Chapter 2 – Alternatives

2 Alternatives

Chapter 2 describes the alternatives evaluated in this EIS, identifies actions common to all action alternatives, and explains what alternatives were considered, but eliminated from detailed analysis in this EIS.

2.1 Alternatives Overview

This EIS evaluates the No Action Alternative and two action alternatives in detail: the Preferred Alternative and the Proposed Action. The Proposed Action was submitted by Tri-State as part of their right-of-way application. The Proposed Action was developed in coordination with the BLM through comprehensive public outreach effort. Based on agency coordination, scoping, and analysis, a second alternative was developed. This alternative was selected as the preferred alternative because it would meet the purpose and need and minimize effects to the built and natural environment to a greater extent than the Proposed Action. The action alternatives are described below, along with the actions common to both. The No Action Alternative is also discussed.

Additional action alternatives were considered and evaluated as part of the alternatives development process. Some were dropped from detailed study early in the process while others were eliminated as analysis progressed. All are discussed in this chapter.

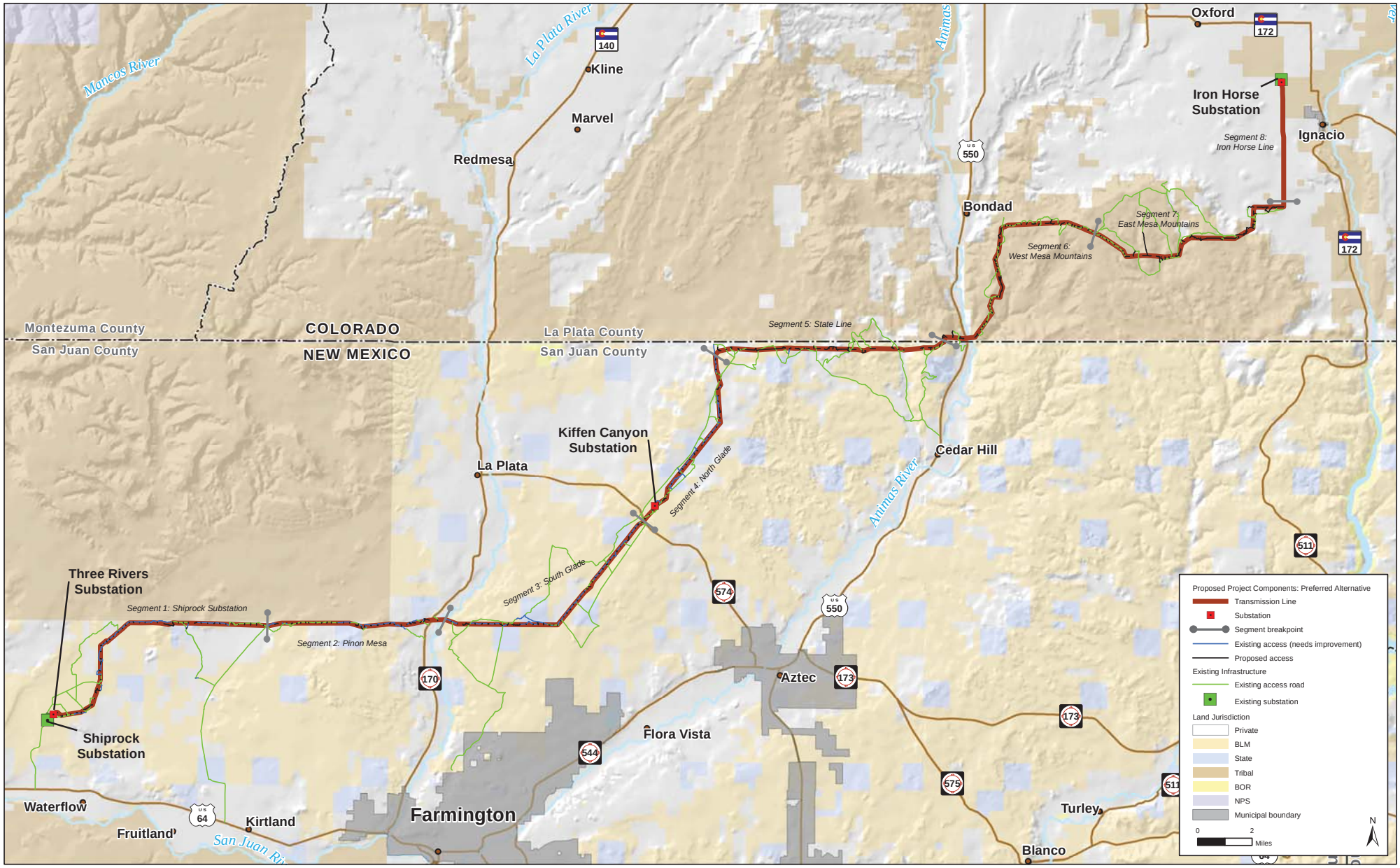
2.1.1 No Action Alternative

With the No Action Alternative, the SJBEC Project would not be constructed. The objectives of the SJBEC Project, which include improving electric reliability and increasing load-serving capabilities, would not be met.

