJECTED ESTMIATE OF PROJECT COST

| | | | | | |
|---|---|---|---|---|---|
| CLIENT NAME: | ITC | VOLTAGE CLASS: | 345 kV | | |
| PROJECT NAME: | Nelson Dewey Route | CABLE SIZE/TYPE: | 3000 kcmil XLPE | | |
| ROUTE LENGTH (ft): | 7,900 | NUMBER OF CIRCUITS: | 1 | PREPARED BY N. Rochel | 10/10/2014 |
| ROUTE LENGTH (mile): | 1.5 | NUMBER OF CABLES PER PHASE: | 2 | CHECKED BY N. Scott | 10/10/2014 |

| | | | |
|---|---|---|---|
| POWER CABLE DUCT SIZE: | 8 | NUMBER OF OTHER DUCTS: | 4 |
| NUMBER OF POWER CABLE DUCTS: | 12 | TYPICAL DUCT BANK DIMENSIONS: | 105 in Wide X 33 in High |

**MAJOR ASSUMPTIONS**

1) Unit Costs Based Upon 3% Escalation, Per Year from 2015 to 2020 for a Total of 16% Escalation
2) Contaminated Material Disposal based upon 0% of Total Civil Cost
3) Utility Relocations based upon 0% of Total Civil Cost
4) Traffic Control based upon assumed 0% of Route Length
5) Unit Costs based upon CCI (Combined) = 0.944
6) Unit Costs based upon Tax = 0%
7) Civil Costs based upon an average trenching excavation of 100 feet per day
8) Civil Costs based upon an average duct bank depth of cover of 3.9 feet
9) Civil Costs based upon an assumed Horizontal Directional Drill Length of 2900 feet
10) Civil Costs based upon an assumed Jack and Bore Length of 0 feet
11) Rock Removal based upon 0% of Civil Excavation Length

PROJECTED ESTMIATE OF PROJECT COST

CLIENT NAME: ITC
PROJECT NAME: Stoneman Route
ROUTE LENGTH (ft): 8,900
ROUTE LENGTH (mile): 1.69

VOLTAGE CLASS: 161 kV
CABLE SIZE/TYPE: 4000 kmcil XLPE
NUMBER OF CIRCUITS: 1
NUMBER OF CABLES PER 1

PREPARED BY N. Rochel 1/6/2015
CHECKED BY N. Scott 1/6/2015

**UNDERGROUND CABLE SYSTEM & ACCESSORIES**

| ITEM NO. | ITEM | UNIT | QUANTITY | MATERIAL UNIT PRICE | MATERIAL COST | LABOR UNIT PRICE | LABOR COST | TOTAL COST |
|---|---|---|---|---|---|---|---|---|
| U01 | 161 kV 4000 kmcil XLPE Cable | L.F. | 27,690 | $ 191.40 | $ 5,299,866.00 | $ 13.92 | $ 385,444.80 | $ 5,685,310.80 |
| U02 | Spare 161 kV 4000 kmcil XLPE Cable | L.F. | 2,000 | $ 191.40 | $ 382,800.00 | $ - | $ - | $ 382,800.00 |
| U03 | 161 kV Open Air Terminators | Ea. | 6 | $ 11,600.00 | $ 69,600.00 | $ 17,400.00 | $ 104,400.00 | $ 174,000.00 |
| U04 | Spare 161 kV Open Air Terminators | Ea. | 2 | $ 11,600.00 | $ 23,200.00 | $ - | $ - | $ 23,200.00 |
| U05 | 161 kV GIS Terminators | Ea. | 0 | $ - | $ - | $ - | $ - | $ - |
| U06 | Spare 161 kV GIS Terminators | Ea. | 0 | $ - | $ - | $ - | $ - | $ - |
| U07 | Cable Splice | Ea. | 18 | $ 10,440.00 | $ 187,920.00 | $ 17,400.00 | $ 313,200.00 | $ 501,120.00 |
| U08 | Spare Cable Splice | Ea. | 1 | $ 10,440.00 | $ 10,440.00 | $ - | $ - | $ 10,440.00 |
| U09 | Lightning Arrester | Ea. | 6 | $ 1,160.00 | $ 6,960.00 | $ 580.00 | $ 3,480.00 | $ 10,440.00 |
| U10 | Spare Lightning Arrester | Ea. | 1 | $ 1,160.00 | $ 1,160.00 | $ - | $ - | $ 1,160.00 |
| U11 | Ground Continuity Conductor | L.F. | 9,230 | $ 5.01 | $ 46,268.14 | $ 4.83 | $ 44,540.29 | $ 90,808.43 |
| U12 | Link Box Without SVL's | Ea. | 7 | $ 4,176.00 | $ 29,232.00 | $ 8,120.00 | $ 56,840.00 | $ 86,072.00 |
| U13 | Link Box With SVL's | Ea. | 7 | $ 5,568.00 | $ 38,976.00 | $ 7,656.00 | $ 53,592.00 | $ 92,568.00 |
| U14 | Fiber Optic/Communications System | L.F. | 9,230 | $ 5.69 | $ 52,557.54 | $ 4.27 | $ 39,418.15 | $ 91,975.69 |
| U15 | Temperature Monitoring System | L.S. | 0 | $ - | $ - | $ - | $ - | $ - |
| U16 | Traffic Control | L.S. | 1 | $ - | $ - | $ - | $ - | $ - |
| U17 | Transition Station | Ea. | 0 | $ - | $ - | $ - | $ - | $ - |
| U18 | Other (Provide a Description) | Ea. | 0 | $ - | $ - | $ - | $ - | $ - |
| U19 | Admin / Mob / De-Mob by Contractor (Electrical) | L.S. | 1 | $ - | $ - | $ 71,498.95 | $ 71,498.95 | $ 71,498.95 |
| | | | | **SUBTOTAL** | **$ 6,148,979.68** | | **$ 1,072,414.19** | **$ 7,221,393.88** |
| | | | **CONTINGENCY** | 40.00% | **$ 2,459,591.87** | | **$ 428,965.68** | **$ 2,888,557.55** |
| | | | | **TOTAL** | **$ 8,608,571.56** | | **$ 1,501,379.87** | **$ 10,109,951.43** |

POWER CABLE DUCT SIZE: 6
NUMBER OF POWER CABLE DUCTS: 4
NUMBER OF OTHER DUCTS: 4
TYPICAL DUCT BANK DIMENSIONS: 24 in Wide X 24 in High

**CIVIL WORKS**

| ITEM NO. | ITEM | UNIT | QUANTITY | MATERIAL UNIT PRICE | MATERIAL COST | LABOR UNIT PRICE | LABOR COST | TOTAL COST |
|---|---|---|---|---|---|---|---|---|
| C01 | Trench Excavation | L.F. | 4,532 | $ 27.11 | $ 122,877.13 | $ 100.53 | $ 455,601.96 | $ 578,479.09 |
| C02 | Rock Excavation (Trench) | L.F. | 4,532 | $ - | $ - | $ - | $ - | $ - |
| C03 | Duct Bank | L.F. | 4,532 | $ 46.15 | $ 209,151.80 | $ 100.62 | $ 456,009.84 | $ 665,161.64 |
| C04 | Fluidized Thermal Backfill (FTB) | L.F. | 4,532 | $ - | $ - | $ - | $ - | $ - |
| C05 | Native Soil Backfill | L.F. | 4,532 | $ - | $ - | $ 19.87 | $ 90,050.84 | $ 90,050.84 |
| C06 | Pavement Restoration | L.F. | 0 | $ - | $ - | $ - | $ - | $ - |
| C07 | Steel Plating | L.F. | 0 | $ - | $ - | $ - | $ - | $ - |
| C08 | Traffic Signal Loop Detector Repair | Ea. | 0 | $ - | $ - | $ - | $ - | $ - |
| C09 | Splice Vaults | Ea. | 6 | $ 37,882.91 | $ 227,297.46 | $ - | $ - | $ 227,297.46 |
| C10 | Splice Vault Excavation | Ea. | 6 | $ 14,223.09 | $ 85,338.54 | $ 33,022.14 | $ 198,132.84 | $ 283,471.38 |
| C11 | Rock Excavation (Vault) | Ea. | 6 | $ - | $ - | $ - | $ - | $ - |
| C12 | Grounding System (civil) | L.S. | 1 | $ 35,479.30 | $ 35,479.30 | $ 35,479.30 | $ 35,479.30 | $ 70,958.60 |
| C13 | Communication Handholes | Ea. | 6 | $ 4,380.16 | $ 26,280.96 | $ 6,570.24 | $ 39,421.44 | $ 65,702.40 |
| C14 | Conduit Proofing (Civil) | L.S. | 1 | $ 27,595.01 | $ 27,595.01 | $ 193,165.06 | $ 193,165.06 | $ 220,760.07 |
| C15 | Substation Termination Structures | Ea. | 3 | $ 10,619.08 | $ 31,857.24 | $ 12,277.74 | $ 36,833.22 | $ 68,690.46 |
| C16 | OH to UG Termination Structures | Ea. | 2 | $ 137,975.04 | $ 275,950.08 | $ 102,933.76 | $ 205,867.52 | $ 481,817.60 |
| C17 | Clearing and Grubbing | L.F. | 3,290 | $ 14.53 | $ 47,803.70 | $ 17.05 | $ 56,094.50 | $ 103,898.20 |
| C18 | Loam and Seed | S.F. | 164,500 | $ 0.28 | $ 46,060.00 | $ 0.28 | $ 46,060.00 | $ 92,120.00 |
| C19 | Horizontal Directional Drill | L.F. | 4,200 | $ 801.79 | $ 3,367,518.00 | $ 658.83 | $ 2,767,086.00 | $ 6,134,604.00 |
| C20 | Jack & Bore | L.F. | 0 | $ - | $ - | $ - | $ - | $ - |
| C21 | Traffic Control, Flagger & Police (Civil) | L.S. | 0 | $ - | $ - | $ - | $ - | $ - |
| C22 | Construction Staking | L.F. | 8,900 | $ - | $ - | $ 1.63 | $ 14,507.00 | $ 14,507.00 |
| C23 | Contaminated Material Testing | L.F. | 8,900 | $ 2.19 | $ 19,491.00 | $ 19.72 | $ 175,508.00 | $ 194,999.00 |
| C24 | Contaminated Material Disposal | L.S. | 0 | $ - | $ - | $ - | $ - | $ - |
| C25 | Utility Relocation (known and unknown) | L.S. | 0 | $ - | $ - | $ - | $ - | $ - |
| C26 | Dewatering | L.S. | 1 | $ 506,463.31 | $ 506,463.31 | $ 935,008.39 | $ 935,008.39 | $ 1,441,471.70 |
| C27 | Other (Provide a Description) | Ea. | 0 | $ - | $ - | $ - | $ - | $ - |
| C28 | Other (Provide a Description) | Ea. | 0 | $ - | $ - | $ - | $ - | $ - |
| C29 | Admin/Mob/De-Mob by Contractor (Civil) | L.S. | 1 | $ - | $ - | $ 107,339.89 | $ 107,339.89 | $ 107,339.89 |
| | | | | **SUBTOTAL** | **$ 5,029,163.53** | | **$ 5,812,165.80** | **$ 10,841,329.33** |
| | | | **CONTINGENCY** | **40.00%** | **$ 2,011,665.41** | | **$ 2,324,866.32** | **$ 4,336,531.73** |
| | | | | **TOTAL** | **$ 7,040,828.94** | | **$ 8,137,032.13** | **$ 15,177,861.06** |

| SUMMARY OF COSTS | UNIT | MATERIAL COST | LABOR COST | TOTAL COST |
|---|---|---|---|---|
| UNDERGROUND CABLE SYSTEM & ACCESSORIES | LOT | $ 8,700,000.00 | $ 1,600,000.00 | $ 10,300,000.00 |
| CIVIL WORKS | LOT | $ 7,100,000.00 | $ 8,200,000.00 | $ 15,300,000.00 |
| ENGINEERING | LOT | $ - | $ 800,000.00 | $ 800,000.00 |
| **PROJECT TOTAL** | **LOT** | **$ 15,800,000.00** | **$ 10,600,000.00** | **$ 26,400,000.00** |
| **PROJECT TOTAL** | **COST / MILE** | **$ 9,373,483.15** | **$ 6,288,539.33** | **$ 15,662,022.47** |

Note: The individual unit rates provide a preliminary estimate of the associated costs prior to design. The unit rates may vary in construction bids and during construction due to placement of the contractors profit and contingency. The unit rates have been increased in an effort to anticipate unforeseen conditions and unknown market fluctuations. Although the unit rates may vary, the overall cost per mile is within the industry standard level of accuracy.

PROJECTED ESTMIATE OF PROJECT COST

| | | | | | | |
|---|---|---|---|---|---|---|
| CLIENT NAME: | ITC | VOLTAGE CLASS: | 161 kV | | | |
| PROJECT NAME: | Stoneman Route | CABLE SIZE/TYPE: | 4000 kmcil XLPE | | | |
| ROUTE LENGTH (ft): | 8,900 | NUMBER OF CIRCUITS: | 1 | PREPARED BY | N. Rochel | 1/6/2015 |
| ROUTE LENGTH (mile): | 1.69 | NUMBER OF CABLES PER PHASE: | 1 | CHECKED BY | N. Scott | 1/6/2015 |

| | | | |
|---|---|---|---|
| POWER CABLE DUCT SIZE: | 6 | NUMBER OF OTHER DUCTS: | 4 |
| NUMBER OF POWER CABLE DUCTS: | 4 | TYPICAL DUCT BANK DIMENSIONS: | 24 in Wide X 24 in High |

**MAJOR ASSUMPTIONS**

1) Unit Costs Based Upon 3% Escalation, Per Year from 2015 to 2020 for a Total of 16% Escalation
2) Contaminated Material Disposal based upon 0% of Total Civil Cost
3) Utility Relocations based upon 0% of Total Civil Cost
4) Traffic Control based upon assumed 0% of Route Length
5) Unit Costs based upon CCI (Combined) = 0.944
6) Unit Costs based upon Tax = 0%
7) Civil Costs based upon an average trenching excavation of 100 feet per day
8) Civil Costs based upon an average duct bank depth of cover of 3.9 feet
9) Civil Costs based upon an assumed Horizontal Directional Drill Length of 4200 feet
10) Civil Costs based upon an assumed Jack and Bore Length of 0 feet
11) Rock Removal based upon 0% of Civil Excavation Length

PROJECTED ESTMIATE OF PROJECT COST

Burns & McDonnell SINCE 1898

CLIENT NAME: ITC
PROJECT NAME: Stoneman Route
ROUTE LENGTH (ft): 8,900
ROUTE LENGTH (mile): 1.69

VOLTAGE CLASS: 345 kV
CABLE SIZE/TYPE: 3000 kcmil XLPE
NUMBER OF CIRCUITS: 1
NUMBER OF CABLES PER 2

PREPARED BY N. Rochel 10/10/2014
CHECKED BY N. Scott 10/10/2014

**UNDERGROUND CABLE SYSTEM & ACCESSORIES**

| ITEM NO. | ITEM | UNIT | QUANTITY | MATERIAL UNIT PRICE | MATERIAL COST | LABOR UNIT PRICE | LABOR COST | TOTAL COST |
|---|---|---|---|---|---|---|---|---|
| U01 | 345 kV 3000 kcmil XLPE Cable | L.F. | 55,380 | $ 110.20 | $ 6,102,876.00 | $ 13.92 | $ 770,889.60 | $ 6,873,765.60 |
| U02 | Spare 345 kV 3000 kcmil XLPE Cable | L.F. | 2,000 | $ 110.20 | $ 220,400.00 | $ - | $ - | $ 220,400.00 |
| U03 | 345 kV Open Air Terminators | Ea. | 12 | $ 20,880.00 | $ 250,560.00 | $ 11,600.00 | $ 139,200.00 | $ 389,760.00 |
| U04 | Spare 345 kV Open Air Terminators | Ea. | 2 | $ 20,880.00 | $ 41,760.00 | $ - | $ - | $ 41,760.00 |
| U05 | 345 kV GIS Terminators | Ea. | 0 | $ - | $ - | $ - | $ - | $ - |
| U06 | Spare 345 kV GIS Terminators | Ea. | 0 | $ - | $ - | $ - | $ - | $ - |
| U07 | Cable Splice | Ea. | 36 | $ 17,400.00 | $ 626,400.00 | $ 11,600.00 | $ 417,600.00 | $ 1,044,000.00 |
| U08 | Spare Cable Splice | Ea. | 1 | $ 17,400.00 | $ 17,400.00 | $ - | $ - | $ 17,400.00 |
| U09 | Lightning Arrester | Ea. | 12 | $ 1,740.00 | $ 20,880.00 | $ 580.00 | $ 6,960.00 | $ 27,840.00 |
| U10 | Spare Lightning Arrester | Ea. | 1 | $ 1,740.00 | $ 1,740.00 | $ - | $ - | $ 1,740.00 |
| U11 | Ground Continuity Conductor | L.F. | 18,460 | $ 10.03 | $ 185,072.58 | $ 9.65 | $ 178,161.15 | $ 363,233.73 |
| U12 | Link Box Without SVL's | Ea. | 13 | $ 4,176.00 | $ 54,288.00 | $ 8,120.00 | $ 105,560.00 | $ 159,848.00 |
| U13 | Link Box With SVL's | Ea. | 13 | $ 5,568.00 | $ 72,384.00 | $ 7,656.00 | $ 99,528.00 | $ 171,912.00 |
| U14 | Fiber Optic/Communications System | L.F. | 9,230 | $ 5.69 | $ 52,557.54 | $ 4.27 | $ 39,418.15 | $ 91,975.69 |
| U15 | Temperature Monitoring System | L.S. | 0 | $ - | $ - | $ - | $ - | $ - |
| U16 | Traffic Control | L.S. | 1 | $ - | $ - | $ - | $ - | $ - |
| U17 | Transition Station | Ea. | 2 | $ 3,500,000.00 | $ 7,000,000.00 | $ 1,000,000.00 | $ 2,000,000.00 | $ 9,000,000.00 |
| U18 | Reactive Compensation | Ea. | 1 | $ 4,000,000.00 | $ 4,000,000.00 | $ 1,000,000.00 | $ 1,000,000.00 | $ 5,000,000.00 |
| U19 | Admin / Mob / De-Mob by Contractor (Electrical) | L.S. | 1 | $ - | $ - | $ 234,036.35 | $ 234,036.35 | $ 234,036.35 |
| | | | | **SUBTOTAL** | **$ 18,646,318.12** | | **$ 4,991,353.26** | **$ 23,637,671.37** |
| | | | **CONTINGENCY** | 40.00% | **$ 7,458,527.25** | | **$ 1,996,541.30** | **$ 9,455,068.55** |
| | | | | **TOTAL** | **$ 26,104,845.36** | | **$ 6,987,894.56** | **$ 33,092,739.92** |

POWER CABLE DUCT SIZE: 8
NUMBER OF POWER CABLE DUCTS: 12
NUMBER OF OTHER DUCTS: 4
TYPICAL DUCT BANK DIMENSIONS: 105 in Wide X 33 in High

**CIVIL WORKS**

| ITEM NO. | ITEM | UNIT | QUANTITY | MATERIAL UNIT PRICE | MATERIAL COST | LABOR UNIT PRICE | LABOR COST | TOTAL COST |
|---|---|---|---|---|---|---|---|---|
| C01 | Trench Excavation | L.F. | 4,532 | $ 27.16 | $ 123,092.83 | $ 139.94 | $ 634,208.08 | $ 757,300.91 |
| C02 | Rock Excavation (Trench) | L.F. | 4,532 | $ - | $ - | $ - | $ - | $ - |
| C03 | Duct Bank | L.F. | 4,532 | $ 213.96 | $ 969,666.72 | $ 345.36 | $ 1,565,171.52 | $ 2,534,838.24 |
| C04 | Fluidized Thermal Backfill (FTB) | L.F. | 4,532 | $ - | $ - | $ - | $ - | $ - |
| C05 | Native Soil Backfill | L.F. | 4,532 | $ - | $ - | $ 64.57 | $ 292,631.24 | $ 292,631.24 |
| C06 | Pavement Restoration | L.F. | 0 | $ - | $ - | $ - | $ - | $ - |
| C07 | Steel Plating | L.F. | 0 | $ - | $ - | $ - | $ - | $ - |
| C08 | Traffic Signal Loop Detector Repair | Ea. | 0 | $ - | $ - | $ - | $ - | $ - |
| C09 | Splice Vaults | Ea. | 18 | $ 37,882.91 | $ 681,892.38 | $ - | $ - | $ 681,892.38 |
| C10 | Splice Vault Excavation | Ea. | 18 | $ 14,223.09 | $ 256,015.62 | $ 33,022.14 | $ 594,398.52 | $ 850,414.14 |
| C11 | Rock Excavation (Vault) | Ea. | 18 | $ - | $ - | $ - | $ - | $ - |
| C12 | Grounding System (civil) | L.S. | 1 | $ 106,437.89 | $ 106,437.89 | $ 106,437.89 | $ 106,437.89 | $ 212,875.78 |
| C13 | Communication Handholes | Ea. | 6 | $ 4,380.16 | $ 26,280.96 | $ 6,570.24 | $ 39,421.44 | $ 65,702.40 |
| C14 | Conduit Proofing (Civil) | L.S. | 1 | $ 55,190.01 | $ 55,190.01 | $ 386,330.12 | $ 386,330.12 | $ 441,520.13 |
| C15 | Substation Termination Structures | Ea. | 3 | $ 10,619.08 | $ 31,857.24 | $ 12,277.74 | $ 36,833.22 | $ 68,690.46 |
| C16 | OH to UG Termination Structures | Ea. | 0 | $ - | $ - | $ - | $ - | $ - |
| C17 | Clearing and Grubbing | L.F. | 3,290 | $ 14.53 | $ 47,803.70 | $ 17.05 | $ 56,094.50 | $ 103,898.20 |
| C18 | Loam and Seed | S.F. | 164,500 | $ 0.28 | $ 46,060.00 | $ 0.28 | $ 46,060.00 | $ 92,120.00 |
| C19 | Horizontal Directional Drill | L.F. | 4,200 | $ 2,310.18 | $ 9,702,756.00 | $ 1,905.10 | $ 8,001,420.00 | $ 17,704,176.00 |
| C20 | Jack & Bore | L.F. | 0 | $ - | $ - | $ - | $ - | $ - |
| C21 | Traffic Control, Flagger & Police (Civil) | L.S. | 0 | $ - | $ - | $ - | $ - | $ - |
| C22 | Construction Staking | L.F. | 8,900 | $ - | $ - | $ 1.63 | $ 14,507.00 | $ 14,507.00 |
| C23 | Contaminated Material Testing | L.F. | 8,900 | $ 2.19 | $ 19,491.00 | $ 19.72 | $ 175,508.00 | $ 194,999.00 |
| C24 | Contaminated Material Disposal | L.S. | 0 | $ - | $ - | $ - | $ - | $ - |
| C25 | Utility Relocation (known and unknown) | L.S. | 0 | $ - | $ - | $ - | $ - | $ - |
| C26 | Dewatering | L.S. | 1 | $ 501,875.64 | $ 501,875.64 | $ 926,488.43 | $ 926,488.43 | $ 1,428,364.07 |
| C27 | Other (Provide a Description) | Ea. | 0 | $ - | $ - | $ - | $ - | $ - |
| C28 | Other (Provide a Description) | Ea. | 0 | $ - | $ - | $ - | $ - | $ - |
| C29 | Admin/Mob/De-Mob by Contractor (Civil) | L.S. | 1 | $ - | $ - | $ 254,439.30 | $ 254,439.30 | $ 254,439.30 |
| | | | | **SUBTOTAL** | **$ 12,568,419.99** | | **$ 13,129,949.26** | **$ 25,698,369.25** |
| | | | **CONTINGENCY** | **40.00%** | **$ 5,027,367.99** | | **$ 5,251,979.70** | **$ 10,279,347.70** |
| | | | | **TOTAL** | **$ 17,595,787.98** | | **$ 18,381,928.97** | **$ 35,977,716.95** |

| SUMMARY OF COSTS | UNIT | MATERIAL COST | LABOR COST | TOTAL COST |
|---|---|---|---|---|
| UNDERGROUND CABLE SYSTEM & ACCESSORIES | LOT | $ 26,200,000.00 | $ 7,000,000.00 | $ 33,200,000.00 |
| CIVIL WORKS | LOT | $ 17,600,000.00 | $ 18,400,000.00 | $ 36,000,000.00 |
| ENGINEERING | LOT | $ - | $ 2,000,000.00 | $ 2,000,000.00 |
| **PROJECT TOTAL** | **LOT** | **$ 43,800,000.00** | **$ 27,400,000.00** | **$ 71,200,000.00** |
| **PROJECT TOTAL** | **COST / MILE** | **$ 25,984,719.10** | **$ 16,255,280.90** | **$ 42,240,000.00** |

Note: The individual unit rates provide a preliminary estimate of the associated costs prior to design. The unit rates may vary in construction bids and during construction due to placement of the contractors profit and contingency. The unit rates have been increased in an effort to anticipate unforeseen conditions and unknown market fluctuations. Although the unit rates may vary, the overall cost per mile is within the industry standard level of accuracy.

PROJECTED ESTMIATE OF PROJECT COST

| | | | | | | |
|---|---|---|---|---|---|---|
| CLIENT NAME: | ITC | VOLTAGE CLASS: | 345 kV | | | |
| PROJECT NAME: | Stoneman Route | CABLE SIZE/TYPE: | 3000 kcmil XLPE | | | |
| ROUTE LENGTH (ft): | 8,900 | NUMBER OF CIRCUITS: | 1 | PREPARED BY | N. Rochel | 10/10/2014 |
| ROUTE LENGTH (mile): | 1.69 | NUMBER OF CABLES PER PHASE: | 2 | CHECKED BY | N. Scott | 10/10/2014 |

| | | | |
|---|---|---|---|
| POWER CABLE DUCT SIZE: | 8 | NUMBER OF OTHER DUCTS: | 4 |
| NUMBER OF POWER CABLE DUCTS: | 12 | TYPICAL DUCT BANK DIMENSIONS: | 105 in Wide X 33 in High |

**MAJOR ASSUMPTIONS**

1) Unit Costs Based Upon 3% Escalation, Per Year from 2015 to 2020 for a Total of 16% Escalation
2) Contaminated Material Disposal based upon 0% of Total Civil Cost
3) Utility Relocations based upon 0% of Total Civil Cost
4) Traffic Control based upon assumed 0% of Route Length
5) Unit Costs based upon CCI (Combined) = 0.944
6) Unit Costs based upon Tax = 0%
7) Civil Costs based upon an average trenching excavation of 100 feet per day
8) Civil Costs based upon an average duct bank depth of cover of 3.9 feet
9) Civil Costs based upon an assumed Horizontal Directional Drill Length of 4200 feet
10) Civil Costs based upon an assumed Jack and Bore Length of 0 feet
11) Rock Removal based upon 0% of Civil Excavation Length

# APPENDIX E - MVP TRIENNIAL REVIEW

# MTEP14 MVP
# Triennial Review

***A 2014 review of the public policy, economic, and qualitative benefits of the Multi-Value Project Portfolio***

**September 2014**

# Contents

# Executive Summary

The MTEP14 Triennial Multi-Value Project (MVP) Review provides an updated view into the projected economic, public policy, and qualitative benefits of the MVP Portfolio. The MTEP14 MVP Triennial Review's business case is on par with, if not stronger than MTEP11, providing evidence that the MVP criteria and methodology works as expected. Analysis shows that projected MISO North and Central Region benefits provided by the MVP Portfolio have increased since MTEP11, the analysis from which the Portfolio's business case was approved.

