



***Feasibility Study  
For  
Generation Interconnection  
Request  
GEN-2006-041***

***SPP Tariff Studies  
(#GEN-2006-041)***

**June, 2007**

## **Executive Summary**

<OMITTED TEXT> (Customer) has requested a Feasibility Study for the purpose of interconnecting 19.8 MW of wind generation into the facilities of Midwest Electric (MIDW) in Thomas County, Kansas. The proposed point of interconnection is at the existing Colby substation, owned by MIDW. The proposed in-service date is August 31, 2008.

Power flow analysis has indicated that for the powerflow cases studied, it is possible to interconnect the 19.8 MW of generation with transmission system reinforcements within the local transmission system. In order to maintain acceptable reactive power compensation, the customer will need to install 1.4 Mvars of 34.5 kV capacitor banks in the Customer's collector substation on the 34.5 kV bus. Dynamic Stability studies performed as part of the impact study will provide additional guidance as to whether the required reactive compensation can be static or a portion must be dynamic (such as a SVC).

The requirement to interconnect the 19.8 MW of generation at the existing Colby substation consists of adding a new 34.5 kV terminal, including one circuit breaker and associated equipment. Customer did not propose a specific 34.5 kV line route extending to serve its 34.5 kV facilities. It is assumed that obtaining all necessary right-of-way for the new transmission line to serve its facilities will not be a significant expense.

The total minimum cost for building the required facilities for this 19.8 MW of generation is \$405,000. These costs are shown in Table 2. Other Network Constraints in the MIDW, Sunflower Electric Cooperative (SUNC), and West Plains (WEPL) transmission systems that may be verified with a transmission service request and associated studies are listed in Table 3. These Network Constraints are in the local area of the new generation when this generation is sunk throughout the SPP footprint for the Energy Resource (ER) Interconnection request. With a defined source and sink in a Transmission Service Request (TSR), this list of Network Constraints will be refined and expanded to account for all Network Upgrade requirements. This cost does not include the Customer's 34.5 kV substation or the 34.5 kV, 1.4 Mvar capacitor bank(s).

In Table 4, a value of Available Transfer Capability (ATC) associated with each overloaded facility is included. These values may be used by the Customer for future analyses including the determination of lower generation capacity levels that may be installed. When transmission service associated with this interconnection is evaluated, the loading of the facilities listed in this table may be greater due to higher priority reservations. If the loading of a facility is higher, the level of ATC will be lower.

There are several other proposed generation additions in the general area of the Customer's facility. It was assumed in this preliminary analysis that not all of these other projects within the MIDW, SUNC, SPS, and WEPL control areas will be in service. Those previously queued projects that have advanced to nearly complete phases were included in this Feasibility Study. In the event that another request for a generation interconnection with a higher priority withdraws, then this request may have to be re-evaluated to determine the local Network Constraints.

## Introduction

<OMITTED TEXT> (Customer) has requested a feasibility study for the purpose of interconnecting 19.8 MW of wind generation into the facilities of Midwest Electric (MIDW) in Thomas County, Kansas. The proposed method of interconnection is to add a 34.5 kV terminal at the existing Colby substation, which is owned by MIDW. The proposed in-service date is August 31, 2008.

## Interconnection Facilities

The primary objective of this study is to identify the system problems associated with connecting the plant to the area transmission system. The Feasibility and other subsequent Interconnection Studies are designed to identify attachment facilities, Network Upgrades and other direct assignment facilities needed to accept power into the grid at the interconnection receipt point.

The requirements for interconnection of the 19.8 MW consist of adding a new 34.5 kV terminal, including one 34.5 kV circuit breaker and associated equipment, at the existing Colby substation owned by MIDW, and building approximately four miles of 34.5kV transmission to the Customer Facility. The Customer did not propose a specific route of its 34.5 kV line to serve its 34.5 kV facilities. It is assumed that obtaining all necessary right-of-way for the Customer substation and line construction will not be a significant expense.

The total cost for adding a new 34.5 kV line terminal and constructing approximately four miles of 34.5kV line is estimated at \$405,000. Other Network Constraints in the MIDW, Sunflower Electric Cooperative (SUNC), and West Plains (WEPL) transmission systems that were identified are listed in Table 3. These estimates will be refined during the development of the impact study based on the final designs. This cost does include building the 34.5 kV transmission line from the Customer substation into the existing Colby substation. However, the Customer may decide to build this line itself under the construction specifications of Midwest Energy. This cost does not include the Customer's 34.5 kV substation, which should be determined by the Customer.

