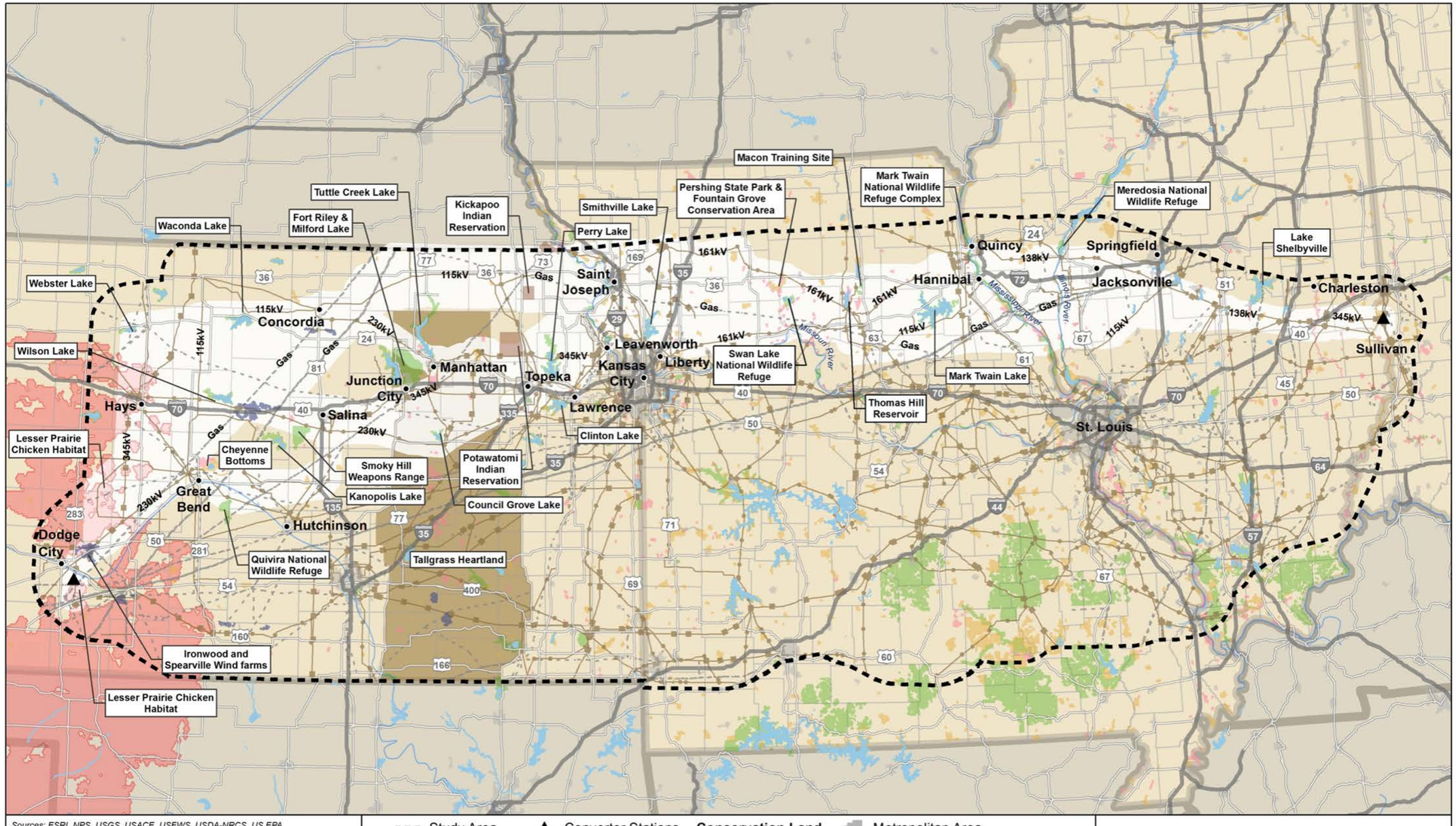
Wildlife Refuge, Thomas Hill Reservoir, Mark Twain Reservoir, the Missouri National Guard Macon Training Site, two state parks, and several state conservation areas. In Illinois, dense development around Quincy, Springfield, and Effingham presented challenges for routing the Project, as well as conservation easements along the Illinois River, the Meredosia National Wildlife Refuge, and Lake Shelbyville.

Opportunity features in the northern portion of the Study Area include the existing network of transmission lines and an array of interstate pipelines passing from southwest to the northeast in Kansas and from west to southeast in Missouri. Section lines and parcel boundaries also served to guide the development of route alignments by allowing alignments to follow along ownership boundaries when possible. Several rail lines and state or federal highways were also considered in the initial development of Conceptual Routes; however, restrictions on overhanging state ROW combined with the close relationship between roads, rail, and commercial or residential development limited the development of reasonable alignments along many of these features.

The Routing Team considered a variety of different route options to exit the western converter station in Kansas toward the northern portion of the Study Area. Route development in this area of Kansas is encumbered by extensive farmlands and irrigation facilities; the physical congestion of existing wind generation facilities, transmission lines, substations, and residences; and sensitive lesser prairie-chicken habitat that surrounds the Spearville area along its eastern and northern periphery. However, several suitable route options were developed along section/parcel boundaries to the north and east and along existing transmission lines to the northeast toward Great Bend.

Conceptual Routes north of Great Bend continued either along section/parcel boundaries west of U.S. Highway 183, north along an existing 115 kV transmission line near U.S. Highway 281, or northeast along the Natural Gas Pipeline of America pipeline corridor to Concordia. Conceptual Routes were initially developed between Cheyenne Bottoms Wildlife Area and Quivira National Wildlife Refuge but were eliminated from further consideration following agency coordination with the Kansas Department of Wildlife, Parks, and Tourism (KDWPT) and USFWS because of concerns relating to migratory birds and the federally listed endangered whooping crane. In addition, Conceptual Routes initially formed along Interstate 70 were also eliminated from further consideration due to the frequent diversions required for development along the interstate and proximity to Fort Riley Army Installation. These routes would also cross the Tallgrass Heartland of the Flint Hills, a highly scenic area viewed by 12,000 to 20,000 travelers a day.

From Concordia to the Missouri River, three main west-to-east Conceptual Routes were developed with periodic north-to-south interconnections between each route. The Routing Team considered three primary Missouri River crossing locations near St. Joseph, Missouri:



Sources: ESRI, NPS, USGS, USACE, USFWS, USDA-NRCS, US EPA, KDWPT, KPRA, KS DASC, KARS, KS Biological Survey, MODNR, MDC, ISGS, ILPRA, IN DNR, The Nature Conservancy

0 20 40 60 80 100 Miles

N

Coordinate System: North America Equidistant Conic
Projection: Equidistant Conic
Datum: North American 1983

- Study Area
- Interstate
- U.S. Highway
- Gas Pipeline
- Converter Stations

Existing Transmission
- < 138 kV
- 138 kV - 230 kV
- > 230 kV

Conservation Land
- Local/Private
- State
- Tribal
- Federal

- Metropolitan Area
- Water Body
- Tallgrass Heartland
- Lesser Prairie Chicken Habitat CHAT Categories 1-3
- Wind Farm

Figure 4-2
Conceptual Route Development in the Northern Portion of the Study Area

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two on a trajectory north of the city and one to the south. The two northern river crossings were developed at locations that avoided a series of MDC lands in the floodplain on the eastern bluffs of the river and crossed at locations that readily provided access to parallel a 345 kV line toward St. Joseph. The southernmost crossing was developed to parallel the Rockies Express/Keystone Pipeline corridor from near Fairview, Kansas, up to and across the Missouri River.

St. Joseph's residential and commercial development served as the primary constraint on the eastern bluffs of the Missouri River. The steep topography beyond the floodplain quickly shifts land use from floodplain farmland to a combination of forest-covered hillsides and moderate to high-density residential development. The Routing Team initially developed alignments from the two northern river crossings along the Cooper – St. Joseph 345 kV line north of the city. However, fingers of residential and commercial development extending northward from the city along Interstates 229 and 29 prevented suitable parallel alignments along the line through this area. Ultimately, the Routing Team developed routing alignments that diverged from a parallel alignment near Amazonia and continued farther east before angling south to continue along the east side of St. Joseph, paralleling the existing Hawthorne – St. Joseph 345 kV transmission line toward the southeastern corner of Buchanan County.

The Routing Team developed a network of Conceptual Routes starting at the Rockies Express/Keystone Pipeline crossing of the Missouri River. Similar to the northern crossing, steep topography beyond the floodplain quickly shifts land use from floodplain farmland to a combination of forested hills and moderate density residential development. A network of routes was developed from this southern crossing location eastward, through the farmlands in the Missouri floodplain and into the sporadic residential development along the bluffs and in the subsequent valleys eastward. Conceptual Routes were developed through this area along pipeline or existing transmission lines to the southeast to pass through the residential development along the bluffs and around the community of Agency, Missouri, located farther east.

Conceptual Routes beyond St. Joseph and east across Missouri were developed around three primary concepts: an alignment based on the section/parcel boundary just south of U.S. Highway 36; a route that continued parallel along the Rockies Express/Keystone Pipeline corridor; and an alignment that paralleled existing transmission lines to the north that looped between St. Joseph, Fairport, Jamesport, Brookfield, and Marceline, Missouri. The Routing Team ultimately removed this latter route alignment from further consideration because the benefits of paralleling the existing transmission lines through this area did not outweigh the likelihood of impacts associated with frequent diversions to avoid residences near Gallatin and Jamesport, multiple transmission line crossings, and crossings of several private and federal conservation easements and Pershing State Park.

Extensive federal, state, and private conservation areas line the banks of the Grand River just east of Highway 65. Two key breaks in these conservation lands along the river were considered for crossing the Grand River and its floodplain forests. The first crossing was identified just north of the Swan Lake National Wildlife Refuge and south of the town of Sumner. The second crossing was identified approximately ten miles south along the Rockies Express/Keystone Pipeline corridor.

East of the Grand River, conceptual routes were developed to avoid the Thomas Hill Reservoir and the conservation lands surrounding it by passing north or south around the reservoir. Conceptual Routes south of Thomas Hill Reservoir paralleled an existing 161 kV transmission line that angles southeast of the reservoir before turning east, just south of Cairo. Conceptual Routes north of Thomas Hill Reservoir avoided conservation lands and the Army National Guard's Macon Training Site, located just east of the reservoir.

In Monroe and Ralls counties, Mark Twain Lake encompasses a large area of land that includes a state park, federal land managed by the USACE, and a patchwork of private conservation easements. Conceptual Routes were developed north and south of the lake. Routes developed along the north side connected to potential Mississippi River crossings near Quincy, Illinois and Hannibal, Missouri. Routes that continued south of the lake—both through Monroe County and along the Rockies Express/Keystone Pipeline farther south in Audrain County—connected to potential river crossings near Hannibal, Louisiana, and Clarksville, Missouri.

The Routing Team considered numerous Mississippi River crossing locations during the Conceptual Route development phase both north and south of St. Louis, from roughly Quincy, Illinois to Grand Tower, Illinois. Conceptual Routes in the northern portion of the Study Area fell between a 75-mile stretch of the Mississippi River from Quincy, Illinois, to Winfield, Missouri. Initial siting efforts focused on locations along the river with existing infrastructure crossings but soon expanded to considered all areas where residential development, sensitive habitats, public lands, and cultural resources were limited. Of the many crossings of the Mississippi River considered, the Routing Team identified six potential crossings from which the preferred crossing location was ultimately selected (see Section 4.3.2 for a discussion of Mississippi River crossings).

Once across the Mississippi and Illinois rivers, the Routing Team developed a network of Conceptual Routes that continued east along existing transmission and pipeline corridors, and along section/parcel boundaries toward the Sullivan Substation. In general, land use in the area is agricultural with an increasing prevalence of forested lands further south near St. Louis. Major communities in the northern portion of the Study Area in Illinois included Quincy, Jacksonville, Springfield, Chatham, Pana, and Effingham.

Minimal or easily avoidable large public land areas exist through this portion of the Study Area, and a range of opportunity features are available to develop Conceptual Routes across the state. However, in general, residential development tended to be higher in the northern portion of the Study Area in Illinois when compared to Missouri or Kansas.

4.2.2 Conceptual Route Development — Central Portion of the Study Area

The central portion of the Study Area essentially consists of those routes that generally followed the most direct path from the western converter station to Sullivan Substation while still considering various opportunity features and avoiding constraints. As **Figures 4-1** and **4-3** readily show, Conceptual Route development efforts through this portion of the Study Area were greatly affected by almost every major metropolitan area, and its associated suburban development sprawl, in the Study Area.

The primary path for exiting the western converter station in the central portion of the study area was along a 115 kV transmission line to Stafford. One other conceptual route was initially considered immediately south of Cheyenne Bottoms but was later eliminated due to concerns from KDWPT and USFWS (see Northern Conceptual Route Discussion).

From Stafford, Conceptual Routes either continued northeast to Hutchinson along existing transmission lines or due east along section/parcel boundaries for more than 75 miles to approximately 7 miles south of Newton. The routes to Hutchinson continued north along an existing 345 kV line between Hutchinson and the Summit Substation and then east through the Tallgrass Heartland along existing transmission lines. Maintaining parallel alignments along this route became increasingly difficult as residential development adjacent to the existing line increased in the satellite communities south of Topeka and Kansas City.

Conceptual Routes from Newton continued either northeast across the Tallgrass Heartland parallel to an existing 345 kV line eventually connecting with the routes described above through Carbondale or east to parallel a 115 kV line across the Tallgrass Heartland. Continuing east of the Tallgrass Heartland, Conceptual Route development became encumbered by development protruding south of Kansas City and the Harry S. Truman Reservoir to the east and south. Attempts were made to develop Conceptual Routes through this area along existing transmission lines that connect the outer suburbs of Gardner, Spring Hill, Raymore, and Pleasant Hill and along a pipeline that passed between Waverly, Kansas, and Holden, Missouri; however, these routes were later eliminated due to the spread and density of residential development and the numerous diversions from parallel alignments along transmission lines, pipelines, and section/parcel boundaries required to avoid individual residences.