2.1.2 Preferred Alternative

The Preferred Alternative includes a 230 kV transmission line that is approximately 64.3 miles long and is shown in Exhibit 2-1, Preferred Alternative. The new 230 kV transmission line would originate at Western's existing Shiprock Substation and would end at the Iron Horse Substation located near Ignacio, Colorado. The Preferred Alternative would include the following components:

- A new 345 kV to 230 kV substation (Three Rivers Substation) near Western's existing Shiprock Substation. The new Three Rivers Substation would connect to the existing Shiprock Substation.
- Approximately 33.1 miles of new double-circuit-capable 230 kV transmission line from the new Three Rivers Substation to the area north of the proposed Kiffen Canyon Substation to Segment 5 (shown in Exhibit 2-1) where the transmission line would turn east and parallel the New Mexico/Colorado state line.
- A new 230 kV substation (Kiffen Canyon Substation) near the existing City of Farmington 115 kV Glade Tap Substation.
- Approximately 31.2 miles of new single-circuit 230 kV transmission line from Segment 5 to the existing Iron Horse Substation. Approximately 4.5 miles south of the existing Iron Horse Substation, the new single-circuit 230 kV transmission line would be strung on existing poles that connect to the existing Iron Horse Substation.
- An expansion of the Iron Horse Substation.
- Access roads, which will include a combination of new unpaved access roads, improvements to existing access roads, and the use of existing roads in their current state.
- Overhead ground wire for the entire 230 kV transmission line. Overhead ground wire protects the transmission line from lightning strikes and contains fiber optics in the wire to transmit data and serve as a communication system.



Source: GIS BLM 2012, GIS CDOT and SJC 2012, GIS Tri-State 2013

Exhibit 2-1 Preferred Alternative

Highlights of Preferred Alternative are summarized below in Exhibit 2-2, Preferred Alternative Highlights.

Exhibit 2-2
Preferred Alternative Highlights

Characteristic		Miles
Total Length of Preferred Alternative		**64.3**
Jurisdiction	Length Crossing BLM-managed Land	25.4
	Length Crossing Southern Ute Indian Tribal Trust Land	15.6
	Length Crossing State of New Mexico–owned Land	3.6
	Length Crossing privately owned Land	19.7

Land required for operation of the Preferred Alternative is shown below in Exhibit 2-3, Summary of Land Required for the Operation of the Preferred Alternative. Temporary disturbance areas during construction are shown in Exhibit 2-4, Summary of Land Required for Construction of the Preferred Alternative.

Exhibit 2-3
Summary of Land Required for Operation of the Preferred Alternative (Permanent Effects)[1]

Description	BLM (acres)	NMSLO (acres)	SUIT (acres)	Private (acres)	Total (acres)
Lattice Tower Tangent	2.306	0.422	–	0.956	**3.684**
Lattice Tower Angle	0.404	0.060	–	0.147	**0.611**
Lattice Tower Deadend	0.511	–	–	0.325	**0.836**
Mono-Pole Tangent	0.001	–	–	–	**0.001**
Mono-Pole Deadend	0.006	–	–	–	**0.006**
3-Pole Self-Supporting Deadend or Angle	0.011	–	0.016	0.011	**0.038**
Wood H-Frame Tangent	0.014	–	0.044	0.014	**0.072**
Wood 3-Pole Deadend or Angle	0.013	–	0.023	0.007	**0.043**
Three Rivers Substation	20.000	–	–	–	**20.000**
Kiffen Canyon Substation	23.000	–	–	–	**23.000**
Iron Horse Expansion	0.000	–	–	3.500	**3.500**
Access Roads	54.749	16.577	28.018	31.086	**130.429**
Total	**101.015**	**17.059**	**28.101**	**36.045**	**182.220**

[1] *The purpose of this table is to provide an estimate of the area that would be permanently affected by the SJBEC Project. These areas may change as final design progresses. Areas were determined using assumptions from Exhibit 2-14, Typical Design Characteristics – 230 kV Transmission Line.*

Exhibit 2-4

Summary of Land Required for Construction of the Preferred Alternative (Temporary Effects)[1]

Description	BLM (acres)	NMSLO (acres)	SUIT (acres)	Private (acres)	Total (acres)
Structure Work Area	103.600	11.900	70.700	70.000	**256.200**
Wire-Pulling for Conductor and Shield Wire	25.389	4.557	15.624	19.530	**65.100**
Wire Pulling for Optical Ground Wire	16.380	2.940	10.080	12.600	**42.000**
Construction Staging Areas	–	–	–	100.000	**100.000**
Helicopter Fly Yard	20.000	–	–	–	**20.000**
Helicopter Staging Areas	13.000	2.000	–	10.000	**25.000**
Guard Structures	0.312	0.056	0.192	0.240	**0.800**
Three Rivers Substation	20.000	–	–	–	**20.000**
Kiffen Canyon Substation	23.000	–	–	–	**23.000**
Iron Horse Expansion	–	–	–	3.500	**3.500**
Access Roads, 30-Foot Right-of-Way	54.329	19.596	17.755	30.873	**122.553**
Access Roads, 50-Foot Right-of Way	46.323	8.782	40.453	26.261	**121.819**
Total	**322.333**	**49.831**	**154.804**	**273.004**	**799.972**

[1] *This exhibit provides an estimate of the area that would be temporarily affected by construction activities for the SJBEC Project. These areas may change as final design progresses. Areas were determined using assumptions from Exhibit 2-14. The area for substations is included both as a permanent and temporary effect, since areas where substations are proposed would be affected by constructing the substations.*

The miles of new access roads and existing access roads requiring improvements for the Preferred Alternative are shown below in Exhibit 2-5, Estimate of New and Improved Access Roads for the Preferred Alternative.