The costs of interconnecting the facility to the MIDW transmission system are listed in Tables 1 & 2. **These costs do not include any cost that might be associated with short circuit study results or dynamic stability study results.** These costs will be determined when and if a System Impact Study is conducted.

A preliminary one-line drawing of the interconnection and direct assigned facilities are shown in Figure 1.

**Table 1: Direct Assignment Facilities**

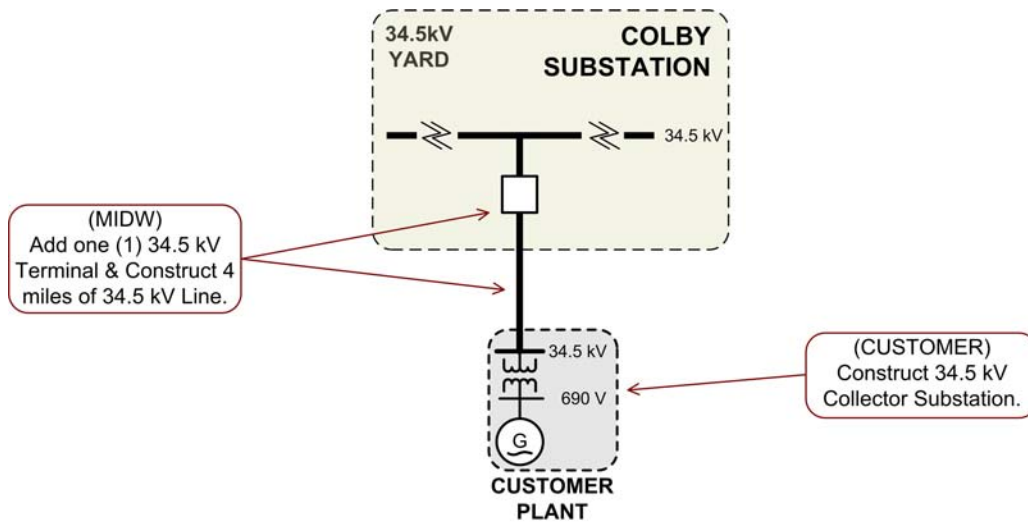
<b>FACILITY</b>	<b>ESTIMATED COST (2007 DOLLARS)</b>
Customer – 34.5 kV Substation facilities.	*
Customer – Right-of-Way for Customer facilities.	*
Customer – 34.5 kV, 1.4 Mvar capacitor bank(s) in Customer substation.	*
MIDW – 34.5 kV transmission line facilities between Customer facilities and Colby substation.	\$335,000
MIDW – Add one 34.5 kV terminal including one 34.5 kV circuit breaker, associated switches, buswork, relaying and all miscellaneous equipment at Colby Substation.	\$70,000
<b>Total</b>	*

NOTES: \* Estimates of cost to be determined by Customer.

**Table 2: Required Interconnection Network Upgrade Facilities**

<b>FACILITY</b>	<b>ESTIMATED COST (2007 DOLLARS)</b>
None identified at this time	
<b>Total</b>	

**Figure 1: Proposed Interconnection  
(Final substation design to be determined)**



**Powerflow Analysis**

A powerflow analysis was conducted for the facility using modified versions of the 2008 and 2011 summer and winter peak, and 2016 summer peak models. The output of the Customer’s facility was offset in each model by a reduction in output of existing online SPP generation. This method allows the request to be studied as an Energy Resource (ER) Interconnection request. The proposed in-service date of the generation is August 31, 2008. The available seasonal models used were through the 2016 Summer Peak of which is the end of the current SPP planning horizon.

The analysis of the Customer’s project indicates that, given the requested generation level of 19.8 MW and location, additional criteria violations will occur on the existing MIDW, SUNC, and WEPL transmission systems under steady state and contingency conditions in the peak seasons.

In Table 4, a value of Available Transfer Capability (ATC) associated with each overloaded facility is included. These values may be used by the Customer to determine lower generation capacity levels that may be installed. When transmission service associated with this interconnection is evaluated, the loading of the facilities listed in this table may be greater due to higher priority reservations. When a facility is overloaded for more than one contingency, only the highest loading on the facility for each season is included in the table.