Analysis shows that projected benefits provided by the MVP Portfolio have increased since MTEP11

The MTEP14 results demonstrate the MVP Portfolio:

- Provides benefits in excess of its costs, with its benefit-to-cost ratio ranging from 2.6 to 3.9; an increase from the 1.8 to 3.0 range calculated in MTEP11
- Creates \$13.1 to \$49.6 billion in net benefits over the next 20 to 40 years, an increase of approximately 50 percent from MTEP11
- Enables 43 million MWh of wind energy to meet renewable energy mandates and goals through year 2028, an additional 2 million MWh from the MTEP11 year 2026 forecast
- Provides additional benefits to each local resource zone relative to MTEP11

Benefit increases are primarily congestion and fuel savings largely driven by natural gas price assumptions.

The fundamental goal of the MISO's planning process is to develop a comprehensive expansion plan that meets the reliability, policy, and economic needs of the system. Implementation of a value-based planning process creates a consolidated transmission plan that delivers regional value while meeting near-term system needs. Regional transmission solutions, or Multi Value Projects (MVPs), meet one or more of three goals:

- Reliably and economically enable regional public policy needs
- Provide multiple types of regional economic value
- Provide a combination of regional reliability and economic value

MISO conducted its first triennial MVP Portfolio review, per tariff requirement, for MTEP14. The MVP Review has no impact on the existing MVP Portfolio cost allocation. MTEP14 Review analysis is performed solely for informational purposes. The intent of the MVP Review is to use the review process and results to identify potential modifications to the MVP methodology and its implementation for projects to be approved at a future date.

The Triennial MVP Review has no impact on the existing MVP Portfolio cost allocation. The intent of the MVP Review is to identify potential modifications to the MVP methodology for projects to be approved at a future date.

The MVP Review uses stakeholder-vetted MTEP14 models and makes every effort to follow procedures and assumptions consistent with the MTEP11 analysis. Metrics that required any changes to the benefit valuation due to changing tariffs, procedures or conditions are highlighted. Consistent with MTEP11, the MTEP14 MVP Review assesses the benefits of the entire MVP Portfolio and does not differentiate between facilities currently in-service and those still being planned. Because the MVP Portfolio's costs are allocated solely to the MISO North and Central Regions, only MISO North and Central Region benefits are included in the MTEP14 MVP Triennial Review.

## Public Policy Benefits

The MTEP14 MVP Review reconfirms the MVP Portfolio's ability to deliver wind generation, in a cost-effective manner, in support of MISO States' renewable energy mandates. Renewable Portfolio Standards assumptions[1] have not changed since the MTEP11 analysis.

Updated analyses find that 10.5 GW of year 2023 dispatched wind would be curtailed in lieu of the MVP Portfolio, which extrapolates to 56 percent of the 2028 full RPS energy. MTEP11 analysis showed that 63 percent of the year 2026 full RPS energy would be curtailed without the installation of the MVP Portfolio. The MTEP14 calculated reduction in curtailment as a percentage of RPS has decreased since MTEP11, primarily because post-MTEP11 transmission upgrades are represented and the actual physical location of installed wind turbines has changed slightly since the 2011 forecast.

In addition to allowing energy to not be curtailed, analyses determined that 4.3 GW of wind generation in excess of the 2028 requirements is enabled by the MVP Portfolio. MTEP11 analysis determined that 2.2 GW of additional year 2026 generation could be sourced from the incremental energy zones. The results are the essentially the same for both analyses as the increase in wind enabled from MTEP 2011 is primarily attributed to additional load growth. The MTEP 2011 analysis was performed on a year 2026 model and MTEP 2014 on year 2028.

When the results from the curtailment analyses and the wind enabled analyses are combined, MTEP 2014 results show the MVP Portfolio enables a total of 43 million MWh of renewable energy to meet the renewable energy mandates through 2028. MTEP 2011 showed the MVP Portfolio enabled a similar level renewable energy mandates – 41 million MWh through 2026.

[1] Assumptions include Renewable Portflio Standard levels and fulfillment methods

## Economic Benefits

MTEP14 analysis shows the Multi-Value Portfolio creates $21.5 to $66.8 billion in total benefits to MISO North and Central Region members (Figure E-1). Total portfolio costs have increased from $5.56 billion in MTEP11 to $5.86 billion in MTEP14. Even with the increased portfolio cost estimates, the increased MTEP14 congestion and fuel savings and transmission line losses benefit forecasts result in portfolio benefit-to-cost ratios that have increased since MTEP11.

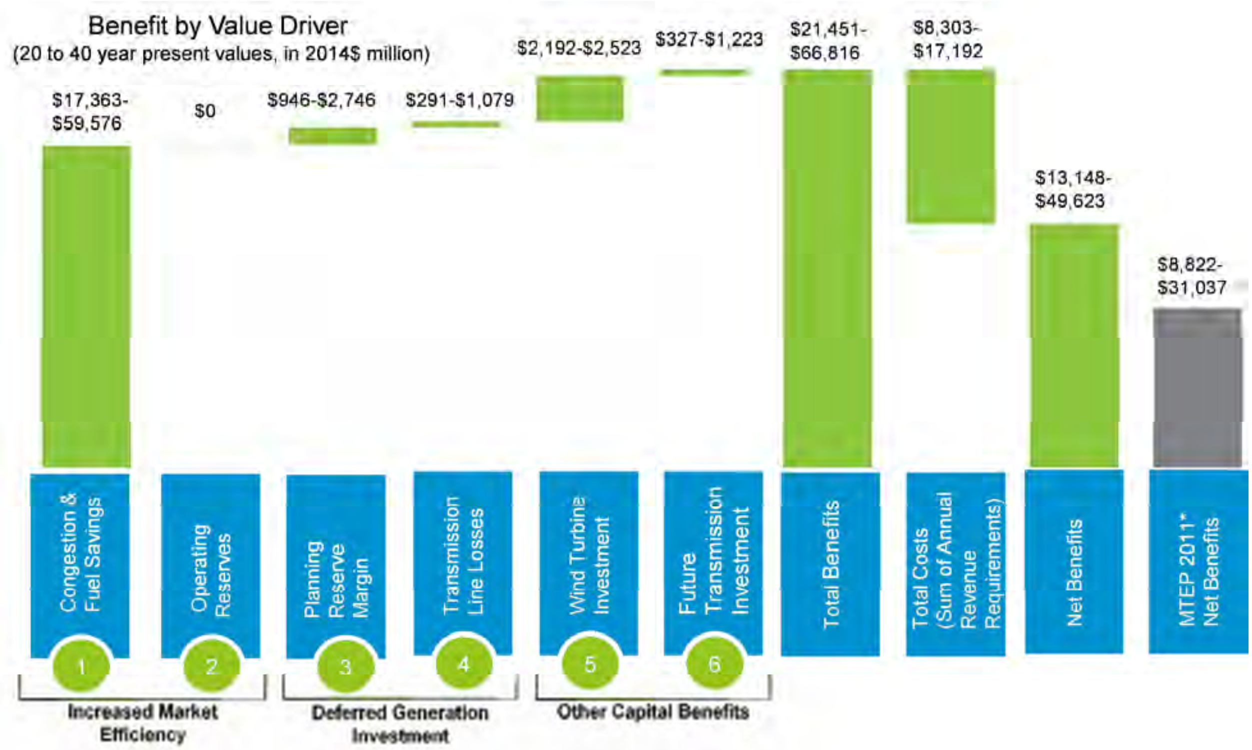



**Figure E-1: MVP Portfolio Economic Benefits from MTEP14 MVP Triennial Review**

The bulk of the increase in benefits is due to an increase in the assumed natural gas price forecast in MTEP14 compared to MTEP11. In addition, the MTEP15 natural gas assumptions, which will be used in the MTEP15 MVP Portfolio Limited Review, are lower than the MTEP14 forecast. Under each of the natural gas price assumption sensitivities, the MVP Portfolio is projected to provide economic benefits in excess of costs (Table E-1).

| Natural Gas Forecast Assumption | Total NPV Portfolio Benefits ($M-2014) | Total Portfolio Benefit to Cost Ratio |
|---|---|---|
| MTEP14 – MVP Triennial Review | 21,451 – 66,816 | 2.6 – 3.9 |
| MTEP11 | 17,875 – 54,186 | 2.2 – 3.2 |
| MTEP15 | 18,472 – 56,670 | 2.2 – 3.3 |

**Table E-1: MVP Portfolio Economic Benefits - Natural Gas Price Sensitivities[2]**

## Increased Market Efficiency

The MVP Portfolio allows for a more efficient dispatch of generation resources, opening markets to competition and spreading the benefits of low-cost generation throughout the MISO footprint. The MVP Review estimates that the MVP Portfolio will yield $17 to $60 billion in 20- to 40-year present value adjusted production cost benefits to MISO's North and Central Regions – an increase of up to 40 percent from the MTEP11 net present value.

An increase in the natural gas price escalation rate, increases congestion and fuel savings benefits by approximately 30 percent in MTEP14 compared to MTEP11

The increase in congestion and fuel savings benefits relative to MTEP11 is primarily due to an increase in the out-year natural gas price forecast assumptions (Figures E-2). The increased escalation rate causes the assumed natural gas price to be higher in MTEP14 compared to MTEP11 in years 2023 and 2028 - the two years from which the congestion and fuel savings results are based (Figure E-2).

The MVP Portfolio allows access to wind units with a nearly $0/MWh production cost and primarily replaces natural gas units in the dispatch, which makes the MVP Portfolio's fuel savings benefit projection directly related to the natural gas price assumption. A sensitivity applying the MTEP11 Low BAU gas prices assumption to the MTEP14 MVP Triennial Review model showed a 29.3 percent reduction in the annual year 2028 MTEP14 congestion and fuel savings benefits (Figure E-2).

Post MTEP14 natural gas price forecast assumptions are more closely aligned with those of MTEP11 (Figure E-2). A sensitivity applying the MTEP15 BAU natural gas prices to the MTEP14 analysis showed a 21.7 percent reduction in year 2028 MTEP14 adjusted production cost savings.

[2] Sensitivity performed applying MTEP11/MTEP15 natural gas price to the MTEP14 congestion and fuel savings model. All other benefit valuations unchanged from the MTEP14 MVP Triennial Review.

MISO membership changes have little net effect on benefit-to-cost ratios. The exclusion of Duke Ohio/Kentucky and First Energy from the MISO pool decreases benefits by 7.4 percent relative to the MTEP14 total benefits; however, per Schedule 39, 6.3 percent of the total portfolio costs are allocated to Duke Ohio/Kentucky and First Energy, thus there is a minimal net effect to the benefit-to-cost ratio.

The MVP Portfolio is solely located in the MISO North and Central Regions and therefore, the inclusion of the MISO South Region to the MISO dispatch pool has little effect on MVP-related production cost savings (Figure E-2).

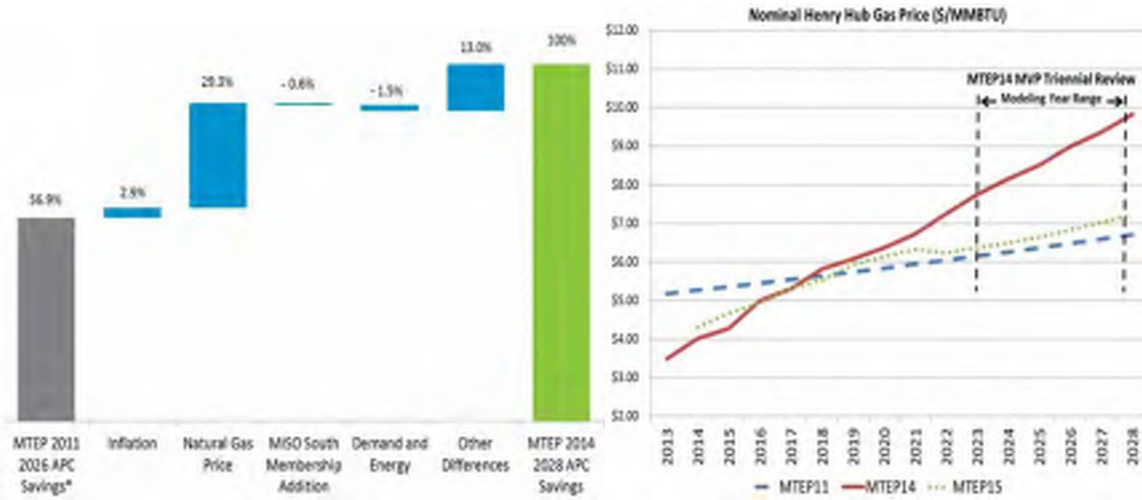



**Figure E-2: Breakdown of Congestion and Fuel Savings Increase from MTEP11 to MTEP14**

In addition to the energy benefits quantified in the production cost analyses, the 2011 business case showed the MVP Portfolio also reduces operating reserve costs. The MVP Review does not estimate a reduced operating reserve benefit in 2014, as a conservative measure, because of the decreased number of days a reserve requirement was calculated since the MTEP11 analysis.

## Deferred Generation Investment

The addition of the MVP Portfolio to the transmission network reduces overall system losses, which also reduces the generation needed to serve the combined load and transmission line losses. Using current capital costs, the deferment from loss reduction equates to a MISO North and Central Regions' savings of $291 to $1,079 million - nearly double the MTEP11 values. Tightening reserve margins, from an additional approximate 12 GW of expected coal generation retirements, have increased the value of deferred capacity from transmission losses in MTEP14. In addition to the tighter reserve margins, a one year shift forward in MVP Portfolio in-service dates since MTEP11 has increased benefits by an additional 30 percent.

The MTEP14 MVP Review estimates the MVPs annually defer more than $900 million in future capacity expansion by increasing capacity import limits, thus reducing the local clearing requirements of the system planning reserve margin requirement. In the 2013 planning year, MISO and the Loss of Load Expectation Working Group improved the methodology that establishes the MISO Planning Reserve Margin Requirement (PRMR). Previously, and in the MTEP11 analysis, MISO developed a MISO-wide

PRMR with an embedded congestion component. The post 2013 planning year methodology no longer uses a congestion component, but rather calculates a more granular zonal PRMR and a local clearing requirement based on the zonal capacity import limit. While terminology and methods have changed between MTEP11 and MTEP14, both calculations capture the same benefit of increased capacity sharing across the MISO region provided by the MVPs; as such, MTEP14 and MTEP11 provide benefit estimates of similar magnitudes.

## Other Capital Benefits

Benefits from the optimization of wind generation siting and the elimination of need for some future baseline reliability upgrades remain at similar levels to those estimated in MTEP11. A slight increase in MTEP14 wind turbine investment benefits relative to MTEP11 benefits is from an update to the wind requirement forecast and wind enabled calculations.

Consistent with MTEP11, the MTEP14 MVP Triennial Review shows that the MVP Portfolio eliminates the need for $300 million in future baseline reliability upgrades. The magnitude of estimated benefits is in close proximity to the estimate from MTEP11; however, the actual identified upgrades have some differences because of load growth, generation dispatch, wind levels and transmission upgrades.

## Distribution of Economic Benefits

The MVP Portfolio provides benefits across the MISO footprint in a manner that is roughly equivalent to costs allocated to each local resource zone (Figure E-3). The MVP Portfolio's benefits are at least 2.3 to 2.8 times the cost allocated to each zone. As a result of changing tariffs/business practices (planning reserve margin requirement and baseline reliability project cost allocation), load growth, and wind siting, zonal benefit distributions have changed slightly since MTEP11.

> Benefit-to-cost ratios have increased in all zones since MTEP11

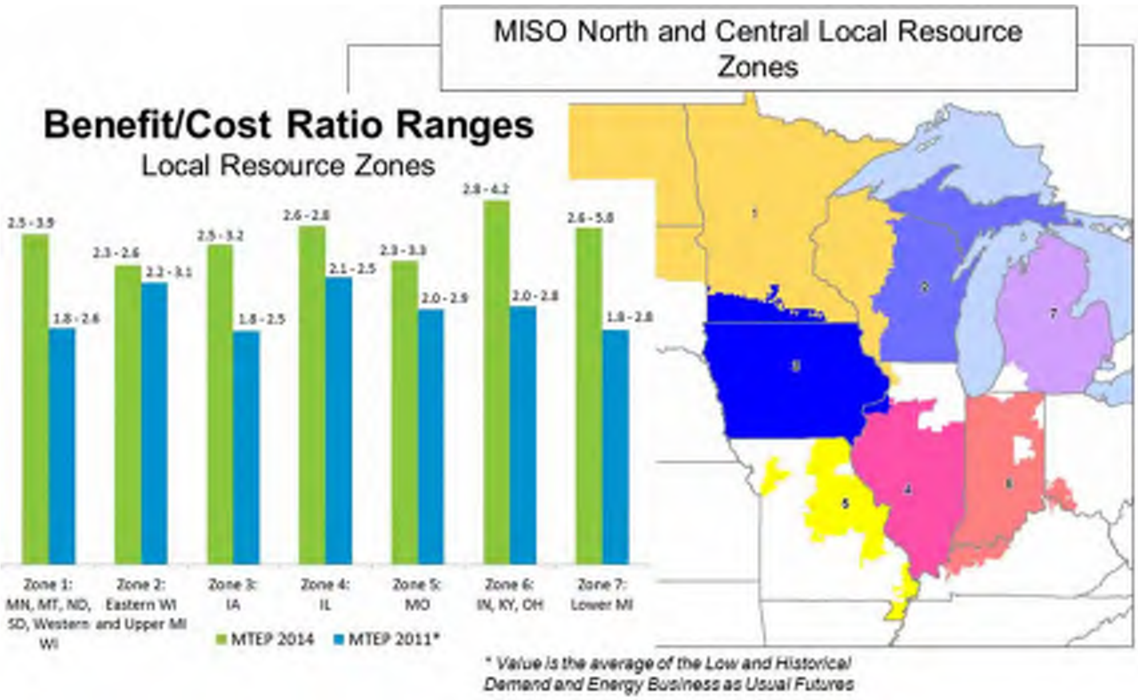



**Figure E-3: MVP Portfolio Total Benefit Distribution**

## Qualitative and Social Benefits

Aside from widespread economic and public policy benefits, the MVP Portfolio also provides benefits based on qualitative or social values. The MVP Portfolio:

- Enhances generation flexibility
- Creates a more robust regional transmission system that decreases the likelihood of future blackouts
- Increases the geographic diversity of wind resources that can be delivered, increasing the average wind output available at any given time
- Supports the creation of thousands of local jobs and billions in local investment
- Reduces carbon emissions by 9 to 15 million tons annually

These benefits suggest quantified values from the economic analysis may be conservative because they do not account for the full potential benefits of the MVP Portfolio.

## Going Forward

MTEP15 and MTEP16 will feature a Limited Review of the MVP Portfolio benefits. Each Limited Review will provide an updated assessment of the congestion and fuel savings using the latest portfolio costs and in-service dates. Beginning in MTEP17, in addition to the Full Triennial Review, MISO will perform an assessment of the congestion costs, energy prices, fuel costs, planning reserve margin requirements, resource interconnections and energy supply consumption based on historical data.

# 1. Study Purpose and Drivers

Beginning in MISO Transmission Expansion Plan (MTEP) 2014, MISO has a triennial tariff requirement to conduct a full review of the Multi-Value Project (MVP) Portfolio benefits. The MTEP14 Triennial MVP Review provides an updated view into the projected economic, public policy and qualitative benefits of the MTEP11 approved MVP Portfolio.

The MVP Triennial Review has no impact on the existing Multi-Value Project Portfolio cost allocation. The study is performed solely for information purposes.

The MVP Review has no impact on the existing MVP Portfolio cost allocation. Analysis is performed solely for information purposes. The intent of the MVP Reviews is to use the review process and results to identify potential modifications to the MVP methodology and its implementation for projects to be approved at a future date. The MVP Reviews are intended to verify if the MVP criteria and methodology is working as expected.

The MVP Review uses stakeholder vetted models and makes every effort to follow consistent procedures and assumptions as the Candidate MVP, also known as the MTEP11 analysis. Any metrics that required changes to the benefit valuation due to revised tariffs, procedures or conditions are highlighted throughout the report. Wherever practical, any differences between MTEP14 and MTEP11 assumptions are highlighted and the resulting differences quantified.

Consistent with MTEP11, the MTEP14 MVP Review assesses the benefits of the entire MVP Portfolio and does not differentiate between facilities currently in-service and those still being planned. The latest MVP cost estimates and in-service dates are used for all analyses.

# 2. Study Background

The MVP Portfolio (Figure 2-1 and Table 2-1) represents the culmination of more than eight years of planning efforts to find a cost-effective regional transmission solution that meets local energy and reliability needs.

In MTEP11, the MVP Portfolio was justified based its ability to:

- Provide benefits in excess of its costs under all scenarios studied, with its benefit-to-cost ratio ranging from 1.8 to 3.0.
- Maintain system reliability by resolving reliability violations on approximately 650 elements for more than 6,700 system conditions and mitigating 31 system instability conditions.
- Enable 41 million MWh of wind energy per year to meet renewable energy mandates and goals.
- Provide an average annual value of $1,279 million over the first 40 years of service, at an average annual revenue requirement of $624 million.
- Support a variety of generation policies by using a set of energy zones which support wind, natural gas and other fuel sources.

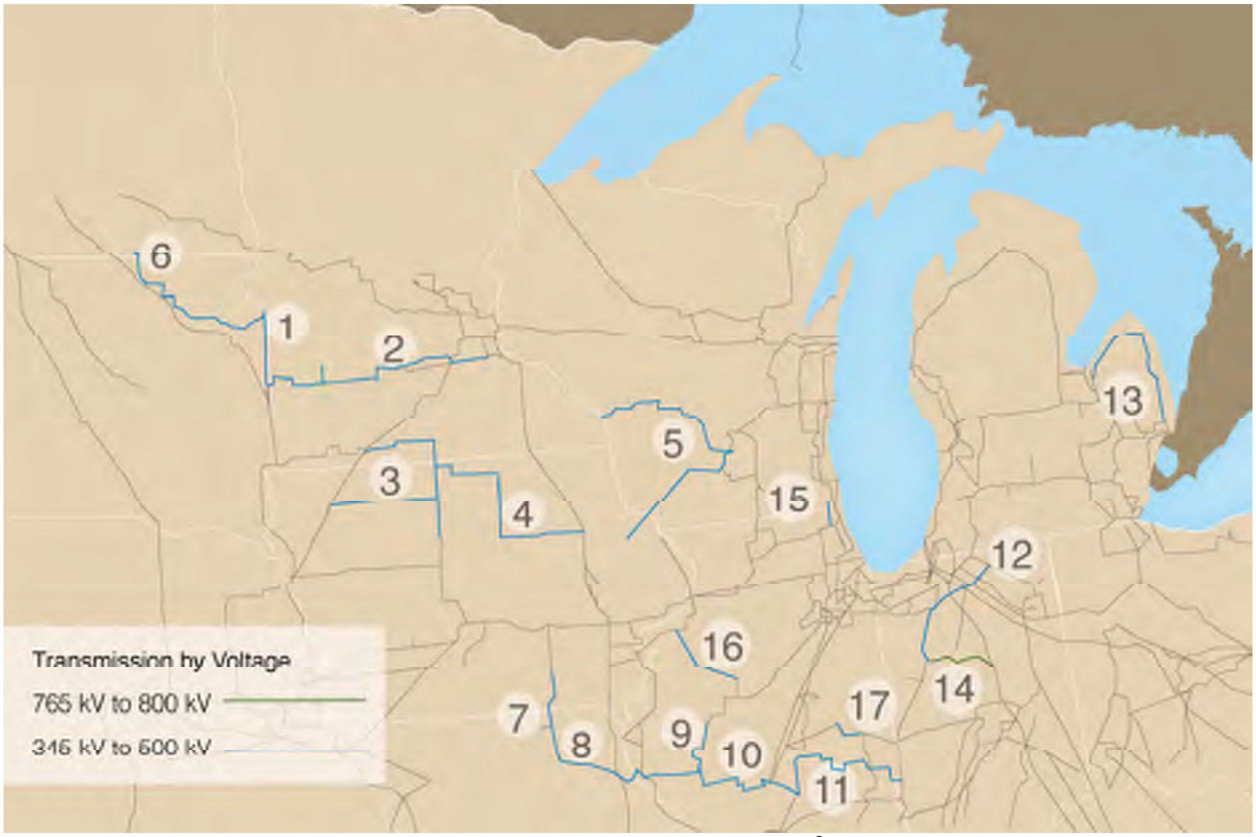



**Figure 2-1: MVP Portfolio[3]**

[3] Figure for illustrative purposes only. Final line routing may differ.

| ID | Project | State | Voltage (kV) |
|---|---|---|---|
| 1 | Big Stone–Brookings | SD | 345 |
| 2 | Brookings, SD–SE Twin Cities | MN/SD | 345 |
| 3 | Lakefield Jct.–Winnebago–Winco–Burt Area & Sheldon–Burt Area–Webster | MN/IA | 345 |
| 4 | Winco–Lime Creek–Emery–Black Hawk–Hazleton | IA | 345 |
| 5 | LaCrosse–N. Madison–Cardinal & Dubuque Co–Spring Green–Cardinal | WI | 345 |
| 6 | Ellendale–Big Stone | ND/SD | 345 |
| 7 | Adair–Ottumwa | IA/MO | 345 |
| 8 | Adair–Palmyra Tap | MO/IL | 345 |
| 9 | Palmyra Tap–Quincy–Merdosia–Ipava & Meredosia–Pawnee | IL | 345 |
| 10 | Pawnee–Pana | IL | 345 |
| 11 | Pana–Mt. Zion–Kansas–Sugar Creek | IL/IN | 345 |
| 12 | Reynolds–Burr Oak–Hiple | IN | 345 |
| 13 | Michigan Thumb Loop Expansion | MI | 345 |
| 14 | Reynolds–Greentown | IN | 765 |
| 15 | Pleasant Prairie–Zion Energy Center | WI/IL | 345 |
| 16 | Fargo-Galesburg–Oak Grove | IL | 345 |
| 17 | Sidney–Rising | IL | 345 |

**Table 2-1: MVP Portfolio**

In 2008, the adoption of Renewable Portfolio Standards (RPS) (Figure 2-2) across the MISO footprint drove the need for a more regional and robust transmission system to deliver renewable resources from often remote renewable energy generators to load centers.