Exhibit 2-5

Estimate of New and Improved Access Roads for the Preferred Alternative

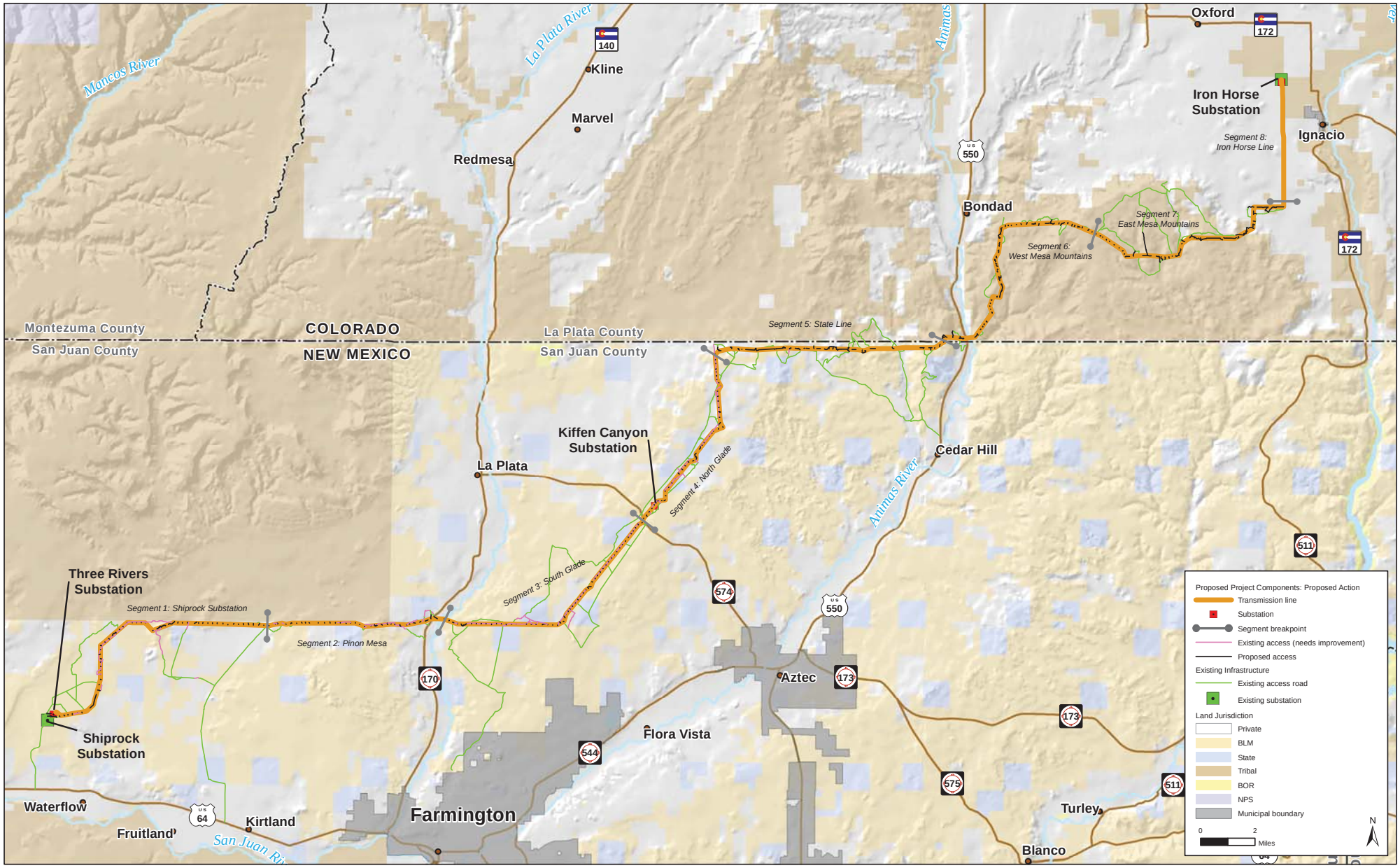
Jurisdiction	Miles of New Access Roads	Miles of Existing Roads Requiring Improvement	Total (miles)
BLM	8.4	14.2	22.6
NMSLO[1]	1.7	5.2	6.9
SUIT	11.6	0	11.6
Private	6.9	6.0	12.9
Total	**28.6**	**25.4**	**54.0**