East of the Kansas-Missouri state boundary and dense residential development south of Kansas City, the Conceptual Routes split with the northernmost routes following an existing gas

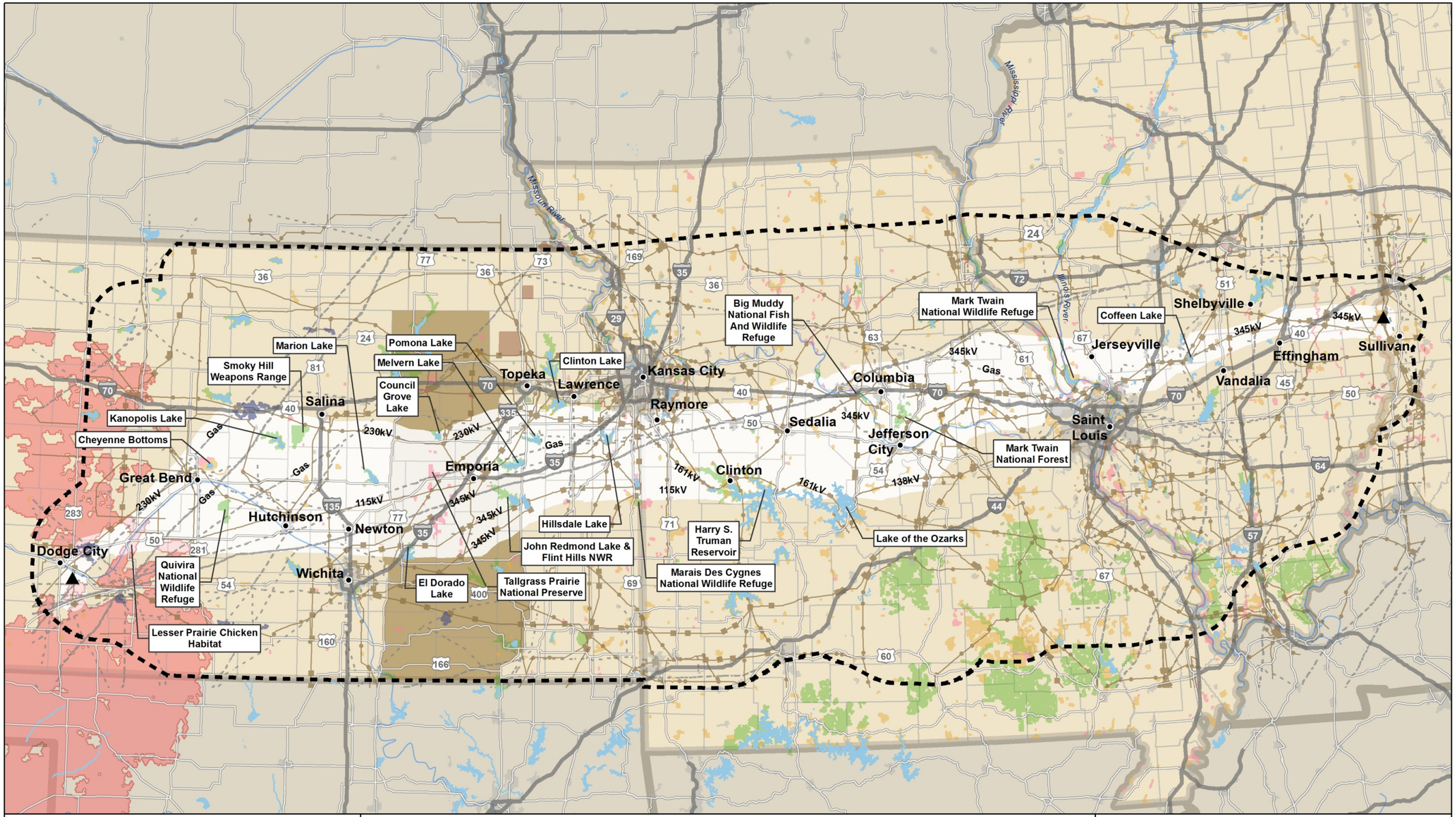
pipeline corridor northeast toward Warrensburg, diverting to find a suitable crossing of the Missouri River and picking up the gas line corridor again north of the Missouri River and south of Franklin. The southernmost Conceptual Routes in this area attempted to follow 161 kV transmission lines around the north shores of the Truman Reservoir and Lake of the Ozarks, although frequent diversions from a parallel alignment were necessary due to residential development and recreational areas adjacent to the reservoirs. Additional Conceptual Routes were developed north of the lakes and south of Warrensburg and Sedalia.

Conceptual Routes following the gas line corridor past Franklin continued north of Columbia and into the northern Conceptual Route area. Increased residential development linking Columbia, Jefferson City, and communities on the north shore of the Lake of the Ozarks, and increased conservation land along the section of the Missouri River from Arrow Rock to Jefferson City decreased routing opportunities and suitable crossings of the Missouri River in this area. The Conceptual Routes that were developed followed primarily parcel boundaries or connected sections of existing transmission lines heading east or northeast for relatively short distances. The terrain between the reservoir complex in the south and the Missouri River in the north became increasingly more variable, and land use became more heavily forested as the Conceptual Routes proceeded east into the Ozark Mountains.

The Conceptual Routes just north of the Lake of the Ozarks turned northeast along 69 kV and 138 kV transmission lines toward Jefferson City and Chamois or toward Owensville. Due east from there, the larger metro area of St. Louis dominates the landscape with development extending far to the west and south of the city preventing the development of Conceptual Routes in these areas. The Conceptual Routes crossed the Missouri River by Chamois and angled northeast across an increasingly agricultural landscape when compared to the Ozark region to the south.

As the Conceptual Routes approached the Mississippi River, the Routing Team identified existing transmission line crossings near Bolter Island and Iowa Island, due north of St. Charles. Conceptual Routes using existing transmission line crossings closer to St. Louis were not feasible due to the density of residential and commercial development outside of St. Louis and significant federal, state, and private conservation lands around the confluence of the Missouri, Mississippi, and Illinois rivers.

Conceptual Routes in the central portion of the Study Area in eastern Missouri continued north to blend into the northern portion of the Study Area or crossed the Mississippi River at locations not occupied by public lands or historic communities. East of the Mississippi and Illinois rivers, the Conceptual Routes converged south of Litchfield to parallel existing 345 kV transmission lines northeast toward Pana, Illinois, in the northern portion of the Study Area or east toward the eastern converter station, staying north of Effingham and south of Charleston, Illinois.



Sources: ESRI, NPS, USGS, USACE, USFWS, USDA-NRCS, US EPA, KDWPT, KPRA, KS DASC, KARS, KS Biological Survey, MODNR, MDC, ISGS, ILPRA, IN DNR, The Nature Conservancy

0 20 40 60 80 100 Miles

N

Coordinate System: North America Equidistant Conic
Projection: Equidistant Conic
Datum: North American 1983

- City
- Study Area
- Interstate
- U.S. Highway
- Gas Pipeline
- Converter Stations

Existing Transmission
- < 138 kV
- 138 kV - 230 kV
- > 230 kV

Conservation Land
- Local/Private
- State
- Tribal
- Federal

- Metropolitan Area
- Water Body
- Tallgrass Heartland
- Lesser Prairie Chicken Habitat CHAT Categories 1-3
- Wind Farm

Figure 4-3
Conceptual Route Development in the Central Portion of the Study Area

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4.2.3 Conceptual Routes — Southern Portion of the Study Area

The southern portion of the study area include routes north and south of Wichita, north of Springfield, and south of St. Louis. Constraints in the southern portion of the Study Area include: Wichita and its associated suburban sprawl, the extensive airfields in and around Wichita, the ecologically unique and scenic Tallgrass Heartland, the expansive Harry S. Truman reservoir, Lake of the Ozarks, Pomme De Terre, Stockton Lake, Mark Twain National Forest, and land administered by the Department of Defense and the National Park Service.

Conceptual Routes exiting the western converter station primarily followed either section lines through farm lands east of Wichita, and/or paralleled existing transmission lines north and south of the Wichita metro area. Routing opportunities near Wichita were highly encumbered by the expansive suburbs both north and south of the city, as well as an abundance of airfields associated with Wichita's extensive aviation industry. These two factors led to routes that were developed either north along existing 345 kV lines that crossed midway between Wichita and Newton or south of the city along section/parcel boundaries 10 and 20 miles south of the city. As a result, Conceptual Routes were developed along each of the four 345 kV transmission lines east of Wichita that transect the Tallgrass Heartlands in this area (see **Figure 4-4**). Beyond the Tallgrass Heartlands, Conceptual Route alignments continued along existing transmission lines or section/parcel boundaries. Although route development through this area was comparatively simple given the low number of residences and public lands, significant oil and gas development and numerous wind farms hindered route development in some areas.

The Conceptual Routes in southeastern Missouri were primarily developed along roads, section/parcel lines, and paralleling existing transmission. Land use in southwestern Missouri is similar to that in eastern Kansas with farms and grasslands primarily used for grazing. The prevalence of grassland areas was specifically noted by MDC as a focus for preservation of grassland/prairie habitat and reintroduction of greater prairie chickens in the area. The Routing Team attempted to avoid these areas and/or parallel existing transmission lines where possible through this area.

Continuing east, terrain becomes more variable with less land suitable for agricultural use and a greater proportion of land under forest cover. An increase in large parcels of publicly owned lands, recreational areas, and reservoirs coincides with this physiographic change and greatly affected Conceptual Route development. Most notably, the irregular sprawl of the extensive Harry S. Truman, Lake of the Ozarks, Pomme De Terre, and Stockton Lake reservoirs significantly limited the potential for reasonable alignments south of Jefferson City and north of Springfield. Through this area, the most suitable alignments were either along the northern edge of the Harry S. Truman and Lake of the Ozarks reservoirs; weaving south of the Harry S. Truman and Lake of the Ozarks reservoirs and north of Stockton Lake and Pomme De Terre;

or following a southern path along an existing 345 kV transmission line between Springfield, Missouri, and Lake Stockton.

Farther east, the large land holdings of the Mark Twain National Forest and interspersed holdings of the Department of Defense, National Park Service, and state of Missouri affected Conceptual Route development. Routes developed through this area primarily followed alignments that diverted either north of the main body of the Mark Twain National Forest (Houston/Rolla and Salem/Potosi Ranger Districts) or south along a trajectory between the National Forest System lands and the Ozark National Scenic Riverway. An alignment was also considered that loosely paralleled the north side of Interstate 40 (along a lower voltage transmission line) for more than 150 miles. Direct parallel along Interstate 40 was avoided because of the significant residential and commercial development along its path and in recognition of its role as part of the historic Route 66 corridor. Remnants of this historic travelway through the Ozarks are found just off Interstate 40 and have been designated as scenic roads by the state of Missouri.

As described in Section 3, the intermediate converter station for the southern portion of the Study Area routes was proposed to be at or near the St. Francois Substation in the northeast corner of St. Francois County, Missouri. The extensive network of public lands west of this area guided and limited route development. Approaches to the converter station were forced to either: 1) follow along a northern trajectory, ultimately turning south into the converter station area once west of the Potosi Ranger District of the Mark Twain National Forest; or 2) follow a path from the southwest after weaving through the patchwork of state parks and National Forest System lands (between the Salem and Fredericktown Ranger Districts) forming the Heart of the Ozarks recreational attractions.

While the extensive network of public lands in the area limited route development opportunities in many places, it also had a compounding effect of concentrating development to the areas in between. This effect was found throughout the Ozarks region, most notably in the area immediately adjacent to the St. Francois Substation. In this area, several large state parks (the St. Joe and St. Francois State Parks) and a dense stretch of intervening development (Farmington, Leadington, Park Hills, Deslodge, and Bonne Terre) served as major constraints to identifying suitable routes into the St. Francois Substation area.

Conceptual Routes east of the midpoint converter station location were largely guided by the identification of suitable Mississippi River crossing locations. The Routing Team focused on the area south of St. Louis and north of the Shawnee National Forest that occupies the east shore of the river from Grand Tower, Illinois, to roughly the Kentucky border. Few existing utility crossings of the river were found in this area, and extensive development extending south of St. Louis combined with large federal and state conservation areas—largely associated with the Mark Twain National Wildlife Complex—made many crossing locations unsuitable. The

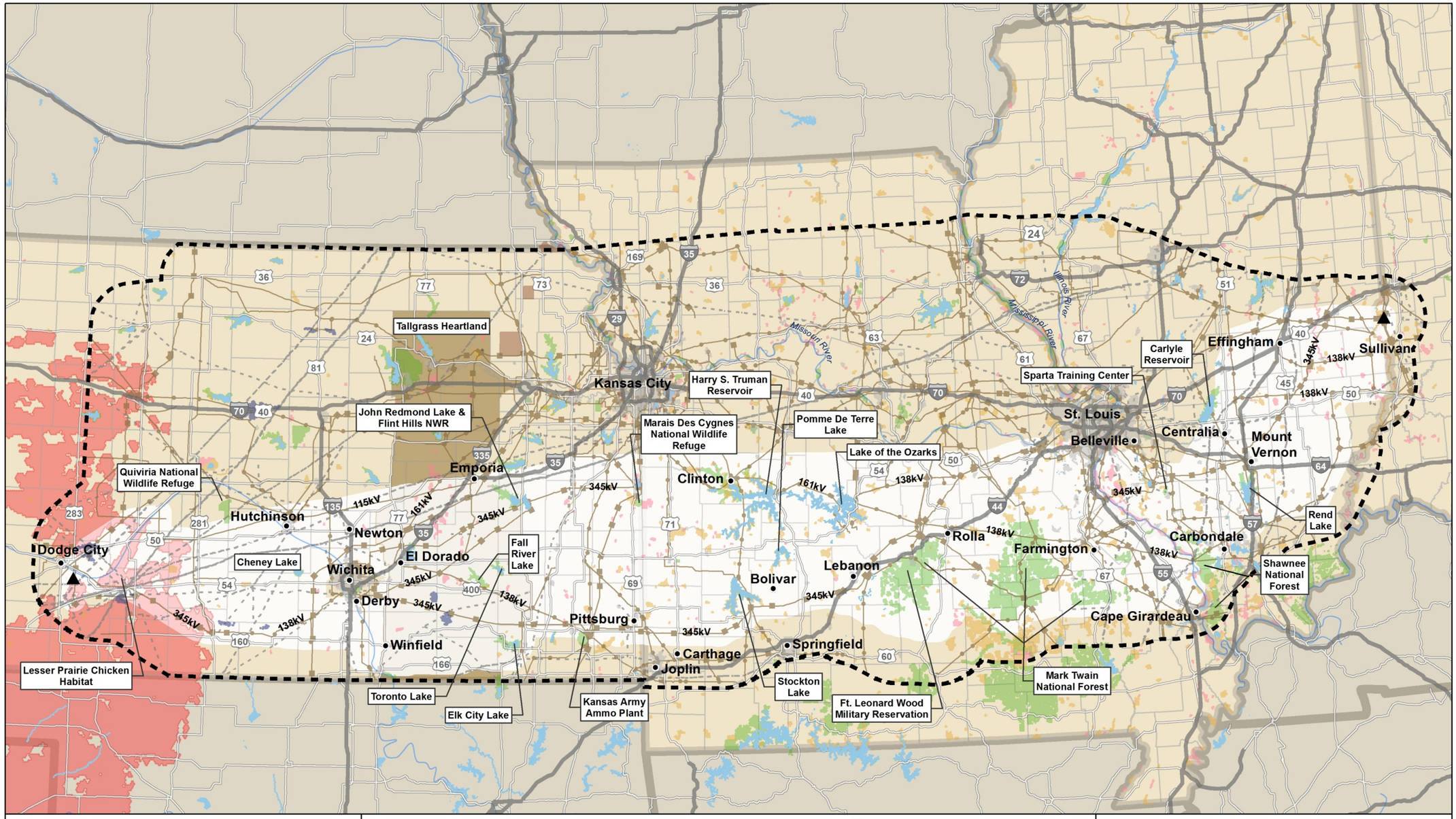

Figure 4-4
Conceptual Route Development in the Southern Portion of the Study Area

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Routing Team considered crossings near Barnhart, along the northern edge of the Mark Twain National Wildlife Refuge; north of the Rush Island Power Plant adjacent to the recently constructed 345 kV line crossing; near Chester, Illinois, at the crossing of Missouri State Route 51; and farther south near Grand Tower, Illinois. Each of these crossings was either highly encumbered by nearby development (Barnhart and Chester crossings) or a combination of state and federal conservation lands (the Shawnee National Forest lands near Grand Tower and the Mark Twain National Wildlife Refuge Complex near Rush Island).

Once in Illinois, the network of Conceptual Routes south of St. Louis continued east and northeast toward the eastern converter station, generally east of the suburbs of St. Louis and Carlyle Lake. Three major Conceptual Routes were developed from the Mississippi River crossing to Sullivan Substation with additional route links developed to connect sections of the three or to avoid highly constrained areas. Two of these major Conceptual Routes followed a series of existing transmission lines across the state. The first route followed the existing 345 kV lines from Rush Island to Baldwin, West Mt. Vernon, Louisville, Newton, Casey, and into Sullivan Substation. The second route followed a more southerly path along a mixture of 345 kV and 138 kV lines from Grand Tower to West Frankfort, Norris City, Albion, Olney, Lawrenceville, Hutsonville, and into Sullivan Substation in Indiana. The third Conceptual Route followed a pipeline from southwest of Steelville, Illinois, and continued northeast past Oakdale, Nashville, and Centralia before turning east at Kinmundy and joining the first Conceptual Route near Louisville, Illinois.