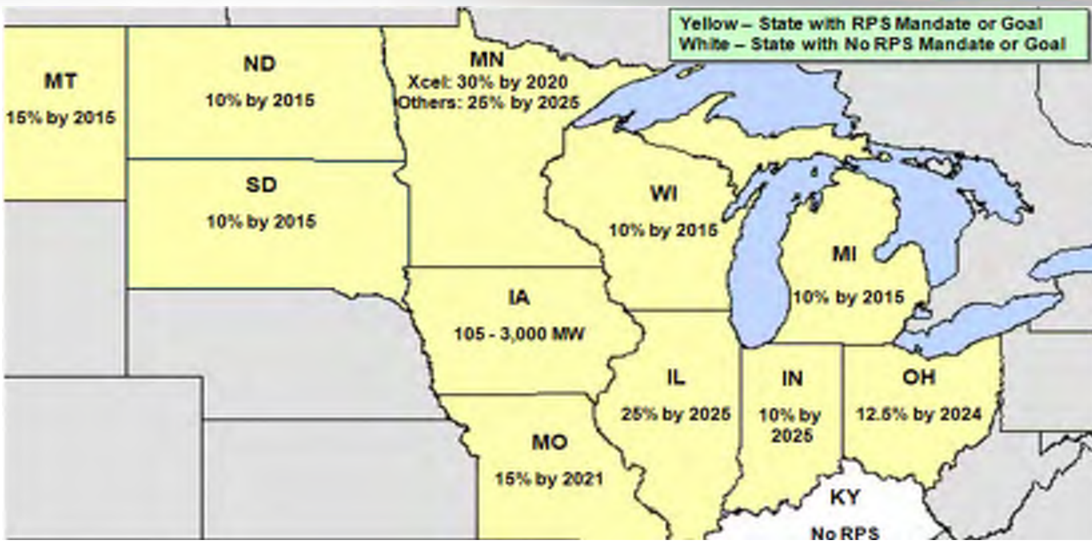



**Figure 2-2: Renewable Portfolio Standards - 2011**

Beginning with the MTEP 2003 Exploratory Studies, MISO and stakeholders began to explore how to best provide a value-added regional planning process to complement the local planning of MISO members. These explorations continued in later MTEP cycles and in specific targeted studies. In 2008, MISO, with the assistance of state regulators and industry stakeholders such as the Midwest Governor's Association (MGA), the Upper Midwest Transmission Development Initiative (UMTDI) and the Organization of MISO States (OMS), began the Regional Generation Outlet Study (RGOS) to identify a set of value-based transmission projects necessary to enable Load Serving Entities (LSEs) to meet their RPS mandates.

While much consideration was given to wind capacity factors when developing the energy zones utilized in the RGOS and MVP Portfolio analyses, the zones were chosen with consideration of more factors than wind capacity. Existing infrastructure, such as transmission and natural gas pipelines, also influenced the selection of the zones. As such, although the energy zones were created to serve the renewable generation mandates, they could be used for a variety of different generation types to serve various future generation policies.

Common elements between the RGOS results and previous reliability, economic and generation interconnection analyses were identified to create the 2011 candidate MVP portfolio. This portfolio represented a set of "no regrets" projects that were believed to provide multiple kinds of reliability and economic benefits under all alternate futures studied. Over the course of the MVP Portfolio analysis, the Candidate MVP Portfolio was refined into the portfolio that was approved by the MISO Board of Directors in MTEP11.

The MVP Portfolio enables the delivery of the renewable energy required by public policy mandates in a manner more reliable and economical than without the associated transmission upgrades. Specifically, the portfolio mitigates approximately 650 reliability constraints under 6,700 different transmission outage conditions for steady state and transient conditions under both peak and shoulder load scenarios. Some of these conditions could be severe enough to cause cascading outages on the system. By mitigating these constraints, approximately 41 million MWh per year of renewable generation can be delivered to serve the MISO state renewable portfolio mandates.

Under all future policy scenarios studied, the MVP Portfolio delivered widespread regional benefits to the transmission system. To use conservative projections relating only to the state renewable portfolio mandates, only the Business as Usual future was used in developing the candidate MVP business case.

The projected benefits are spread across the system, in a manner commensurate with costs (Figure 2-3).

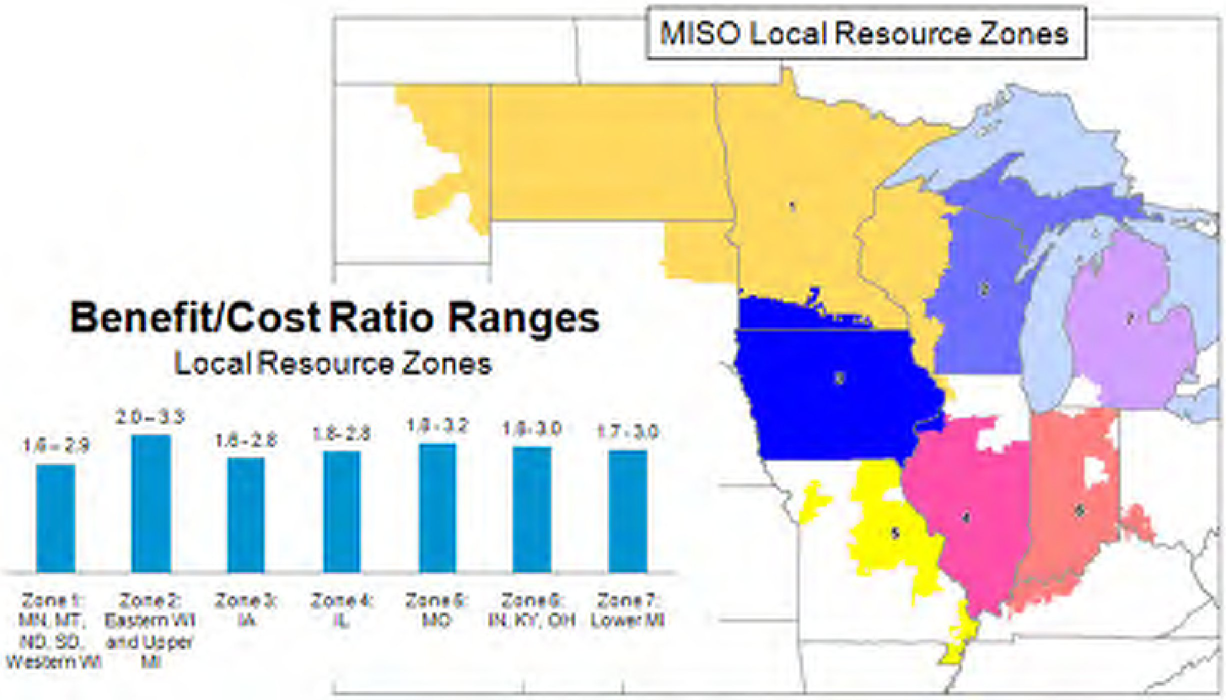



**Figure 2-3: MTEP11 MVP Portfolio Benefit Spread**

Taking into account the significant economic value created by the portfolio, the distribution of these value, and the ability of the portfolio to meet MVP criteria through its reliability and public policy benefits, the MVP Portfolio was approved by the MISO Board of Directors in MTEP11.

# 3. MTEP14 Review Model Development

The MTEP14 MVP Triennial Review uses MTEP14 economic models as the basis for the analysis. The MTEP14 economic models were developed in 2012 and 2013 with topology based on the MTEP13 series MISO powerflow models. To maintain consistency between economic and reliability models, MVP Triennial Review reliability analysis was performed with MTEP13 vintage powerflows.

MTEP14 economic models, developed in 2013, are the basis for the MTEP14 MVP Triennial Review.

The MTEP models were developed through an open stakeholder process and vetted through the MISO Planning Advisory Committee. The details of the economic and reliability models used in the MTEP14 MVP Triennial Review are described in the following sections. The MTEP models are publically available via the MISO FTP site with proper licenses and confidentiality agreements.

## 3.1 Economic Models

The MVP Benefit Review uses PROMOD IV as the primary tool to evaluate the economic benefits of the MVP Portfolio. The MTEP14 MISO North/Central economic models, stakeholder vetted in 2013, are used as the basis for the MTEP14 Review. The same economic models are used in the MTEP14 North/Central Market Congestion Planning Study, formerly known as the Market Efficiency Planning Study.

Consistent with the MTEP11 MVP business case[4], the MTEP14 Review relies solely on the Business as Usual (BAU) future.

The MTEP14 BAU future is most representative of the average of the MTEP11 Low and High BAU futures

The MTEP14 BAU future is defined as: A *status quo environment that assumes a slow recovery from the economic downturn and its impact on demand and energy projections. This scenario assumes existing standards for renewable mandates and little or no change in environmental legislation.*

MTEP11 had two definitions of the BAU future – a typical MTEP Planning Advisory Committee defined future and a slightly modified version from the Cost Allocation and Regional Planning (CARP) process. For the purposes of this report the two MTEP11 BAU futures are identified by their load growth rates – one with a slightly higher baseline growth rate and one with a slightly lower growth rate (Table 3-1). Based on current definitions, the MTEP14 BAU future's demand and energy growth rate is closest to the MTEP11 BAU-Low Demand and Energy, but the natural gas price is closest to the MTEP11 BAU-High Demand and Energy (Table 3-1). The MTEP14 BAU future is most representative of the average of the MTEP11 Low and High BAU futures; as such, all MTEP14 Triennial MVP Review results in this report will be compared to the arithmetic mean of the MTEP11 Low BAU and High BAU results.

[4] The Candidate MVP Analysis provided results for information purposes under all MTEP11 future scenarios; however, the business case only used the Business as Usual futures.

| | | MTEP14 BAU | MTEP11 Low BAU | MTEP11 High BAU |
|---|---|---|---|---|
| **Demand and Energy** | **Demand Growth Rate** | 1.06 percent | 1.26 percent | 1.86 percent |
| | **Energy Growth Rate** | 1.06 percent | 1.26 percent | 1.86 percent |
| **Natural Gas Forecast**[5] | **Starting Point** | 3.48 $/MMBTU | 5 $/MMBTU | 5 $/MMBTU |
| | **2018 Price** | 5.81 $/MMBTU | 5.64 $/MMBTU | 6.11 $/MMBTU |
| | **2023 Price** | 7.76 $/MMBTU | 6.15 $/MMBTU | 7.05 $/MMBTU |
| | **2028 Price** | 9.83 $/MMBTU | 6.70 $/MMBTU | 8.14 $/MMBTU |
| **Fuel Cost (Starting Price)** | **Oil** | Powerbase Default | Powerbase Default | Powerbase Default |
| | **Coal** | Powerbase Default | Powerbase Default | Powerbase Default |
| | **Uranium** | 1.14 $/MMBTU | 1.12 $/MMBTU | 1.12 $/MMBTU |
| **Fuel Escalations** | **Oil** | 2.50 percent | 1.74 percent | 2.91 percent |
| | **Coal** | 2.50 percent | 1.74 percent | 2.91 percent |
| | **Uranium** | 2.50 percent | 1.74 percent | 2.91 percent |
| **Emission Costs** | **SO2** | 0 | 0 | 0 |
| | **NOx** | 0 | 0 | 0 |
| | **CO2** | 0 | 0 | 0 |
| **Other Variables** | **Inflation** | 2.50 percent | 1.74 percent | 2.91 percent |
| | **Retirements** | Known + EPA Driven Forecast MISO ~12,600 MW | Known Retirements MISO ~400 MW | Known Retirements MISO ~400 MW |
| | **Renewable Levels** | State Mandates | State Mandates | State Mandates |
| **MISO Footprint** | | Duke and FE in PJM; includes MISO South | MTEP11 | MTEP11 |

**Table 3-1: MTEP14 and MTEP11 Key PROMOD Model Assumptions**

Models include all publically announced retirements as well as 12,600 MW of baseline generation retirements driven by environmental regulations. Unit-specific retirements are based on a MISO Planning Advisory Committee vetted generic process as the results of the MISO Asset Owner EPA Survey are confidential.

MISO footprint changes since the MTEP11 analysis are modeled verbatim to current[6] configurations, i.e. Duke Ohio/Kentucky and First Energy are modeled as part of PJM and the MISO pool includes the MISO South Region. While the MISO pool includes the South Region, only the MISO North and Central Region benefits are being included in the MTEP14 MVP Triennial Review's business case.

[5] MTEP11 and MTEP13 use different natural gas escalation methodologies
[6] As of July 2014

MTEP13 powerflow models for the year 2023 are used as the base transmission topology for the MVP Triennial Review. Because there are no significant transmission topology changes known between years 2023 and 2028, the 2028 production cost models use the same transmission topology as 2023.

PROMOD uses an “event file” to provide pre- and post-contingent ratings for monitored transmission lines. The latest MISO Book of Flowgates and the NERC Book of Flowgates are used to create the event file of transmission constraints in the hourly security constrained model. Ratings and configurations are updated for out-year models by taking into account all approved MTEP Appendix A projects.

## 3.2 Capacity Expansion Models

The MTEP14 Triennial Review decreased transmission line losses benefit (Section 6.4) is monetized using the Electricity Generation Expansion Analysis System (EGEAS) model. EGEAS is designed by the Electric Power Research Institute to find the least-cost integrated resource supply plan given a demand level. EGEAS expansions include traditional supply-side resources, demand response, and storage resources. The EGEAS model is used annually in MISO’s MTEP process to identify future capacity needs beyond the typical five-year project-planning horizon.

The EGEAS optimization process is based on a dynamic programming method where all possible resource addition combinations that meet user-specified constraints are enumerated and evaluated. The EGEAS objective function minimizes the present value of revenue requirements. The revenue requirements include both carrying charges for capital investment and system operating costs.

MTEP14 Triennial MVP Review analysis was performed using the MTEP14 BAU future, developed in 2012 and 2013. The capacity model shares the same input database and assumptions as the economic models (Section 3.1).

## 3.3 Reliability Models

To maintain consistency between economic and reliability models, MTEP13 vintage MISO powerflow models are used as the basis for the MTEP14 MVP Triennial Review reliability analysis. The MTEP14 economic models are developed with topology based on the MTEP13 MISO powerflow models. Siemens PTI Power System Simulator for Engineering (PSS E) and Power System Simulator for Managing and Utilizing System Transmission (PSS MUST) is utilized for the MTEP14 MVP Triennial Review.

Powerflow models are built using MISO's Model on Demand (MOD) model data repository. Models include approved MTEP Appendix A projects and the Eastern Interconnection Reliability Assessment Group (ERAG) Multiregional Modeling Working Group (MMWG) modeling for the external system. Load and generation profiles are seasonal dependent (Table 3-2). MTEP powerflow models have wind dispatched at 90 percent connected capacity in Shoulder models and 20 percent in the Summer Peak.

Additional wind units were added to the MTEP14 MVP Triennial Review cases to meet renewable portfolio standards.

Demand is grown in the Future Transmission Investment case using the extrapolated growth rate between the year 2018 MTEP13 Summer Peak case and the 2023 MTEP13 Summer Peak Case.

| Analysis | Model(s) |
|---|---|
| Wind Curtailment | 2023 MTEP13 Shoulder |
| Wind Enabled | 2023 MTEP13 Shoulder with Wind at 2028 Levels |
| Transmission Line Losses | 2023 MTEP13 Summer Peak |
| Future Transmission Investment | 2023 MTEP13 Summer Peak with Demand and Wind at 2033 Levels |

**Table 3-2: Reliability Models by Analysis**

## 3.4 Capacity Import Limit Models

The MTEP13 series of MISO powerflow models updated for the 2014 Loss of Load Expectations (LOLE) study are used as the basis for the MTEP14 MVP Triennial Review capacity import limit analysis. Siemens Power Technology International Power System Simulator for Engineering (PSS E) and Power System Simulator for Managing and Utilizing System Transmission (PSS MUST) were utilized for the LOLE analyses, which produced results used in the MTEP14 MVP Triennial Review analysis.

Wind modeling and dispatch assumptions for LOLE studies were updated since completion of the 2014 LOLE analysis. These changes were applied to the MVP Triennial Review models so the Triennial analysis is using the up-to-date LOLE study methodology. Consistent with the current LOLE methodology, MISO wind dispatch was set at the wind capacity credit level. Applicable updates to generation retirements or suspensions were applied to the MTEP14 Triennial Review Models.

Zonal Local Clearing Requirements are calculated using the capacity import limits that are identified using PSS MUST transfer analysis. The MTEP14 MVP Triennial Review incorporates capacity import limits calculated using a year 2023 model both with and without the MVP Portfolio.

PSS MUST contingency files from Coordinated Seasonal Assessment (CSA) and MTEP[7] reliability assessment studies were used in the MTEP14 MVP Review (Table 3-3). Single-element contingencies in MISO and seam areas were evaluated in addition to submitted files.

| Model | Contingency files used |
|---|---|
| 2014-15 Planning Year | 2013 Summer CSA |
| 5-year-out peak | MTEP13 study |

**Table 3-3: Contingency files per model**

PSS MUST subsystem files include source and sink definitions. The PSS MUST monitored file includes all facilities under MISO functional control and seam facilities 100 kV and above.

Additional details on the models used in the Planning Reserve Margin benefit estimation can be found in the 2014 Loss of Load Expectation Report.

## 3.5 Loss of Load Expectation Models

MISO utilizes the General Electric-developed Multi-Area Reliability Simulation (MARS) program to calculate the loss of load expectation for the applicable planning year. GE MARS uses a sequential Monte Carlo simulation to model a generation system and assess the system's reliability based on any number of interconnected areas. GE MARS calculates the annual LOLE for the MISO system and each Local Resource Zone (LRZ) by stepping through the year chronologically and taking into account generation, load, load modifying and energy efficiency resources, equipment forced outages, planned and maintenance outages, load forecast uncertainty and external support.

The 2014 planning year LOLE models, updated to include generation retirements, were the basis for the MTEP14 MVP Triennial Review models. Additional model details can be found in the 2014 Loss of Load Expectation Report.

[7] Refer to sections 4.3.4 and 4.3.6 of the Transmission Planning BPM for more information regarding MTEP PSS MUST input files. https://www.misoenergy.org/_layouts/MISO/ECM/Redirect.aspx?ID=19215

# 4. Project Costs and In-Service Dates

The MTEP14 MVP Triennial Review cost and in-service data is referenced from the MTEP Quarter One 2014 Report – dated April 11, 2014 (Figure 4-1).

| MVP No. | Project Name | State | Estimated In Service Date[1] | | Status | | Cost[1] | |
|---|---|---|---|---|---|---|---|---|
| | | | MTEP Approved | Q1 2014 | State Regulatory Status | Construction | MTEP Approved | Q1 2014 |
| 1 | Big Stone-Brookings | SD | 2017 | 2017 | ● | Pending | 226.7 | 226.7 |
| 2 | Brookings, SD-SE Twin Cities | MN/SD | 2011-2015 | 2013-2015 | ● | Underway | 738.4 | 640.9 |
| 3 | Lakefield Jct. - Winnebago-Winco-Burt area & Sheldon-Burt Area-Webster | MN/IA | 2015-2016 | 2016-2018 | ◑ | Pending | 550.4 | 541.1 |
| 4 | Winco-Lime Creek-Emery-Black Hawk-Hazelton | IA | 2015 | 2015-2018 | ◑ | Pending | 468.6 | 464.3 |
| 5 | N. LaCrosse-N. Madison-Cardinal (a/k/a Badger-Coulee Project) & Dubuque Co.-Spring Green-Cardinal | WI/IA | 2018-2020 | 2013-2018 | ◑ | Pending | 797.5 | 879.0 |
| 6 | Big Stone South - Ellendale | ND/SD | 2019 | 2019 | ◑ | Pending | 330.7 | 395.7 |
| 7 | Adair-Ottumwa | IA/MO | 2017-2020 | 2017-2018 | ○ | Pending | 152.3 | 178.2 |
| 8 | Adair-Palmyra Tap | MO | 2016-2018 | 2016-2018 | ○ | Pending | 112.8 | 108.1 |
| 9 | Palmyra Tap-Quincy-Merdosia-Ipava & Meredosia-Pawnee | MO/IL | 2016-2017 | 2016-2017 | ● | Pending | 432.2 | 524.2 |
| 10 | Pawnee-Pana | IL | 2018 | 2016-2018 | ● | Pending | 99.4 | 108.6 |
| 11 | Pana-Mt. Zion-Kansas-Sugar Creek | IL/IN | 2018-2019 | 2016-2019 | ● | Pending | 318.4 | 356.2 |
| 12 | Reynolds-Burr Oak-Hiple | IN | 2019 | 2019 | ● | Pending | 271.0 | 271.0 |
| 13 | Michigan Thumb Loop Expansion | MI | 2013-2015 | 2013-2015 | ● | Underway | 510.0 | 510.0 |
| 14 | Reynolds-Greentown | IN | 2018 | 2018 | ● | Pending | 245.0 | 328.7 |
| 15 | Pleasant Prairie-Zion Energy Center | WI | 2014 | 2013 | ● | Complete | 28.8 | 33.0 |
| 16 | Fargo-Galesburg-Oak Grove | IL | 2014-2019 | 2016-2018 | ○ | Pending | 199.0 | 225.5 |
| 17 | Sidney-Rising | IL | 2016 | 2016 | ● | Pending | 83.2 | 66.3 |
| | | | | | | *Totals:* | ***5,564*** | ***5,858*** |

**Figure 4-1: MVP Cost and In-Service Dates – MTEP11 version MTEP14[8]**

For MTEP14, all benefit calculations start in year 2020, the first year when all projects are in service. For MTEP11, year 2021 was the first year when the MVP Portfolio was expected in-service.

The costs contained within the MTEP database are in nominal, as spent, dollars. Nominal dollars are converted to real dollars for net present value benefit cost calculations using the facility level in-service dates. To obtain a real value in 2020 dollars from the nominal values in the MTEP database each facility's cost escalates using a 2.5 percent inflation rate from in-service year to 2020.

A load ratio share was developed to allocate the benefit-to-cost ratios in each of the seven MISO North/Central local resource zones (LRZ). Load ratios are based off the actual 2010 energy withdrawals with an applied Business as Usual (BAU) MTEP growth rate applied.

[8] All costs in nominal dollars.

MTEP14 MVP Triennial Review benefit-to-cost calculations only include direct benefits to MISO North and Central members. Therefore it is necessary to exclude costs paid by parties outside of MISO via exports and costs paid by Duke Ohio/Kentucky and First Energy pursuant to Schedule 39. Consistent with MTEP11, export revenue is estimated as 1.94 percent of the total MVP Portfolio costs. Schedule 39 is estimated as 6.24 percent of the total portfolio costs. MISO South Region benefits are excluded from all estimations.

Total costs are annualized using the MISO North/Central-wide average Transmission Owner annual charge rate/revenue requirement. Consistent with the MTEP11 analysis and other Market Efficiency Projects, the MTEP14 MVP Triennial Review assumes that costs start in 2020, such as year one of the annual charge rate is 2020 and construction work in progress (CWIP) is excluded from the total costs.

# 5. Portfolio Public Policy Assessment

The MTEP14 MVP Triennial Review redemonstrates the MVP Portfolio's ability to enable the renewable energy mandates of the footprint. Renewable Portfolio Standards assumptions[9] have not changed since the MTEP11 analysis and any changes in capacity requirements are solely attributed to load forecast changes and the actual installation of wind turbines.

The MVP portfolio enables a total of 43 million MWh of renewable energy to meet the renewable energy mandates and goals through 2028.

This analysis took place in two parts. The first part demonstrated the wind needed to meet renewable energy mandates would be curtailed but for the approved MVP Portfolio. The second demonstrated the additional renewable energy, above the mandate, that will be enabled by the portfolio. This energy could be used to serve mandated renewable energy needs beyond 2028, as most of the mandates are indexed to grow with load.

## 5.1 Wind Curtailment

A wind curtailment analysis was performed to find the percentage of mandated renewable energy that could not be enabled but for the MVP Portfolio.
The shift factors for all wind machines were calculated on the worst NERC Category B and C contingency constraints of each monitored element identified in 2011 as mitigated by the MVP Portfolio. The 488 monitored element/contingent element pairs (flowgates) consisted of 233 Category B and 255 Category C contingency events. These constraints were taken from a blend of projected 2023 and 2028 wind levels with the final calculations based on the projected 2028 wind levels.

Since the majority of the MISO West Region MVP justification was based on 2023 wind levels, it was assumed that any incremental increase to reach the 2028 renewable energy mandated levels would be curtailed. A transfer of the 279 wind units, sourced from both committed wind units and the Regional Generation Outlet Study (RGOS) energy zones to the system sink, Browns Ferry in the Tennessee Valley Authority, was used to develop the shift factors on the flowgates.

Linear optimization logic was used to minimize the amount of wind curtailed while reducing loadings to within line capacities. Similar to the MTEP11 justifications, a target loading of less than or equal to 95 percent was used. Fifty-four of the 488 flowgates could not achieve the target loading reduction, and their targets were relaxed in order to find a solution.

[9] Assumptions include Renewable Portflio Standard levels and fulfillment methods

The algorithm found that 9,315 MW of year 2023 dispatched wind would be curtailed. It was also assumed that any additional wind in the West to meet Renewable Portfolio Standard (RPS) levels would be curtailed. This equated to 1,212 MW of dispatched wind. As a connected capacity, 11,697 MW would be curtailed, as the wind is modeled at 90 percent of its nameplate. The MTEP14 results are similar in magnitude to MTEP11, which found that 12,201 MW of connected wind would be curtailed through 2026.

The curtailed energy was calculated to be 32,176,153 MWh from the connected capacity multiplied by the capacity factor times 8,760 hours of the year. A MISO-wide per-unit capacity factor was averaged from the 2028 incremental wind zone capacities to 31.4 percent. Comparatively, the full 2028 RPS energy is 57,019,978 MWh. As a percentage of the 2028 full RPS energy, 56.4 percent would be curtailed in lieu of the MVP Portfolio. MTEP11 analysis showed that 63 percent of the year 2026 full RPS energy would be curtailed without the installation of the MVP Portfolio. The MTEP14 calculated reduction in curtailment as a percentage of RPS has decreased since MTEP11, primarily because post-MTEP11 transmission upgrades are represented and the actual physical location of installed wind turbines has changed slightly since the 2011 forecast.

## 5.2 Wind Enabled

Additional analyses were performed to determine the incremental wind energy in excess of the 2028 requirements enabled by the approved MVP Portfolio. This energy could be used to meet renewable energy mandates beyond 2028, as most of the state mandates are indexed to grow with load. A set of three First Contingency Incremental Transfer Capability (FCITC) analyses were run on the 2028 model to determine how much the wind in each zone could be ramped up prior to additional reliability constraints occurring.