NMSLO – New Mexico State Land Office

2.1.3 Proposed Action

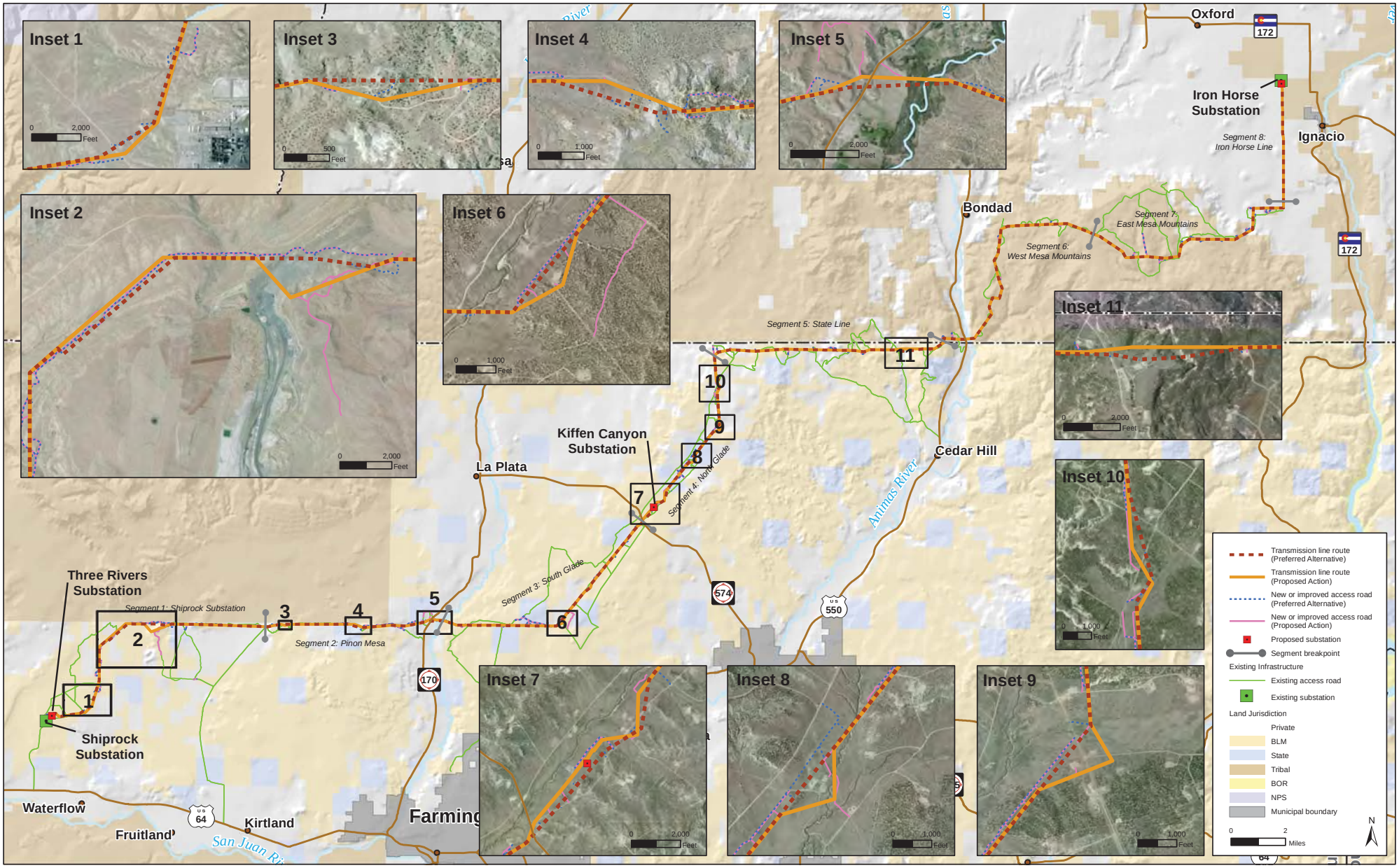
The Proposed Action includes a 230 kV transmission line that is approximately 64.9 miles long and is shown in Exhibit 2-6, Proposed Action. The Proposed Action would follow a slightly different alignment and would have a different access road network than what is proposed for the Preferred Alternative as shown in Exhibit 2-7, Differences Between the Preferred Alternative and the Proposed Action. The Proposed Action would have similar components as described for Preferred Alternative. The Proposed Action includes:

- A new 345 kV to 230 kV substation (Three Rivers Substation) near Western's existing Shiprock Substation. The new Three Rivers Substation would connect to the existing Shiprock Substation.
- Approximately 33.7 miles of new double-circuit-capable 230 kV transmission line from the new Three Rivers Substation to the New Mexico/Colorado state line.
- A new 230 kV substation (Kiffen Canyon Substation) near the existing City of Farmington 115 kV Glade Tap Substation.
- Approximately 31.2 miles of new single-circuit 230 kV transmission line between the proposed New Mexico/Colorado state line and the existing Iron Horse Substation.
- Approximately 4.5 miles south of the existing Iron Horse Substation, the new single-circuit 230 kV transmission line would be strung on existing poles that connect to the existing Iron Horse Substation.
- An expansion of the Iron Horse Substation.
- Access roads, which will include a combination of new unpaved access roads, improvements to existing access roads, and the use of existing roads in their current state.
- Overhead ground wire for the entire 230 kV transmission line. Overhead ground wire protects the transmission line from lightning strikes, and contains fiber optics in the wire to transmit data and serve as a communication system.



Source: GIS BLM 2012, GIS CDOT and SJC 2012, GIS Tri-State 2013

Exhibit 2-6 Proposed Action



Source: GIS BLM 2012, GIS CDOT and SJC 2012, GIS Tri-State 2013

Exhibit 2-7 Differences Between the Preferred Alternative and the Proposed Action

Highlights of Proposed Action are summarized below in Exhibit 2-8, Proposed Action Highlights.

Exhibit 2-8
Proposed Action Highlights

	Characteristic	Miles
Total Length of Proposed Action		**64.9**
Jurisdiction	Length Crossing BLM-managed Land	25.5
	Length Crossing Southern Ute Indian Tribal Trust Land	15.6
	Length Crossing State of New Mexico-owned Land	4.4
	Length Crossing privately owned Land	19.4

Land required for operation of the Proposed Action is shown below in Exhibit 2-9, Summary of Land Required for Operation of the Proposed Action. Temporary disturbance areas during construction are shown in Exhibit 2-10, Summary of Land Required for Construction of the Proposed Action.