In order to maintain a zero reactive power flow exchanged at the point of interconnection, additional reactive compensation is required at the point of interconnection. The Customer will be required to install 1.4 Mvar of capacitor banks in their substation on the 34.5 kV buses in the Customer substation. Dynamic Stability studies performed as part of the impact study will provide additional guidance as to whether the reactive compensation can be static or a portion must be dynamic (such as a SVC or STATCOM). It is possible that an SVC or STATCOM device will be required at the Customer facility because of FERC Order 661A Low Voltage Ride-Through Provisions (LVRT) which went into effect January 1, 2006. FERC Order 661A orders that wind farms stay on line for 3 phase faults at the point of interconnection even if that requires the installation of a SVC or STATCOM device.

There are several other proposed generation additions in the general area of the Customer's facility. Some of the local projects that were previously queued were assumed to be in service in this Feasibility Study. Those local projects that were previously queued and have advanced to nearly complete phases were included in this Feasibility Study.

### **Powerflow Analysis Methodology**

The Southwest Power Pool (SPP) criteria states that: "The transmission system of the SPP region shall be planned and constructed so that the contingencies as set forth in the Criteria will meet the applicable *NERC Planning Standards* for System Adequacy and Security – Transmission System Table I hereafter referred to as NERC Table I) and its applicable standards and measurements".

Using the created models and the ACCC function of PSS\E, single contingencies in portions or all of the modeled control areas of Sunflower Electric Power Corporation (SUNC), Missouri Public Service (MIPU), Westar (WESTAR), Kansas City Power & Light (KCPL), West Plains (WEPL), Midwest Energy (MIDW), Oklahoma Gas and Electric OKGE, American Electric Power West (AEPW), Grand River Dam Authority (GRDA), Southwestern Public Service (SPS), Western Farmers Electric Cooperative (WFEC) and other control areas were applied and the resulting scenarios analyzed. This satisfies the 'more probable' contingency testing criteria mandated by NERC and the SPP criteria.

**Table 3: Network Constraints**

<b>AREA</b>	<b>ELEMENT</b>
MIDW	2006-32 - S HAYS 230KV CKT 1
MIDW	ALEXANDER - NEKOMA 115KV CKT 1
MIDW	ALEXANDER - NESS CITY 115KV CKT 1
MIDW	COLBY - HOXIE 115KV CKT 1
MIDW	KNOLL - VINE STREET 115KV CKT 1
MIDW	S HAYS - HAYS 115KV CKT 1
MIDW	VINE STREET - HAYS 115KV CKT 1
MIDW/SUNC	NESS CITY - NESS CITY 115KV CKT 1
SUNC	BEEELER - DIGHTON TAP 115KV CKT 1
SUNC	BEEELER - NESS CITY 115KV CKT 1
SUNC	DIGHTON TAP - MANNING TAP 115KV CKT 1
SUNC	HOLCOMB - PLYMELL 115KV CKT 1
SUNC/WEPL	SPEARVILLE (SPEARVL) 345/230/13.8KV TRANSFORMER CKT 1
WEPL	CIMARRON RIVER PLANT - NORTH LIBERAL TAP 115KV CKT 1
WEPL	CIMARRON RIVER TAP - EAST LIBERAL 115KV CKT 1
WEPL	CUDAHY - JUDSON LARGE 115KV CKT 1
WEPL	EAST HALL TAP - MULLERGREN 115KV CKT 1
WEPL	GREENSBURG - JUDSON LARGE 115KV CKT 1
WEPL	GREENSBURG - SUN CITY 115KV CKT 1
WEPL	MEDICINE LODGE - SUN CITY 115KV CKT 1
WEPL	MEDICINE LODGE (MED-LDG4) 138/115/2.72KV TRANSFORMER CKT 1
WEPL	MULLERGREN - SPEARVILLE 230KV CKT 1
WEPL	SMITH CENTER - WALDO 115KV CKT 1
MIDW	Midwest Energy
SUNC	Sunflower Electric Cooperative
WEPL	West Plains