Transfers were sourced from the wind zones in proportion to their 2028 maximum output. All Bulk Electric System (BES) elements in the MISO system were monitored, with constraints being flagged at 100 percent of the applicable ratings. All single contingencies in the MISO footprint were evaluated during the transfer analysis. This transfer was sunk against MISO, PJM, and SPP units (Table 5-1). More specifically, the power was sunk to the smallest units in each region, with the assumption that these small units would be the most expensive system generation.

| Region | Sink |
|---|---|
| MISO | 33 percent |
| PJM | 44 percent |
| SPP | 23 percent |

**Table 5-1: Transfer Sink Distribution**

MTEP14 analysis determined that 4,335 MW of additional year 2028 generation could be sourced from the incremental energy zones to serve future renewable energy mandates (Table 5-2). MTEP11 analysis determined that 2,230 MW of additional year 2026 generation could be sourced from the incremental energy zones. The results are the essentially the same for both analyses as the increase in wind enabled from MTEP11 is primarily attributed to additional load growth. MTEP11 analysis was performed on a year 2026 model and MTEP14 on year 2028.

| Wind Zone | Incremental Wind Enabled | Wind Zone | Incremental Wind Enabled |
|---|---|---|---|
| MI-B | 250 | IL-K | 465 |
| MI-C | 238 | IN-K | 70 |
| MI-D | 318 | WI-B | 491 |
| MI-E | 264 | WI-D | 452 |
| MI-F | 320 | WI-F | 144 |
| MI-I | 210 | MO-C | 347 |
| IL-F | 167 | MO-A | 599 |

**Table 5-2: Incremental Wind Enabled Above 2028 Mandated Level, by Zone**

Consistent with the MTEP11 analysis, incremental wind enabled was calculated using a multiple pass technique – a first pass where wind is sourced from all wind zones, and a second where wind is sourced from just wind zones east of the Mississippi River. System-wide transfers from west to east across this boundary have historically been limited, and the first transfer limitations are seen along this corridor.

In the MTEP14 Review, no additional wind was enabled in much of the West. The MTEP14 Review power flow model had significantly stronger base dispatch flows from the Western portion of the system compared to the MTEP11 analysis. A first transfer including all zones east of the Mississippi as well as those from Missouri enabled the addition of 2,334 MW nameplate wind, at which point the wind zones in Michigan began meeting system limits. That wind was added to the model, and the analysis repeated for a second pass. The second transfer sourced wind from the Eastern wind zones minus those in Michigan, allowing an addition of 584 MW of nameplate wind, at which point a wind zone in Missouri met a local limit. The last transfer was performed leaving out the Missouri zone, and 1,416 MW of additional nameplate wind was enabled, before meeting a transfer limit in West-Central Illinois.

When the results from the curtailment analyses and the wind enabled analyses are combined, MTEP14 results show the MVP Portfolio enables a total of 43 million MWh of renewable energy to meet the renewable energy mandates through 2028. MTEP11 showed the MVP Portfolio enabled a similar level renewable energy mandates – 41 million MWh through 2026.

# 6. Portfolio Economic Analysis

MTEP14 estimates show the Multi-Value Portfolio creates $13.1 to $49.6 billion in net benefits to MISO North and Central Region members, an increase of approximately 50 percent from MTEP11 (Figure 6-1). Increases are primarily congestion and fuel savings driven by natural gas prices. Total portfolio costs have increased from $5.56 billion in MTEP11 to $5.86 billion in MTEP14. Even with the increased portfolio cost estimates, the increased MTEP14 benefit estimation results in portfolio benefit-to-cost ratios that have increased from 1.8 to 3.0 in MTEP11 to 2.6 to 3.9 in MTEP14.

> The MTEP14 Triennial MVP Review estimates the MVP benefit-to-cost ratio has increased from 1.8 – 3.0 in MTEP11 to 2.6 – 3.9.

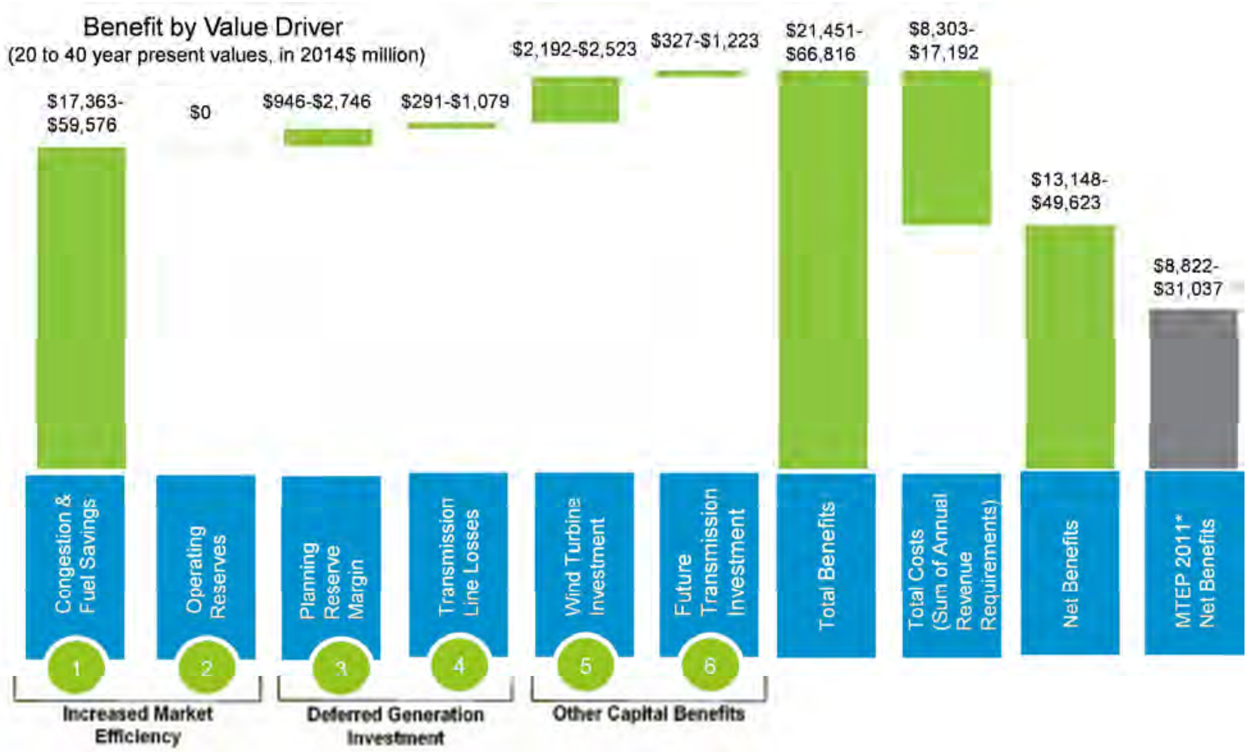



**Figure 6-1: MVP Portfolio Economic Benefits from MTEP14 MVP Triennial Review**

The bulk of the increase in benefits is due to an increase in the assumed natural gas price forecast in MTEP14 compared to MTEP11. In addition, the MTEP15 natural gas assumptions, which will be used in the MTEP15 MVP Portfolio Limited Review, are lower than the MTEP14 forecast. Under each of the natural gas price assumption sensitivities, the MVP Portfolio is projected to provide economic benefits in excess of costs (Table 6-1).

| Natural Gas Forecast Assumption | Total NPV Portfolio Benefits ($M-2014) | Total Portfolio Benefit to Cost Ratio |
|---|---|---|
| MTEP14 – MVP Triennial Review | 21,451 – 66,816 | 2.6 – 3.9 |
| MTEP11 | 17,875 – 54,186 | 2.2 – 3.2 |
| MTEP15 | 18,472 – 56,670 | 2.2 – 3.3 |

**Table 6-1: MVP Portfolio Economic Benefits - Natural Gas Price Sensitivities[10]**

The MVP Portfolio provides benefits across the MISO footprint in a manner that is roughly equivalent to cost allocated to each North and Central Region local resource zones (Figure 6-2). MTEP14 MVP Triennial Review results indicate that benefit-to-cost ratios have increased in all zones since MTEP11. Portfolio's benefits are at least 2.3 to 2.8 times the cost allocated to each zone. Zonal benefit distributions have changed slightly since the MTEP11 business case as a result of changing tariffs/business practices (planning reserve margin requirement and baseline reliability project cost allocation), load growth, and wind siting. As state demand and energy forecasts change and additional clarity is gained in to the location of actual wind turbine installation so does the siting of forecast wind.

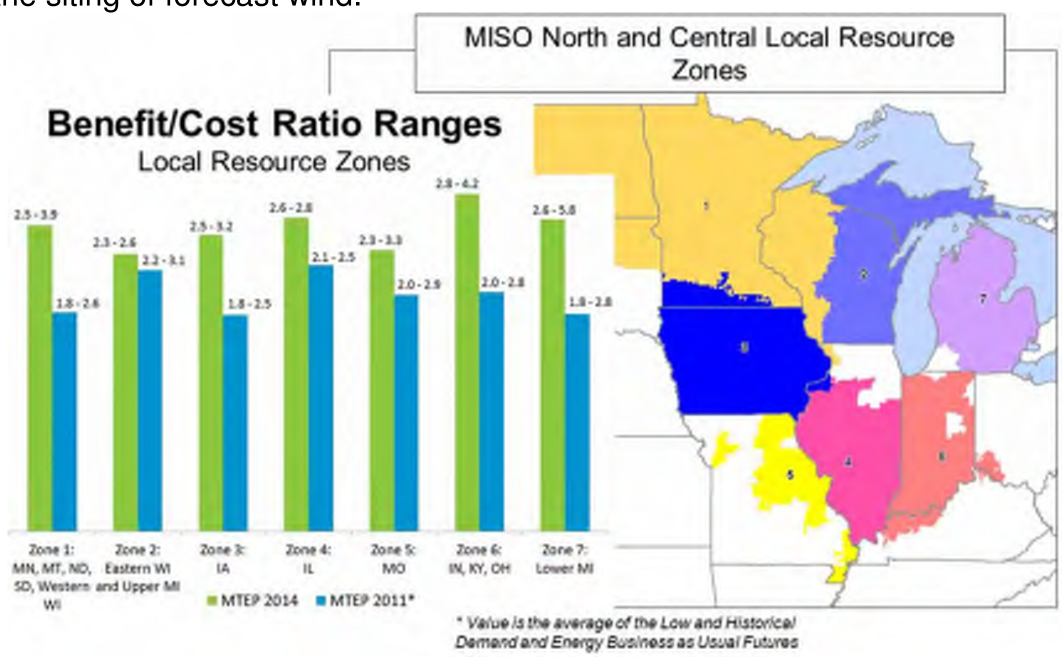



**Figure 6-2: MVP Portfolio Production Cost Benefit Spread**

10 Sensitivity performed applying MTEP11/MTEP15 natural gas price to the MTEP14 congestion and fuel savings model. All other benefit valuations unchanged from the MTEP14 MVP Triennial Review.

MVP Portfolio benefits under lower natural gas price sensitivities are at least 1.9 to 2.5 times the cost allocated to each zone (Figure 6-3). Under each natural gas price sensitivity benefits are zonally distributed in a manner roughly equivalent to the zonal cost allocation.

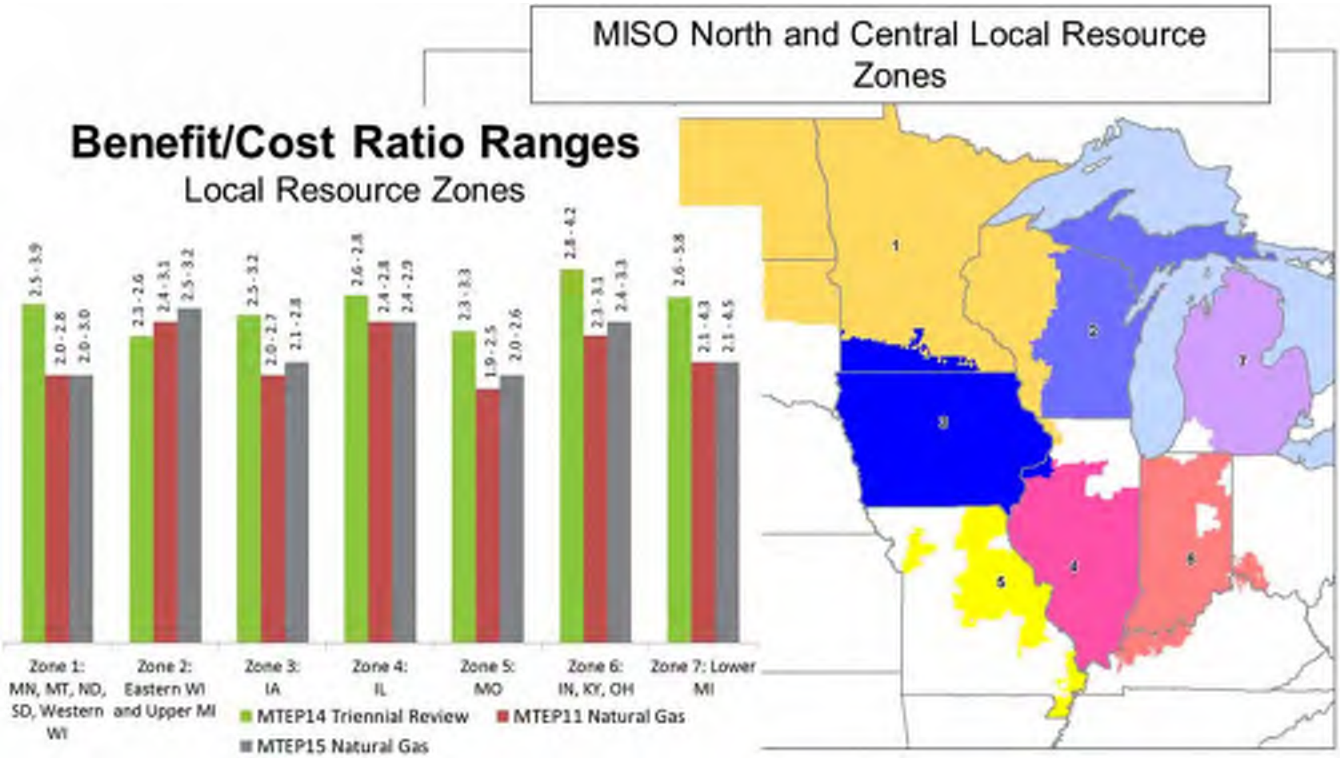



**Figure 6-3: MVP Portfolio Production Cost Benefit Spread – Natural Gas Price Sensitivities[11]**

[11] Sensitivity performed applying MTEP11/MTEP15 natural gas price to the MTEP14 congestion and fuel savings model. All other benefit valuations unchanged from the MTEP14 MVP Triennial Review.

## 6.1 Congestion and Fuel Savings

The MVP Portfolio allows for a more efficient dispatch of generation resources, opening markets to competition and spreading the benefits of low-cost generation throughout the MISO footprint. These benefits were outlined through a series of production cost analyses, which capture the economic benefits of the MVP transmission and the wind it enables. These benefits reflect the savings achieved through the reduction of transmission congestion costs and through more efficient use of generation resources.

Primarily because of an increase in natural gas price forecast assumptions, congestion and fuel savings have increased by approximately 40 percent since MTEP11

Congestion and fuel savings is the most significant portion of the MVP benefits (Figure 6-1). The MTEP14 Triennial MVP Review estimates that the MVP Portfolio will yield $17 to $60 billion in 20- to 40-year present value adjusted production cost benefits, depending on the timeframe and discount rate assumptions. This value is up 22 percent to 44 percent from the original MTEP11 valuation (Table 6-2).

| | MTEP14 | MTEP11[12] |
|---|---|---|
| 3 percent Discount Rate; 20 Year Net Present Value | 28,057 | 21,918 |
| 8 percent Discount Rate; 20 Year Net Present Value | 17,363 | 14,203 |
| 3 percent Discount Rate; 40 Year Net Present Value | 59,576 | 41,330 |
| 8 percent Discount Rate; 40 Year Net Present Value | 25,088 | 19,016 |

**Table 6-2: Congestion and Fuel Savings Benefit ($M-2014)**

The increase in congestion and fuel savings benefits relative to MTEP11 is primarily from an increase in the out-year natural gas price forecast assumptions (Figures 6-4, 6-5, and 6-6). In 2013, as part of the futures development, the MISO Planning Advisory Committee adopted a natural gas price escalation rate assumption sourced from a combination of the New York Mercantile Exchange (NYMEX) and Energy Information Administration (EIA) forecasts. The MTEP14 assumed natural gas price escalation rate is approximately 7.2% per year[13], compared to 1.74% per year in MTEP11. The increased escalation rate causes the assumed natural gas price to be $1.61/MMBTU higher in MTEP14 than MTEP11 in year 2023 and $3.13/MMBTU higher in year 2028 - the two years from which congestion and fuel savings results are based.

[12] Average of the High and Low MTEP11 BAU Futures

[13] 2.5% of the assumed MTEP14 natural gas price escalation rate represents inflation . Inflation rate added to the NYMEX and EIA sourced growth rate.

The MVP Portfolio allows access to wind units with a nearly $0/MWh production cost and primarily replaces natural gas units in the dispatch[14], which makes the MVP Portfolio's fuel savings benefit projection directly related to the natural gas price assumption. A sensitivity applying the MTEP11 Low BAU gas prices assumption to the MTEP14 MVP Triennial Review model showed a 29.3 percent reduction in the annual year 2028 MTEP14 congestion and fuel savings benefits (Figure 6-5). Approximately 68% of the difference between the MTEP11 and MTEP14 congestion and fuel savings benefit is attributable to the natural gas price escalation rate assumed in MTEP14 (Figure 6-6).

Post MTEP14 natural gas price forecast assumptions are more closely aligned with those of MTEP11 (Figure 6-4). A sensitivity applying the MTEP15 BAU natural gas prices to the MTEP14 analysis showed a 21.7 percent reduction in year 2028 MTEP14 adjusted production cost savings.

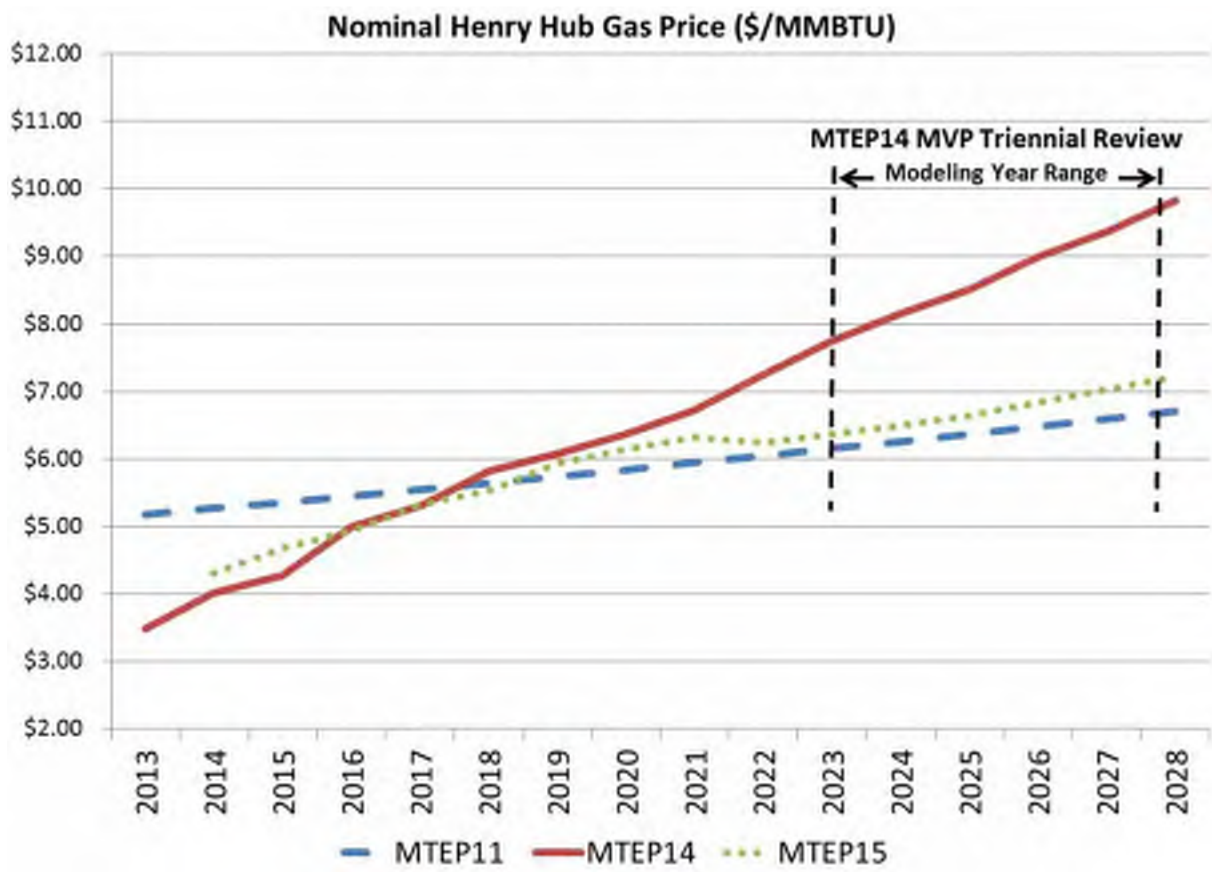



**Figure 6-4: Natural Gas Price Forecast Comparison**

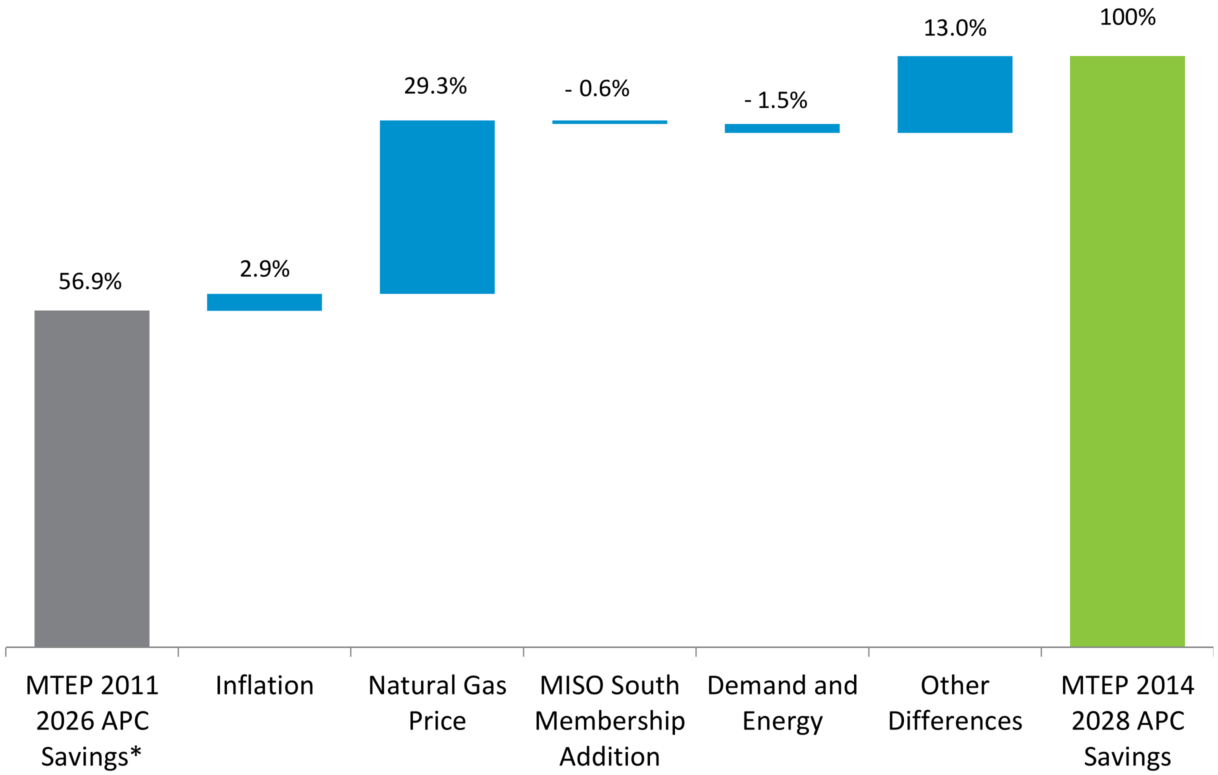
MISO membership changes have little net effect on benefit-to-cost ratios. For example if Duke Ohio/Kentucky and First Energy's benefits and costs are either both included or excluded the benefit-to-cost ratio calculation yields similar results. The exclusion of Duke Ohio/Kentucky and First Energy from the MISO pool decreases benefits by 7.4

[14] In the year 2028 simulation, the MVP enabled wind replaced 66% natural gas, 33% coal, and 1% other fueled units in the dispatch

percent relative to the MTEP14 total benefits; however, per Schedule 39, 6.3 percent of the total portfolio costs are allocated to Duke Ohio/Kentucky and First Energy, thus there is a minimal net effect to the benefit-to-cost ratio.

The MVP Portfolio is solely located in the MISO North and Central Regions and therefore, the inclusion of the South Region to the MISO dispatch pool has little effect on MVP related production cost savings (Figure 6-5).

Because demand and energy levels are similar between the MTEP11 Low BAU and MTEP14 cases, the updated demand and energy assumptions have little relative effect. Other Differences is calculated as the remaining difference between the MTEP14 saving and the sum of MTEP11 2026 APC Savings, Inflation, Natural Gas Prices, Footprint Changes, and Demand and Energy values. The largest modeling assumption differences in the Other Differences category is Environmental Protection Agency driven generation retirements, forecast generation siting, and topology upgrades. Other Differences also includes the compounding/synergic effects of all categories together.