In general, the density of residential and commercial development in Illinois was highest near East St. Louis, in the suburbs extending east of the city toward Belleville, and along the Interstate 70 and U.S. Highway 40 corridor.[3] In addition, residential development near Centralia, Mt. Vernon, and West Frankfort also encumbered route development forcing the development of several new routes that only loosely parallel existing section/ parcel boundaries. Overall, residential density was highest in Illinois in the central and southern portions of the Study Area, when compared to the northern portion of the Study Area.

4.2.4 Comparison of Conceptual Routes in the Study Area

Once the network of Conceptual Routes for the entire Study Area was developed, the Routing Team conducted a comparative review of the Conceptual Routes. The analysis considered the likelihood for potential impacts from the Project through comparisons of key environmental, land use, and engineering factors for a given route or segment of route.

[3] Like the remnants of Historic Route 66 found along Interstate 40 in Missouri, historic features of the Historic 'National Road' created in 1806 by legislation signed by President Thomas Jefferson are found along the Interstate 70/40 corridor. This corridor is listed as a National Scenic Byway by the U.S. Department of Transportation, Federal Highway Administration.

Initially, comparisons were conducted at the individual Conceptual Route or route segment level to eliminate routes that were not likely suitable as a result of new insight derived from ongoing public and agency coordination efforts, newly acquired data sources, or route reconnaissance efforts. Similar to a fatal flaws analysis, this effort removed those Conceptual Routes that were not likely to reasonably meet the routing guidelines, or simply resulted in likely impacts that were inconsistent with the majority of other routes considered. Several of these removals were referenced in the preceding sections.

The Routing Team then compared the overall feasibility of siting the Project in either the northern, central, or southern portion of the Study Area based on major differences between groups of Conceptual Routes in each. These analyses identified the broad scale challenges and limitations of each portion of the Study Area, and ultimately led to the selection of the portion of the Study Area that the Routing Team would continue to pursue by developing Potential Routes.

Residential density was one of the most notable differences between the northern, central, and southern portions of the Study Area. Given the importance of residences in the siting process, it was a key factor in the comparison. During the development of Conceptual Routes, the Routing Team recognized significant differences in the density of residential development and its effect on developing reasonable alignments along existing transmission lines and pipelines and allowing for relatively straight alignments along section/parcel boundaries.

At the four-state scale, digitizing individual residences was not practical, so the Routing Team used census information to provide numerical evidence to support the challenges it observed during development of the Conceptual Routes. The 2010 census data include an estimate of the number of residences within each census block, allowing the Routing Team to derive a residential density (residences/square mile). The results of this analysis, with an overlay of the three generalized portions of the Study Area, are presented in **Figure 4-5**. To provide the color categorization for the density ranges, the Routing Team evaluated the difficulty of developing routes in areas with varying numbers of residences per square mile. This was accomplished by sampling Public Land Survey System sections (each roughly 1 square mile) throughout the Study Area, assessing the overall difficulty of routing a transmission line through it, and then counting the number of houses to derive a density.

As is clearly shown in **Figure 4-5**, the Conceptual Routes through the central portion of the Study Area in Missouri, although generally shorter, impact areas with significantly greater residential density. Areas of higher residential density begin south of Kansas City and continue to Sedalia, Columbia, Jefferson City, St. Peters, and the metro area north of St. Louis. Moreover, where low residential areas appear in the central portion of the Study Area south of Kansas City, reservoirs and conservation areas occupy key areas. In addition to high residential densities, the Conceptual Routes in the central portion of the Study Area also had fewer miles

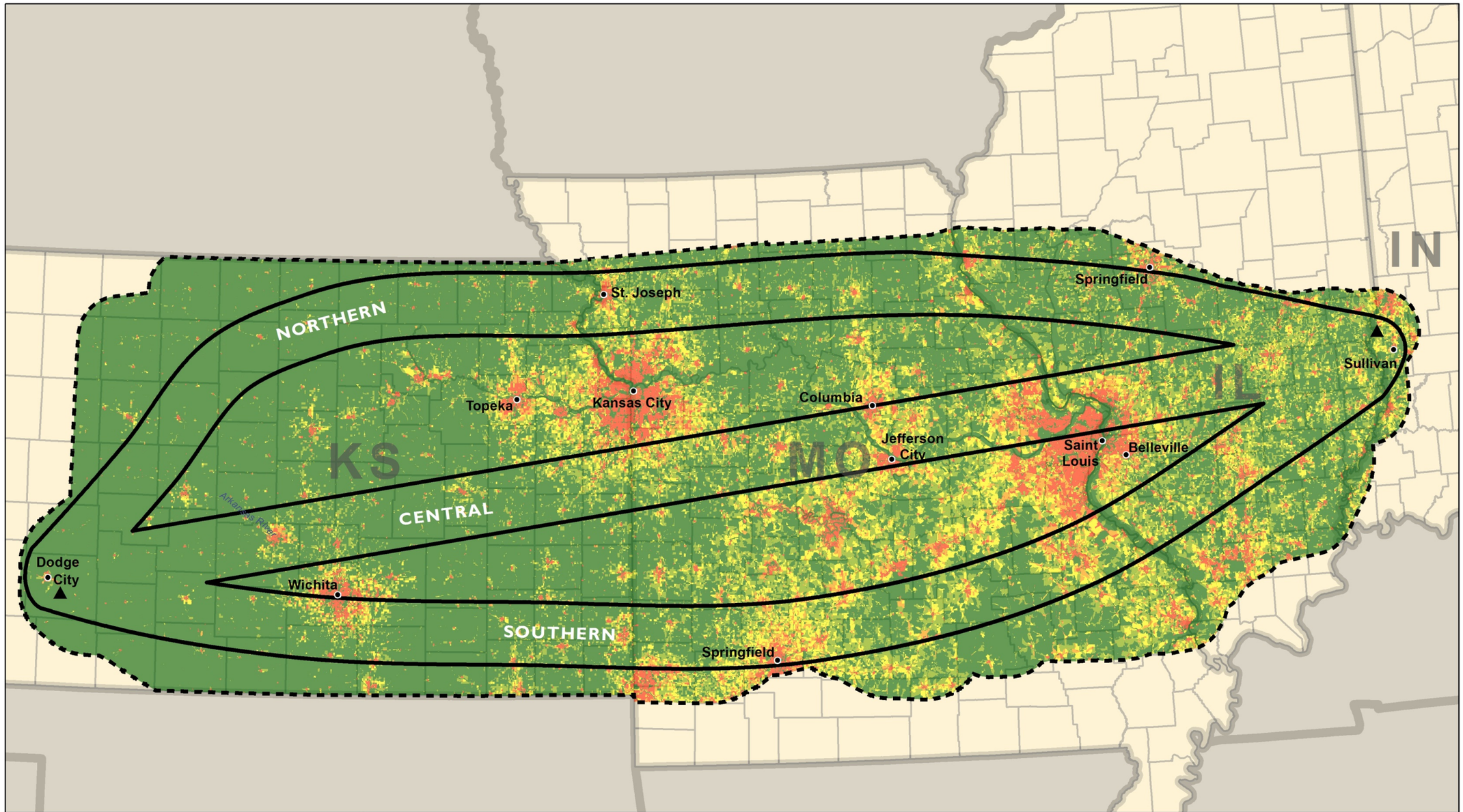

Figure 4-5
U.S. Census Residential Density in the Four State Study Area

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parallel to existing transmission lines or pipelines; fewer suitable crossings of the Missouri River that did not impact either federal, state, or private conservation lands; and no suitable locations for crossing the Mississippi River without diverting north to reach crossings in the northern portion of the Study Area—all of these issues increased overall length. For these reasons, the Routing Team removed the Conceptual Routes in the central portion of the Study Area from further consideration and did not hold Roundtables in these areas.

Conceptual Routes in the southern portion of the Study Area also had higher residential densities in Missouri and Illinois than in the northern portion of the Study Area. Residential density north of Springfield, Missouri, along Interstate 44 (Lebanon and Rolla), and into the St. Francois Substation near Farmington made Conceptual Route development difficult. In addition, the extensive and irregular sprawl of the Harry S. Truman, Lake of the Ozarks, Pomme De Terre, and Stockton Lake reservoirs significantly limited the potential for reasonable alignments. The presence of the U.S. Department of Agriculture, Forest Service's Mark Twain National Forest, U.S. Army's Fort Leonard Wood, National Park Service's Ozark National Scenic Riverway, and extensive state and private conservation lands in the southern portion of the Study Area further constrained the development of reasonable Conceptual Routes. Discussion with MDC and USFWS revealed the southern portion of the Study Area to be least suited for Conceptual Route development because of the amount of land already protected for sensitive species and habitats.

Despite these notable challenges in the southern portion of the Study Area, the Routing Team considered the southern portion more reasonable than the central portion of the Study Area and held a series of Roundtables in southern Illinois to add to data gathered at Roundtables from southern Kansas and Missouri. However, additional routing challenges were identified during meetings with community leaders and regulatory agency representatives in Illinois, and based on further review and consideration of the few suitable Mississippi River crossings south of St. Louis, the Conceptual Routes in the southern portion of the Study Area were also removed from further consideration.

Ultimately, the Routing Team considered the Conceptual Routes in the northern portion of the Study Area to be the most suitable for the Project and focused its route development efforts there. As is clearly shown in **Figure 4-5**, Conceptual Routes through the northern portion of the Study Area fall largely within areas with low overall residential density for the majority of the route. In addition, although public lands and reservoirs are common in the northern portion of the Study Area, they tend to be smaller and more dispersed, preventing the concentration of residential development in the lands between and generally provide multiple routing options to consider through an area. At the same time, sensitive habitats are generally limited in northern Missouri and Illinois, and those that are present are either largely avoidable or would result in impacts that could be minimized or mitigated. Lastly, an array of opportunity features of different types are available for the development and refinement of Potential Routes,

and multiple suitable river crossing locations were identified for each of the major river crossings.

4.3 Potential Routes

4.3.1 Developing the Potential Route Network

Once the Routing Team focused on the northern portion of the Study Area, the Study Area was effectively reduced for the continued siting of the Project and additional route revisions.

Because of the multi-state nature of the Project, Alternative Routes were developed and analyzed in Kansas first to determine the Proposed Route (detailed in the Kansas Route Selection Study, 2013). Once the Kansas Proposed Route was selected, Potential Routes in Missouri were refined based on the known location of the Missouri River crossing. Additional agency coordination and field reconnaissance was conducted to further refine Potential Routes.

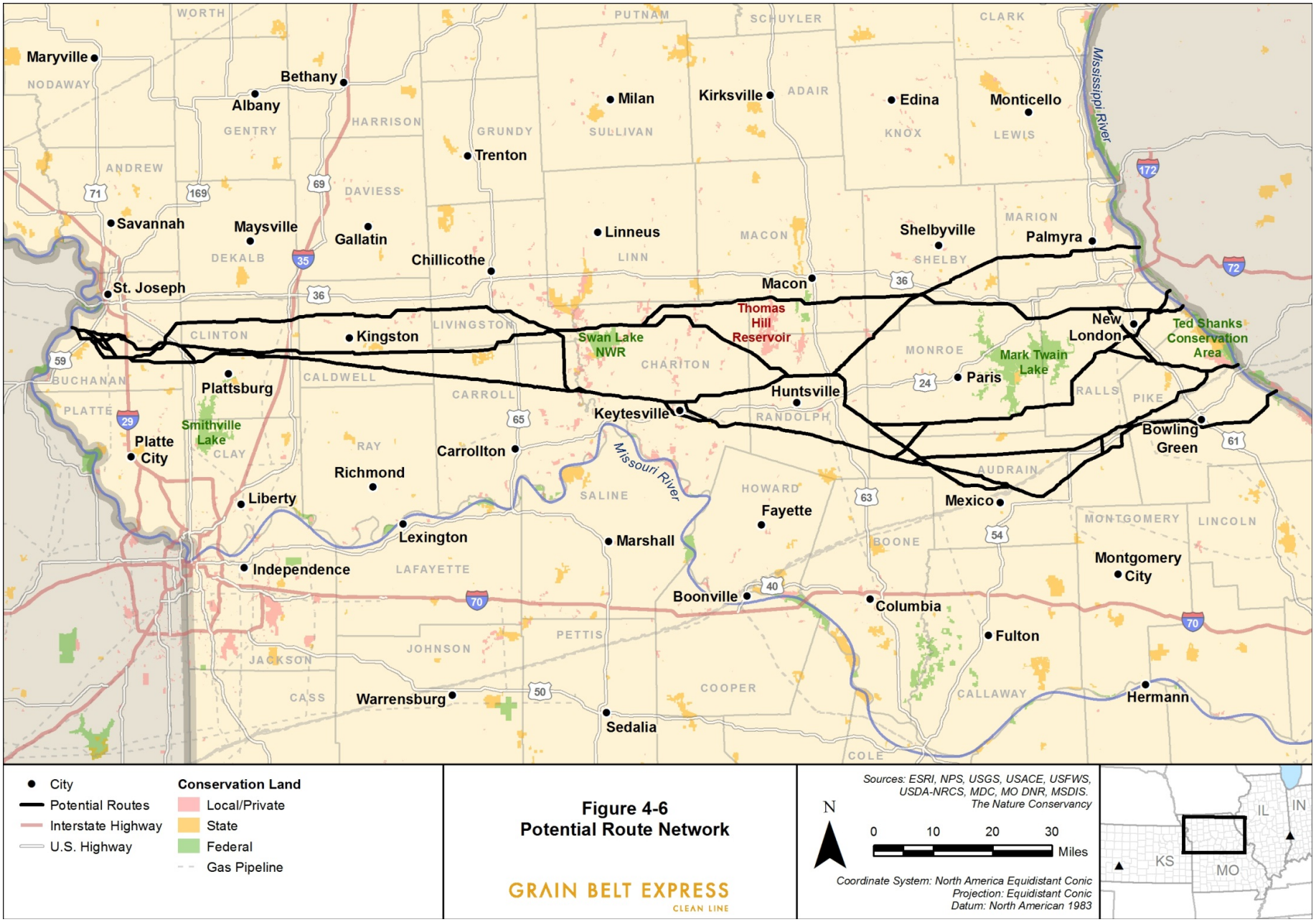
In some cases, input from regulatory agencies informed route revisions; in others cases, comparative review of routes with similar start and endpoints eliminated or forced the revision of other routes. Potential Routes were added or modified as a result of suggestions received at the Roundtables. Ultimately, the Routing Team identified the Potential Route Network (**Figure 4-6**) that would be suitable for presentation to the general public at Open House meetings. As discussed in Section 3.3.2, the Routing Team assisted attendees in locating their property or other features of concern on aerial photography maps showing the array of Potential Routes under consideration. Participants were provided pens and markers and were encouraged to document the location of their houses, places of business, properties of concern, or other sensitive resources on the printed maps. After the Open Houses, all of the maps were scanned, geo-referenced, and integrated into the GIS database, and comments received via comment card were correlated with landowner addresses.

4.3.2 Revisions to the Potential Route Network

The Routing Team spent several months reviewing the hundreds of comments received during and after the Open House meetings (see Section 3.3), making adjustments to individual route segments and refining the Potential Route Network. Below is a discussion of the key revisions made to the Potential Route Network after the Open Houses.