**Table 4: Contingency Analysis**

SEASON	ELEMENT	RATE (MVA)	LOADING (%)	ATC (MW)	CONTINGENCY
08SP	GREENSBURG - JUDSON LARGE 115KV CKT 1	80	225	0	2003-13 - POTTER COUNTY INTERCHANGE 345KV CKT 1
08SP	MEDICINE LODGE (MED-LDG4) 138/115/2.72KV TRANSFORMER CKT 1	65	213	0	2003-13 - POTTER COUNTY INTERCHANGE 345KV CKT 1
08SP	MEDICINE LODGE - SUN CITY 115KV CKT 1	80	199	0	MULLERGREN - SPEARVILLE 230KV CKT 1
08SP	S HAYS - HAYS 115KV CKT 1	88	190	0	KNOLL - S HAYS 230KV CKT 1
08SP	MULLERGREN - SPEARVILLE 230KV CKT 1	355	170	0	2003-13 - POTTER COUNTY INTERCHANGE 345KV CKT 1
08SP	VINE STREET - HAYS 115KV CKT 1	88	165	0	KNOLL - S HAYS 230KV CKT 1
08SP	KNOLL - VINE STREET 115KV CKT 1	88	159	0	KNOLL - S HAYS 230KV CKT 1
08SP	MEDICINE LODGE (MED-LDG4) 138/115/2.72KV TRANSFORMER CKT 1	56	152	0	BASE CASE
08SP	SPEARVILLE (SPEARVL) 345/230/13.8KV TRANSFORMER CKT 1	336	136	0	2003-13 - POTTER COUNTY INTERCHANGE 345KV CKT 1
08SP	ALEXANDER - NESS CITY 115KV CKT 1	101	136	0	MULLERGREN - SPEARVILLE 230KV CKT 1
08SP	ALEXANDER - NEKOMA 115KV CKT 1	101	128	0	MULLERGREN - SPEARVILLE 230KV CKT 1
08SP	GREENSBURG - SUN CITY 115KV CKT 1	130	127	0	MULLERGREN - SPEARVILLE 230KV CKT 1
08SP	DIGHTON TAP - MANNING TAP 115KV CKT 1	98	126	0	MULLERGREN - SPEARVILLE 230KV CKT 1
08SP	BEELER - DIGHTON TAP 115KV CKT 1	98	118	0	MULLERGREN - SPEARVILLE 230KV CKT 1
08SP	CIMARRON RIVER PLANT - NORTH LIBERAL TAP 115KV CKT 1	115	117	0	2003-13 - POTTER COUNTY INTERCHANGE 345KV CKT 1
08SP	MULLERGREN - SPEARVILLE 230KV CKT 1	330	115	0	BASE CASE
08SP	BEELER - NESS CITY 115KV CKT 1	98	114	0	MULLERGREN - SPEARVILLE 230KV CKT 1
08SP	COLBY - HOXIE 115KV CKT 1	101	107	0	MULLERGREN - SPEARVILLE 230KV CKT 1
08SP	EAST HALL TAP - MULLERGREN 115KV CKT 1	90	105	0	KNOLL - SALINE RIVER 115KV CKT 1
08SP	HOLCOMB - PLYMELL 115KV CKT 1	143	103	0	2003-13 - POTTER COUNTY INTERCHANGE 345KV CKT 1
08SP	2006-32 - S HAYS 230KV CKT 1	250	104	13	KNOLL - SALINE RIVER 115KV CKT 1
08SP	SMITH CENTER - WALDO 115KV CKT 1	60	104	15	KNOLL - SALINE RIVER 115KV CKT 1
08SP	NESS CITY - NESS CITY 115KV CKT 1	143	100	19	MULLERGREN - SPEARVILLE 230KV CKT 1
08WP	MEDICINE LODGE (MED-LDG4) 138/115/2.72KV TRANSFORMER CKT 1	65	182	0	2003-13 - POTTER COUNTY INTERCHANGE 345KV CKT 1
08WP	GREENSBURG - JUDSON LARGE 115KV CKT 1	80	174	0	MULLERGREN - SPEARVILLE 230KV CKT 1
08WP	MEDICINE LODGE - SUN CITY 115KV CKT 1	80	159	0	MULLERGREN - SPEARVILLE 230KV CKT 1
08WP	MEDICINE LODGE (MED-LDG4) 138/115/2.72KV TRANSFORMER CKT 1	56	154	0	BASE CASE
08WP	SPEARVILLE (SPEARVL) 345/230/13.8KV TRANSFORMER CKT 1	336	123	0	HOLCOMB - SPEARVILLE 345KV CKT 1
11SP	GREENSBURG - JUDSON LARGE 115KV CKT 1	80	182	0	MULLERGREN - SPEARVILLE 230KV CKT 1
11SP	MEDICINE LODGE (MED-LDG4) 138/115/2.72KV TRANSFORMER CKT 1	65	168	0	MINGO - RED WILLOW 345KV CKT 1
11SP	MEDICINE LODGE - SUN CITY 115KV CKT 1	80	160	0	MULLERGREN - SPEARVILLE 230KV CKT 1
11SP	MEDICINE LODGE (MED-LDG4) 138/115/2.72KV TRANSFORMER CKT 1	56	148	0	BASE CASE
11SP	MULLERGREN - SPEARVILLE 230KV CKT 1	355	126	0	HOLCOMB - SPEARVILLE 345KV CKT 1
11SP	SPEARVILLE (SPEARVL) 345/230/13.8KV TRANSFORMER CKT 1	336	122	0	HOLCOMB - SPEARVILLE 345KV CKT 1
11SP	2006-32 - S HAYS 230KV CKT 1	250	105	2	MINGO - RED WILLOW 345KV CKT 1
11WP	MEDICINE LODGE (MED-LDG4) 138/115/2.72KV TRANSFORMER CKT 1	65	175	0	2003-13 345 - POTTER COUNTY INTERCHANGE 345KV CKT 1
11WP	GREENSBURG - JUDSON LARGE 115KV CKT 1	80	167	0	MULLERGREN - SPEARVILLE 230KV CKT 1
11WP	MEDICINE LODGE - SUN CITY 115KV CKT 1	80	151	0	MULLERGREN - SPEARVILLE 230KV CKT 1
11WP	MEDICINE LODGE (MED-LDG4) 138/115/2.72KV TRANSFORMER CKT 1	56	150	0	BASE CASE
11WP	SPEARVILLE (SPEARVL) 345/230/13.8KV TRANSFORMER CKT 1	336	118	0	HOLCOMB - SPEARVILLE 345KV CKT 1