**Excludes Duke Ohio/Kentucky - MTEP 2011 Business Case included Duke Ohio/Kentucky but excluded First Energy*

**Figure 6-5: Breakdown of Annual Congestion and Fuel Savings Benefit Increase from MTEP11 to MTEP14 – Values a percentage of MTEP14 year 2028 Adjusted Production Cost (APC) Savings**

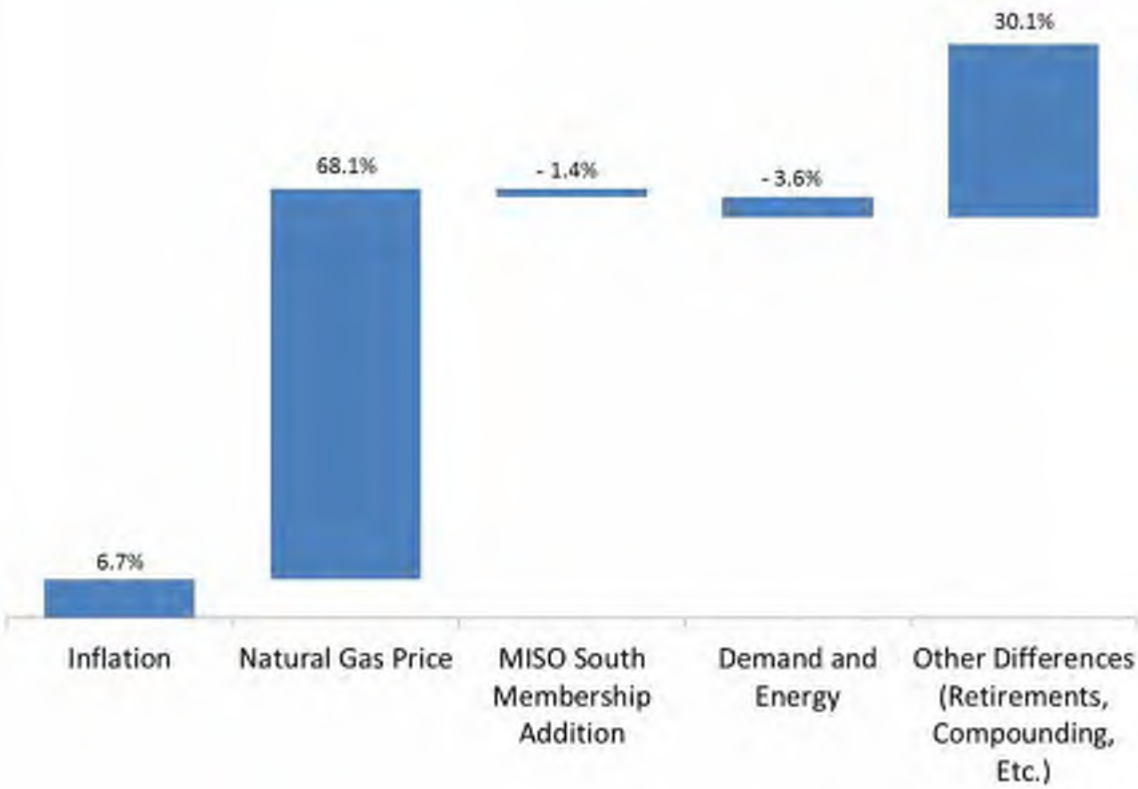



**Figure 6-6: Breakdown of Annual Congestion and Fuel Savings Benefit Increase from MTEP11 to MTEP14 – Values a percentage of difference between MTEP14 year 2028 and MTEP11 year 2026 Adjusted Production Cost (APC) Savings**

The MTEP14 MVP Triennial Review economic analysis was performed with 2023 and 2028 BAU future production cost models, with incremental wind mandates considered for 2023, 2028 and 2033. The 2033 case was used as a proxy case to determine the additional benefits from wind enabled above and beyond that mandated by the year 2028 (Section 5.2).

## 6.2 Operating Reserves

In addition to the energy benefits quantified in the production cost analyses, the 2011 business case showed the MVP Portfolio also reduce operating reserve costs. The 2011 business case showed that the MVP Portfolio decreases congestion on the system, increasing the transfer capability into several areas that would otherwise have to hold additional operating reserves under certain system conditions. While MTEP14 analysis shows the MVP Portfolio improves flows on the flowgates for which the reserves are calculated (Table 6-3), as a conservative measure, the MTEP14 Triennial MVP Review is not estimating a reduced operating reserve benefit. Since MTEP11, a reserve requirement has been calculated only a limited number of days (Table 6-4).

As a conservative measure, the MVP Triennial Review does not estimate a reduced operating reserve benefit in MTEP14.

| Zone | Limiter | Contingency | Change in Flows |
|---|---|---|---|
| Indiana | Bunsonville - Eugene 345 | Casey - Breed 345 | -15.0 percent |
| Indiana | Crete - St. Johns Tap 345 | Dumont-Wilton Center 765 | 3.0 percent |
| Michigan | Benton Harbor - Palisades 345 | Cook - Palisades 345 | -9.4 percent |
| Wisconsin | MWEX | N/A | -11.6 percent |
| Minnesota | Arnold-Hazleton 345 | N/A | 23.9 percent |

**Table 6-3: Change in Transfers; Pre-MVP minus Post-MVP**

| Zone | MTEP11 (June 2010 – May 2011) | | | MTEP14 (January 2013 – December 2013) | | |
|---|---|---|---|---|---|---|
| | Total Requirement (MW) | Days with Requirement (#) | Average daily requirement (MW) | Total Requirement (MW) | Days with Requirement (#) | Average daily requirement (MW) |
| Missouri/Illinois[15] | 95 | 1 | 95.1 | 0 | 0 | 0 |
| Indiana | 14966 | 53 | 282.4 | 0 | 0 | 0 |
| Northern Ohio | 9147 | 15 | 609.8 | N/A | N/A | N/A |
| Michigan | 4915 | 17 | 289.1 | 0 | 0 | 0 |
| Wisconsin | 227 | 2 | 113.4 | 0 | 0 | 0 |
| Minnesota | 376 | 1 | 376.3 | 32 | 2 | 16 |

**Table 6-4: Historic Operating Requirements**

MTEP11 MVP analysis concluded that the addition of the MVP Portfolio eliminated the need for the Indiana operating reserve zone and the reduction by half of additional system reserves held in other zones across the footprint. This created the opportunity to locate an average of 690,000 MWh of operating reserves annually where it would be most economical to do so, as opposed to holding these reserves in prescribed zones. MTEP11 estimated benefits from reduced operating reserves of $33 to $82 million in 20 to 40 year present value terms (Table 6-5).

| | MTEP14 | MTEP11[16] |
|---|---|---|
| 3 percent Discount Rate; 20 Year Net Present Value | - | 50 |
| 8 percent Discount Rate; 20 Year Net Present Value | - | 34 |
| 3 percent Discount Rate; 40 Year Net Present Value | - | 84 |
| 8 percent Discount Rate; 40 Year Net Present Value | - | 42 |

**Table 6-5: Reduction in Operating Reserves Benefit ($M-2014)**

As operating reserve zones are determined on an ongoing basis, by monitoring the energy flowing through flowgates across the system, the benefit valuation in future MVP Triennial Reviews may provide a different result.

15 The Missouri Reserve Zone was changed to Illinois in 2012. The Illinois Reserve Zone was eliminated in September 2013
16 Average of the High and Low MTEP11 BAU Futures

## 6.3 Planning Reserve Margin Requirements

The MVPs increase capacity sharing between local resource zones which defers more than $900 million in future capacity expansion

MTEP14 MVP Triennial Review analysis estimates the MVPs annually defer more than 800 MW in capacity expansion by increasing capacity import limits thus reducing the local clearing requirements of the planning reserve margin requirement. Local clearing requirements are the amount of capacity that must be physically located within a resource zone to meet resource adequacy standards. The MTEP14 Review estimates that the MVPs increase capacity sharing between local resource zones (LRZ), which defers $946 to $2,746 million in future capacity expansion (Table 6-7).

In the 2013 planning year, MISO and the Loss of Load Expectation Working Group improved the methodology that establishes the MISO Planning Reserve Margin Requirement (PRMR). Previously, and in the MTEP11 analysis, MISO developed a MISO-wide PRMR with an embedded congestion component. The Candidate MVP Analysis showed the MVP Portfolio reduces total system congestion and thus reduces the congestion component of the PRMR. The MVP Portfolio allows MISO to carry a decreased PRMR while maintaining the same system reliability. The post-2013 planning year methodology no longer uses a single congestion component, but instead calculates a more granular zonal PRMR and a local clearing requirement based on the zonal capacity import limit. While terminology and methods have changed between MTEP11 and MTEP14, both calculations are capturing the same benefit of increased capacity sharing across the MISO region provided by the MVPs; as such, MTEP14 and MTEP11 provide benefit estimates of similar magnitudes (Table 6-6).

| | MTEP14 | MTEP11[17] |
|---|---|---|
| 3 percent Discount Rate; 20 Year Net Present Value | 1,440 | 2,846 |
| 8 percent Discount Rate; 20 Year Net Present Value | 946 | 1,237 |
| 3 percent Discount Rate; 40 Year Net Present Value | 2,746 | 3,760 |
| 8 percent Discount Rate; 40 Year Net Present Value | 1,266 | 1,421 |

**Table 6-6: Local Clearing Requirement Benefit ($M-2014)**

[17] Average of the High and Low MTEP11 BAU Futures

Loss of load expectation (LOLE) analysis was performed to show the decrease in the local clearing requirement of the planning reserve margin requirement due to MVP Portfolio. This analysis used the 2014-2015 Planning Reserve Margin (PRM) 10-year out (2023) case. Capacity import limit increases from the MVPs were captured by comparing the zonal capacity import limits of a case with the MVP Portfolio to a case without inclusion of the MVP Portfolio. The 2023 Local Reliability Requirement (LRR) for each LRZ was determined by running GE MARS. Local clearing requirements were calculated for both the "with" and "without" MVP cases by subtracting the CIL values from the LRR values (Table 6-7).

| Local Resource Zone | 1 | 2 | 3 | 4 | 5 | 6 | 7 | Formula Key |
|---|---|---|---|---|---|---|---|---|
| **2023 Unforced Capacity (MW)** | 17,583 | 14,592 | 9,646 | 10,664 | 8,135 | 19,735 | 24,833 | [A] |
| **2023 Local Reliability Requirement Unforced Capacity (MW)** | 21,515 | 15,737 | 11,696 | 12,754 | 10,998 | 21,222 | 25,793 | [B] |
| **No MVP Capacity Import Limit (CIL) (MW)** | 5,326 | 2,958 | 1,198 | 4,632 | 5,398 | 5,328 | 3,589 | [C] |
| **MVP Capacity Import Limit (MW)** | 5,576 | 3,387 | 2,925 | 9,534 | 4,328 | 5,761 | 3,648 | [D] |
| **No MVP CIL Local Clearing Requirement (MW)** | 16,189 | 12,779 | 10,498 | 8,122 | 5,600 | 15,894 | 22,204 | [E]=[B]-[C] |
| **With MVP CIL Local Clearing Requirement (MW)** | 15,939 | 12,351 | 8,771 | 3,220 | 6,670 | 15,461 | 22,145 | [F]=[B]-[D] |
| **Excess capacity after LCR with No MVP CIL (MW)** | 1,394 | 1,813 | -852 | 2,542 | 2,535 | 3,841 | 2,629 | [G]=[A]-[E] |
| **Excess capacity after LCR with MVP CIL (MW)** | 1,644 | 2,242 | 875 | 7,444 | 1,465 | 4,274 | 2,688 | [H]=[A]-[F] |
| **Deferred Capacity Value ($M-2014)** | | | $75.8 | | | | | [I]=[G]*CONE |

**Table 6-7: Deferred Capacity Value Calculation**

The MTEP14 MVP Triennial Review analysis shows the MVP Portfolio allows 852 MW of capacity expansion deferral in LRZ 3. The deferred capacity benefit is valued using the Cost of New Entry (CONE) (Table 6-8). It's important to note that the capacity expansion deferral benefit may or may not be realized due to future market design changes around external resource capacity qualification.

The MTEP14 MVP Triennial Review methodology does not capture the MVP benefit to the capacity import of LRZ 5. This limitation is driven by the selection of generation used to perform import studies. MISO's LOLE methodology defines the selection of generation used as the source for a transfer study based on a zone's Local Balancing Area (LBA) ties. Based on its LBA ties, import studies indicate LRZ 5 primarily uses generation from the MISO South Region since its LBA ties in the North and Central Regions have very limited available capacity. The MVP facilities are not used to transfer power from the South Region so a benefit for LRZ 5 is not quantified.

| Local Resource Zone | Cost of New Entry ($/MW-year) |
|---|---|
| **1** | 89,500 |
| **2** | 90,320 |
| **3** | 88,450 |
| **4** | 89,890 |
| **5** | 91,610 |
| **6** | 89,670 |
| **7** | 90,100 |

**Table 6-8: Cost of New Entry for Planning Year 2014/15**[18]

[18] From MISO Business Practice Manual 011 Resource Adequacy – January 2014

## 6.4 Transmission Line Losses

The addition of the MVP Portfolio to the transmission network reduces overall system losses, which also reduces the generation needed to serve the combined load and transmission line losses. The energy value of these loss reductions is considered in the congestion and fuel savings benefits, but the loss reduction also helps to reduce future generation capacity needs.

> Reflective of MISO's tighter reserve margins, the value of MTEP14 capacity deferment benefits from reduced losses has increased

The MTEP14 Review found that system losses decrease by 122 MW with the inclusion of the MVP Portfolio. MTEP11 estimates that the MVPs reduced losses by 150 MW. The difference between MTEP11 and MTEP14 results is attributed to decreased system demand, the MISO North and Central Regions membership changes, and transmission topology upgrades in the base model.

Tightening reserve margins, from an additional approximate 12 GW of expected generation retirements due mostly to emissions compliance restrictions, have increased the value of deferred capacity from transmission losses in MTEP14. In MTEP11, baseload additions were not required in the 20-year capacity expansion forecast to maintain planning reserve requirements. In MTEP11, the decreased transmission losses from the MVP Portfolio allowed the deferment of a single combustion turbine. In MTEP14, the decreased losses cause a large shift in the proportion of baseload combined cycle units and peaking combustion turbines in the capacity expansion forecast.

In addition to the tighter reserve margins, a one-year shift forward in the MVP Portfolio expected in-service date relative to MTEP11, has increased benefits by approximately 30 percent. In MTEP11, the MVP Portfolio's expected in-service date was year 2021. In MTEP14, the MVP's Portfolio's expected in-service date has shifted to year 2020. Given current reserve margins, additional capacity is needed as soon as year 2016 to maintain out-year reserve requirements. The in-service date shift forward allows earlier access to the 122 MW of reduced losses which allows earlier and less discounted deferment of capacity expansions.

The combined result of the tighter reserve margins and in-service date shift has caused the estimated benefits from reduced transmission line losses to more than double compared to the MTEP11 values (Table 6-9). Using current capital costs, the deferment equates to a savings of $291 to $1,079 million ($-2014), excluding the impacts of any potential future policies.

| | MTEP14 | MTEP11[19] |
|---|---|---|
| 3 percent Discount Rate; 20 Year Net Present Value | 734 | 227 |
| 8 percent Discount Rate; 20 Year Net Present Value | 291 | 287 |
| 3 percent Discount Rate; 40 Year Net Present Value | 1,079 | 315 |
| 8 percent Discount Rate; 40 Year Net Present Value | 401 | 327 |

**Table 6-9: Transmission Line Losses Benefit ($M-2014)**

The benefit valuation methodology used in the MTEP14 Review is identical to that used in MTEP11. The transmission loss reduction was calculated by comparing the transmission line losses in the 2023 summer peak powerflow model both with and without the MVP Portfolio. This value was then used to extrapolate the transmission line losses for 2018 through 2023, assuming escalation at the business as usual demand growth rate. The change in required system capacity expansion due to the impact of the MVP Portfolio was calculated through a series of EGEAS simulations. In these simulations, the total system generation requirement was set to the system PRMR multiplied by the system load plus the system losses (Generation Requirements = (1+PRMR)*(Load + Losses)). To isolate the impact of the transmission line loss benefit, all variables in these simulations were held constant, except system losses.

MVP benefits from the optimization of wind generation siting remain similar in magnitude since MTEP11

The difference in capital fixed charges and fixed operation and maintenance costs in the no-MVP case and the post-MVP case is equal to the capacity benefit from transmission loss reduction, due to the addition of the MVP portfolio to the transmission system.

## 6.5 Wind Turbine Investment

During the Regional Generator Outlet Study (RGOS), the pre-cursor to the Candidate MVP Study, MISO developed a wind siting approach that results in a low-cost solution when transmission and generation capital costs are considered. This approach sources generation in a combination of local and regional locations, placing wind local to load, where less transmission is required; and regionally, where the wind is the strongest (Figure 6-7). However, this strategy depends on a strong regional transmission system to deliver the wind energy. Without this regional transmission backbone, the wind generation has to be sited close to load, requiring the construction of significantly larger amounts of wind capacity to produce the renewable energy mandated by public policy.

[19] Average of the High and Low MTEP11 BAU Futures

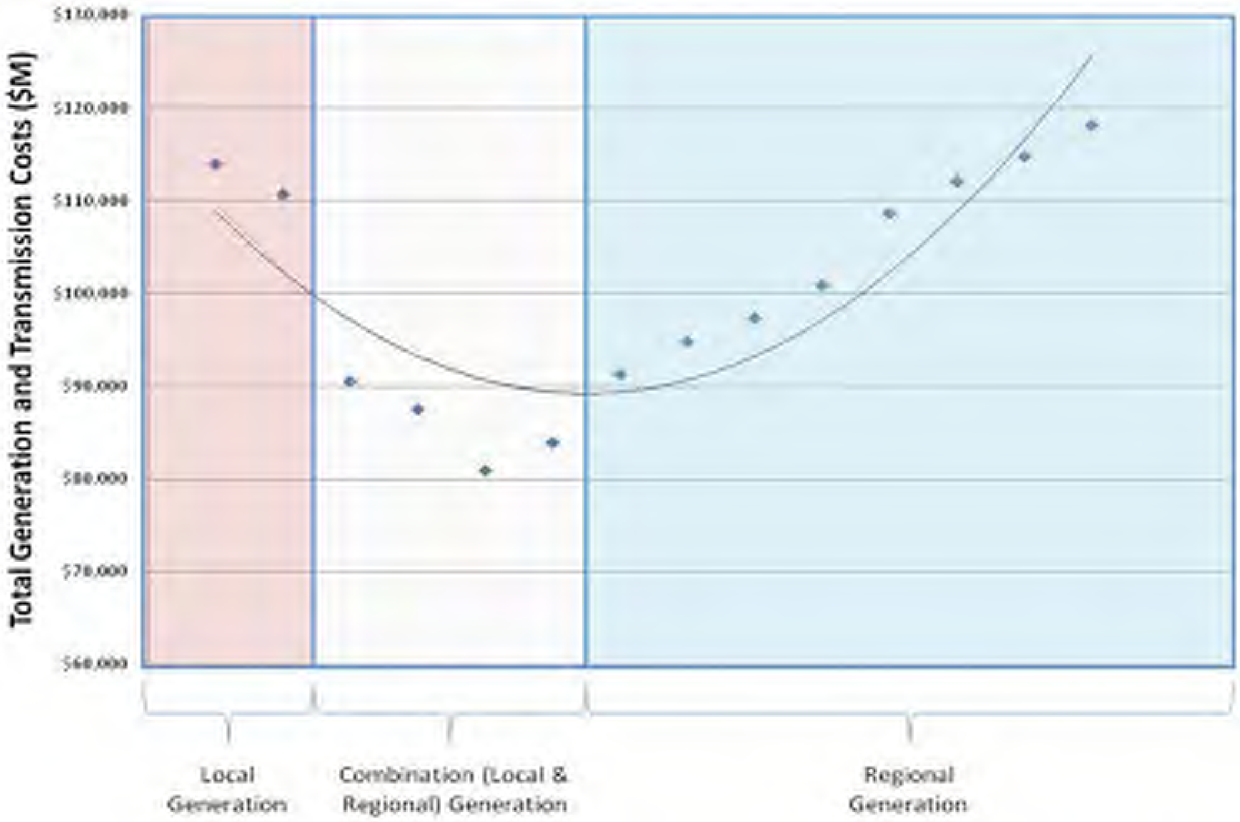



**Figure 6-7: Local versus Combination Wind Siting**

The MTEP14 Triennial MVP Review found that the benefits from the optimization of wind generation siting remain similar in magnitude since MTEP11 (Table 6-10). The slight increase in MTEP14 benefits relative to MTEP11 is from an update to the wind requirement forecast and wind enabled calculations. The MTEP14 Review found that the MVPs reduce turbine capital investments by 3,262 MW through 2028, compared to 2,884 MW through 2026 in MTEP11.

| | MTEP14 | MTEP11[20] |
|---|---|---|
| 3 percent Discount Rate; 20 Year Net Present Value | 2,192 | 1,850 |
| 8 percent Discount Rate; 20 Year Net Present Value | 2,523 | 2,222 |
| 3 percent Discount Rate; 40 Year Net Present Value | 2,192 | 1,850 |
| 8 percent Discount Rate; 40 Year Net Present Value | 2,523 | 2,222 |

**Table 6-10: Wind Turbine Investment Benefit ($M-2014)**

[20] Average of the High and Low MTEP11 BAU Futures

In the RGOS study, it was determined that 11 percent less wind would need to be built to meet renewable energy mandates in a combination local/regional methodology relative to a local only approach. This change in generation was applied to energy required by the renewable energy mandates, as well as the total wind energy enabled by the MVP Portfolio (Section 5). This resulted in a total of 3.2 GW of avoided wind generation (Table 6-11).

| Year | MVP Portfolio Enabled Wind (MW) | Equivalent Local Wind Generation (MW) | Incremental Cumulative Wind Benefit (MW) |
|---|---|---|---|
| Pre-2018 | 16,403 | 18,246 | 1,843 |
| 2018 | 20,289 | 22,568 | 2,279 |
| 2023 | 22,946 | 25,524 | 2,578 |
| 2028 | 24,702 | 27,477 | 2,775 |
| Full Wind Enabled | 29,037 | 32,299 | 3,262 |

**Table 6-11: Renewable Energy Requirements, Combination versus Local Approach**

The incremental wind benefits were monetized by applying a value of $2 to $2.8 million/MW, based on the U.S. Energy Information Administration's estimates of the capital costs to build onshore wind[21]. The total wind enabled benefits were then spread over the expected life of a wind turbine. Consistent with the MTEP11 business case that avoids overstating the benefits of the combination wind siting, a transmission cost differential of approximately $1.5 billion was subtracted from the overall wind turbine capital savings to represent the expected lower transmission costs required by a local-only siting strategy.

[21] Value as of November 2013

## 6.6 Future Transmission Investment

Consistent with MTEP11, the MTEP14 MVP Triennial Review shows that the MVP Portfolio eliminates the need for $300 million in future baseline reliability upgrades (Table 6-12). The magnitude of estimated benefits is in close proximity to the estimate from MTEP11; however, the actual identified upgrades have some differences because of bus-level load growth, generation dispatch, wind levels and transmission upgrades.

MTEP14 analysis shows the MVP Portfolio eliminates the need for $300 million in future baseline reliability upgrades.

| | MTEP14 | MTEP11[22] |
|---|---|---|
| 3 percent Discount Rate; 20 Year Net Present Value | 674 | 521 |
| 8 percent Discount Rate; 20 Year Net Present Value | 327 | 286 |
| 3 percent Discount Rate; 40 Year Net Present Value | 1,223 | 931 |
| 8 percent Discount Rate; 40 Year Net Present Value | 452 | 394 |

**Table 6-12: Future Transmission Investment Benefits ($M-2014)**

Reflective of the post-Order 1000 Baseline Reliability Project cost allocation methodology, capital cost deferment benefits were fully distributed to the LRZ in which the avoided investment is physically located; a change from the MTEP11 business case that distributed 20 percent of the costs regionally and 80 percent locally.

A model simulating 2033 summer peak load conditions was created by growing the load in the 2023 summer peak model by approximately 8 GW. The 2033 model was run both with and without the MVP Portfolio to determine which out-year reliability violations are eliminated with the inclusion of the MVP Portfolio (Table 6-13).

[22] Average of the High and Low MTEP11 BAU Futures

| Avoided Investment | Upgrade Required | Miles |
|---|---|---|
| New Carlisle - Olive 138 kV | Transmission line, < 345 kV | 2.0 |
| Reynolds 345/138 kV Transformer | Transformer | N/A |
| Lee - Lake Huron Pumping Tap 120 kV | Transmission line, < 345 kV | 8.5 |
| Waterman - Detroit Water 120 kV | Transmission line, < 345 kV | 2.9 |
| Dresden - Electric Junction 345 kV | Transmission line, 345 kV | 31.1 |
| Dresden - Goose Lake 138 kV | Transmission line, < 345 kV | 5.8 |
| Golf Mill - Niles Tap 138 kV | Transmission line, < 345 kV | 2.5 |
| Boy Branch - Saint Francois 138 kV | Transmission line, < 345 kV | 7.1 |
| Newton - Robinson Marathon 138 kV | Transmission line, < 345 kV | 34.3 |
| Weedman - North Leroy 138 kV | Transmission line, < 345 kV | 3.6 |
| Wilmarth - Eastwood 115 kV | Transmission line, < 345 kV | 4.6 |
| Swan Lake - Fort Ridgely 115 kV | Transmission line, < 345 kV | 13.2 |
| Black Dog - Pilot Knob 115 kV | Transmission line, < 345 kV | 10.3 |
| Lake Marion - Kenrick 115 kV | Transmission line, < 345 kV | 3.5 |
| Johnson Junction - Ortonville 115 kV | Transmission line, < 345 kV | 24.7 |
| Maquoketa - Hillsie 161 kV | Transmission line, < 345 kV | 12.0 |
| New Iowa Wind - Lime Creek 161 kV | Transmission line, < 345 kV | 10 |
| Lore - Turkey River 161 kV | Transmission line, < 345 kV | 19.6 |
| Lore - Kerper 161 kV | Transmission line, < 345 kV | 7.0 |
| Salem 161 kV Bus Tie | Bus Tie | N/A |
| 8th Street - Kerper 161 kV | Transmission line, < 345 kV | 2.6 |
| Rock Creek 161 kV Bus Tie | Bus Tie | N/A |
| Beaver Channel 161 kV Bus Tie | Bus Tie | N/A |
| East Calamus - Grand Mound 161 kV | Transmission line, < 345 kV | 2.6 |
| Dundee - Coggon 161 kV | Transmission line, < 345 kV | 18.1 |
| Sub 56 (Davenport) - Sub 85 161 kV | Transmission line, < 345 kV | 3.8 |
| Vienna - North Madison 138 kV | Transmission line, < 345 kV | 0.2 |
| Townline Road - Bass Creek 138 kV | Transmission line, < 345 kV | 11.8 |
| Portage - Columbia 138 kV Ckt 2 | Transmission line, < 345 kV | 5.7 |
| Portage - Columbia 138 kV Ckt 1 | Transmission line, < 345 kV | 5.7 |

**Table 6-13: Avoided Transmission Investment**

The cost of this avoided investment was valued using generic transmission costs, as estimated from projects in the MTEP database and recent transmission planning studies (Table 6-14). Generic estimates, in nominal dollars, are unchanged since the MTEP11 analysis. Transmission investment costs were assumed to be spread between 2029 and 2033. To represent potential production cost benefits that may be missed by avoiding this transmission investment, the 345 kV transmission line savings was reduced by half.

| Avoided Transmission Investment | Estimated Upgrade Cost |
|---|---|
| Bus Tie | $1,000,000 |
| Transformer | $5,000,000 |
| Transmission lines (per mile, for voltages under 345 kV) | $1,500,000 |
| Transmission lines (per mile, for 345 kV) | $2,500,000 |

**Table 6-14: Generic Transmission Costs**

# 7. Qualitative and Social Benefits

Aside from widespread economic and public policy benefits, the MVP Portfolio also provides benefits based on qualitative or social values. Consistent with the MTEP11 analysis, these benefits are excluded from the business case. The quantified values from the economic analysis may be conservative because they do not account for the full potential benefits of the MVP Portfolio.

> The MVP Portfolio also provides benefits based on qualitative or social values, which suggests that the quantified values from the economic analysis may be conservative because they do not account for the full benefit potential.