Exhibit 2-9
Summary of Land Required for Operation the Proposed Action (Permanent Effects)[1]

Description	BLM (acres)	NMSLO (acres)	SUIT (acres)	Private (acres)	Total (acres)
Lattice Tower Tangent	1.90	0.50	–	1.0	**3.400**
Lattice Tower Angle	0.24	–	–	0.09	**0.330**
Lattice Tower Deadend	0.72	0.04	–	0.12	**0.880**
Mono-Pole Tangent	0.002	–	–	–	**0.002**
Mono-Pole Deadend	0.009	–	–	–	**0.009**
3-Pole Self-Supporting Deadend or Angle	0.01	–	0.01	–	**0.020**
Wood H-Frame Tangent	0.02	–	0.05	0.01	**0.080**
Wood 3-Pole Deadend or Angle	0.02	–	0.02	0.01	**0.050**
Three Rivers Substation	20.00	–	–	–	**20.000**
Kiffen Canyon Substation	23.00	–	–	–	**23.000**
Iron Horse Expansion	0.00	–	–	3.5	**3.500**
Access Roads	56.60	14.8	27.40	33.1	**132.000**
Total	**102.50**	**15.3**	**27.50**	**37.9**	**183.2**

[1] *The purpose of this table is to provide an estimate of the area that would be permanently affected by the SJBEC Project. These areas may change as final design progresses. Areas were determined using assumptions from Exhibit 2-14, Typical Design Characteristics – 230 kV Transmission Line.*

Exhibit 2-10
Summary of Land Required for Construction of the Proposed Action (Temporary Effects)[1]

Description	BLM (acres)	NMSLO (acres)	SUIT (acres)	Private (acres)	Total (acres)
Structure Work Area	119.7	19.6	70.7	77.7	**287.70**
Wire-Pulling for Conductor and Shield Wire	25.4	4.6	15.6	19.5	**65.10**
Wire Pulling for Optical Ground Wire	16.4	2.9	10.1	12.6	**42.00**
Construction Staging Areas	–	–	–	100.0	**100.00**
Helicopter Fly Yard	20.0	–	–	–	**20.00**
Helicopter Staging Areas	13.0	2	–	10.0	**25.00**
Guard Structures	0.2	0.04	0.1	0.2	**0.06**
Three Rivers Substation	20.0	–	–	–	**20.00**
Kiffen Canyon Substation	23.0	–	–	–	**23.00**
Iron Horse Expansion	–	–	–	3.5	**3.50**
Access Roads, 30-Foot Right-of-Way	63.8	21.2	16.9	32.5	**134.40**
Access Roads, 50-Foot Right-of Way	35.2	1.6	40.5	28.7	**106.00**
Total	**336.7**	**51.9**	**153.8**	**284.7**	**827.2**

[1] *This exhibit provides an estimate of the area that would be temporarily affected by construction activities for the SJBEC Project. These areas may change as final design progresses. Areas were determined using assumptions from Exhibit 2-14. The area for substations is included both as a permanent and temporary effect, since areas where substations are proposed would be affected by constructing the substations.*

The miles of new access roads and existing access roads requiring improvements for the Proposed Action are shown below in Exhibit 2-11, Estimate of New and Improved Access Roads for the Proposed Action.

Exhibit 2-11
Estimate of New and Improved Access Roads for the Proposed Action

Jurisdiction	Miles of New Access Roads	Miles of Existing Roads Requiring Improvement	Total (miles)
BLM	8.3	14.9	23.2
NMSLO	1.2	4.8	6.1
SUIT	11.6	0	11.6
Private	6.9	6.5	13.4
Total	**28.0**	**26.3**	**54.2**

2.2 Actions Common to All Action Alternatives

Key features, construction activities, operations and maintenance activities, and Environmental Protection Measures (EPMs) common to both the Preferred Alternative and the Proposed Action are described in greater detail below.

2.2.1 230 kV Transmission Line

The proposed 230 kV transmission line would be approximately 65 miles long and includes both double-circuit and single-circuit sections. A 230 kV and 345 kV line would originate at Western's existing Shiprock Substation and interconnect to a new substation to be built nearby, called the Three Rivers Substation. From the Three Rivers Substation, the new 230 kV transmission line would be built as a double-circuit line, though only one circuit would be built. The double-circuit transmission line would parallel Western's existing 345 kV transmission line north for approximately 4 miles and then east for approximately 17 miles. In this section, the double-circuit transmission line would cross the La Plata River at a location parallel to the existing 345 kV transmission line. Exhibit 2-12, Existing Transmission Lines, shows the location of existing transmission lines located near the proposed transmission line route.

Transmission Line Highlights

The proposed transmission line is about 65 miles long and would:

- parallel existing transmission lines for 31 miles.
- be co-located with an existing transmission line for 4.5 miles.