**Table 4: Contingency Analysis (continued)**

SEASON	ELEMENT	RATE (MVA)	LOADING (%)	ATC (MW)	CONTINGENCY
16SP	MEDICINE LODGE (MED-LDG4) 138/115/2.72KV TRANSFORMER CKT 1	65	207	0	2003-13 345 - POTTER COUNTY INTERCHANGE 345KV CKT 1
16SP	GREENSBURG - JUDSON LARGE 115KV CKT 1	80	198	0	2003-13 345 - POTTER COUNTY INTERCHANGE 345KV CKT 1
16SP	CIMARRON RIVER PLANT - NORTH LIBERAL TAP 115KV CKT 1	115	179	0	2003-13 345 - POTTER COUNTY INTERCHANGE 345KV CKT 1
16SP	MEDICINE LODGE - SUN CITY 115KV CKT 1	80	173	0	2003-13 345 - POTTER COUNTY INTERCHANGE 345KV CKT 1
16SP	MULLERGRENN - SPEARVILLE 230KV CKT 1	355	139	0	2003-13 345 - POTTER COUNTY INTERCHANGE 345KV CKT 1
16SP	MEDICINE LODGE (MED-LDG4) 138/115/2.72KV TRANSFORMER CKT 1	56	135	0	BASE CASE
16SP	SPEARVILLE (SPEARVL) 345/230/13.8KV TRANSFORMER CKT 1	336	121	0	HOLCOMB - SPEARVILLE 345KV CKT 1
16SP	CIMARRON RIVER TAP - EAST LIBERAL 115KV CKT 1	120	116	0	CIMARRON RIVER PLANT - NORTH LIBERAL TAP 115KV CKT 1
16SP	GREENSBURG - SUN CITY 115KV CKT 1	130	111	0	2003-13 345 - POTTER COUNTY INTERCHANGE 345KV CKT 1
16SP	CUDAHY - JUDSON LARGE 115KV CKT 1	130	104	0	HOLCOMB - SPEARVILLE 345KV CKT 1

*Note: When transmission service associated with this interconnection is evaluated, the loading of the facilities listed in this table may be greater due to higher priority reservations. If the loading of a facility is higher, the level of ATC will be lower.*