## 7.1 Enhanced Generation Flexibility

The MVP Portfolio is primarily evaluated on its ability to reliably deliver energy required by renewable energy mandates. However, the MVP Portfolio also provides value under a variety of different generation policies. The energy zones, which were a key input into the MVP Portfolio analysis, were created to support multiple generation fuel types. For example, the correlation of the energy zones to the existing transmission lines and natural gas pipelines were a major factor considered in the design of the zones (Figure 7-1).

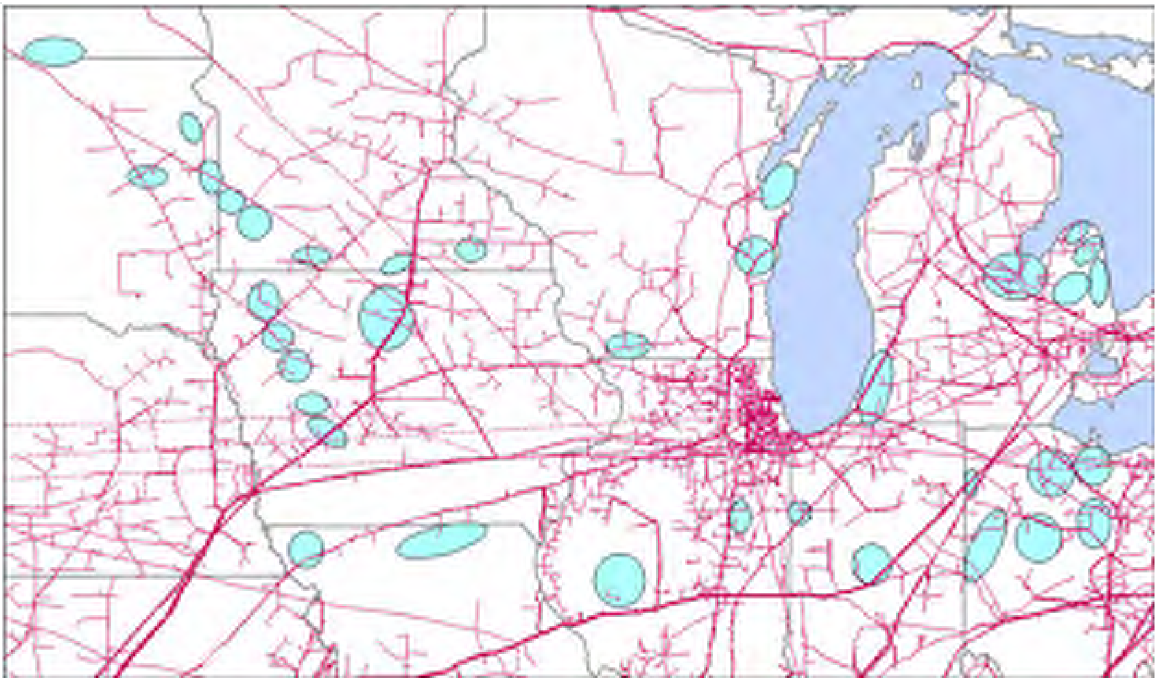


**Figure 7-1: Energy Zone Correlation with Natural Gas Pipelines**

## 7.2 Increased System Robustness

A transmission system blackout, or similar event, can have wide spread repercussions and result in billions of dollars of damage. The blackout of the Eastern and Midwestern United States in August 2003 affected more than 50 million people and had an estimated economic impact of between $4 and $10 billion.

The MVP Portfolio creates a more robust regional transmission system that decreases the likelihood of future blackouts by:

- Strengthening the overall transmission system by decreasing the impacts of transmission outages
- Increasing access to additional generation under contingent events
- Enabling additional transfers of energy across the system during severe conditions

## 7.3 Decreased Natural Gas Risk

Natural gas prices vary widely (Figure 7-2) causing corresponding fluctuations in the cost of energy from natural gas. In addition, recent and pending U.S. Environmental Protection Agency regulations limiting the emissions permissible from power plants will likely lead to more natural gas generation. This may cause the cost of natural gas to increase along with demand. The MVP Portfolio can partially offset the natural gas price risk by providing additional access to generation that uses fuels other than natural gas (such as nuclear, wind, solar and coal) during periods with high natural gas prices. Assuming a natural gas price increase of 25 percent to 50 percent, 2014 analysis shows the MVP Portfolio provides approximately a 24 to 45 percent higher adjusted production cost benefits.

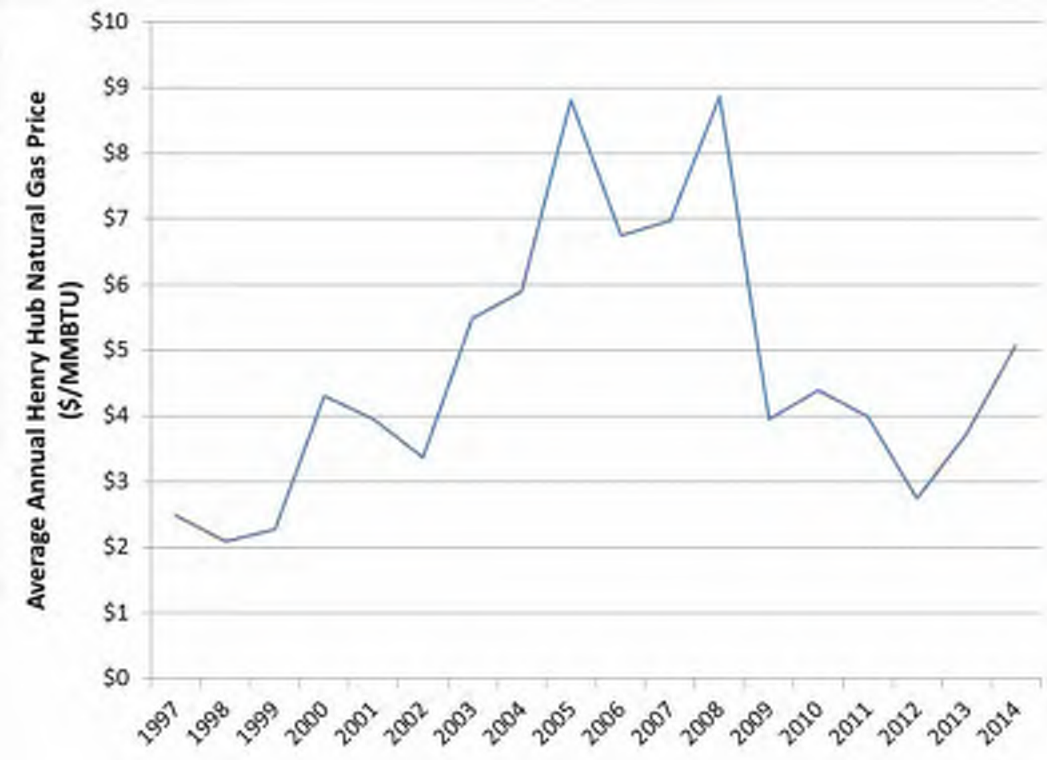



**Figure 7-2: Historic Henry Hub Natural Gas Prices**

A set of sensitivity analyses were performed to quantify the impact of changes in natural gas prices. The sensitivity cases maintained the same modeling assumptions from the base business case analyses, except for the gas prices. The gas prices were increased from $3.50 to $4.35 and $5.22/MMBTU and then escalated to year 2028 using MTEP14 rates.

The system production cost is driven by many variables, including fuel prices, carbon emission regulations, variable operations, management costs and renewable energy mandates. The increase in natural gas prices imposed additional fuel costs on the system, which in turn produced greater production cost benefits due to the inclusion of the MVP Portfolio. These increased benefits were driven by the efficient usage of renewable and low cost generation resources (Figure 7-3).

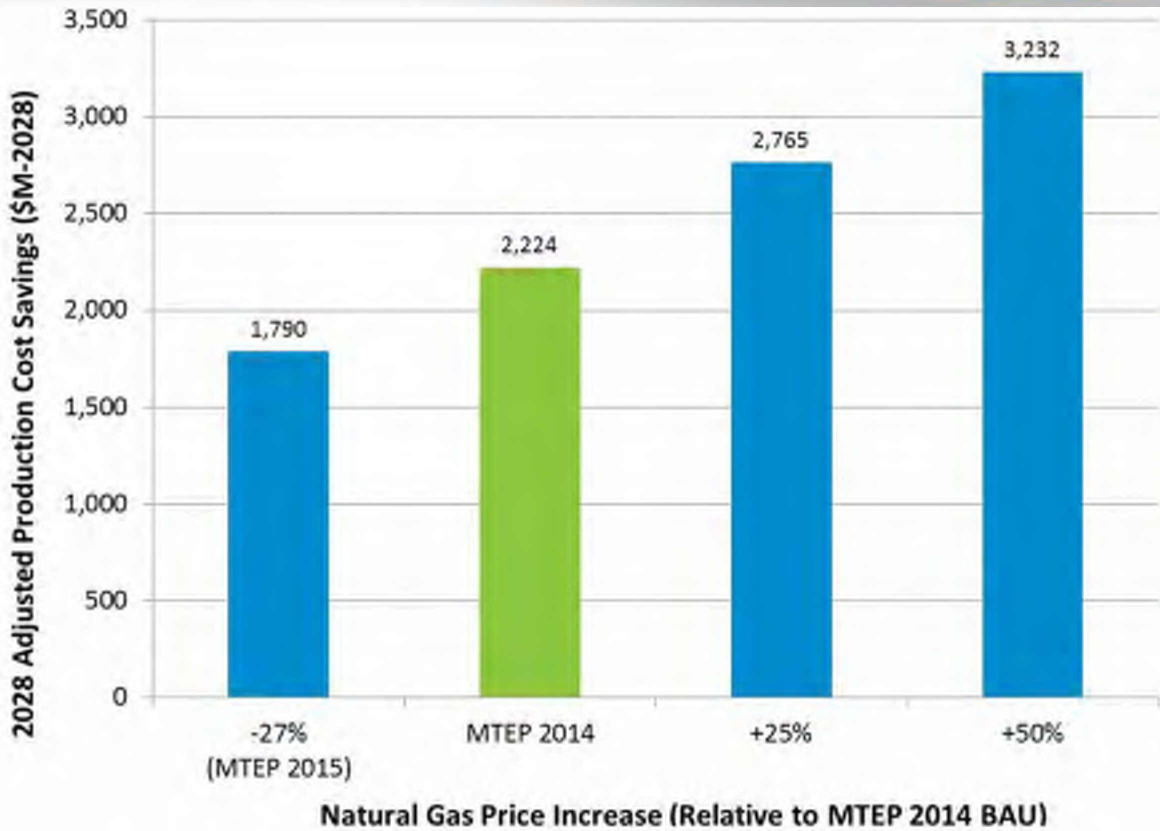



**Figure 7-3: MVP Portfolio Adjusted Production Cost Savings by Natural Gas Price**

## 7.4 Decreased Wind Generation Volatility

As the geographical distance between wind generators increases, the correlation in the wind output decreases (Figure 7-4). This relationship leads to a higher average output from wind for a geographically diverse set of wind plants, relative to a closely clustered group of wind plants. The MVP Portfolio will increase the geographic diversity of wind resources that can be delivered, increasing the average wind output available at any given time.

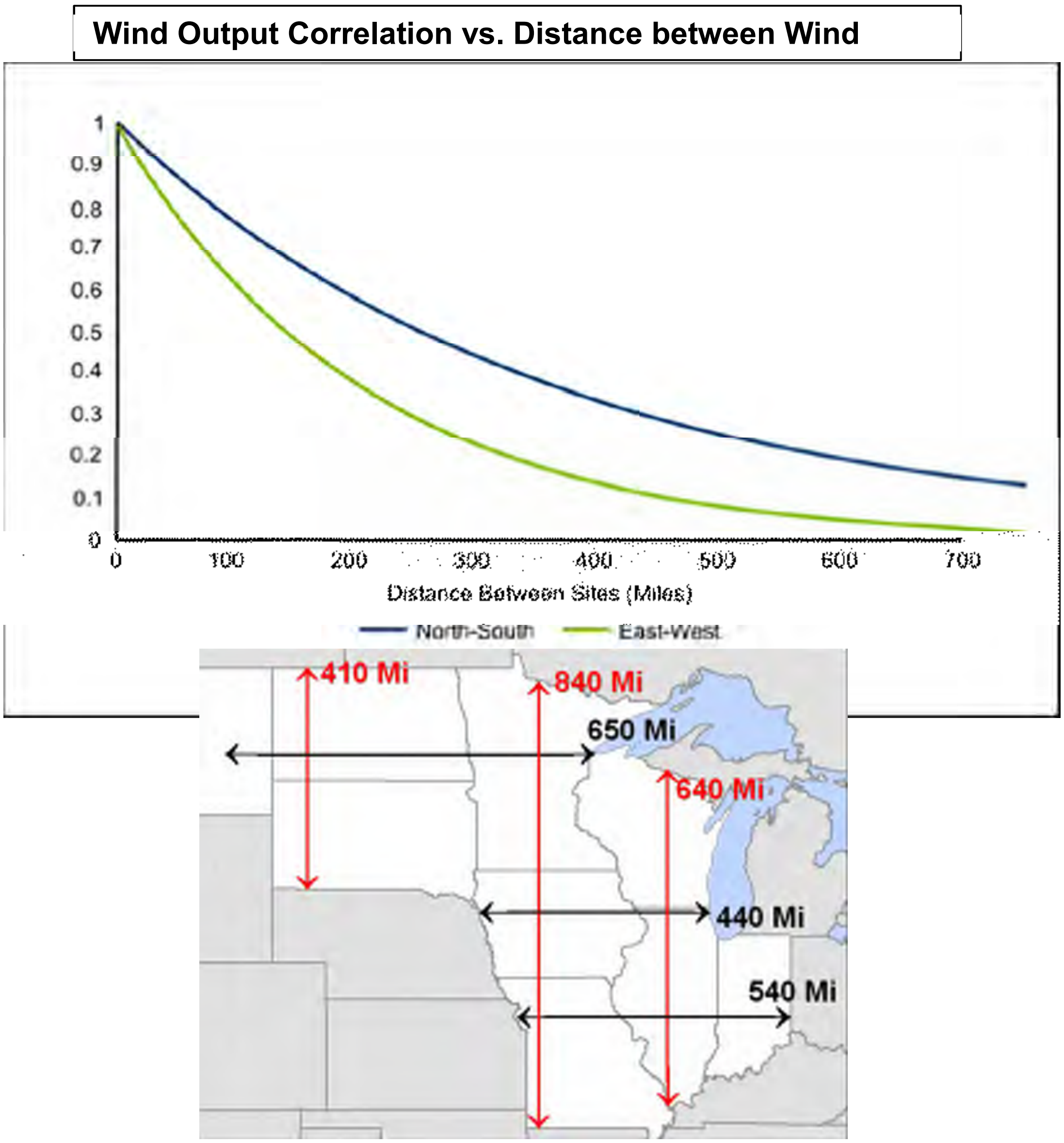



**Figure 7-4: Wind Output Correlation to Distance between Wind Sites**

## 7.5 Local Investment and Jobs Creation

In addition to the direct benefits of the MVP Portfolio, studies performed by the State Commissions have shown the indirect economic benefits of the MVP transmission investment. The MVP Portfolio supports thousands of local jobs and creates billions in local investment. In MTEP11, it was estimated that the MVP Portfolio supports between 17,000 and 39,800 local jobs, as well as $1.1 to $9.2 billion in local investment. Going forward, MISO is exploring the use of the IMPLAN model to quantify the direct, indirect, and induced effects on jobs and income related to transmission construction.

## 7.6 Carbon Reduction

The MVP Portfolio reduces carbon emissions by 9 to 15 million tons annually (Figure 7-5).

The MVP Portfolio enables the delivery of significant amounts of wind energy across MISO and neighboring regions, which reduces carbon emissions.

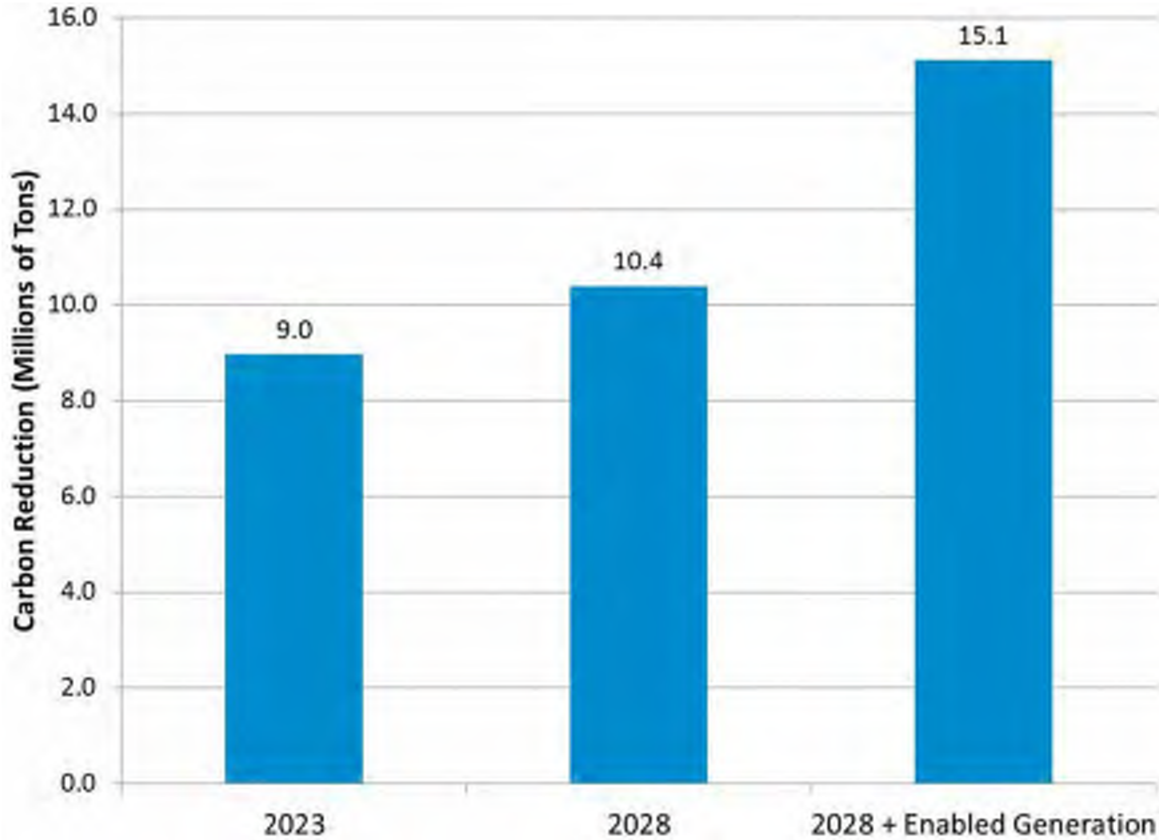



**Figure 7-5: Forecasted Carbon Reduction from the MVP Portfolio by Year**

# 8. Conclusions and Going Forward

The MTEP14 Triennial MVP Review provides an updated view into the projected economic, public policy and qualitative benefits of the MTEP11 MVP Portfolio. Analysis shows Multi-Value Project benefit-to-cost ratios have increased from 1.8 to 3.0 to a range of 2.6 to 3.9 since the MTEP11 analysis. Benefit increases are primarily congestion and fuel savings largely driven by natural gas prices.

The MTEP14 MVP Triennial Review's business case is on par with, if not stronger than, MTEP11 providing proof that the MVP criteria and methodology is working as expected. While the economic cost savings provide further benefit, the updated MTEP14 assessment corroborates the MVP Portfolio's ability to enable the delivery of wind generation in support of the renewable energy mandates of the MISO states in a cost effective manner.

Results prepared through the MTEP14 Triennial Review are for information purposes only and have no effect on the existing MVP Portfolio status or cost allocation.

MTEP15 and MTEP16 will feature a Limited Review of the MVP Portfolio benefits. Each Limited Review will provide an updated assessment of the congestion and fuel savings (Section 6.1) using the latest portfolio costs and in-service dates. Beginning in MTEP17, in addition to the Full Triennial Review, MISO will perform an assessment of the congestion costs, energy prices, fuel costs, planning reserve margin requirements, resource interconnections and energy supply consumption based on historical operations data.

# Appendix

## Detailed Transfer Analysis Results

| LRZ | FCITC | Import Limit (CIL in MW) | Monitored Element | Contingency |
|---|---|---|---|---|
| 1 | -209 | 5,576 | 631115 OTTUMWA5 161 631116 BRDGPRT5 161 1 | C:631115 OTTUMWA5 161 631134 TRICNTY5 161 1 |
| 2 | -146 | 3,387 | 270810 LOCKPORT; B 345 274702 KENDALL; BU 345 1 | C:270811 LOCKPORT; R 345 274703 KENDALL; RU 345 1 |
| 3 | 810 | 2,925 | 630388 WINCOR 8 69.0 630395 WNTRSET8 69.0 1 | C:635631 BOONVIL5 161 635632 EARLHAM5 161 1 |
| 4 | 9,913 | 9,534 | Limited by generation in tiers 1 and 2 - resulting limit considering Tier 1 and 2 available capacity and base interchange | |
| 5 | 3,027 | 4,328 | 337651 8WHT BLUFF percent 500 337957 8KEO percent 500 1 | C:P1_2-1312 |
| 6 | 2,002 | 5,761 | 243212 05BENTON 345 243250 05BENTON 138 1 | C:P1_2_EXT_31 |
| 7 | 987 | 3,648 | 256290 18TITBAW 138 256542 18REDSTONE 138 1 | C:b\|18BULOCK-18SUMRTN 138-1 |

**Table A-1: With MVP Capacity Import Limits**

| LRZ | FCITC | Import Limit (CIL in MW) | Monitored Element | Contingency |
|---|---|---|---|---|
| 1 | -204 | 5,326 | 699211 PT BCH3 345 699630 KEWAUNEE 345 1 | C:ATC_B2_NAPL121 |
| 2 | -237 | 2,958 | 270810 LOCKPORT; B 345 274702 KENDALL; BU 345 1 | C:345-L10806_R-S |
| 3 | -564 | 1,198 | 300049 7THOMHL 345 300120 5THMHIL 161 1 | C:345088 7MCCREDIE 345 345408 7OVERTON 345 1 |
| 4 | 4,429 | 4,632 | 256026 18THETFD 345 264580 19JEWEL 345 1 | C:b\|19BAUER-19PONTC 345-1 |
| 5 | 3,917 | 5,398 | 337651 8WHT BLUFF percent 500 337957 8KEO percent 500 1 | C:P1_2-1312 |
| 6 | 1,277 | 5,328 | 256026 18THETFD 345 264580 19JEWEL 345 1 | C:b\|19BAUER-19PONTC 345-1 |
| 7 | 470 | 3,589 | 264522 19MENLO1 120 264947 19BUNCE2 120 1 | C:x\|19GRNEC 345-120-1 |

**Table A-2: Without MVP Capacity Import Limits**

# APPENDIX F - STATE PROTECTED SPECIES

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## State Protected Species - Project Study Area

| Common Name | Scientific Name | Type of Organism | State Listing Status | | | |
|---|---|---|---|---|---|---|
| | | | Clayton County, IA* | Dubuque County, IA** | Jo Daviess County, IL*** | Grant County, WI**** |
| Blanchard's Cricket Frog | *Acris blanchardi* | Amphibian | | | | E |
| Four-toed Salamander | *Hemidactylium scutatum* | Amphibian | | | T | |
| Mudpuppy | *Necturus maculosus* | Amphibian | T | | | |
| Pickerel Frog | *Lithobates palustris* | Amphibian | | | | S/H |
| Acadian Flycatcher | *Empidonax virescens* | Bird | | | | T |
| Bald Eagle | *Haliaeetus leucocephalus* | Bird | S | S | | |
| Barn Owl | *Tyto alba* | Bird | E | | | S/M |
| Bell's Vireo | *Vireo bellii* | Bird | | | | T |
| Cerulean Warbler | *Dendroica cerulea* | Bird | | | T | T |
| Great Egret | *Ardea alba* | Bird | | | | T |
| Henslow's Sparrow | *Ammodramus henslowii* | Bird | T | | | T |
| Hooded Warbler | *Setophaga citrina* | Bird | | | | T |
| Kentucky Warbler | *Geothlypis formosa* | Bird | | | | T |
| King Rail | *Rallus elegans* | Bird | | E | | |
| Lark Sparrow | *Chondestes grammacus* | Bird | | | | S/M |
| Least Bittern | *Ixobrychus exilis* | Bird | | | | S/M |
| Loggerhead Shrike | *Lanius ludovicianus* | Bird | | | E | |
| Louisiana Waterthrush | *Parkesia motacilla* | Bird | | | | S/M |
| Peregrine Falcon | *Falco peregrinus* | Bird | | | | E |
| Prothonotary Warbler | *Protonotaria citrea* | Bird | | | | S/M |
| Red-shouldered Hawk | *Buteo lineatus* | Bird | E | | | T |
| Trumpeter Swan | *Cygnus buccinator* | Bird | | | | S/M |
| Upland Sandpiper | *Bartramia longicauda* | Bird | | | E | |
| Worm-eating Warbler | *Helmitheros vermivorum* | Bird | | | | E |
| Yellow-headed Blackbird | *Xanthocephalus xanthocephalus* | Bird | | | E | |
| Yellow-throated Warbler | *Setophaga dominica* | Bird | | | | E |
| American Brook Lamprey | *Lampetra appendix* | Fish | T | | | |
| American Eel | *Anguilla rostrata* | Fish | | | | S/N |
| Black Buffalo | *Ictiobus niger* | Fish | | | | T |
| Black Redhorse | *Moxostoma duquesnei* | Fish | T | | | |
| Blue Sucker | *Cycleptus elongatus* | Fish | | | | T |
| Bluntnose Darter | *Etheostoma chlorosoma* | Fish | E | | | E |
| Burbot | *Lota lota* | Fish | T | | | |
| Crystal Darter | *Crystallaria asprella* | Fish | | | | E |
| Goldeye | *Hiodon alosoides* | Fish | | | | E |
| Grass Pickerel | *Esox americanus* | Fish | T | | | |
| Lake Chubsucker | *Erimyzon sucetta* | Fish | | | | S/N |
| Lake Sturgeon | *Acipenser fulvescens* | Fish | E | | E | S/H |
| Least Darter | *Etheostoma microperca* | Fish | E | | | |
| Mud Darter | *Etheostoma asprigene* | Fish | | | | S/N |
| Ozark Minnow | *Notropis nubilus* | Fish | | | | S/N |
| Paddlefish | *Polyodon spathula* | Fish | | | | T |
| Pallid Shiner | *Hybopsis amnis* | Fish | | | E | E |
| Pirate Perch | *Aphredoderus sayanus* | Fish | | | | S/N |