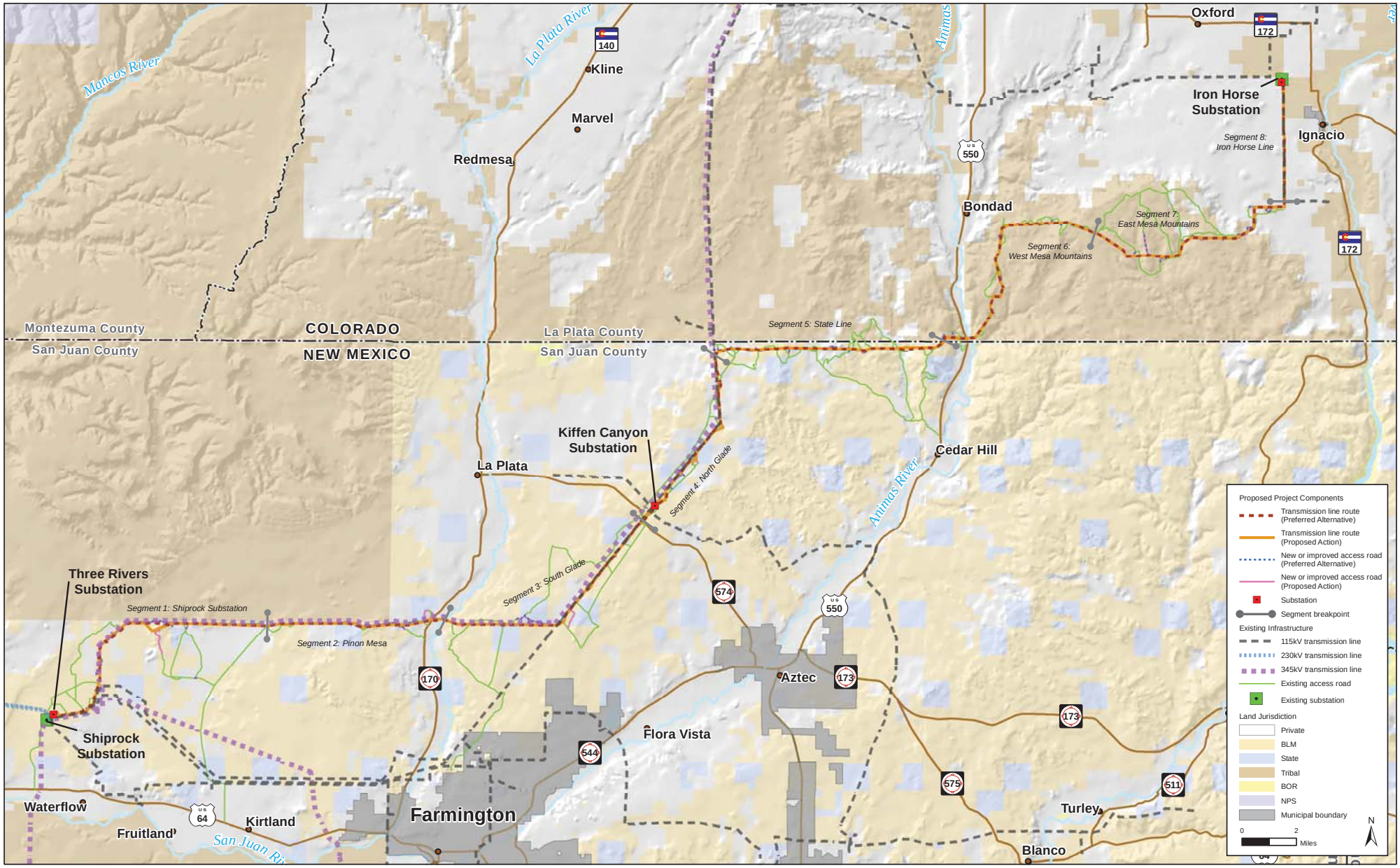
Approximately 4 miles east of the La Plata River crossing, the double-circuit transmission line would travel northeast for approximately 12 miles and would continue to parallel Western's 345 kV transmission line and the City of Farmington's 115 kV transmission line. It would continue through the BLM-managed Glade Run Recreation Area to the proposed location for the Kiffen Canyon Substation.

From the Kiffen Canyon Substation, the double-circuit transmission line would continue northeast towards the Colorado-New Mexico state line, where the double-circuit configuration would change to a single-circuit configuration. Approximately 0.25 mile south of the state line, the proposed single-circuit transmission line would deviate from the 115 kV and 345 kV transmission lines and, to the greatest extent feasible, would follow existing oil and gas well access roads along the state line for approximately 10 miles to the Animas River. The proposed single-circuit transmission line would

continue across SUIT tribal trust lands across the Animas River and US 550 with one span just north of the state line. From this point, the proposed single-circuit transmission line would follow existing oil and gas well access roads and pipeline corridors on SUIT lands north and east for approximately 15 miles.