Key Revisions to Potential Route Links

Revisions were made to the Potential Routes following Open Houses in Missouri to respond to comments, consider new information, and as a result of ongoing reviews of engineering challenges and solutions. Most of these revisions were relatively small (on the order of 50 feet to about 200 feet); however, several were larger in scale (on the order of miles) and deserve


Maryville
Bethany
Albany
Milan
Kirksville
Edina
Monticello
Mississippi River
Trenton
Savannah
Maysville
Gallatin
Linneus
Chillicothe
Shelbyville
Palmyra
St. Joseph
Macon
Thomas Hill Reservoir
Kingston
Swan Lake NWR
New London
Ted Shanks Conservation Area
Mark Twain Lake
Paris
Plattsburg
Huntsville
Keytesville
Smithville Lake
Platte City
Carrollton
Bowling Green
Missouri River
Richmond
Liberty
Fayette
Mexico
Lexington
Marshall
Montgomery City
Independence
Boonville
Columbia
Fulton
Warrensburg
Sedalia
Hermann
WORTH
PUTNAM
SCHUYLER
CLARK
NODAWAY
ADAIR
GENTRY
HARRISON
GRUNDY
SULLIVAN
KNOX
LEWIS
ANDREW
DAVIESS
MARION
DEKALB
MACON
SHELBY
LINN
CLINTON
LIVINGSTON
MONROE
CHARITON
BUCHANAN
CALDWELL
CARROLL
RALLS
PIKE
PLATTE
RANDOLPH
CLAY
RAY
AUDRAIN
SALINE
HOWARD
BOONE
MONTGOMERY
LINCOLN
LAFAYETTE
JOHNSON
PETTIS
JACKSON
CASS
COOPER
CALLAWAY
COLE
71
169
69
35
36
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24
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54
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70
50
61
72
172
City
Potential Routes
Interstate Highway
U.S. Highway
Conservation Land
Local/Private
State
Federal
Gas Pipeline
Figure 4-6
Potential Route Network
GRAIN BELT EXPRESS
CLEAN LINE
Sources: ESRI, NPS, USGS, USACE, USFWS, USDA-NRCS, MDC, MO DNR, MSDIS. The Nature Conservancy
N
0 10 20 30
Miles
Coordinate System: North America Equidistant Conic
Projection: Equidistant Conic
Datum: North American 1983
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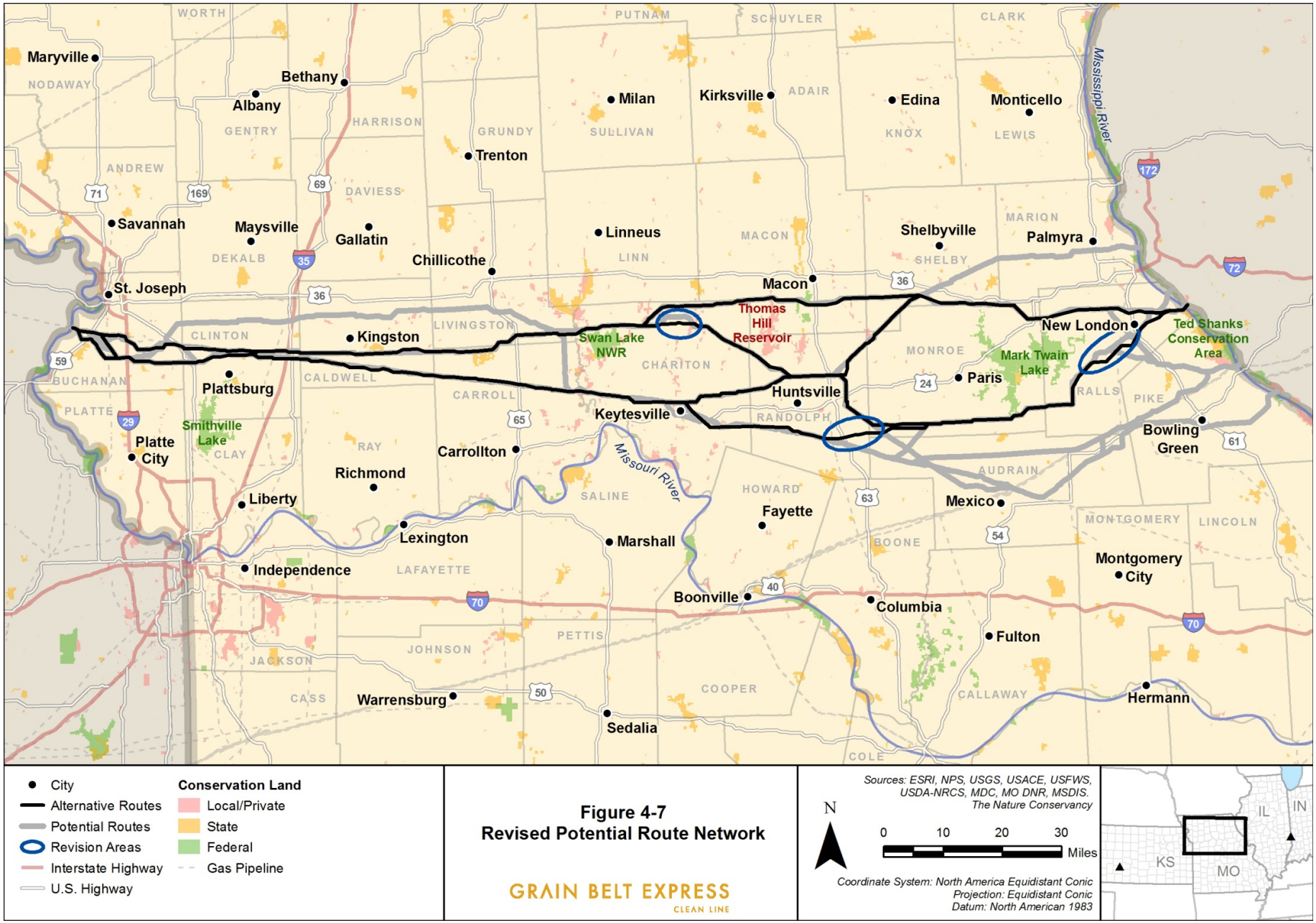
specific mention for those who may have reviewed slightly different alignments at the Open House meetings (see **Figure 4-7**).

1. *Southeast of Moberly*: After the Open Houses, a new Potential Route link was added southeast of Moberly that connected the Potential Route along the Rockies Express/Keystone Pipeline to Potential Routes in southern Monroe County. The new link provided a more direct path to the other potential routes, eliminated the circuity of the Potential Route near Mexico, and decreased the overall length of routes in this area. An additional Open House (as discussed in Section 3.3.2) was held for this new Potential Route.

2. *East of Rothville*: The Potential Route presented at the Open Houses diverted from the transmission line to the northeast approximately 2 miles before heading east for 3.5 miles to the Thomas Hill 161 kV transmission line. The Potential Route paralleled the Thomas Hill line for less than 1 mile before deviating southeast for 1 mile to avoid Natural Resources Conservation Service (NRCS) wetland conservation easements. The Potential Route then rejoined the Thomas Hill 161 kV transmission line and continued to parallel the existing transmission line southeast.

   The Routing Team evaluated the area and determined the Potential Route did not need to divert as far north in this area and could be refined to provide a better trajectory to the Thomas Hill 161 kV transmission line and avoid NRCS conservation easements. Thus, the Potential Route was shifted 0.5 mile north and then east along section/parcel boundaries for approximately 2.5 miles before shifting north another 0.5 mile, just east of Missouri Highway 5. After approximately 1.5 miles, the Potential Route moved south to follow section/parcel boundaries to the east for approximately 2 miles. The route then turned southeast and east to begin paralleling the Thomas Hill 161 kV transmission line. By refining the route in this location, the Routing Team was able to eliminate the circuity of the route and decrease its overall length.

3. *Center to New London*: The Potential Route presented at the Open Houses paralleled an existing 115 kV transmission line diagonally to the northeast from the town of Center to a point southwest of New London. During the Open Houses, the Routing Team discovered that the existing transmission line was being relocated to parallel Missouri Highway 19. Therefore, the Potential Route as shown at the Open Houses would not be parallel to the existing line as intended. The Routing Team opted to reevaluate the area to determine if another location was more suitable for the Potential Route. Residential development north of the town of Center along Missouri Highway 19 did not provide adequate space for both the relocated transmission line and the Potential Route. Therefore, routes along the highway were not carried forward north of Center. A new Potential Route was added that parallels Missouri Highway 19 to a point just south of Center before turning east for 2.5 miles and northeast for 7.5 miles where it rejoins the original Potential Route that was


Maryville
Bethany
Albany
Milan
Kirksville
Edina
Monticello
Mississippi River
Trenton
Savannah
Maysville
Gallatin
Linneus
Chillicothe
Shelbyville
Palmyra
St. Joseph
Macon
Thomas Hill Reservoir
New London
Ted Shanks Conservation Area
Kingston
Swan Lake NWR
Mark Twain Lake
Paris
Plattsburg
Huntsville
Keytesville
Smithville Lake
Platte City
Carrollton
Missouri River
Bowling Green
Richmond
Liberty
Fayette
Mexico
Lexington
Marshall
Montgomery City
Independence
Boonville
Columbia
Fulton
Warrensburg
Hermann
Sedalia
WORTH
NODAWAY
GENTRY
HARRISON
PUTNAM
SCHUYLER
CLARK
ADAIR
KNOX
LEWIS
SULLIVAN
GRUNDY
ANDREW
DAVIESS
MACON
LINN
MARION
SHELBY
DEKALB
CLINTON
LIVINGSTON
CHARITON
MONROE
BUCHANAN
CALDWELL
CARROLL
RANDOLPH
RALLS
PIKE
PLATTE
CLAY
RAY
SALINE
HOWARD
AUDRAIN
BOONE
MONTGOMERY
LINCOLN
LAFAYETTE
JOHNSON
PETTIS
JACKSON
CASS
COOPER
CALLAWAY
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City
Alternative Routes
Potential Routes
Revision Areas
Interstate Highway
U.S. Highway
Conservation Land
Local/Private
State
Federal
Gas Pipeline
Figure 4-7
Revised Potential Route Network
GRAIN BELT EXPRESS
CLEAN LINE
Sources: ESRI, NPS, USGS, USACE, USFWS, USDA-NRCS, MDC, MO DNR, MSDIS. The Nature Conservancy
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presented at the Open Houses.

Potential Route Links Removed from Further Consideration

Following the Open Houses, the Routing Team reviewed the Potential Route Network in detail with respect to a variety of environmental and land use factors, public input on area constraints near the Potential Routes, and engineering input, and began eliminating those Potential Route links that were considered less suitable for the Project.

Potential Route links in Segment 1 were encumbered by residential development near St. Joseph. Potential Route links in this area were refined to minimize the number of residences near the Potential Routes, while still maximizing the use of existing linear features. In addition, one Potential Route link was removed due to a private airstrip that was identified near a Potential Route and perpendicular to the end of the runway. Individual Potential Route links in Segment 1 that would likely result in greater impacts were removed from the network. The resulting configuration of routes is presented in **Figure 4-7**.

Potential Route links in Segment 2 generally followed three main alignments across the remainder of Missouri. The northernmost Potential Routes were developed to consider alignments near U.S. Highway 36, but ultimately followed along section/parcel boundaries just south of the highway due to residential and commercial development. The southernmost Potential Routes were developed to consider suitable alignments along the existing Rockies Express/Keystone Pipeline corridor. Lastly, Potential Routes were developed along a central path following section/parcel boundaries between the northern and southern Potential Routes.

Numerous Potential Route links were also considered that connected these three main west-to-east routes. In general, Potential Route links in Segment 2 of the Study Area were encumbered by development near U.S. Highway 36, Moberly, and Hannibal, as well as by numerous public lands and conservation easements along the Grand River, Mark Twain Lake, and the Mississippi River. The Potential Routes in Segment 2 were also highly dependent on the identification of a suitable crossing location for the Mississippi River. For example, Potential Route links in Audrain County were ultimately removed from further consideration in part because they unnecessarily increased the circuity and length of the line (in addition to having more homes in close proximity) given the trajectory of the river crossings under consideration.

Identification of the Mississippi River Crossing Location

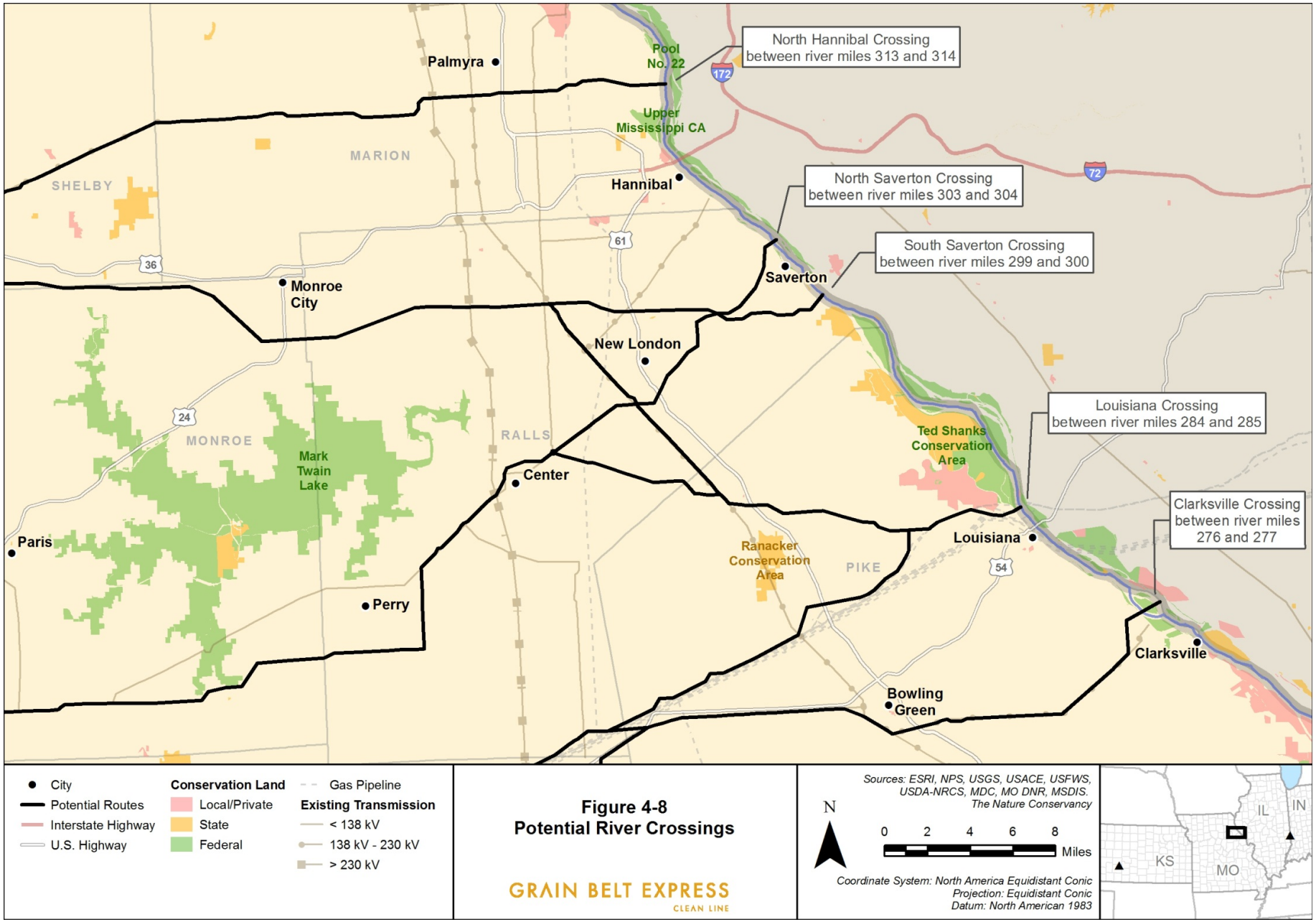
Although many river crossings were considered during the Conceptual Route phase, Potential Route crossings of the Mississippi River were primarily focused between a stretch of the Mississippi River from Hannibal to Clarksville, Missouri. Initial siting efforts focused on locations along the river with existing infrastructure crossings. However, those few sites that were identified with existing crossing locations were either encumbered by residential and commercial development, existing infrastructure, sensitive cultural and recreational resources,

or environmentally sensitive federal lands. Thus, the Routing Team also considered an array of crossing locations where no existing infrastructure currently crosses the river. For these crossings, the team considered a variety of factors in the identification of these crossings, including (but not limited to): potential for impacts on public land resources, existing irrigation infrastructure, sensitive species habitats, historic resources, and the technical design requirements of the crossing itself.