## State Protected Species - Project Study Area

| Common Name | Scientific Name | Type of Organism | State Listing Status | | | |
|---|---|---|---|---|---|---|
| | | | Clayton County, IA* | Dubuque County, IA** | Jo Daviess County, IL*** | Grant County, WI**** |
| Pugnose Minnow | *Opsopoeodus emiliae* | Fish | S | S | | S/N |
| River Chub | *Nocomis micropogon* | Fish | | | E | |
| River Redhorse | *Moxostoma carinatum* | Fish | | | | T |
| Shoal Chub | *Macrhybopsis hyostoma* | Fish | | | | T |
| Silver Chub | *Macrhybopsis storeriana* | Fish | | | | S/N |
| Starhead Topminnow | *Fundulus dispar* | Fish | | | | E |
| Weed Shiner | *Notropis texanus* | Fish | E | | E | S/N |
| Western Sand Darter | *Ammocrypta clara* | Fish | T | | T | S/N |
| Black Sandshell | *Ligumia recta* | Freshwater Mussel | | | T | |
| Buckhorn/Pistolgrip | *Tritogonia verrucosa* | Freshwater Mussel | E | E | | T |
| Bullhead/Sheepnose | *Plethobasus cyphyus* | Freshwater Mussel | E | | | E |
| Creek Heelsplitter | *Lasmigona compressa* | Freshwater Mussel | | T | | |
| Creeper | *Strophitus undulatus* | Freshwater Mussel | T | T | | |
| Cylindrical Papershell | *Anodontoides ferussacianus* | Freshwater Mussel | | T | | |
| Ebony Shell | *Fusconaia ebena* | Freshwater Mussel | | | | E |
| Elephant Ear | *Elliptio crassidens* | Freshwater Mussel | | | | E |
| Elktoe | *Alasmidonta marginata* | Freshwater Mussel | | | | S/P |
| Ellipse | *Venustaconcha ellipsiformis* | Freshwater Mussel | | T | | T |
| Fawnsfoot | *Truncilla donaciformis* | Freshwater Mussel | | | | T |
| Flat Floater | *Anodonta suborbiculata* | Freshwater Mussel | | | | S/P |
| Higgin's-eye Pearly Mussel | *Lampsilis higginsii* | Freshwater Mussel | E | E | E | E |
| Mapleleaf | *Quadrula quadrula* | Freshwater Mussel | | | | S/P |
| Monkeyface | *Quadrula metanevra* | Freshwater Mussel | | | | T |
| Purple Wartyback | *Cyclonaias tuberculata* | Freshwater Mussel | T | T | | E |
| Rock Pocketbook | *Arcidens confragosus* | Freshwater Mussel | | | | T |
| Round Pigtoe | *Pleurobema sintoxia* | Freshwater Mussel | E | E | | |
| Salamander Mussel | *Simpsonaias ambigua* | Freshwater Mussel | | | | x |
| Slippershell | *Alasmidonta viridis* | Freshwater Mussel | | T | T | |
| Spectacle Case | *Cumberlandia monodonta* | Freshwater Mussel | | | | E |
| Wartyback | *Quadrula nodulata* | Freshwater Mussel | | | | T |
| Washboard | *Megalonaias nervosa* | Freshwater Mussel | | | | S/P |
| Yellow Sandshell | *Lampsilis teres* | Freshwater Mussel | E | | | E |
| A Flat-headed Mayfly | *Macdunnoa persimplex* | Invertebrate | | | | S/N |
| A Leafhopper | *Attenuipyga vanduzeei* | Invertebrate | | | | E |
| A Melyrid Beetle | *Collops vicarius* | Invertebrate | | | | S/N |
| A Predaceous Diving Beetle | *Neoporus hybridus* | Invertebrate | | | | S/N |
| A Riffle Beetle | *Stenelmis musgravei* | Invertebrate | | | | S/N |
| A Small Minnow Mayfly | *Paracloeodes minutus* | Invertebrate | | | | S/N |
| A Small Square-gilled Mayfly | *Caenis hilaris* | Invertebrate | | | | S/N |
| A Small Square-gilled Mayfly | *Sparbarus lacustris* | Invertebrate | | | | S/N |
| A Small Square-gilled Mayfly | *Sparbarus nasutus* | Invertebrate | | | | S/N |
| A Water Savenger Beetle | *Cymbiodyta toddi* | Invertebrate | | | | S/N |
| Abbreviated Underwing Moth | *Catocala abbreviatella* | Invertebrate | | | | S/N |
| An Issid Planthopper | *Fitchiella robertsonii* | Invertebrate | | | | T |

## State Protected Species - Project Study Area

| Common Name | Scientific Name | Type of Organism | State Listing Status | | | |
|---|---|---|---|---|---|---|
| | | | Clayton County, IA* | Dubuque County, IA** | Jo Daviess County, IL*** | Grant County, WI**** |
| Bluff Vertigo | *Vertigo meramecensis* | Invertebrate | E | E | | |
| Briarton Pleistoscene Vertigo | *Vertigo brierensis* | Invertebrate | E | | | |
| Brilliant Granule | *Guppya sterkii* | Invertebrate | | | | S/N |
| Butterfly | *Ellipsaria lineolata* | Invertebrate | T | T | T | E |
| Byssus Skipper | *Problema byssus* | Invertebrate | | | | S/N |
| Cherrystone Drop | *Hendersonia occulta* | Invertebrate | | | | T |
| Club-horned Grasshopper | *Aeropedellus clavatus* | Invertebrate | | | | S/N |
| Columbine Dusky Wing | *Erynnis lucilius* | Invertebrate | S | | | S/N |
| Douglas Stenelmis Riffle Beetle | *Stenelmis douglasensis* | Invertebrate | | | | S/N |
| Dusted Skipper | *Atrytonopsis hianna* | Invertebrate | | | | S/N |
| Fox Small Square-gilled Mayfly | *Cercobrachys fox* | Invertebrate | | | | S/N |
| Frigid Ambersnail | *Catinella gelida* | Invertebrate | E | E | | |
| Gorgone Checker Spot | *Chlosyne gorgone* | Invertebrate | | | | S/N |
| Gray Copper | *Lycaena dione* | Invertebrate | | | | S/N |
| Great Spreadwing | *Archilestes grandis* | Invertebrate | | | | S/N |
| Highland Dancer | *Argia plana* | Invertebrate | | | | S/N |
| Hine's Emerald | *Somatochlora hineana* | Invertebrate | | | | E |
| Honey Vertigo | *Vertigo tridentata* | Invertebrate | | | | S/N |
| Iowa Amphipod | *Stygobromus iowae* | Invertebrate | | | E | |
| Iowa Pleistocene Snail | *Discus macclintocki* | Invertebrate | E | E | E | |
| Iowa Pleistocene Vertigo | *Vertigo iowaensis* | Invertebrate | E | | | |
| Juniper Hairstreak | *Callophrys gryneus* | Invertebrate | | | | S/N |
| Knobel's Riffle Beetle | *Stenelmis knobeli* | Invertebrate | | | | E |
| Leadplant Flower Moth | *Shinia lucens* | Invertebrate | | | | S/N |
| Midwest Pleistocene Vertigo | *Vertigo hubrichti* | Invertebrate | T | T | | E |
| Ojibwe Small Square-gilled Mayfly | *Brachycercus ojibwe* | Invertebrate | | | | S/N |
| Ottoe Skipper | *Hesperia ottoe* | Invertebrate | | | | E |
| Pecatonica River Mayfly | *Acanthametropus pecatonica* | Invertebrate | | | | E |
| Phyllira Tiger Moth | *Grammia phyllira* | Invertebrate | | | | S/N |
| Prairie Leafhopper | *Polyamia dilata* | Invertebrate | | | | T |
| Regal Fritillary | *Speyeria idalia* | Invertebrate | | | T | |
| Royal River Cruiser | *Macromia taeniolata* | Invertebrate | | | | S/N |
| Smooth Coil | *Helicodiscus singleyanus* | Invertebrate | | | | S/N |
| Swamp Darner | *EpiaeShna heros* | Invertebrate | | | | S/N |
| Trumpet Vallonia | *Vallonia parvula* | Invertebrate | | | | S/N |
| Velvet-striped Grasshopper | *Eritettix simplex* | Invertebrate | | | | S/N |
| Wallace's Deepwater Mayfly | *Spinadis simplex* | Invertebrate | | | | E |
| Whitney's Underwing Moth | *Catocala whitneyi* | Invertebrate | | | | S/N |
| Wing Snaggletooth | *Gastrocopta procera* | Invertebrate | | | | T |
| Wisconsin Small Square-gilled Mayfly | *Cercobrachys lilliei* | Invertebrate | | | | S/N |
| Yellowbanded Bumble Bee | *Bombus terricola* | Invertebrate | | | | S/N |
| Big Brown Bat | *Eptesicus fuscus* | Mammal | | | | T |
| Eastern Pipistrelle | *Perimyotis subflavus* | Mammal | | | | T |
| Franklin's Ground Squirrel | *Spermophilus franklinii* | Mammal | | | | S/N |

**State Protected Species - Project Study Area**

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|---|---|---|---|---|---|---|
| | | | Clayton County, IA* | Dubuque County, IA** | Jo Daviess County, IL*** | Grant County, WI**** |
| Gray/Timber Wolf | *Canis lupus* | Mammal | | | T | |
| Indiana Bat | *Myotis sodalis* | Mammal | | E | E | |
| Little Brown Bat | *Myotis lucifugus* | Mammal | | | | T |
| Northern Long-eared Bat | *Myotis septentrionalis* | Mammal | | | | T |
| Prairie Vole | *Microtus ochrogaster* | Mammal | | | | S/N |
| Southern Flying Squirrel | *Glaucomys volans* | Mammal | S | S | | |
| Spotted Skunk | *Spilogale putorius* | Mammal | E | E | | |
| Western Harvest Mouse | *Reithrodontomys megalotis* | Mammal | | | | S/N |
| Woodland Vole | *Microtus pinetorum* | Mammal | | | | S/N |
| Alderleaf Buckthorn | *Rhamnus alnifolia* | Plant | S | S | | |
| American Speedwell | *Veronica americana* | Plant | | S | | |
| Balsam Fir | *Abies balsamea* | Plant | S | | | |
| Beaked Hazelnut | *Corylus cornuta* | Plant | | | E | |
| Bearded Wheat Grass | *Elymus trachycaulus* | Plant | | | T | |
| Bigroot Prickly-pear | *Opuntia macrorhiza* | Plant | | E | | |
| Bird's-eye Primrose | *Primula mistassinica* | Plant | | | E | |
| Blue Giant Hyssop | *Agastache foeniculum* | Plant | E | | | |
| Blue Grama | *Bouteloua gracilis* | Plant | | | E | |
| Blue Sage | *Salvia azurea* ssp. *pitcheri* | Plant | | | T | |
| Bog Bedstraw | *Galium labradoricum* | Plant | E | | | |
| Bog Birch | *Betula pumila* | Plant | T | | | |
| Bog Bluegrass | *Poa paludigena* | Plant | S | S | | |
| Bog Willow | *Salix pedicellaris* | Plant | T | | | |
| Broad Beech Fern | *Phegopteris hexagonoptera* | Plant | | | | S |
| Bunchberry | *Cornus canadensis* | Plant | T | | | |
| Buttonweed | *Diodia teres* var. *teres* | Plant | | | | S |
| Canada Plum | *Prunus nigra* | Plant | E | | | |
| Canada Violet | *Viola canadensis* | Plant | | | E | |
| Carey Sedge | *Carex careyana* | Plant | S | S | | |
| Chinquapin Oak | *Quercus muehlenbergii* | Plant | | | | S |
| Cinnamon Fern | *Osmunda cinnamomea* | Plant | E | | | S |
| Cleft Phlox | *Phlox bifida* | Plant | | | | S |
| Cliff Goldenrod | *Solidago sciaphila* | Plant | | | T | |
| Clustered Poppy-mallow | *Callirhoe triangulata* | Plant | | | | S |
| Crowfoot Clubmoss | *Lycopodium digitatum* | Plant | S | S | | |
| Cutleaf Water-milfoil | *Myriophyllum pinnatum* | Plant | | S | | |
| Dragon Wormwood | *Artemisia dracunculus* | Plant | | | | S |
| Drooping Bluegrass | *Poa languida* | Plant | S | | | |
| Drooping Sedge | *Carex prasina* | Plant | | | T | |
| Dwarf Scouring-rush | *Equisetum scirpoides* | Plant | S | S | | |
| Earleaf Foxglove | *Tomanthera auriculata* | Plant | S | | | |
| False Heather | *Hudsonia tomentosa* | Plant | | | E | |
| False Melic Grass | *Schizachne purpurascens* | Plant | | | E | |
| False Mermaid-weed | *Floerkea proserpinacoides* | Plant | E | E | | |

**State Protected Species - Project Study Area**

| Common Name | Scientific Name | Type of Organism | State Listing Status | | | |
|---|---|---|---|---|---|---|
| | | | Clayton County, IA* | Dubuque County, IA** | Jo Daviess County, IL*** | Grant County, WI**** |
| Field Sedge | *Carex conoidea* | Plant | | S | | |
| Fineberry Hawthorn | *Crataegus chrysocarpa* | Plant | | S | | |
| Flat Top White Aster | *Aster pubentior* | Plant | S | | | |
| Flat-stemmed Spike-rush | *Eleocharis compressa* | Plant | | | | S |
| Fragile Prickly Pear | *Opuntia fragilis* | Plant | | | E | |
| Frost Grape | *Vitis vulpina* | Plant | S | | | |
| Glade Fern | *Diplazium pycnocarpon* | Plant | | | | S |
| Glandular Wood Fern | *Dryopteris intermedia* | Plant | T | T | | |
| Glomerate Sedge | *Carex aggregata* | Plant | | S | | |
| Golden Saxifrage | *Chrysosplenium iowense* | Plant | T | T | | |
| Grape-stemmed Clematis | *Clematis occidentalis* | Plant | S | S | E | |
| Grass Pink | *Calopogon tuberosus* | Plant | S | | | |
| Great Plains Ladies'-tresses | *Spiranthes magnicamporum* | Plant | | S | | |
| Great Water-leaf | *Hydrophyllum appendiculatum* | Plant | | | | S |
| Green Violet | *Hybanthus concolor* | Plant | T | T | | |
| Ground Juniper | *Juniperus communis* | Plant | | | T | |
| Hairy Umbrella-wort | *Mirabilis hirsuta* | Plant | | | E | |
| Hairy White Violet | *Viola blanda* | Plant | | | E | |
| Hairy Wild-petunia | *Ruellia humilis* | Plant | | | | E |
| Hairy Woodrush | *Luzula acuminata* | Plant | | | E | |
| Hazel Dodder | *Cuscuta coryli* | Plant | | | | S |
| Heart-leaved Skullcap | *Sutellaria ovata* ssp. *ovata* | Plant | | | | S |
| Hedge Nettle | *Stachys aspera* | Plant | S | | | |
| Hemlock Parsley | *Conioselinum chinense* | Plant | | | E | |
| Hill's Thistle | *Cirsium hillii* | Plant | | S | | T |
| Hoary Tick-trefoil | *Desmodium canescens* | Plant | | | | S |
| Hooker's Orchid | *Platanthera hookeri* | Plant | T | T | | S |
| Intermediate Sedge | *Carex media* | Plant | | | | E |
| James' Clammyweed | *Polanisia jamesii* | Plant | | | E | |
| Jeweled Shooting Star | *Dodecatheon amethystinum* | Plant | T | T | | S |
| Kentucky Coffee-tree | *Gymnocladus dioicus* | Plant | | | | S |
| Kidney-leaf White Violet | *Viola renifolia* | Plant | T | T | | |
| Kittentails | *Besseya bullii* | Plant | | | T | |
| Lanced-leaved Buckthorn | *Rhamnus lanceolata* ssp. *glabrata* | Plant | | | | S |
| Leathery Grape Fern | *Botrychium multifidum* | Plant | T | T | | |
| Ledge Spikemoss | *Selaginella rupestris* | Plant | S | S | | |
| Limestone Oak Fern | *Gymnocarpium robertianum* | Plant | S | S | | S |
| Limestone Rockcress | *Arabis divaricarpa* | Plant | | S | | |
| Low Bindweed | *Calystegia spithamaea* | Plant | S | S | | |
| Low Sweet Blueberry | *Vaccinium angustifolium* | Plant | T | | | |
| Marginal Shield Fern | *Dryopteris marginalis* | Plant | | T | | |
| Maryland Senna | *Senna marilandica* | Plant | | | | S |
| Meadow Bluegrass | *Poa wolfii* | Plant | S | | | |
| Meadow Horsetail | *Equisetum pratense* | Plant | | | T | |

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| Common Name | Scientific Name | Type of Organism | State Listing Status | | | |
|---|---|---|---|---|---|---|
| | | | Clayton County, IA* | Dubuque County, IA** | Jo Daviess County, IL*** | Grant County, WI**** |
| Moschatel | *Adoxa moschatellina* | Plant | | | E | |
| Mountain Maple | *Acer spicatum* | Plant | S | S | | |
| Mountain Ricegrass | *Oryzopsis asperifolia* | Plant | S | S | | |
| Mullein Foxglove | *Dasistoma macrophylla* | Plant | | | | S |
| Muskroot | *Adoxa moschatellina* | Plant | S | S | | T |
| Narrowleaf Pinweed | *Lechea intermedia* | Plant | | T | | |
| Narrow-leaved Dayflower | *Commelina erecta* var. *deamiana* | Plant | | | | S |
| Nodding Onion | *Allium cernuum* | Plant | T | T | | |
| Nodding Pogonia | *Triphora trianthophora* | Plant | | | | S |
| Nodding Rattlesnake-root | *Prenanthes crepidinea* | Plant | | | | E |
| Northern Adder's-tongue | *Ophioglossum pusillum* | Plant | S | | | |
| Northern Black Currant | *Ribes hudsonianum* | Plant | T | T | | |
| Northern Lungwort | *Mertensia paniculata* | Plant | E | | | |
| Northern Monkshood | *Aconitum noveboracense* | Plant | T | T | | T |
| Northern Panic-grass | *Dichanthelium boreale* | Plant | E | | | |
| Oak Fern | *Gymnocarpium dryopteris* | Plant | T | T | T | |
| October Lady's-tresses | *Spiranthes ovalis* var. *erostellata* | Plant | | | | S |
| One-flowered Broomrape | *Orobanche uniflora* | Plant | | | | S |
| Oval Ladies'-tresses | *Spiranthes ovalis* | Plant | | T | | |
| Ovate Spikerush | *Eleocharis ovata* | Plant | S | | | |
| Pale False Foxglove | *Agalinis skinneriana* | Plant | | E | | E |
| Pale Purple Coneflower | *Echinacea pallida* | Plant | | | | T |
| Pale Vetchling | *Lathyrus ochroleucus* | Plant | | | T | |
| Partridge Berry | *Mitchella repens* | Plant | | T | | |
| Pearly Everlasting | *Anaphalis margaritacea* | Plant | S | S | | |
| Pin Oak | *Quercus palustris* | Plant | | | | S |
| Pinesap | *Monotropa hypopithys* | Plant | T | T | | |
| Pink Milkwort | *Polygala incarnata* | Plant | | | | E |
| Prairie Bush-clover | *Lespedeza leptostachya* | Plant | | | | E |
| Prairie Dandelion | *Nothocalais cuspidata* | Plant | | | E | S |
| Prairie Dock | *Silphium terebinthinaceum* | Plant | | S | | |
| Prairie Fame-flower | *Phemeranthus rugospermus* | Plant | | | | S |
| Prairie Indian-plantain | *Arnoglossum plantagineum* | Plant | | | | S |
| Prairie Ragwort | *Packera plattensis* | Plant | | | | S |
| Prairie Turnip | *Pediomelum esculentum* | Plant | | | | S |
| Prairie White-fringed Orchid | *Platanthera leucophaea* | Plant | | | | E |
| Pretty Sedge | *Carex woodii* | Plant | | | T | |
| Prickly Rose | *Rosa acicularis* | Plant | E | E | E | |
| Purple Angelica | *Angelica atropurpurea* | Plant | | S | | |
| Purple Cliff-brake Fern | *Pellaea atropurpurea* | Plant | E | E | | S |
| Purple Milkweed | *Asclepias purpurascens* | Plant | | | | E |
| Purple Rocket | *Iodanthus pinnatifidus* | Plant | | | | S |
| Putty Root | *Aplectrum hyemale* | Plant | | | | S |
| Redroot | *Ceanothus herbaceus* | Plant | | | E | |

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| Common Name | Scientific Name | Type of Organism | State Listing Status | | | |
|---|---|---|---|---|---|---|
| | | | Clayton County, IA* | Dubuque County, IA** | Jo Daviess County, IL*** | Grant County, WI**** |
| Rock Clubmoss | *Lycopodium porophilum* | Plant | T | | | S |
| Rock Elm | *Ulmus thomasii* | Plant | | | E | |
| Rock Sandwort | *Minuartia michauxii* | Plant | | S | | |
| Rosy Twisted Stalk | *Streptopus roseus* | Plant | T | T | | |
| Rough Bedstraw | *Galium asprellum* | Plant | S | S | | |
| Rough Buttonweed | *Diodia teres* | Plant | | S | | |
| Rough Rattlesnake-root | *Prenanthes aspera* | Plant | | | | E |
| Round-fruited St. John's-wort | *Hypericum sphaerocarpum* | Plant | | | | T |
| Roundstem Foxglove | *Agalinis gattingeri* | Plant | | | | T |
| Sage Willow | *Salix candida* | Plant | S | | | |
| Saskatoon Service-berry | *Amelanchier alnifolia* | Plant | S | | | |
| Scarlet Hawthorn | *Crataegus coccinea* | Plant | | S | | |
| Sedge | *Carex cephalantha* | Plant | S | | | |
| Sedge | *Carex inops* ssp. *heliophila* | Plant | | | E | |
| Shadbush | *Amelanchier interior* | Plant | | | T | |
| Shadbush | *Amelanchier sanguinea* | Plant | S | S | | |
| Shinners' Tee-awned Grass | *Aristida dichotoma* | Plant | | | | S |
| Short's Rock-cress | *Arabis shortii* | Plant | | | | S |
| Showy Lady's Slipper | *Cypripedium reginae* | Plant | T | | | |
| Silvery Scurf Pea | *Pediomelum argophyllum* | Plant | | | | S |
| Slender Mountain-ricegrass | *Oryzopsis pungens* | Plant | E | | | |
| Slender Sedge | *Carex tenera* | Plant | | S | | |
| Slim-leaved Panic Grass | *Dichanthelium linearifolium* | Plant | | T | | |
| Small Enchanter's Nightshade | *Circaea alpina* | Plant | | | E | |
| Small Forget-me-not | *Myosotis laxa* | Plant | | | | S |
| Small White Lady's-slipper | *Cypripedium candidum* | Plant | | | | T |
| Snow Trillium | *Trillium nivale* | Plant | | | | T |
| Snowberry | *Symphoricarpos albus* | Plant | S | | | |
| Snowberry | *Symphoricarpos albus* var. *albus* | Plant | | | E | |
| Snowy Campion | *Silene nivea* | Plant | | | | S |
| Solomon's Seal | *Polygonatum pubescens* | Plant | S | | | |
| Spotted Coralroot | *Corallorhiza maculata* | Plant | T | T | | |
| Spreading Chervil | *Chaerophyllum procumbens* | Plant | | | | S |
| Spreading Hawthorn | *Crataegus disperma* | Plant | | S | | |
| Spurge | *Euphorbia commutata* | Plant | S | | | |
| Stickseed | *Hackelia deflexa* var. *americana* | Plant | | | E | |
| Sullivantia | *Sullivantia sullivantii* | Plant | | | T | |
| Summer Grape | *Vitis aestivalis* | Plant | S | S | | |
| Sycamore | *Platanus occidentalis* | Plant | | | | S |
| Tall Cotton Grass | *Eriophorum angustifolium* | Plant | S | | | |
| Tee-flowered Melic Grass | *Melica nitens* | Plant | | | | S |
| Tree Clubmoss | *Lycopodium dendroideum* | Plant | T | T | | |
| Twinflower | *Linnaea borealis* | Plant | T | | | |
| Twinleaf | *Jeffersonia diphylla* | Plant | T | T | | S |

## State Protected Species - Project Study Area

| Common Name | Scientific Name | Type of Organism | State Listing Status | | | |
|---|---|---|---|---|---|---|
| | | | Clayton County, IA* | Dubuque County, IA** | Jo Daviess County, IL*** | Grant County, WI**** |
| Umbrella Sedge | *Cyperus grayoides* | Plant | | | T | |
| Upland Boneset | *Eupatorium sessilifolium* | Plant | S | | | |
| Valerian | *Valeriana edulis* | Plant | S | | | |
| Velvet Leaf Blueberry | *Vaccinium myrtilloides* | Plant | T | | | |
| Violet Bush-clover | *Lespedeza violacea* | Plant | | | | S |
| Wafer-ash | *Ptelea trifoliata* | Plant | | | | S |
| Western Prairie Fringed Orchid | *Platanthera praeclara* | Plant | T | | | |
| Whip Nutrush | *Sleria triglomerata* | Plant | | | | S |
| White Camass | *Zigadenus elegans* | Plant | | | E | S |
| Wild Licorice | *Glycyrrhiza lepidota* | Plant | | | | S |
| Wooly Milkweed | *Asclepias lanuginosa* | Plant | | | E | T |
| Yellow Giant Hyssop | *Agastache nepetoides* | Plant | | | | S |
| Yellow Monkey Flower | *Mimulus glabratus* | Plant | | T | | |
| Yellow Trout-lily | *Erythronium americanum* | Plant | T | T | | |
| Yerba-de-tajo | *Eclipta prostrata* | Plant | | | | S |
| Blanding's Turtle | *Emydoidea blandingii* | Reptile | T | | T | S/H |
| Bullsnake/Gophersnake | *Pituophis catenifer* | Reptile | S | | | S/P |
| Common Musk Turtle | *Sternotherus odoratus* | Reptile | T | | | |
| Gray Ratsnake | *Pantherophis spiloides* | Reptile | | | | S/P |
| Lined Snake | *Tropidoclonion lineatum* | Reptile | | | T | |
| North American Racer | *Coluber constrictor* | Reptile | | | | S/P |
| Ornate Box Turtle | *Terrapene ornata* | Reptile | T | T | T | E |
| Plains Hog-nosed Snake | *Heterodon nasicus* | Reptile | | | T | |
| Prairie Ring-necked Snake | *Diadophis punctatus arnyi* | Reptile | | | | S/H |
| Six-lined Racerunner | *Aspidoscelis sexlineata* | Reptile | | | | S/H |
| Smooth Softshell | *Apalone mutica* | Reptile | | | | S/H |
| Timber Rattlesnake | *Crotalus horridus* | Reptile | | | T | S/P |
| Western Wormsnake | *Carphophis vermis* | Reptile | | | | S/H |
| Wood Turtle | *Glyptemys insculpta* | Reptile | | | | T |

Iowa and Illinios listing statuses: T - Threatened, E - Endangered, S - Special Concern.