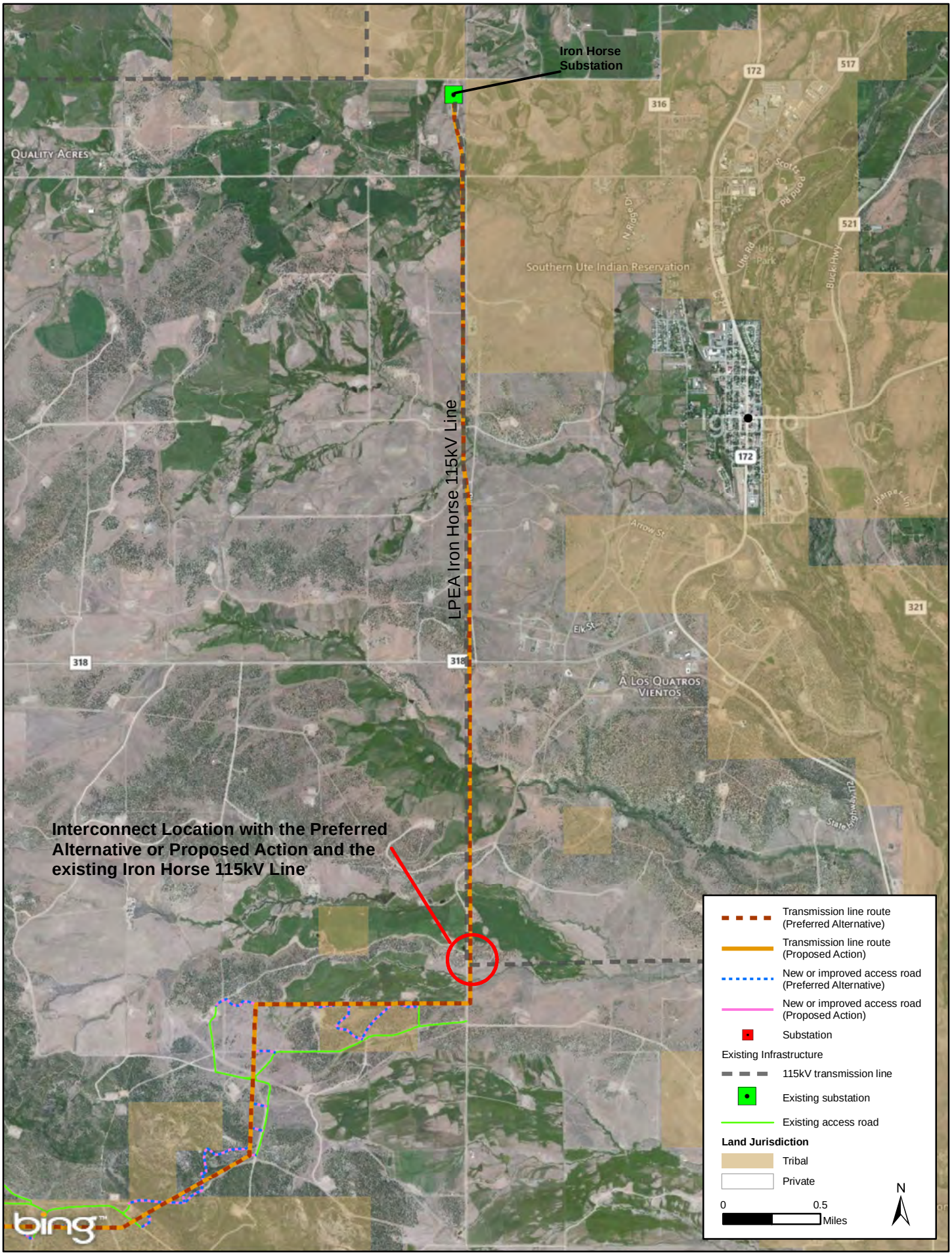
After exiting SUIT trust land, the single-circuit transmission line would continue east for approximately 2 miles where it would intersect with the existing La Plata 115 kV transmission line along County Road 319 as shown in Exhibit 2-13, Proposed Routes and the Existing Iron Horse Line. At this point, the transmission line would share structures with the existing 115 kV Iron Horse to Salvador line for approximately 4.5 miles and travel north on private land to the interconnection point with the Iron Horse Substation. In this 4.5-mile section, Tri-State's new 230 kV line would be strung on the existing structures that carry the existing 115 kV Iron Horse line, which would change this section from a single-circuit transmission line to a double-circuit transmission line.

The transmission line components include structures, foundations, conductors, insulators and associated hardware, and overhead ground wire. Exhibit 2-14, Typical Design Characteristics – 230 kV Transmission Line, summarizes typical design characteristics.



Source: GIS BLM 2012, GIS CDOT and SJC 2012, GIS Tri-State 2013, GIS Tri-State 2008

Exhibit 2-12 Existing Transmission Lines



Source: GIS BLM 2012, GIS CDOT and SJC 2012, GIS Tri-State 2013, GIS Tri-State 2008

Exhibit 2-13 Proposed Routes and the Existing Iron Horse Line

Exhibit 2-14

Typical Design Characteristics – 230 kV Transmission Line

Feature	Double-Circuit 230 kV Steel Lattice Structure	Single- or Double-Circuit 230 kV Steel Mono-Pole or 3-Pole Structure	Single-Circuit 230 kV Wood Structure
Physical Properties			
Typical right-of-way width	150 feet	150 feet	150 feet
Typical distance between structures	600–1,500 feet	600–1,500 feet	600–1,200 feet
Typical structure height	112–162 feet	70–130 feet	65–100 feet
Typical structures per mile	4–6	4–6	4–7
Ground clearance (beneath conductor under maximum operating conditions)	28 feet	28 feet	28 feet
Minimum clearance of equipment to energized conductor	14 feet	14 feet	14 feet
Land Temporarily Disturbed			
Structure work area	Right-of-way width x 200 feet per structure (assembly, erection, and crane pads).		
Wire-pulling, tensioning, and splicing sites	Right-of-way width x 600 feet for mid-span and deadend structure conductor, shield wire, and optical ground wire pulling sites.		
Construction yards and staging areas	5 locations, approximately 20 acres in size. Sites would be located in previously disturbed areas close to improved roads.		
Helicopter fly yard	1 location, approximately 10 to 20 acres in size. 25 temporary 1-acre locations for setting down and refueling the helicopter while stringing the line. Sites would be adjacent to access roads.		
Batch plant sites	Most concrete would be purchased from local ready-mix vendors. If a batch plant were necessary then the batch plant (approximately 1–3 acres) would be located within the construction yards and staging areas.		
Guard structures	Structures measuring 10 x 50 feet, located at road and existing electrical distribution line crossings.		
Land Permanently Required			
Structure Base - Preferred Alternative	Steel lattice tower (tangent): 1,225 square feet (35- x 35-foot tower base). Steel lattice tower (angle): 1,600 square feet (40- x 40-foot tower base). Steel lattice tower (deadend): 2,025 square feet (45- x 45-foot tower base).	Steel tubular mono-pole structure (tangent): 29 square feet (6-foot-diameter foundation). Steel tubular mono-pole structure (deadend): 64 square feet (9-foot-diameter foundation). Steel 3-pole self-supporting structure (deadend or angle): 236 square feet (3 poles x 8- to 10-foot-diameter foundations).	Wood H-frame (tangent): 25 square feet (2 poles x a 4-foot-diameter hole at each pole). Wood 3-pole (angle or deadend): 48 square feet (3 poles x a 4-foot-diameter hole for each pole plus 10 square feet for 4 to 14 anchors).