Of the many potential Mississippi River crossings considered, the Routing Team identified five from which the preferred crossing location was ultimately selected (**Figure 4-8**). The northernmost crossing was just north of Hannibal, Missouri, while the southernmost was just north of Clarksville, Missouri. All potential river crossing locations were presented at the Open Houses for comment and feedback. In addition, several agency meetings were held with MDNR, MDC, USFWS, USACE (Rock Island and St. Louis Districts), IDNR, and Missouri SHPO to discuss each river crossing and receive feedback for incorporation into the final decision. A brief description of each river crossing along with the feedback received from the agencies is discussed below.

1. *Northern Hannibal Crossing (River Mile 313–314)*: The northernmost river crossing is located approximately 3.5 miles north of Hannibal, Missouri. This location crosses approximately 14,300 feet of floodplain on the Missouri side before crossing the Mississippi River with an approximate span (from bank to bank) of 5,800 feet. On the Illinois side, the Potential Route crosses approximatley16,150 feet of floodplain. The Potential Route crosses McDonald and Schaffer islands, both of which are administered by USACE Rock Island District. Land use on either side of the river within the floodplain is agricultural with few residences located near the Potential Route. Outside the floodplain, the topography increases with steep slopes and varying terrain.

   The agencies identified several potential concerns with this crossing. USFWS raised an increased concern for the Indiana bat (a federally listed endangered species) along all of the northern river crossings (including this crossing and the two crossings north and south of Saverton). Forested lands along the northern crossings have a higher potential occurrence for both winter hibernacula and summer maternity colony presence. In addition, USACE Rock Island District noted its ownership of the two islands and stated that these areas are leased to USFWS and the state of Illinois. USACE also noted that crossing Pool 22 may be incompatible with its current designated use as a Natural Area.


North Hannibal Crossing
between river miles 313 and 314
North Saverton Crossing
between river miles 303 and 304
South Saverton Crossing
between river miles 299 and 300
Louisiana Crossing
between river miles 284 and 285
Clarksville Crossing
between river miles
276 and 277
Palmyra
Pool
No. 22
Upper
Mississippi CA
Hannibal
Saverton
Monroe
City
New London
Center
Ted Shanks
Conservation
Area
Louisiana
Ranacker
Conservation
Area
Paris
Perry
Clarksville
Bowling
Green
MARION
SHELBY
MONROE
RALLS
PIKE
Mark
Twain
Lake
172
72
61
36
24
54
City
Potential Routes
Interstate Highway
U.S. Highway
Conservation Land
Local/Private
State
Federal
Gas Pipeline
Existing Transmission
< 138 kV
138 kV - 230 kV
> 230 kV
Figure 4-8
Potential River Crossings
GRAIN BELT EXPRESS
CLEAN LINE
Sources: ESRI, NPS, USGS, USACE, USFWS,
USDA-NRCS, MDC, MO DNR, MSDIS.
The Nature Conservancy
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0 2 4 6 8
Miles
Coordinate System: North America Equidistant Conic
Projection: Equidistant Conic
Datum: North American 1983
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2. *North Saverton (River Mile 303–304)*: A second potential river crossing approximately 1 mile north of Saverton was considered. This crossing includes steep slopes and topography in a densely forested area on the Missouri side, but does not include any floodplain area outside of the edge of the river. The approximate span length across the river is 4,000 feet. On the Illinois side, the route crosses approximately 26,450 feet of floodplain. Landownership on the Missouri side of the river is private and the route crosses the Camp Oko-Tipi, a non-profit youth camp. USACE Rock Island District administers land on the Illinois side of the river and the route crosses an unnamed island. This Potential Route is approximately 2 miles north of the Saverton lock and dam. The USFWS noted the pool, which forms at the head of the lock and dam, is used by wintering and migratory waterfowl.

   USACE Rock Island District stated that the land administered by USACE is leased to USFWS and the state of Illinois. In this area, the land use designation is Wildlife Management/Reserve Forest, and USACE maintains the timber rights. Like the northernmost crossing, USFWS also stated this Potential Route may have a higher potential occurrence of both Indiana bat winter hibernacula and summer roosting habitats. In addition, several archaeological sites would require further investigation for this crossing alternative.

3. *South Saverton (River Mile 299–300)*: The third crossing is approximately 2.5 miles south of the town of Saverton. Like the previous crossing, this Potential Route goes from steep topography with dense forest cover to crossing 500 feet of floodplain and the Mississippi River. The Potential Route has an approximate span of 3,370 feet across the river and crosses approximately 36,750 feet of floodplain on the Illinois side. Land ownership on both sides of the river is private; however, the Anderson Conservation Area owned by MDC is located just south of the crossing on the Missouri side of the river. The route also crosses land on the Missouri side of the river owned by Knox County Stone Company, which has an active quarry located just north of the route. A structure would be required on Jim Young Island, which would reduce both the overall span length between structures and their required height.

   USACE St. Louis District has jurisdiction over this river crossing (and all crossings further south), although the Rock Island District maintains jurisdiction over the land on the Illinois side of the river. USACE St. Louis District stated a preference for this crossing location.

   Similar to the two crossings discussed previously, USFWS noted a higher potential occurrence of both winter hibernacula and summer roosting habitat. In addition, the Saverton lock and dam, a National Register Historic District (also known as Lock and

Dam No. 22) is located approximately 1.5 miles north of the crossing location and USFWS noted this as a concern for potential impacts to bald eagles. In particular, the USFWS noted concerns related to potential collision issues with the transmission line. Due to these potential impacts to bald eagles in the area south of Saverton Lock and Dam, the USFWS requested a crossing north of the lock and dam be selected.

The crossing location in this area has some flexibility and would require additional engineering prior to determining the exact location. Archaeological sites would re uire further investigation for this crossing alternative.

4. *Louisiana (River Mile 284–285)*: This river crossing, located approximately 1.25 miles north of the town of Louisiana, Missouri, is the only crossing that paralleled an existing linear feature across the river (a gas pipeline). The Potential Route crosses very little floodplain on the Missouri side and transitions from steep slopes down to the river. The Potential Route crosses the southern edge of Blackburn Island, parallel to the existing gas pipeline. Once on the Illinois side of the river, the Potential Route crosses 28,000 feet of floodplain. The total span across the river at this location is 3,200 feet. Structures would be placed on Blackburn Island, which would reduce the span length between structures crossing the river and decrease their required height.

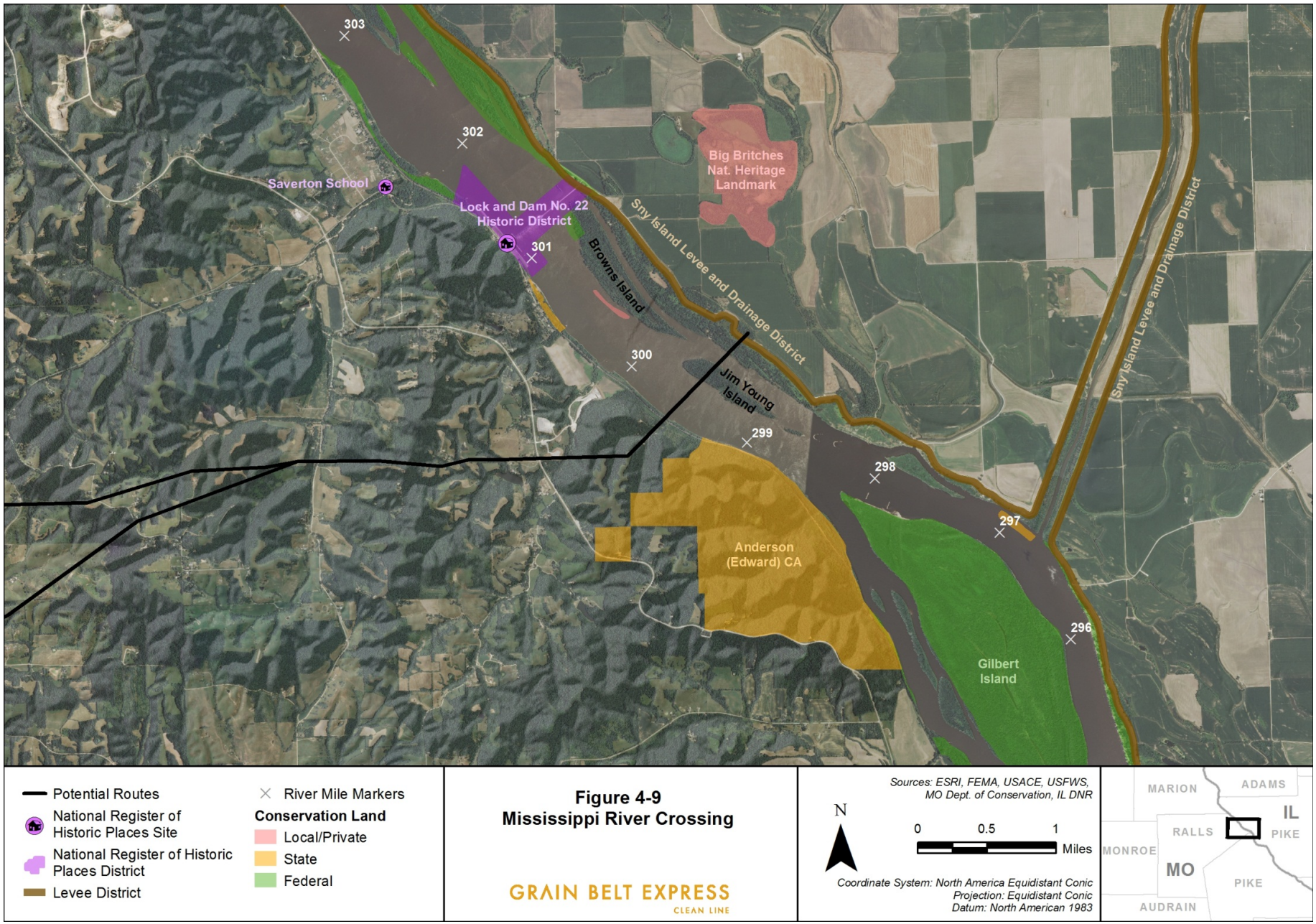
   Both USFWS and MDC stated this particular location is known for the presence of bald eagles as well as numerous migratory birds, and USFWS expressed concern about potential avian impacts. In addition, USACE St. Louis District and MDC discouraged the use of this crossing because of public land associated with the Ted Shanks Conservation Area on Blackburn Island. The conservation area is undergoing a large-scale environmental restoration project for forests and wetlands and further impacts on the island are discouraged. In addition, it was noted that bald eagles, herons, and egrets are known to nest on the island. Although this Potential Route parallels an existing pipeline, USACE noted that impacts from the transmission line may be greater because permanent vegetation clearing would be required to maintain appropriate electrical clearances.

   The town of Louisiana is the most densely populated area of the five crossings and contains a historic downtown that is included in the National Register. In addition to the above considerations, the Missouri Department of Transportation is evaluating whether to rebuild the bridge at Louisiana in its current location or re-locate the bridge. Therefore, potential conflicts may arise if the bridge is relocated close to the Potential Route crossing.

5. *Clarksville (River Mile 276–277)*: The final river crossing that was presented at the Open Houses is approximately 3 miles north of Clarksville. The topography is steep and rapidly transitions to the river without crossing floodplain area on the Missouri side. The Potential Route crosses over Pharrs Island before reaching the Illinois side of the river and crossing 24,950 feet of floodplain. The crossing in this location would span approximately 7,950 feet of the river and would require a structure s on Pharrs Island to decrease the overall span length between structures and their height. Pharrs Island is surrounded by a bullnose that was constructed to increase habitat for waterfowl and fisheries. The island includes suitable habitat for bald eagle nesting and roosting, as well as Indiana bat habitat. It also provides recreational uses for waterfowl hunting with numerous blinds scattered on the island. In addition to Pharrs Island, a state wildlife management area just south of the crossing location is managed for waterfowl and other migratory birds. Additionally, numerous cultural sites have been identified along this stretch of the Mississippi River and the Missouri SHPO believes more sites may exist along the bluffs on the Missouri side.

Once all the information was reviewed, the preferred river crossing location was determined to be the South Saverton crossing between river miles 299 and 300 (**Figure 4-9**). This crossing location was preferred by USACE St. Louis District and had the fewest conflicts associated with current land use of any the crossings. Although the USFWS considered this crossing less desirable due to potential for bald eagle impacts, residential development in this location is low with a quarry bordering the north side of the route and the Anderson Conservation Area on the south side. From an engineering perspective, the South Saverton crossing offered some flexibility in the exact alignment across the river and would allow a structure to be placed on Jim Young Island to reduce span length and structure height. In addition, this crossing is located south of the lock and dam where the river is narrower, which also would help reduce structure height. Collision may be considered a potential risk for bald eagles as well as other avian species at waterbody crossings such as at the Mississippi River. Grain Belt Express will implement an Avian Protection Plan in accordance with the Avian Power Line Interaction Committee guidance to minimize any potential impacts to avian resources.

The selection of the preferred river crossing location allowed other Potential Route links to the river crossings to be removed from consideration. The result was a refined route network with Alternative Routes from a specific Missouri River crossing location (identified in the Kansas Siting Study) to a specific Mississippi River crossing location. Section 4.3.3 below discusses the Alternative Routes carried forward in this siting study.


303
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Saverton School
Lock and Dam No. 22 Historic District
Big Britches Nat. Heritage Landmark
Browns Island
Jim Young Island
Sny Island Levee and Drainage District
Sny Island Levee and Drainage District
Anderson (Edward) CA
Gilbert Island
Potential Routes
National Register of Historic Places Site
National Register of Historic Places District
Levee District
River Mile Markers
Conservation Land
Local/Private
State
Federal
Figure 4-9
Mississippi River Crossing
GRAIN BELT EXPRESS
CLEAN LINE
Sources: ESRI, FEMA, USACE, USFWS, MO Dept. of Conservation, IL DNR
N
0 0.5 1
Miles
Coordinate System: North America Equidistant Conic
Projection: Equidistant Conic
Datum: North American 1983
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4.3.3 Description of Alternative Routes

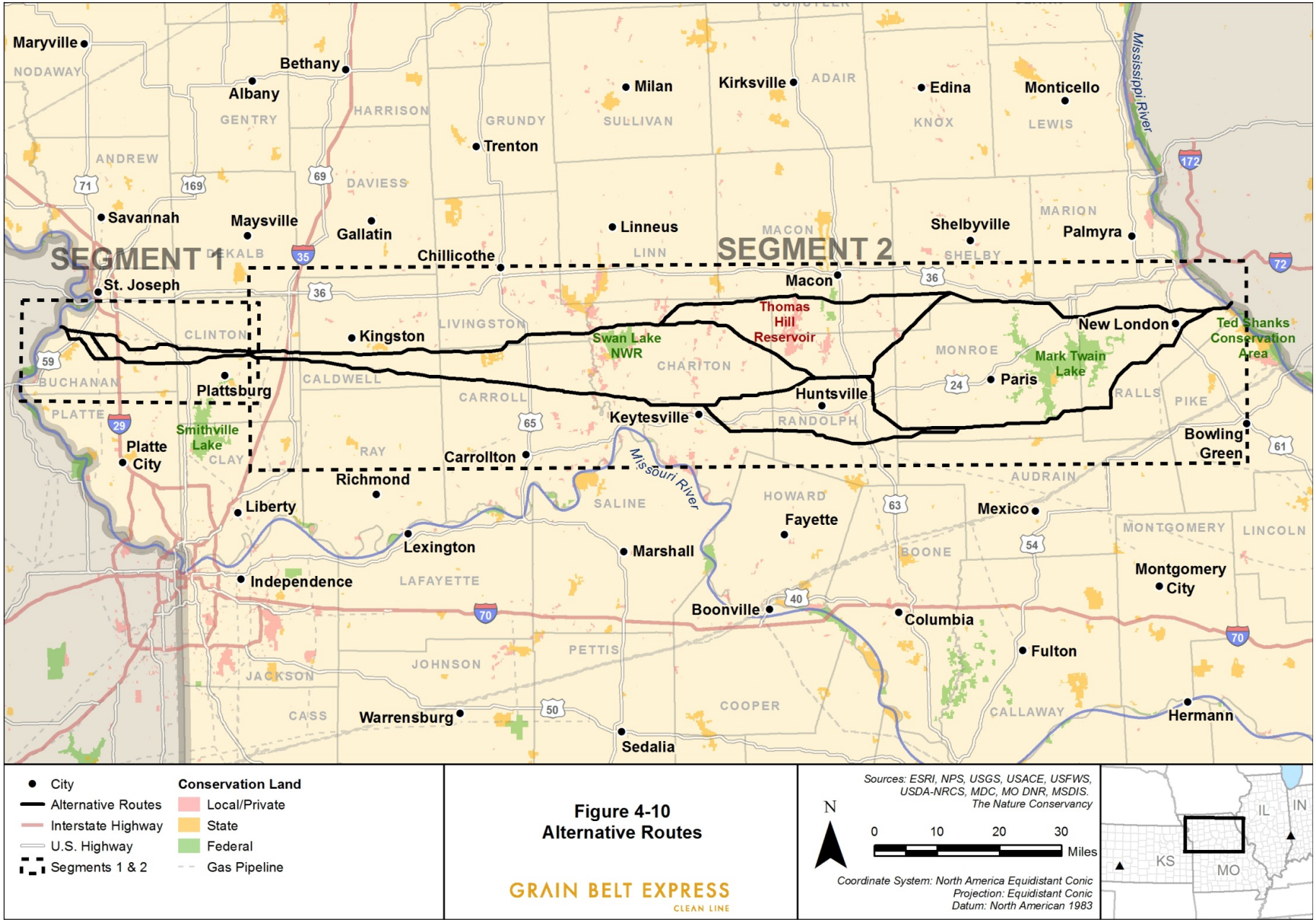
The Routing Team compiled the remaining links in the Refined Potential Route Network into Alternative Routes (**Figure 4-10**). To accommodate a reasonable comparison between Alternative Routes, the Routing Team divided the routes into two distinct segments, Segment 1 (Alternative Routes A–C) (**Figure 4-11**) and Segment 2 (Alternative Routes D–I) (**Figure 4-12**).