## Conclusion

The minimum cost of interconnecting the Customer's interconnection request is estimated at \$405,000 for Direct Assignment facilities and Network Upgrades listed in Tables 1 and 2. These costs exclude upgrades of other transmission facilities that were listed in Table 3 of which are Network Constraints. At this time, the cost estimates for other Direct Assignment facilities including those in Table 1 have not been defined by the Customer. In addition to the Customer's proposed interconnection facilities, the Customer will be responsible for installing 1.4 Mvar of 34.5 kV capacitors in the Customer substation for reactive support. Dynamic stability analysis will determine if a portion of this should be dynamic (SVC). As stated earlier, some but not all of the local projects that were previously queued are assumed to be in service in this Feasibility Study.

In Table 4, a value of Available Transfer Capability (ATC) associated with each overloaded facility is included. These values may be used by the Customer to determine lower generation capacity levels that may be installed. When transmission service associated with this interconnection is evaluated, the loading of the facilities listed in this table may be greater due to higher priority reservations. When a facility is overloaded for more than one contingency, only the highest loading on the facility for each season is included in the table.

These interconnection costs do not include any cost that may be associated with short circuit or transient stability analysis. These studies will be performed if the Customer signs a System Impact Study Agreement.

The required interconnection costs listed in Table 2 and other upgrades associated with Network Constraints listed in Table 3 do not include all costs associated with the deliverability of the energy to final customers. These costs are determined by separate studies if the Customer requests transmission service through Southwest Power Pool's OASIS.

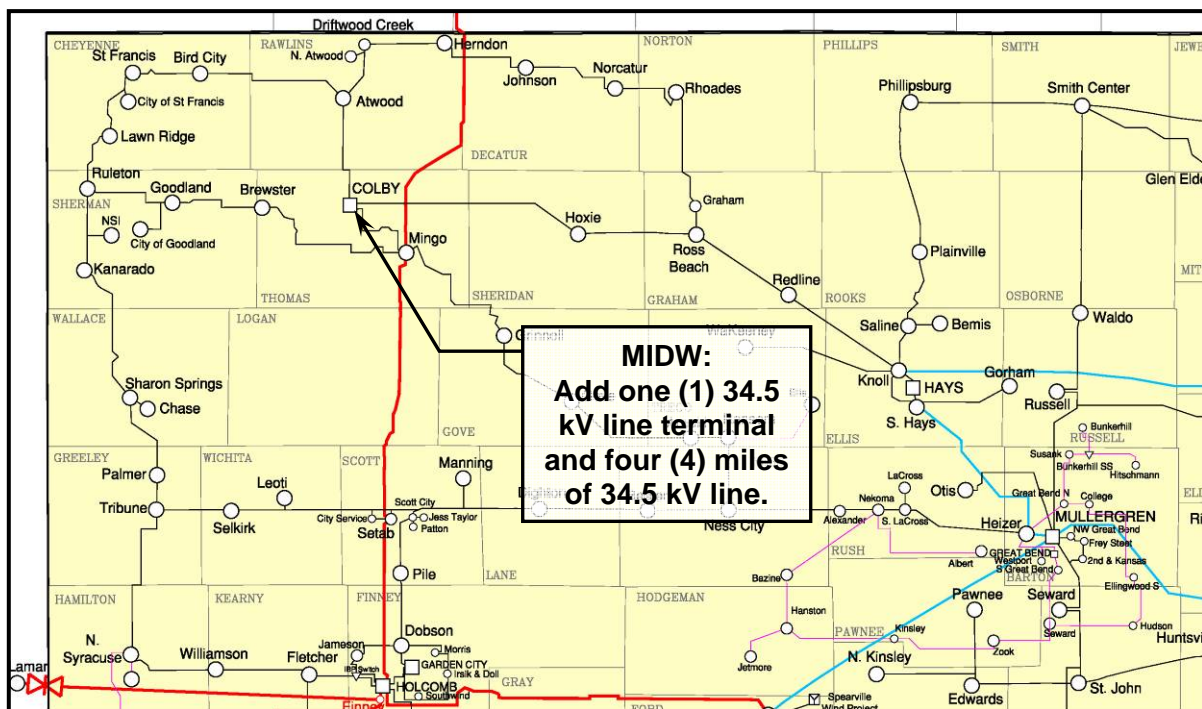


FIGURE 2. MAP OF THE LOCAL AREA