Wisconsin listing statuses: S - Special concern fully protected, S/N - Special concern no laws regulating use, S/H - Special concern take regulated by establishment of open closed seasons, S/FL - Special concern federal protected as endangered or threatened, but not so designated by the WI DNR, S/M - Special concern fully protected by federal and state laws under the MBTA

* Iowa Natural Areas Inventory, Clayton County, IA. https://programs.iowadnr.gov/naturalareasinventory/pages/RepDistinctSpeciesByCounty.aspx?CountyID=22. Accessed October 12, 2015.

** Iowa Natural Areas Inventory, Dubuque County, IA. https://programs.iowadnr.gov/naturalareasinventory/pages/RepDistinctSpeciesByCounty.aspx?CountyID=31. Accessed October 12, 2015.

*** Illinois Threatened and Endangered Species by County. https://www.dnr.illinois.gov/espb/documents/et_by_county.pdf. Accessed October 12, 2015.

**** Wisconsin Department of Natural Resources, Natural Heritage Inventory Data. http://dnr.wi.gov/topic/NHI/Data.asp?tool=county. Accessed October 12, 2015.

# APPENDIX G - OPTIONAL TRANSMISSION DESIGN THROUGH THE REFUGE

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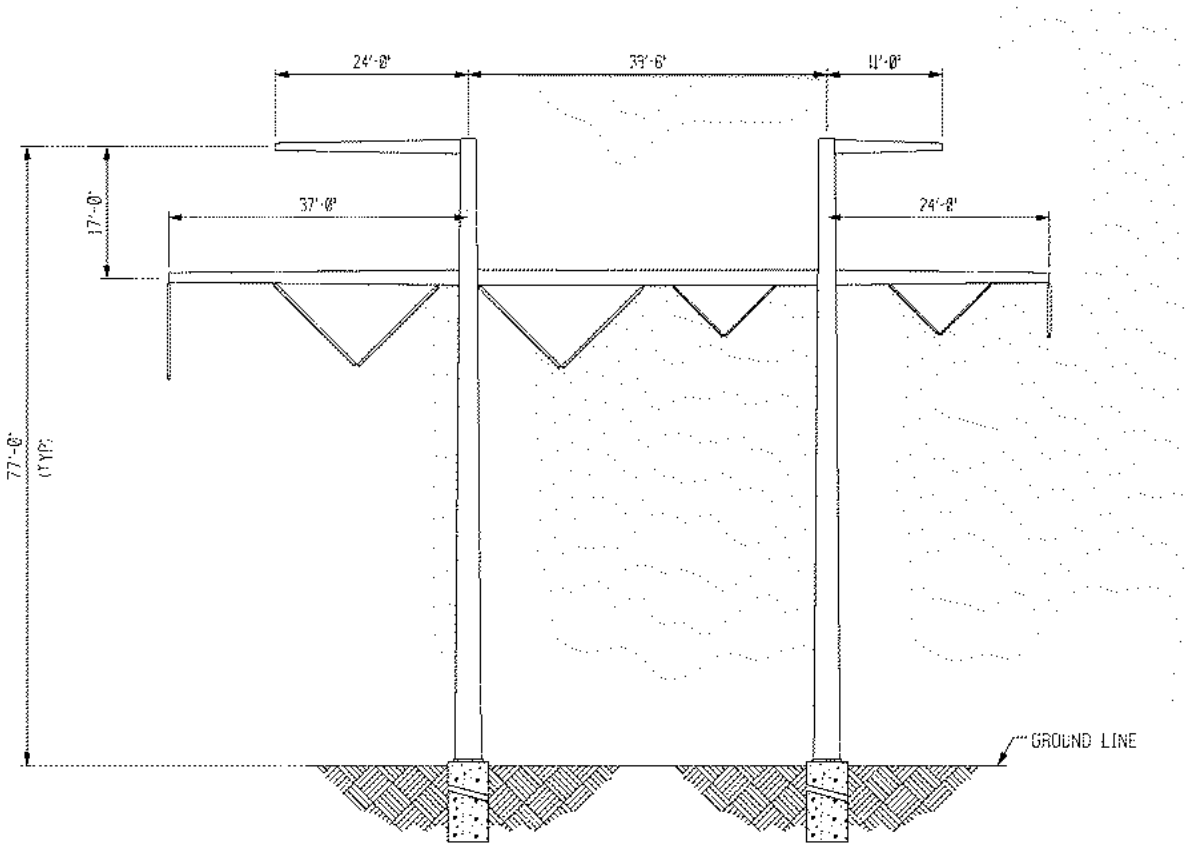
**Proposed Optional Transmission Design through Refuge**

**345 kV/161 kV Double Circuit H-Frame**



**Impact Summary Table**

**Nelson Dewey Optional Transmission Design through Refuge**

| **Route Name** | **Nelson Dewey** |
|---|---|
| Total length (Miles) | 14.6 |
| Number of angles greater than 30˚ | 13 |
| Length not Along Transmission Lines (miles | 12.7 |
| Length of river crossing (miles) | 0.3 |
| Airport, airstrip, or heliport within 1 mile (number) | 0 |
| Water towers within 1,000 feet (number) | 0 |
| Communication facilities within 1,000 feet (number) | 18 |
| Length through Corps Restricted Area (miles) | 0.0 |
| Length through floodplain (miles) | 0.8 |
| Length Through Terrain with Greater than 30% Slope (miles) | 0.1 |
| Total Wetland acres in ROW (acres) | 8.7 |
| Woody wetland in ROW (acres) | 6.9 |
| Emergent wetland in ROW (acres) | 1.8 |
| Total Woodland acres in ROW (acres) | 61.5 |
| Number of streams/ waterways crossed | 15 |
| Length through state or local public lands (miles) | 0.0 |
| Length through private conservation easements (miles) | 0.5 |
| Length through USFWS Refuge (feet) | 3698.0 |
| USFWS Refuge Land within ROW (acres) | 20.4 |
| Parks within 1,000 feet (number) | 0 |
| Residences within 0-25 feet (number) | 0 |
| Residences within 26-50 feet (number) | 1 |
| Residences within 51-100 feet (number) | 1 |
| Residences within 101-300 feet (number) | 6 |
| Schools within 300 feet (number) | 0 |
| Daycares within 300 feet (number) | 0 |
| Hospitals within 300 feet (number) | 0 |
| Places of Worship within 300 feet (number) | 0 |
| Business/ Commercial structure within 300 feet (number) | 0 |
| Public Facilities within 300 feet (number) | 0 |
| Cemeteries within 300 feet (number) | 0 |
| Archaeological sites in ROW (number) | 1 |
| Historical resources within 1,000 feet (number) | 1 |
| Length not along actual fence row or property line (miles) | 2.7 |
| Length through developed space (miles) | 3.3 |
| Length through cultivated crops (miles) | 5.1 |
| Length through pasture/hayland (miles) | 0.5 |
| Length through prime farmland (miles) | 2.1 |

# APPENDIX H - NATIONAL WILDLIFE REFUGE SYSTEM IMPROVEMENT ACT OF 1997

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PUBLIC LAW 105–57—OCT. 9, 1997

# NATIONAL WILDLIFE REFUGE SYSTEM IMPROVEMENT ACT OF 1997

Public Law 105–57
105th Congress

# An Act

Oct. 9, 1997
[H.R. 1420]

To amend the National Wildlife Refuge System Administration Act of 1966 to improve the management of the National Wildlife Refuge System, and for other purposes.

*Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,*

National Wildlife Refuge System Improvement Act of 1997.
16 USC 668dd note.

**SECTION 1. SHORT TITLE; REFERENCES.**

(a) SHORT TITLE.—This Act may be cited as the "National Wildlife Refuge System Improvement Act of 1997".

(b) REFERENCES.—Whenever in this Act an amendment or repeal is expressed in terms of an amendment to, or repeal of, a section or other provision, the reference shall be considered to be made to a section or provision of the National Wildlife Refuge System Administration Act of 1966 (16 U.S.C. 668dd et seq.).

16 USC 668dd note.

**SEC. 2. FINDINGS.**

The Congress finds the following:

(1) The National Wildlife Refuge System is comprised of over 92,000,000 acres of Federal lands that have been incorporated within 509 individual units located in all 50 States and the territories of the United States.

(2) The System was created to conserve fish, wildlife, and plants and their habitats and this conservation mission has been facilitated by providing Americans opportunities to participate in compatible wildlife-dependent recreation, including fishing and hunting, on System lands and to better appreciate the value of and need for fish and wildlife conservation.

(3) The System serves a pivotal role in the conservation of migratory birds, anadromous and interjurisdictional fish, marine mammals, endangered and threatened species, and the habitats on which these species depend.

(4) The System assists in the fulfillment of important international treaty obligations of the United States with regard to fish, wildlife, and plants and their habitats.

(5) The System includes lands purchased not only through the use of tax dollars but also through the proceeds from sales of Duck Stamps and national wildlife refuge entrance fees. It is a System that is financially supported by those benefiting from and utilizing it.

(6) When managed in accordance with principles of sound fish and wildlife management and administration, fishing, hunting, wildlife observation, and environmental education in national wildlife refuges have been and are expected to continue to be generally compatible uses.

(7) On March 25, 1996, the President issued Executive Order 12996, which recognized "compatible wildlife-dependent recreational uses involving hunting, fishing, wildlife observation and photography, and environmental education and interpretation as priority public uses of the Refuge System".

(8) Executive Order 12996 is a positive step and serves as the foundation for the permanent statutory changes made by this Act.

**SEC. 3. DEFINITIONS.**

(a) IN GENERAL.—Section 5 (16 U.S.C. 668ee) is amended to read as follows:

**"SEC. 5. DEFINITIONS.**

"For purposes of this Act:

"(1) The term 'compatible use' means a wildlife-dependent recreational use or any other use of a refuge that, in the sound professional judgment of the Director, will not materially interfere with or detract from the fulfillment of the mission of the System or the purposes of the refuge.

"(2) The terms 'wildlife-dependent recreation' and 'wildlife-dependent recreational use' mean a use of a refuge involving hunting, fishing, wildlife observation and photography, or environmental education and interpretation.

"(3) The term 'sound professional judgment' means a finding, determination, or decision that is consistent with principles of sound fish and wildlife management and administration, available science and resources, and adherence to the requirements of this Act and other applicable laws.

"(4) The terms 'conserving', 'conservation', 'manage', 'managing', and 'management', mean to sustain and, where appropriate, restore and enhance, healthy populations of fish, wildlife, and plants utilizing, in accordance with applicable Federal and State laws, methods and procedures associated with modern scientific resource programs. Such methods and procedures include, consistent with the provisions of this Act, protection, research, census, law enforcement, habitat management, propagation, live trapping and transplantation, and regulated taking.

"(5) The term 'Coordination Area' means a wildlife management area that is made available to a State—

"(A) by cooperative agreement between the United States Fish and Wildlife Service and a State agency having control over wildlife resources pursuant to section 4 of the Fish and Wildlife Coordination Act (16 U.S.C. 664); or

"(B) by long-term leases or agreements pursuant to title III of the Bankhead-Jones Farm Tenant Act (50 Stat. 525; 7 U.S.C. 1010 et seq.).

"(6) The term 'Director' means the Director of the United States Fish and Wildlife Service or a designee of that Director.

"(7) The terms 'fish', 'wildlife', and 'fish and wildlife' mean any wild member of the animal kingdom whether alive or dead, and regardless of whether the member was bred, hatched, or born in captivity, including a part, product, egg, or offspring of the member.

"(8) The term 'person' means any individual, partnership, corporation, or association.

"(9) The term 'plant' means any member of the plant kingdom in a wild, unconfined state, including any plant community, seed, root, or other part of a plant.

"(10) The terms 'purposes of the refuge' and 'purposes of each refuge' mean the purposes specified in or derived from the law, proclamation, executive order, agreement, public land order, donation document, or administrative memorandum establishing, authorizing, or expanding a refuge, refuge unit, or refuge subunit.

"(11) The term 'refuge' means a designated area of land, water, or an interest in land or water within the System, but does not include Coordination Areas.

"(12) The term 'Secretary' means the Secretary of the Interior.

"(13) The terms 'State' and 'United States' mean the several States of the United States, Puerto Rico, American Samoa, the Virgin Islands, Guam, and the territories and possessions of the United States.

"(14) The term 'System' means the National Wildlife Refuge System designated under section 4(a)(1).

"(15) The terms 'take', 'taking', and 'taken' mean to pursue, hunt, shoot, capture, collect, or kill, or to attempt to pursue, hunt, shoot, capture, collect, or kill.".

(b) CONFORMING AMENDMENT.—Section 4 (16 U.S.C. 668dd) is amended by striking "Secretary of the Interior" each place it appears and inserting "Secretary".

**SEC. 4. MISSION OF THE SYSTEM.**

Section 4(a) (16 U.S.C. 668dd(a)) is amended—

(1) by redesignating paragraphs (2) and (3) as paragraphs (5) and (6), respectively;

(2) in clause (i) of paragraph (6) (as so redesignated), by striking "paragraph (2)" and inserting "paragraph (5)"; and

(3) by inserting after paragraph (1) the following new paragraph:

"(2) The mission of the System is to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans.".

**SEC. 5. ADMINISTRATION OF THE SYSTEM.**

(a) ADMINISTRATION GENERALLY.—Section 4(a) (16 U.S.C. 668dd(a)), as amended by section 4 of this Act, is further amended by inserting after new paragraph (2) the following new paragraphs:

"(3) With respect to the System, it is the policy of the United States that—

"(A) each refuge shall be managed to fulfill the mission of the System, as well as the specific purposes for which that refuge was established;

"(B) compatible wildlife-dependent recreation is a legitimate and appropriate general public use of the System, directly related to the mission of the System and the purposes of many refuges, and which generally fosters refuge management and through which the American public can develop an appreciation for fish and wildlife;

"(C) compatible wildlife-dependent recreational uses are the priority general public uses of the System and shall receive priority consideration in refuge planning and management; and

"(D) when the Secretary determines that a proposed wildlife-dependent recreational use is a compatible use within a refuge, that activity should be facilitated, subject to such restrictions or regulations as may be necessary, reasonable, and appropriate.

"(4) In administering the System, the Secretary shall—

"(A) provide for the conservation of fish, wildlife, and plants, and their habitats within the System;

"(B) ensure that the biological integrity, diversity, and environmental health of the System are maintained for the benefit of present and future generations of Americans;

"(C) plan and direct the continued growth of the System in a manner that is best designed to accomplish the mission of the System, to contribute to the conservation of the ecosystems of the United States, to complement efforts of States and other Federal agencies to conserve fish and wildlife and their habitats, and to increase support for the System and participation from conservation partners and the public;

"(D) ensure that the mission of the System described in paragraph (2) and the purposes of each refuge are carried out, except that if a conflict exists between the purposes of a refuge and the mission of the System, the conflict shall be resolved in a manner that first protects the purposes of the refuge, and, to the extent practicable, that also achieves the mission of the System;

"(E) ensure effective coordination, interaction, and cooperation with owners of land adjoining refuges and the fish and wildlife agency of the States in which the units of the System are located;

"(F) assist in the maintenance of adequate water quantity and water quality to fulfill the mission of the System and the purposes of each refuge;

"(G) acquire, under State law, water rights that are needed for refuge purposes;

"(H) recognize compatible wildlife-dependent recreational uses as the priority general public uses of the System through which the American public can develop an appreciation for fish and wildlife;

"(I) ensure that opportunities are provided within the System for compatible wildlife-dependent recreational uses;

"(J) ensure that priority general public uses of the System receive enhanced consideration over other general public uses in planning and management within the System;

"(K) provide increased opportunities for families to experience compatible wildlife-dependent recreation, particularly opportunities for parents and their children to safely engage in traditional outdoor activities, such as fishing and hunting;

"(L) continue, consistent with existing laws and interagency agreements, authorized or permitted uses of units of the System by other Federal agencies, including those necessary to facilitate military preparedness;

"(M) ensure timely and effective cooperation and collaboration with Federal agencies and State fish and wildlife agencies during the course of acquiring and managing refuges; and

"(N) monitor the status and trends of fish, wildlife, and plants in each refuge.".

(b) POWERS.—Section 4(b) (16 U.S.C. 668dd(b)) is amended—

(1) in the matter preceding paragraph (1) by striking "authorized—" and inserting "authorized to take the following actions:";

(2) in paragraph (1) by striking "to enter" and inserting "Enter";

(3) in paragraph (2)—

(A) by striking "to accept" and inserting "Accept"; and

(B) by striking ", and" and inserting a period;

(4) in paragraph (3) by striking "to acquire" and inserting "Acquire"; and

(5) by adding at the end the following new paragraphs:

"(4) Subject to standards established by and the overall management oversight of the Director, and consistent with standards established by this Act, to enter into cooperative agreements with State fish and wildlife agencies for the management of programs on a refuge.

Regulations. "(5) Issue regulations to carry out this Act.".

**SEC. 6. COMPATIBILITY STANDARDS AND PROCEDURES.**

Section 4(d) (16 U.S.C. 668dd(d)) is amended by adding at the end the following new paragraphs:

"(3)(A)(i) Except as provided in clause (iv), the Secretary shall not initiate or permit a new use of a refuge or expand, renew, or extend an existing use of a refuge, unless the Secretary has determined that the use is a compatible use and that the use is not inconsistent with public safety. The Secretary may make the determinations referred to in this paragraph for a refuge concurrently with development of a conservation plan under subsection (e).

"(ii) On lands added to the System after March 25, 1996, the Secretary shall identify, prior to acquisition, withdrawal, transfer, reclassification, or donation of any such lands, existing compatible wildlife-dependent recreational uses that the Secretary determines shall be permitted to continue on an interim basis pending completion of the comprehensive conservation plan for the refuge.

"(iii) Wildlife-dependent recreational uses may be authorized on a refuge when they are compatible and not inconsistent with public safety. Except for consideration of consistency with State laws and regulations as provided for in subsection (m), no other determinations or findings are required to be made by the refuge official under this Act or the Refuge Recreation Act for wildlife-dependent recreation to occur.

"(iv) Compatibility determinations in existence on the date of enactment of the National Wildlife Refuge System Improvement Act of 1997 shall remain in effect until and unless modified.

Regulations. "(B) Not later than 24 months after the date of the enactment of the National Wildlife Refuge System Improvement Act of 1997, the Secretary shall issue final regulations establishing the process for determining under subparagraph (A) whether a use of a refuge is a compatible use. These regulations shall—

"(i) designate the refuge official responsible for making initial compatibility determinations;

"(ii) require an estimate of the timeframe, location, manner, and purpose of each use;

"(iii) identify the effects of each use on refuge resources and purposes of each refuge;

"(iv) require that compatibility determinations be made in writing;

"(v) provide for the expedited consideration of uses that will likely have no detrimental effect on the fulfillment of the purposes of a refuge or the mission of the System;

"(vi) provide for the elimination or modification of any use as expeditiously as practicable after a determination is made that the use is not a compatible use;

"(vii) require, after an opportunity for public comment, reevaluation of each existing use, other than those uses specified in clause (viii), if conditions under which the use is permitted change significantly or if there is significant new information regarding the effects of the use, but not less frequently than once every 10 years, to ensure that the use remains a compatible use, except that, in the case of any use authorized for a period longer than 10 years (such as an electric utility right-of-way), the reevaluation required by this clause shall examine compliance with the terms and conditions of the authorization, not examine the authorization itself;

"(viii) require, after an opportunity for public comment, reevaluation of each compatible wildlife-dependent recreational use when conditions under which the use is permitted change significantly or if there is significant new information regarding the effects of the use, but not less frequently than in conjunction with each preparation or revision of a conservation plan under subsection (e) or at least every 15 years, whichever is earlier; and

Public information.

"(ix) provide an opportunity for public review and comment on each evaluation of a use, unless an opportunity for public review and comment on the evaluation of the use has already been provided during the development or revision of a conservation plan for the refuge under subsection (e) or has otherwise been provided during routine, periodic determinations of compatibility for wildlife-dependent recreational uses.

"(4) The provisions of this Act relating to determinations of the compatibility of a use shall not apply to—

"(A) overflights above a refuge; and

"(B) activities authorized, funded, or conducted by a Federal agency (other than the United States Fish and Wildlife Service) which has primary jurisdiction over a refuge or a portion of a refuge, if the management of those activities is in accordance with a memorandum of understanding between the Secretary or the Director and the head of the Federal agency with primary jurisdiction over the refuge governing the use of the refuge.".

**SEC. 7. REFUGE CONSERVATION PLANNING PROGRAM.**

(a) IN GENERAL.—Section 4 (16 U.S.C. 668dd) is amended—

(1) by redesignating subsections (e) through (i) as subsections (f) through (j), respectively; and

(2) by inserting after subsection (d) the following new subsection:

"(e)(1)(A) Except with respect to refuge lands in Alaska (which shall be governed by the refuge planning provisions of the Alaska National Interest Lands Conservation Act (16 U.S.C. 3101 et seq.)), the Secretary shall—

"(i) propose a comprehensive conservation plan for each refuge or related complex of refuges (referred to in this subsection as a 'planning unit') in the System;

Federal Register, publication.

"(ii) publish a notice of opportunity for public comment in the Federal Register on each proposed conservation plan;

"(iii) issue a final conservation plan for each planning unit consistent with the provisions of this Act and, to the extent practicable, consistent with fish and wildlife conservation plans of the State in which the refuge is located; and

"(iv) not less frequently than 15 years after the date of issuance of a conservation plan under clause (iii) and every 15 years thereafter, revise the conservation plan as may be necessary.

"(B) The Secretary shall prepare a comprehensive conservation plan under this subsection for each refuge within 15 years after the date of enactment of the National Wildlife Refuge System Improvement Act of 1997.

"(C) The Secretary shall manage each refuge or planning unit under plans in effect on the date of enactment of the National Wildlife Refuge System Improvement Act of 1997, to the extent such plans are consistent with this Act, until such plans are revised or superseded by new comprehensive conservation plans issued under this subsection.

"(D) Uses or activities consistent with this Act may occur on any refuge or planning unit before existing plans are revised or new comprehensive conservation plans are issued under this subsection.

"(E) Upon completion of a comprehensive conservation plan under this subsection for a refuge or planning unit, the Secretary shall manage the refuge or planning unit in a manner consistent with the plan and shall revise the plan at any time if the Secretary determines that conditions that affect the refuge or planning unit have changed significantly.

"(2) In developing each comprehensive conservation plan under this subsection for a planning unit, the Secretary, acting through the Director, shall identify and describe—

"(A) the purposes of each refuge comprising the planning unit;

"(B) the distribution, migration patterns, and abundance of fish, wildlife, and plant populations and related habitats within the planning unit;

"(C) the archaeological and cultural values of the planning unit;

"(D) such areas within the planning unit that are suitable for use as administrative sites or visitor facilities;

"(E) significant problems that may adversely affect the populations and habitats of fish, wildlife, and plants within the planning unit and the actions necessary to correct or mitigate such problems; and

"(F) opportunities for compatible wildlife-dependent recreational uses.

"(3) In preparing each comprehensive conservation plan under this subsection, and any revision to such a plan, the Secretary, acting through the Director, shall, to the maximum extent practicable and consistent with this Act—

"(A) consult with adjoining Federal, State, local, and private landowners and affected State conservation agencies; and

"(B) coordinate the development of the conservation plan or revision with relevant State conservation plans for fish and wildlife and their habitats.

"(4)(A) In accordance with subparagraph (B), the Secretary shall develop and implement a process to ensure an opportunity for active public involvement in the preparation and revision of comprehensive conservation plans under this subsection. At a minimum, the Secretary shall require that publication of any final plan shall include a summary of the comments made by States, owners of adjacent or potentially affected land, local governments, and any other affected persons, and a statement of the disposition of concerns expressed in those comments. Public information.

"(B) Prior to the adoption of each comprehensive conservation plan under this subsection, the Secretary shall issue public notice of the draft proposed plan, make copies of the plan available at the affected field and regional offices of the United States Fish and Wildlife Service, and provide opportunity for public comment.". Public information.

**SEC. 8. EMERGENCY POWER; STATE AUTHORITY; WATER RIGHTS; COORDINATION.**

(a) IN GENERAL.—Section 4 (16 U.S.C. 668dd) is further amended by adding at the end the following new subsections:

"(k) Notwithstanding any other provision of this Act, the Secretary may temporarily suspend, allow, or initiate any activity in a refuge in the System if the Secretary determines it is necessary to protect the health and safety of the public or any fish or wildlife population.

"(l) Nothing in this Act shall be construed to authorize the Secretary to control or regulate hunting or fishing of fish and resident wildlife on lands or waters that are not within the System.

"(m) Nothing in this Act shall be construed as affecting the authority, jurisdiction, or responsibility of the several States to manage, control, or regulate fish and resident wildlife under State law or regulations in any area within the System. Regulations permitting hunting or fishing of fish and resident wildlife within the System shall be, to the extent practicable, consistent with State fish and wildlife laws, regulations, and management plans.

"(n)(1) Nothing in this Act shall—

"(A) create a reserved water right, express or implied, in the United States for any purpose;

"(B) affect any water right in existence on the date of enactment of the National Wildlife Refuge System Improvement Act of 1997; or

"(C) affect any Federal or State law in existence on the date of the enactment of the National Wildlife Refuge System Improvement Act of 1997 regarding water quality or water quantity.

"(2) Nothing in this Act shall diminish or affect the ability to join the United States in the adjudication of rights to the use of water pursuant to the McCarran Act (43 U.S.C. 666).

"(o) Coordination with State fish and wildlife agency personnel or with personnel of other affected State agencies pursuant to this Act shall not be subject to the Federal Advisory Committee Act (5 U.S.C. App.).".

(b) CONFORMING AMENDMENT.—Section 4(c) (16 U.S.C. 668dd(c)) is amended by striking the last sentence.

16 USC 668dd note.

**SEC. 9. STATUTORY CONSTRUCTION WITH RESPECT TO ALASKA.**

(a) IN GENERAL.—Nothing in this Act is intended to affect—

(1) the provisions for subsistence uses in Alaska set forth in the Alaska National Interest Lands Conservation Act (Public Law 96–487), including those in titles III and VIII of that Act;

(2) the provisions of section 102 of the Alaska National Interest Lands Conservation Act, the jurisdiction over subsistence uses in Alaska, or any assertion of subsistence uses in Alaska in the Federal courts; and

(3) the manner in which section 810 of the Alaska National Interest Lands Conservation Act is implemented in national wildlife refuges in Alaska.

(b) CONFLICTS OF LAWS.—If any conflict arises between any provision of this Act and any provision of the Alaska National Interest Lands Conservation Act, then the provision in the Alaska National Interest Lands Conservation Act shall prevail.

Approved October 9, 1997.

LEGISLATIVE HISTORY—H.R. 1420:

HOUSE REPORTS: No. 105–106 (Comm. on Resources).
CONGRESSIONAL RECORD, Vol. 143 (1997):
June 3, considered and passed House.
Sept. 10, considered and passed Senate, amended.
Sept. 23, House concurred in Senate amendments.
WEEKLY COMPILATION OF PRESIDENTIAL DOCUMENTS, Vol. 33 (1997):
Oct. 9, Presidential statement.

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