Each segment begins and ends at a common point for all of the Alternative Routes within that segment, which provides for a reasonable comparison between each of the Alternative Routes. From each of the segments, one Alternative Route is ultimately selected, and when both Alternative Routes are connected, the Proposed Route is formed. Segment 1 begins at the Missouri River crossing south of St. Joseph and terminates in Clinton County, just southwest of Turney, Missouri. Segment 1 carries forward three Alternative Routes for consideration. Segment 2 begins at the termination point of Segment 2 and covers the remaining portion of Missouri to the Mississippi River crossing. Segment 2 carries forward six Alternative Routes. The Alternative Routes are the focus of the comparative analysis presented in Chapter 5. Below is a description of each Alternative Route.

Segment 1

Alternative Route A

Alternative Route A (**Figure 4-10)** crosses the Missouri River close to the Rockies Express/Keystone Pipeline, just south of the Jentell Brees access area on County Road 207 in Buchannan County. After crossing the Missouri River and the Halls Levee, the route turns southeast continuing for approximately 1mile and then turns east crossing County Road 54 SW. The route continues east over County Road 41 SW before dropping south a half section across U.S. Highway 59. The route continues east for approximately 1 mile before running parallel, south of the Rockies Express/Keystone Pipeline for approximately 5 miles to U.S. Interstate 29. Prior to crossing Interstate 29, the route turns southeast around several residences before continuing toward the intersection of State Route H and County Road 65 SE, just southwest of the town of Agency. The route turns east crossing over the intersection of State Routes MM and H and the Platte River then moves north a half section crossing agriculture and pasture lands. Just before State Route E, the route turns northeast and crosses over the St. Joseph Light and Power Company's 345 kV transmission line and Mt. Moriah SE Road. The route then turns east, continuing 2 miles to U.S. Highway 169. North of Gower, the route turns southeast and parallels the Gower – Plattsburg 115 kV transmission line for approximately 0.5 mile before turning east where it follows along section/parcel boundaries across agricultural land toward the intersection of NW 29th Street and NW Perkings Road. The route continues east parallel to the Rockies Express/Keystone Pipeline for approximately 6 miles before crossing over the gas pipeline near Missouri Highway 33. The route continues east for 0.5 mile along section/parcel boundaries, dropping south a half section and ending near the intersection of NE 228th Street and Breckenridge Road.


Maryville
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Kirksville
Edina
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Mississippi River
Trenton
Savannah
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Gallatin
Linneus
Shelbyville
Palmyra
SEGMENT 1
SEGMENT 2
Chillicothe
St. Joseph
Macon
Thomas Hill Reservoir
Kingston
Swan Lake NWR
New London
Ted Shanks Conservation Area
Mark Twain Lake
Paris
Plattsburg
Huntsville
Keytesville
Smithville Lake
Platte City
Carrollton
Bowling Green
Missouri River
Richmond
Liberty
Fayette
Mexico
Lexington
Marshall
Montgomery City
Independence
Boonville
Columbia
Fulton
Warrensburg
Hermann
Sedalia
NODAWAY
ANDREW
GENTRY
HARRISON
GRUNDY
SULLIVAN
ADAIR
KNOX
LEWIS
DAVIESS
DEKALB
LINN
MACON
SHELBY
MARION
CLINTON
LIVINGSTON
CHARITON
MONROE
BUCHANAN
CALDWELL
CARROLL
RANDOLPH
RALLS
PIKE
PLATTE
CLAY
RAY
SALINE
HOWARD
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MONTGOMERY
LINCOLN
BOONE
LAFAYETTE
PETTIS
JOHNSON
JACKSON
CASS
COOPER
CALLAWAY
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72
172
City
Alternative Routes
Interstate Highway
U.S. Highway
Segments 1 & 2
Conservation Land
Local/Private
State
Federal
Gas Pipeline
Figure 4-10
Alternative Routes
GRAIN BELT EXPRESS
CLEAN LINE
Sources: ESRI, NPS, USGS, USACE, USFWS, USDA-NRCS, MDC, MO DNR, MSDIS. The Nature Conservancy
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Coordinate System: North America Equidistant Conic
Projection: Equidistant Conic
Datum: North American 1983
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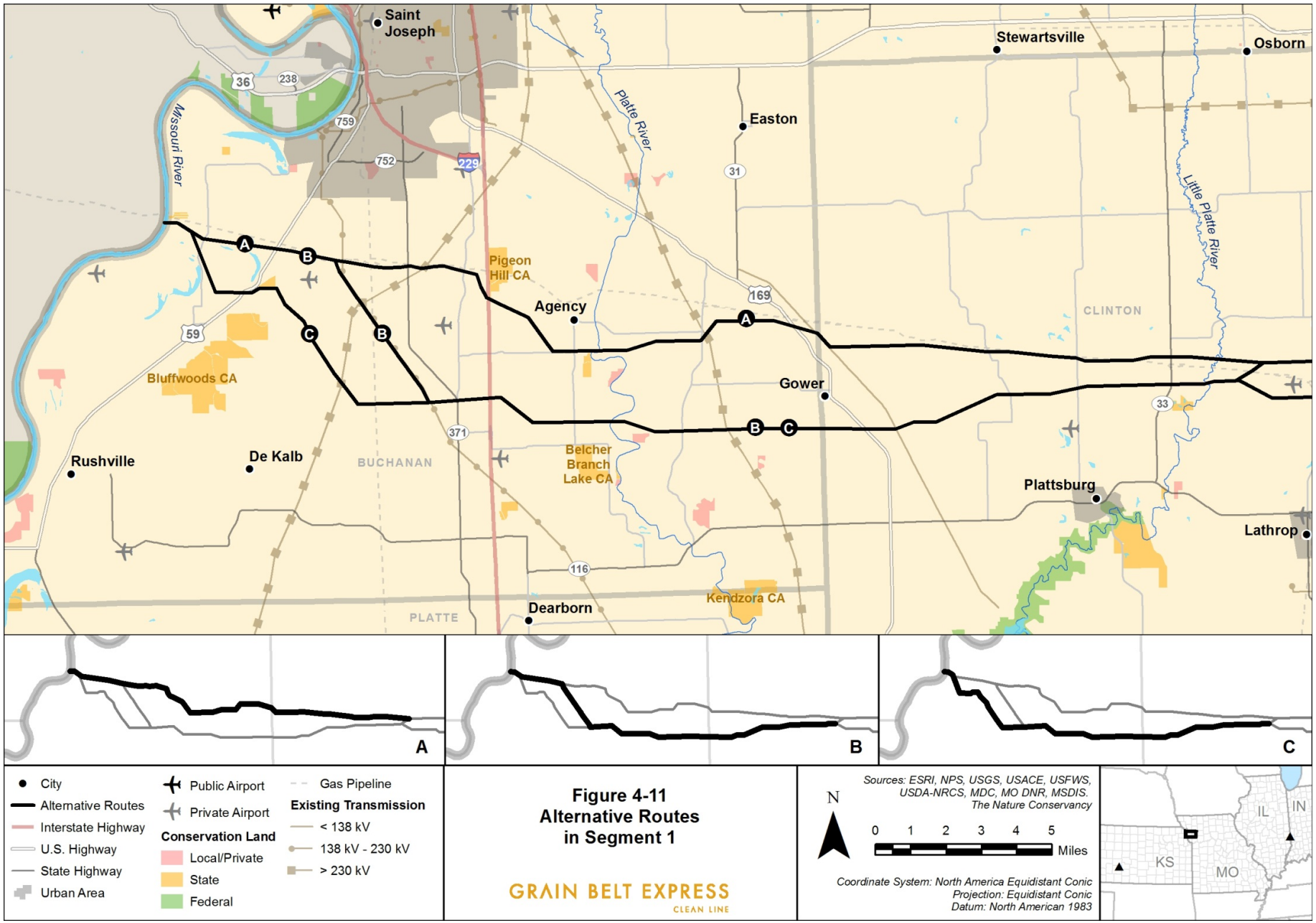
Saint Joseph
Stewartsville
Osborn
Easton
Missouri River
Platte River
Little Platte River
Pigeon Hill CA
Agency
CLINTON
Bluffwoods CA
Gower
Rushville
De Kalb
BUCHANAN
Belcher Branch Lake CA
Plattsburg
Lathrop
Dearborn
Kendzora CA
PLATTE
A
B
C
City
Alternative Routes
Interstate Highway
U.S. Highway
State Highway
Urban Area
Public Airport
Private Airport
Conservation Land
Local/Private
State
Federal
Gas Pipeline
Existing Transmission
< 138 kV
138 kV - 230 kV
> 230 kV
Figure 4-11
Alternative Routes
in Segment 1
GRAIN BELT EXPRESS
CLEAN LINE
N
0 1 2 3 4 5
Miles
Sources: ESRI, NPS, USGS, USACE, USFWS, USDA-NRCS, MDC, MO DNR, MSDIS. The Nature Conservancy
Coordinate System: North America Equidistant Conic
Projection: Equidistant Conic
Datum: North American 1983
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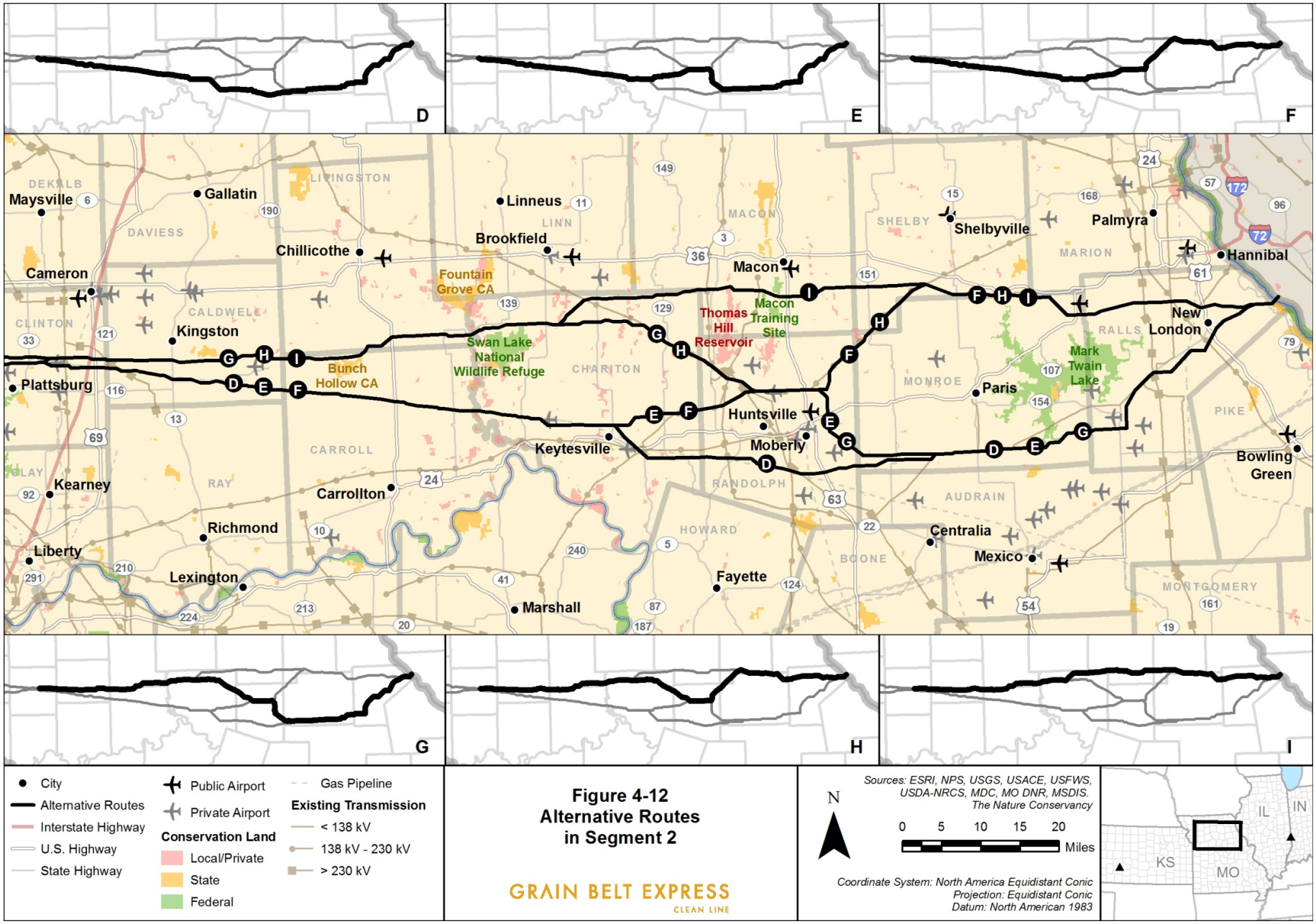
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E
F
DEKALB
Maysville
Gallatin
LIVINGSTON
Linneus
DAVIESS
Chillicothe
Brookfield
LINN
MACON
SHELBY
Shelbyville
Palmyra
Hannibal
MARION
Cameron
Fountain Grove CA
Macon
CALDWELL
CLINTON
Kingston
Thomas Hill Reservoir
Macon Training Site
New London
RALLS
Swan Lake National Wildlife Refuge
Mark Twain Lake
Bunch Hollow CA
CHARITON
MONROE
Paris
Plattsburg
Huntsville
PIKE
Keytesville
Moberly
CARROLL
Bowling Green
RAY
Kearney
Carrollton
RANDOLPH
AUDRAIN
Richmond
HOWARD
Centralia
Liberty
BOONE
Mexico
Lexington
Fayette
MONTGOMERY
Marshall
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City
Alternative Routes
Interstate Highway
U.S. Highway
State Highway
Public Airport
Private Airport
Conservation Land
Local/Private
State
Federal
Gas Pipeline
Existing Transmission
< 138 kV
138 kV - 230 kV
> 230 kV
Figure 4-12
Alternative Routes
in Segment 2
GRAIN BELT EXPRESS
CLEAN LINE
N
Sources: ESRI, NPS, USGS, USACE, USFWS, USDA-NRCS, MDC, MO DNR, MSDIS. The Nature Conservancy
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Projection: Equidistant Conic
Datum: North American 1983
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Alternative Route B

Alternative Route B (**Figure 4-10**) follows the same path as Alternative Route A for the first 5 miles before diverting south-southeast to parallel the west side of the exiting Nashua – Lake Road 161 kV transmission line for 4.5 miles. Just northwest of the town of Faucett, the route turns east crossing the existing transmission line and continuing approximately 2 miles to Interstate 29. After crossing Interstate 29, the route shifts slightly south for approximately 0.5 mile then turns, heading southeast crossing Tillery SE Road for approximately 1 mile. Near County Road Kelley SE, the route turns east again continuing 2.5 miles crossing the Platte River. The route shifts south a quarter section crossing County Road 95 SE then continues east over the Hawthorne – St. Joseph 345 kV transmission line to U.S. Highway 169 just south of Gower. After crossing U.S. Highway 169, the route continues east over Castile Creek and NW Poage Road then turns northeast for approximately 0.5 mile. The route then turns to the east for approximately 1 mile. After crossing County Road 326, the route again turns northeast for approximately 1 mile before crossing NW Prairie View Road. The route continues northeast for approximately 1 mile before turning east along section/parcel boundaries for approximately 2 miles. The route crosses over NW Country Land Road, moves north a quarter section and continues along section/parcel boundaries before terminating 0.5 mile east of NE Dixon Road.

Alternative Route C

Alternative Route C (**Figure 4-10**) follows the same path as Alternative Routes A and B for the first mile before diverting in a more south-southeast direction. The route continues south-southeast for approximately 2 miles, crossing County Road 54 SW and Crockett SW Road. It turns east after crossing Cottonwood SW Road continuing 1 mile before crossing U.S. Highway 59 and St. Joseph Sub railroad. The route continues east for approximately 0.5 mile before turning northeast for a short distance and then turning east again for 0.5 mile. Alternative Route C then turns southeast, and crosses State Route JJ, County Roads Dittemore SW and SW 25, and the intersection of Lower Dekalb SW and Bethel SW roads. The route continues in a south-easterly direction crossing the Iatan – St. Joseph 345 kV transmission line. Just south of intersection State Route V and County Road Call SW, the route turns continuing east across agriculture and pasture lands and merges with Alternative Route B to follow the same path to the termination point.

Segment 2

Alternative Route D

Alternative Route D (**Figure 4-11**) begins near the intersection of NE 288th Street and NE Crowley Corner Road approximately 2 miles southwest of the town of Turney in Clinton County. The route continues due east for a short distance before it drops south a section and continues east along section/parcel boundaries south of the Lathrop Substation. The route

crosses State Route A and the Fairport – Lathrop 161 kV transmission line and continues east a short distance before turning southeast for approximately 2 miles to Interstate 35. The route crosses Interstate 35 and continues east for approximately 1 mile before paralleling the Rockies Express/Keystone Pipeline on the south side for approximately 3 miles before shifting south a half section and crossing the intersection of State Route Z and Ore Road. The route continues east along section/parcel boundaries for approximately 2 miles before turning southeast to parallel the south side of the gas pipeline for another 4 miles until it turns southeast for approximately 1 mile before crossing Missouri Highway 13. In an effort to parallel section/parcel boundaries, the route turns east for approximately 6.5 miles to just north of the town of Cowgill. It then turns southeast, crossing the gas pipeline once more, and continues east for nearly 1 mile before turning southeast again to parallel the south side of the gas pipeline for 12.5 miles. Near the intersection of State Route C and County Road 151 in Carroll County, the route crosses over the gas pipeline and continues to parallel on the north side for approximately 9 miles to U.S. Highway 65.

After crossing U.S. Highway 65, the route crosses over and continues to parallel the gas pipeline on the south side for approximately 9 miles before crossing back to the north side to avoid impacting an Emergency Watershed Protection Easement. The route continues paralleling the gas pipeline on the north side for approximately 6 miles before crossing back to the south side to avoid a residence located near the gas pipeline. The route maintains this parallel alignment for approximately 6 more miles. Near the intersection of Powell Avenue and Hickory Grove Road, the route turns east along section/parcel boundaries for approximately 5.5 miles. It then turns southeast (east of Keytesville) for approximately 6 miles before turning east and crossing over the gas pipeline. Because of residential development along the gas pipeline, the route deviates north of the pipeline and heads southeast for approximately 7 miles before beginning its parallel alignment again on the north side for approximately 4 miles. The route then turns due east crossing over the Thomas Hill 345 kV transmission line, and continues east over U.S. Highway Business 63 and the St. Louis District Railroad, approximately 1 mile south of Moberly and just north of the town of Renick. The route then angles northeast and then turns due east 0.5 mile north of the intersection of State Route Y and County Road 1039. The route continues east along section/parcel boundaries for approximately 2.5 miles then moves north a half section crossing over Missouri Highway 151. It continues east along State Route M for 5 miles before picking up the parallel alignment to the Thomas Hill 115 kV transmission line for 9.5 miles.

South of the intersection of State Route D and County Road 779, the route and the 161 kV line split and the route continues east along pasture and agricultural land. At the intersection of State Route D and County Road 624, the route turns northeast then east again approximately 1 mile north of the town of Santa Fe. The route crosses the South Fork Salt River then turns northeast before the intersection of State Routes D and E. After approximately 1.5 miles, the

route turns east again continuing along section/parcel boundaries for 3 miles before moving north a half section and continuing due east crossing over Missouri Highway 19 in Ralls County.

Approximately 1 mile east of Missouri Highway 19, the route makes a 90 degree turn continuing north along Wyoming and York roads. The route turns northeast and parallels Missouri Highway 19 for 6 miles before diverting north and east around the town of Center. The route turns east and continues east for 2.5 miles, crossing over Missouri Highway 19. The route then turns northeast for 2 miles, east for 2.5 miles, and finally northeast for another 3.5 miles. The route crosses over the Ameren Missouri 161 kV transmission line and U.S. Highway 61 before turning east-northeast and crossing the Salt River. It continues east-northeast with slight deviations for approximately 5 miles, then it turns east near the intersection of Oakhill and Malaruni roads. After crossing Missouri Highway 79, approximately 2 miles south of Saverton, the route continues east approximately 0.5 mile before turning northeast for approximately 0.5 mile prior to reaching the Mississippi River.

Alternative Route E

Alternative Route E (**Figure 4-11**) follows the same alignment as Alternative Route D to the point just north of Keytesville. Here, Alternative Route E continues east along the north side of Dooley Ford Road. At the intersection of State Route UU and Scribner Road, the route turns northeast crossing over Log Cabin Lane and then turns east crossing the Chariton River. The route continues due east for approximately 3 miles along section/parcel boundaries before moving north a half section and crossing Missouri Highway 129. The route continues east for 1.5 miles, crossing Prairie Valley Avenue, and then begins paralleling the north side of the Salisbury – Thomas Hill 161 kV transmission line. The route continues the parallel alignment, with one deviation around several residences along the existing transmission line, for approximately 6 miles. After the route crosses Missouri Highway 3, it crosses the Salisbury – Thomas Hill 161 kV transmission line and turns northeast near County Road 1135. The route crosses a 161 kV and a 115 kV transmission line as it proceeds northeast. Approximately 0.5 mile north of the State Route Z and County Road 1145 intersection, the route turns east crossing a 345 kV transmission line before merging and paralleling south of another Kansas City Power and Light Company 161 kV transmission line. The route continues to parallel the 161 kV transmission line for approximately 7 miles crossing U.S. Highway 63 and then turns south near the intersection of County Roads 1490 and 1495. The route continues south, parallel to a lower voltage transmission line, crossing U.S. Highway 24, for approximately 4.5 miles then turns southeast to parallel north of the Ameren Missouri 69 kV transmission line for 5.5 miles. Approximately 0.75 mile northwest of the County Roads 1018 and 1023 intersection, the route turns due east and follows the same alignment as Alternative Route D to the Mississippi River.

Alternative Route F

Alternative Route F (**Figure 4-11**) follows the same alignment as Alternative Route D to the point just north of Keytesville. Here, Alternative Route F continues east along the same alignment as Alternative Route E to the intersection of County Roads 1490 and 1495, east of Cairo. It turns north-northeast crossing State Route K and continues north along section/parcel boundaries for 1.5 miles. The route crosses State Route FF then turns northeast to parallel the south side of a Kansas City Power and Light Company 161 kV transmission line for approximately 16.5 miles with two diversions around residences and an NRCS Wetland Reserve Program (WRP) easement.

Approximately 3 miles west of Shelbina (in Shelby County) near the intersection of County Roads 425 and 432, the route diverts from the Kansas City Power and Light Company 161 kV transmission line to the southeast. The route diagonally crosses agriculture and pasture land towards the intersection of State Route WW and County Road 439 then turns east crossing Missouri Highway 15. The route continues east mostly along section/parcel boundaries for 3.5 miles, dropping south a half section into Monroe County. After crossing State Route PP, the route continues east along the border of Shelby and Monroe counties for 2 miles before turning southeast. Approximately 0.5 mile south of Hunnewell, the route turns due east continuing along section/parcel boundaries for approximately 2 miles. It turns south-southeast crossing near the intersection of County Roads 375 and 390. The route continues for 2.5 miles, crossing the Hannibal District Railroad then turning east, 2 miles south of Monroe City. Continuing east for 1.0 mile, the route crosses Missouri Highway 24 and parallels north of County Road 594 and Hereford Lane into Ralls County.

Alternative Route F continues east from the county line for approximately 1.5 miles then turns northeast. The route continues in a northeasterly direction for approximately 5 miles turning east near the intersection of Huntington Lane and Hawthorne Road. The route continues east crossing Ameren Missouri's Maywood - Montgomery 345 kV transmission line and State Route H. It continues east for 2 miles crossing a Central Electric Power Cooperative 115 kV transmission line and the Marblehead – Tap 161 kV transmission line just south of Rensselaer and Hannibal. Continuing east, the route crosses State Route M then turns southeast for 2 miles. Near the intersection of Choctaw Trail and U.S. Highway 61, the route turns east again continuing along the north side of the Salt River. Just south of the intersection of State Route O and Flint Hill Road, the route turns east-southeast for approximately 1 mile before heading due east along section/parcel boundaries for 1 mile. It continues to travel east, making three slight deviations to avoid residences before joining with the same alignment as Alternative Routes D and E to the Mississippi River.

Alternative Route G

Alternative Route G (**Figure 4-11**) begins near the intersection of NE 288th Street and Breckenridge Road approximately 1.5 miles southwest of the town of Turney in Clinton County. The route continues east for 5 miles to NE Estep Road. It moves south a half section, crosses Interstate 35 and U.S. Highway 69 continuing east along section/parcel boundaries. Near the Clinton and Caldwell County line, the route moves south a half section and continues east for 3 miles to the intersection of Duroc Drive and Texas Road. The route moves south another half section, crossing State Route D and continues east along section/parcel boundaries for 5 miles to Missouri Highway 13. After crossing Missouri Highway 13, the route moves south a half section continuing east across agriculture and pasture land for about 7 miles. The route moves north a section and parallels south of Ayres and Honeysuckle Drive. Approximately 1.5 miles north of the town of Braymer, the route shifts south a section crossing State Route A and continuing east along section/parcel boundaries into Carroll County.

The route continues east along section boundaries approximately 3 miles into Carroll County. Just after crossing State Route D, the route moves south a half section continuing east, north of County Road 110. The route passes north of Bunch Hollow Conservation Area then turns northeast near the intersection of County Road 110 and State Route Z. The route continues for 1.5 miles, parallels for a short distance a Northwest Missouri Electric Cooperative 69 kV transmission line, and then turns east crossing the 69 kV transmission line. The route continues east for approximately 1.5 miles then turns northeast crossing County Roads 451 and 430. Just west of U.S. Highway 65, the route turns and continues east 7 miles crossing Missouri Highway 139 approximately 1.5 miles north of the town of Hale. The route briefly parallels the south side of a Northwest Missouri Electric Cooperative 69 kV transmission line then crosses the 69 kV transmission line and continues east for 3 miles. After the route crosses the Brookfield Sub Railroad, it turns northeast crossing the Grand River into Chariton County.

The route continues in a northeast direction in Chariton County, avoiding NRCS WRP easements, several residences, and a cemetery then turns east at the intersection of Lakeside Road and State Route Ra. The route continues east passing between the town of Sumner and the Swan Lake National Wildlife Refuge before moving north a half section and continuing east for 5 miles to Missouri Highway 11. After crossing Missouri Highway 11, the route moves south a half section, crosses the Marceline Sub Railroad and continues another 5 miles to Missouri Highway 5. The route continues east and moves north at Cumberland Avenue to avoid several residences. The route moves back south just west of State Road ZZ and continues east for 1.5 miles. It then turns southeast to move south a section and then turns east again until reaching the Thomas Hill 161 kV transmission line. The route parallels the west side of the 161 kV transmission line for 10 miles, crossing Missouri Highway 3, and then turns east-southeast near the intersection of State Route F and County Road 1150. The route crosses four different transmission lines coming out of the Thomas Hill power plant, before

turning south-southeast near the intersection of County Roads 1155 and 1160. It crosses and parallels the east side of a Northeast Missouri Electric Power Cooperative 69 kV transmission line for 1.5 miles. Continuing south-southeast, it crosses State Route C and a Kansas City Power and Light Company 161 kV transmission line. The route parallels the 161 kV transmission line on the south side and follows the same alignment as Alterative Route E to the Mississippi River.

Alternative Route H

Alternative Route H (**Figure 4-11**) is a combination of Alternative Routes G and F. Alternative Route H follows the same alignment as Alternative Route G from the starting point to just east of Cairo where Alternative Routes E and G head south and Alternative Routes F and H head northeast. From here, Alternative Route H follows the same alignment as Alternative Route F to the Mississippi River.

Alternative Route I

Alternative Route I (**Figure 4-11**) follows the same alignment as Alternative Routes G and H from the starting point to just below the town of Rothville in Chariton County. After the routes cross the Marceline Sub Railroad, Alternative Route I turns northeast and parallels the railroad for 4.5 miles. North of the Twichell Road and Pioneer Avenue intersection, the route turns east crossing Northwest Missouri Electric Cooperative 161 and 69 kV transmission lines. Approximately 0.5 mile south of Marceline, the route crosses Missouri Highway 5 continuing east mostly along parcel boundaries for 8.5 miles before crossing Missouri Highway 129. After crossing Missouri Highway 129, the route continues east for 2 miles then gradually moves north a section into Macon County. It continues east crossing the Chariton River and the Ameren Missouri 161 kV transmission line before reaching Missouri Highway 3. After crossing Missouri Highway 3, the route diverts north of the Thomas Hill Reservoir then moves south a section continuing east crossing State Route FF and C. The route continues east crossing a Kansas City Power and Light Company 161 kV transmission line, then passes between the U.S. Army National Guard Macon Training Site south of Macon. Near the intersection of Kayak Avenue and Keswick Place, the route turns east crossing U.S. Highway 63 continuing for 3.5 miles before moving north a section close to the intersection of Nature Avenue and Noble Road. The route continues east for approximately 4 miles into Shelby County crossing U.S. Highway 151 just south of Clarence. The route continues east for 7 miles then turns southeast near the intersection of County Roads 417 and 432. It crosses a Kansas City Power and Light Company 161 kV transmission line and then follows the same alignment as Alternative Routes F and H to the Mississippi River crossing.

5. Alternative Route Evaluation

This chapter describes the key resources in the Study Area and a comparative analysis of the potential impacts of each Alternative Route on these resources. The analysis relies on a combination of information collected in the field, GIS data sources, supporting documents, stakeholder input, and the knowledge and experience of the Routing Team. Information presented throughout the chapter is based on an aerial photo-aligned centerline for each Alternative Route. The final location of any route is subject to modification based on final engineering, ground surveys, minimization of impacts on site specific resources, and landowner negotiations.

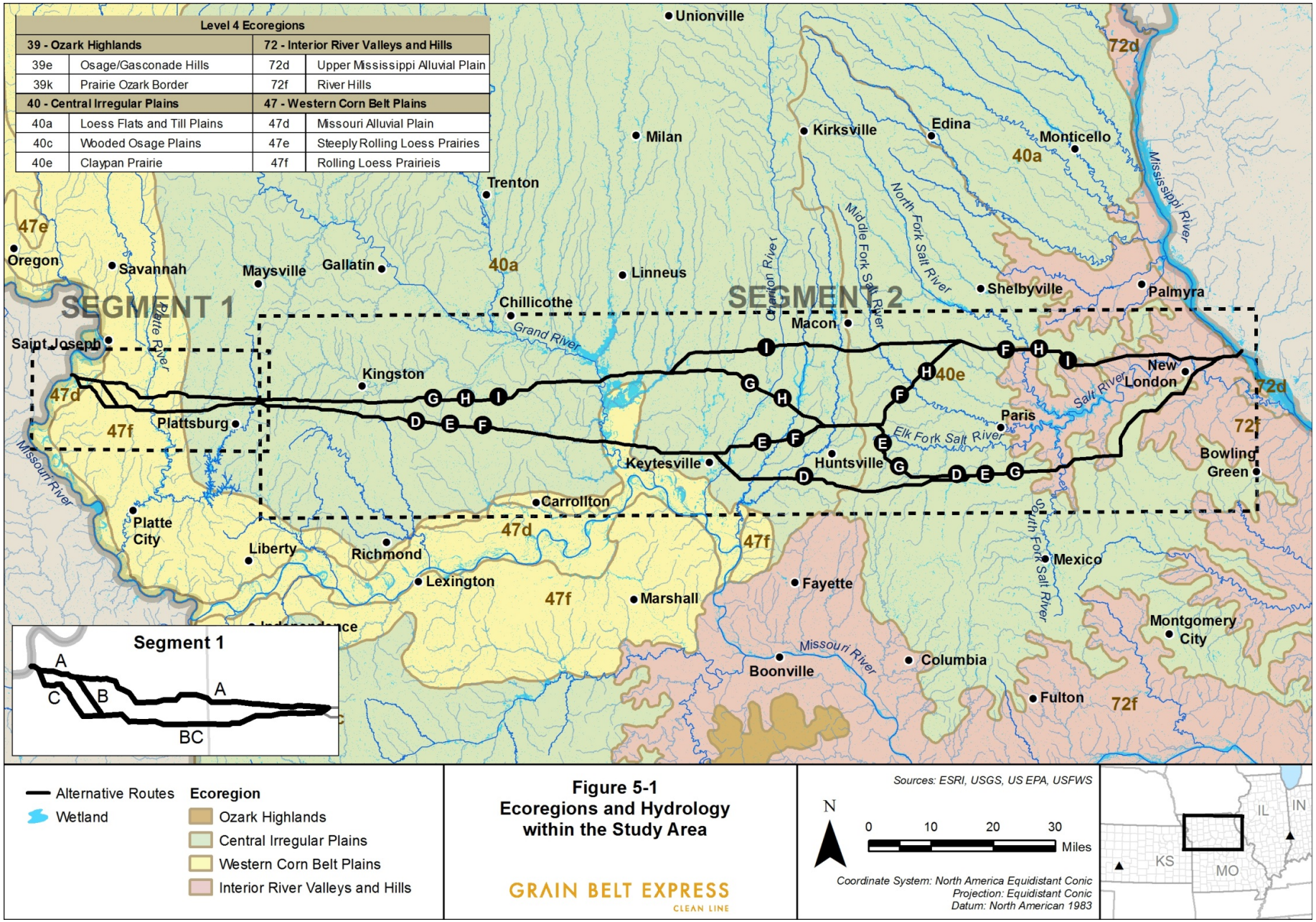
5.1 Natural Environment Impacts

5.1.1 Water Resources

Water resources of northern Missouri fall within the Missouri River and Upper Mississippi River basins. As a result of the areas' glacial past, the drainage patterns consist of nearly parallel streams that trend south in northwestern Missouri and drain into the Missouri River. Streams in northeastern Missouri flow southeast and into the Mississippi River. The glacial till of northern Missouri has low permeability; therefore, infiltration is low and runoff is rapid (Vandike 1995). This low permeability and a lack of groundwater inflow make for low base flows during dry weather. Northern Missouri is extensively row-cropped, and glacial till is easily eroded, especially on steeper slopes. This combination leads to high suspended sediment loads in many streams and rivers in northern Missouri (Vandike 1995). Water resources in the study area are presented in **Figure 5-1**.

The vast majority of the ponds and lakes in Missouri are privately owned and used for agricultural or recreational purposes. USACE has constructed numerous reservoirs for flood control, including the Mark Twain Lake in Monroe and Ralls counties. Wetlands are typically located in the floodplains along rivers and streams, in swales associated with rivers, or as margins of lakes and impoundments.

In Segment 1, all streams and rivers drain to the Missouri River. The segment begins at the Missouri River and crosses the Independence-Sugar, Platte, and Upper Grand watersheds. Major surface water features include the Missouri River, Platte River, Little Platte River, Grand River, Shoal Creek, and the East Fork Grand River. Groundwater resources are poor with the exception of the Missouri River alluvium, which averages well yields of 1,000 gallons per minute (Miller and Vandike 1997).


Level 4 Ecoregions
39 - Ozark Highlands
39e Osage/Gasconade Hills
39k Prairie Ozark Border
40 - Central Irregular Plains
40a Loess Flats and Till Plains
40c Wooded Osage Plains
40e Claypan Prairie
72 - Interior River Valleys and Hills
72d Upper Mississippi Alluvial Plain
72f River Hills
47 - Western Corn Belt Plains
47d Missouri Alluvial Plain
47e Steeply Rolling Loess Prairies
47f Rolling Loess Prairieis
SEGMENT 1
SEGMENT 2
Segment 1
A
B
C
BC
Unionville
Milan
Kirksville
Edina
Monticello
Trenton
Oregon
Savannah
Maysville
Gallatin
Linneus
Chillicothe
Macon
Shelbyville
Palmyra
Saint Joseph
Kingston
Plattsburg
Keytesville
Huntsville
Paris
New London
Bowling Green
Carrollton
Platte City
Liberty
Richmond
Lexington
Marshall
Fayette
Mexico
Montgomery City
Boonville
Columbia
Fulton
Missouri River
Mississippi River
Grand River
Platte River
Middle Fork Salt River
North Fork Salt River
Elk Fork Salt River
South Fork Salt River
Alternative Routes
Wetland
Ecoregion
Ozark Highlands
Central Irregular Plains
Western Corn Belt Plains
Interior River Valleys and Hills
Figure 5-1
Ecoregions and Hydrology
within the Study Area
GRAIN BELT EXPRESS
CLEAN LINE
Sources: ESRI, USGS, US EPA, USFWS
N
0 10 20 30
Miles
Coordinate System: North America Equidistant Conic
Projection: Equidistant Conic
Datum: North American 1983
IL
IN
KS
MO

In Segment 2, streams and rivers drain to the Missouri and Mississippi rivers. The segment crosses nine watersheds including the Upper Grand, Lower Grand, Lower Chariton, Little Chariton, Lower Missouri-Crooked, Salt, North Fork Salt, South Fork Salt, and the Sny. Major surface water features include the Chariton River, Mussel Fork, Grand River, North Fork Salt River, South Fork Salt River, Crooked River, Salt River, and the Mississippi River. Segment 2 also has two large reservoirs, Thomas Hill Reservoir and Mark Twain Lake. Groundwater resources are more diverse in the northeastern part of the state and can have areas of moderate yields for irrigation (Miller and Vandike 1997).

Portions of Shoal Creek, Crabapple Creek, Log Creek, and Brush Creek in the Bonanza Conservation Area are designated Outstanding State Resource Waters (State of Missouri 2012). In contrast, several waters in this segment are also listed on the state's 303(d) list that identifies impaired waterbodies that are not currently meeting water quality standards. Other 303(d) listed waters in the area of Segment 2 include Salt Creek in Chariton County, Middle Fork – Salt River in Macon County, a tributary to Coon Creek in Randolph County, and Salt River in Ralls/Pike County, all of which are impaired for low dissolved oxygen levels (MDNR 2013).

Swan Lake National Wildlife Refuge, managed by USFWS, is located in the floodplain of the Grand River near its confluence with the Missouri River. The refuge provides 7,000 acres of wetlands and more than 3,000 acres of open water (USFWS 2013a). In addition, numerous NRCS WRP conservation easements are located along the Grand River.

Mark Twain Lake, impounded by Clarence Cannon Dam, is the only major reservoir in northeastern Missouri in the Mississippi River basin. Clarence Cannon Dam is 1,940 feet long and 138 feet high. At multipurpose pool level (elevation 606 feet), the surface area of Mark Twain Lake is 18,600 acres, and storage is 457,000 acre-feet (Vandike 1995). Mark Twain Lake is used for flood control, recreation, and water supply.

Thomas Hill Reservoir was formed by damming the Middle Fork Little Chariton River in Randolph County. The reservoir, which is privately owned by Associated Electric Cooperative, is used primarily to supply cooling water for the Thomas Hill Power Plant. The lake drains 147 square miles and has a normal surface area of about 4,400 acres. Although it is primarily used for cooling water, it is also a source of water for Thomas Hill Public Water Supply District #1 and is used for recreation (Vandike 1995).

General Impacts and Mitigation Measures

Surface Waters

Direct impacts on hydrologic features are often minimized or avoided by spanning wetlands, rivers, or drainages, when feasible. In the absence of other constraints, engineers typically seek to place structures at high points in topography, inherently resulting in the avoidance of

structure placement that impacts water or wetland features in low-lying areas. However, in a few rare instances, such as at crossings of large wetland areas or complexes, a structure may need to be placed within a wetland. In these instances, the area of permanent wetland loss is limited to the area of the footprint of the structure foundation, typically between 0.0005 and 0.0009 acre of permanent impact (average permanent impact acreage for lattice steel and steel monopole structures, respectively).

Regardless of the type of impact, Grain Belt Express will continue to coordinate with USACE concerning potential impacts on jurisdictional wetlands and attempt to minimize permanent impacts when feasible and practicable. Grain Belt Express would implement best management practices during the design, construction, and operational phases to avoid or minimize impacts on wetlands. These practices may include the consideration of designs that limit clearing forests near drainages and in areas of steep topography, requiring the use of wetland mats to minimize impacts of construction traffic, and avoiding construction during seasonally wet periods in certain areas.

At the Mississippi River crossing location, no structures would be placed in the river; however, a structure would be placed on Jim Young Island. Although impacts to the Mississippi River are not anticipated, wetlands may occur on the island and along the riparian margins of the Mississippi River. Grain Belt Express will continue coordination with USACE to identify and mitigate potential impacts that may be associated with wetlands located at the crossing as well as across the project.

Other indirect impacts to surface waters, such as sedimentation and erosion of surrounding soils, can result from ground-disturbing activities. Typically, sedimentation is easily controlled with proper perimeter controls around the transmission line construction area. Best management practices may include implementation of sediment control measures such as silt fences, access road drainage management measures, and timely reseeding of disturbed soil areas. Grain Belt Express will coordinate with MDNR and obtain and comply with the necessary storm water permits for construction of the Project.

Groundwater

Generally, transmission line construction does not impact groundwater. In some instances, dewatering may need to occur in areas with a high water table to place foundations in the ground. Any dewatering activities required by construction would follow best management practices and be covered under the National Pollution Discharge Elimination System Permit or under a separate dewatering permit, as appropriate.

Alternative Route Comparison

For each segment, Alternative Routes were analyzed for the number of stream crossings (including streams, rivers, or drainages that can be perennial, seasonal, intermittent, or

ephemeral), number of waterbodies (lakes or ponds) crossed, and acres of wetlands (forested and scrub/shrub). **Figure 5-1** shows the ecoregions and hydrology for both segments.

Segment 1

Excluding the Missouri River itself, all streams and waterbodies in Segment 1 can be easily spanned, and potential wetland acreage within the ROW of each Alternative Route is generally similar (**Table 5-1)**. Alternative Route A crosses the fewest streams; however, it also crosses the greatest number of waterbodies and has the greatest total wetland acreage and forested wetland acreage within the ROW. Alternative Routes B and C are comparable with a similar number of stream crossings, waterbody crossings and wetlands within the ROW.

Table 5-1. Segment 1 Alternative Routes Water Resources Information

Water Resources Category	Alternative Routes		
	A	B	C
Stream crossings (count)	53	58	63
Waterbody crossings (count)	9	6	3
Wetlands[1] within the ROW[2] (acres)	41	36	33
Forested wetlands[1] within the ROW[2] (acres)	21	11	12
Scrub-shrub wetlands[1] within the ROW[2] (acres)	--	--	--

[1] National Wetlands Inventory (2013)

[2] ROW is 100 feet on either side of centerline

Segment 2

Excluding the Mississippi River crossing, all waterbodies and streams can be spanned by all of the Alternative Routes. Wetlands will be spanned when feasible. No structures will be placed in the Mississippi River; however, taller structures and longer spans will be required. Alternative Route D has the fewest stream crossings, while Alternative Route F has the most stream crossings, though the number of stream crossings and waterbody crossings is generally similar across all six alternatives (**Table 5-2**).

All of the Alternative Routes intersect one or more reaches of a 303(d) impaired water. However, based on the impairments listed for these streams (*Escherichia coli*, or E. coli, and low dissolved oxygen), the Project is not likely to further impair the streams crossed. Alternative Route D has the fewest stream crossings and the fewest acres of total wetlands within the ROW. Therefore, Alternative Route D would likely have the least overall impact on water resources in Segment 2.

Table 5-2. Segment 2 Alternative Routes Water Resources Information						
Water Resources Category	Alternative Routes					
	D	E	F	G	H	I
Stream crossings (count)	228	248	252	245	249	238
Waterbody crossings (count)	24	24	25	24	25	27
Wetlands[1] within the ROW[2] (acres)	118	129	132	137	141	143
Forested wetlands within the ROW[1] (acres)	69	76	77	76	77	77
Scrub-shrub wetlands within the ROW[1] (acres)	1	1	1	<1	<1	<1

[1] National Wetlands Inventory (2013)

[2] ROW is 100 feet on either side of centerline

5.1.2 Wildlife and Habitat

Vegetation and Habitats

Missouri was once a complex mixture of grassland (or prairie), savanna, woodland, and forest occurring on a diversity of landforms that vary in degree of relief, dissection, and geologic parent materials. Grasslands occupied approximately one-third of the state occurring as both upland grasslands and wet grasslands on the wide alluvial plains along rivers.

Today, native grasslands are rare with most converted to pastures composed of planted nonnative pasture species. Existing native vegetation in Missouri has undergone extensive fragmentation into smaller tracts. The general land cover today is a complex mixture of cropland on smoother surfaces and better soils, pasture on irregular surfaces and eroded soils, and woodlands and forests on steeper soils and rougher areas (Nigh and Schroeder 2002).

Along the Missouri River, on the Missouri River alluvial plain, lands that were once wet prairies and marshes with narrow bands and isolated pockets of bottomland forest have been drained and are now devoted mainly for use as highly productive croplands. However, a substantial number of wetlands still remain, and since the flood of 1993, several large areas have been converted to managed wetlands (Nigh and Schroeder 2002).

Just east of the Missouri River alluvial plain, an area of rolling loess prairies occurs that was historically mainly grasslands with oak savannas and woodlands in valleys and on steeper side slopes. This area is now mostly farms with cropland on alluvial plains and less dissected uplands and nonnative pastures occurring on more sloping lands (Nigh and Schroeder 2002).

North central Missouri consists of loess flats and till plains of varied topography due to several larger stream headwaters occurring in this area creating topography from flat to moderately