Exhibit 2-14

Typical Design Characteristics – 230 kV Transmission Line

Land Permanently Required (Continued)			
Structure Base - Proposed Action	Steel lattice tower (tangent): 900 square feet (30- x 30-foot tower base). Steel lattice tower (angle): 1,225 square feet (35- x 35-foot tower base). Steel lattice tower (deadend): 1,600 square feet (40- x 40-foot tower base).	Steel tubular mono-pole structure (tangent): 40 square feet (6-foot-diameter foundation). Steel tubular mono-pole structure (deadend): 64 square feet (9-foot-diameter foundation). Steel 3-pole self-supporting structure (deadend or angle): 150 square feet (3 poles x 8- to 10-foot-diameter foundations).	Wood H-frame (tangent): 24 square feet (2 poles x a 4-foot-diameter hole at each pole). Wood 3-pole (angle or deadend): 46 square feet (3 poles x a 4-foot-diameter hole for each pole plus 10 square feet for 4 to 14 anchors).
Access Roads			
Permanent access right-of-way requirements	The right-of-way width for construction, maintenance, and operation of the line depends on improvement level required. The minimum right-of-way width is 30 feet and maximum right-of-way width is 50 feet. The permanent road surface will be approximately 20 feet wide. The remaining area in the right-of-way (either 10 or 30 feet) may be temporarily affected due to cut and fill and associated drainage features. Areas outside of the 30-foot area will be reseeded and reclaimed following construction.		
Electrical Properties			
Nominal voltage	+/- 230,000 volts AC		
Circuit configuration	Single-circuit line: 3-phase horizontal configuration with one shield wire and one optical ground wire Double-circuit line: 3-phase vertical configuration with one shield wire and one optical ground wire		
Conductor size	Single conductor per phase of 1272 “Bittern” (1.345-inch diameter) ACSR		
Ground clearance of conductor	28 feet minimum at a conductor temperature of 212 degrees Fahrenheit (100 degrees Celsius)		
Phase-to-phase conductor clearance	Single-Circuit Line: 19.5 feet (horizontal configuration) Double-Circuit Line: 19.5 feet (vertical configuration)		

2.2.1.1 Structures

The transmission line would be constructed of steel lattice structures, wood H-frame structures, wood 3-pole structures, or steel mono-poles (shown in Exhibit 2-15, Typical 230 kV Double-Circuit Steel Lattice Structure; Exhibit 2-16, Typical 230 kV Single-Circuit Wood H-Frame Structure; Exhibit 2-17, Typical 230 kV 3-Pole Wood Large Angle Deadend Structure; and Exhibit 2-18, Typical 230 kV Double-Circuit Steel Mono-Pole Structure) or steel or wood three-pole structures. The choice of structure type would be based on voltage, number of circuits, location, and design conditions. Structure configuration and design would be refined as project development progresses. Transmission structure heights would vary from 52 feet to 162 feet depending upon the structure type, terrain, span, and line crossings. The distance between structures would typically range from 600 to 1,500 feet depending upon topography.

Double-circuit construction would be accomplished using steel lattice or steel mono-pole structures. Single-circuit construction would be accomplished using two-pole wood H-frame structures for tangent structures. Three-pole guyed wood structures or three-pole self-supporting steel structures would be used for single-circuit line angles and deadends. The double-circuit steel lattice and steel mono-poles are designed to support six conductors (three per circuit), with the conductors arranged in a vertical configuration and the individual circuits on opposite sides of the structure. The H-frame structures are designed to support three conductors in a horizontal configuration. Overhead ground wires would be installed at the top of all structures.

2.2.1.2 Structure Foundations

Depending on soil and loads, the foundations would be installed either on drilled pier foundations or they would be directly embedded into the ground. Each structure location would be evaluated individually during final engineering to determine the exact foundation dimensions. Anchors needed for single-circuit guyed structures would either be plate or rock anchors depending on soil conditions. Refer to Exhibit 2-14 under the category structure base for typical foundation characteristics.

2.2.1.3 Conductors

Conductor phase-to-phase and phase-to-ground clearance parameters are determined in accordance with the National Electrical Safety Code ANSI C2 produced by the American National Standards Institute (ANSI). This code provides the basic clearances between the conductors and ground; crossing points of other lines, the transmission support structure, and other conductors; and the basic working clearances for personnel during energized operation and maintenance activities.[1] The configuration of the conductor would be designed to provide adequate current carrying capacity and minimize audible noise interference to radio operations.

Phase-to-phase conductor clearance for the single-circuit lines is expected to be 19.5 feet in a horizontal configuration as shown in Exhibit 2-16. For the new double-circuit line, phase-to-phase conductor clearance is expected to be 19.5 feet in a vertical configuration, as shown in Exhibit 2-15. Typically, the clearance of conductors above ground would be a minimum of 28 feet for the 230 kV transmission line. During detailed design, clearances may be increased to account for localized conditions.

2.2.1.4 Insulators and Associated Hardware

Insulators would be lightweight, non-reflective light gray polymer rubber. Ground rods would be installed next to structure foundations and would be bonded to the structure. Lattice steel structures would be grounded to the rebar steel in each of the concrete pier foundations. Double-circuit mono-pole and single-circuit steel structures would be grounded either to the rebar steel in the concrete pier foundation or to direct embedded structures using a ground rod. Single-circuit wood pole structures would be grounded using a stapled and wrapped ground wire for each wood pole. Supplemental grounding, in the form of ground rods, would be selectively placed next to structures throughout the length of the transmission line, as needed, for reliable operation of the transmission line.

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[1] IEEE 2007

Exhibit 2-15

Typical 230 kV Double-Circuit Steel Lattice Structure

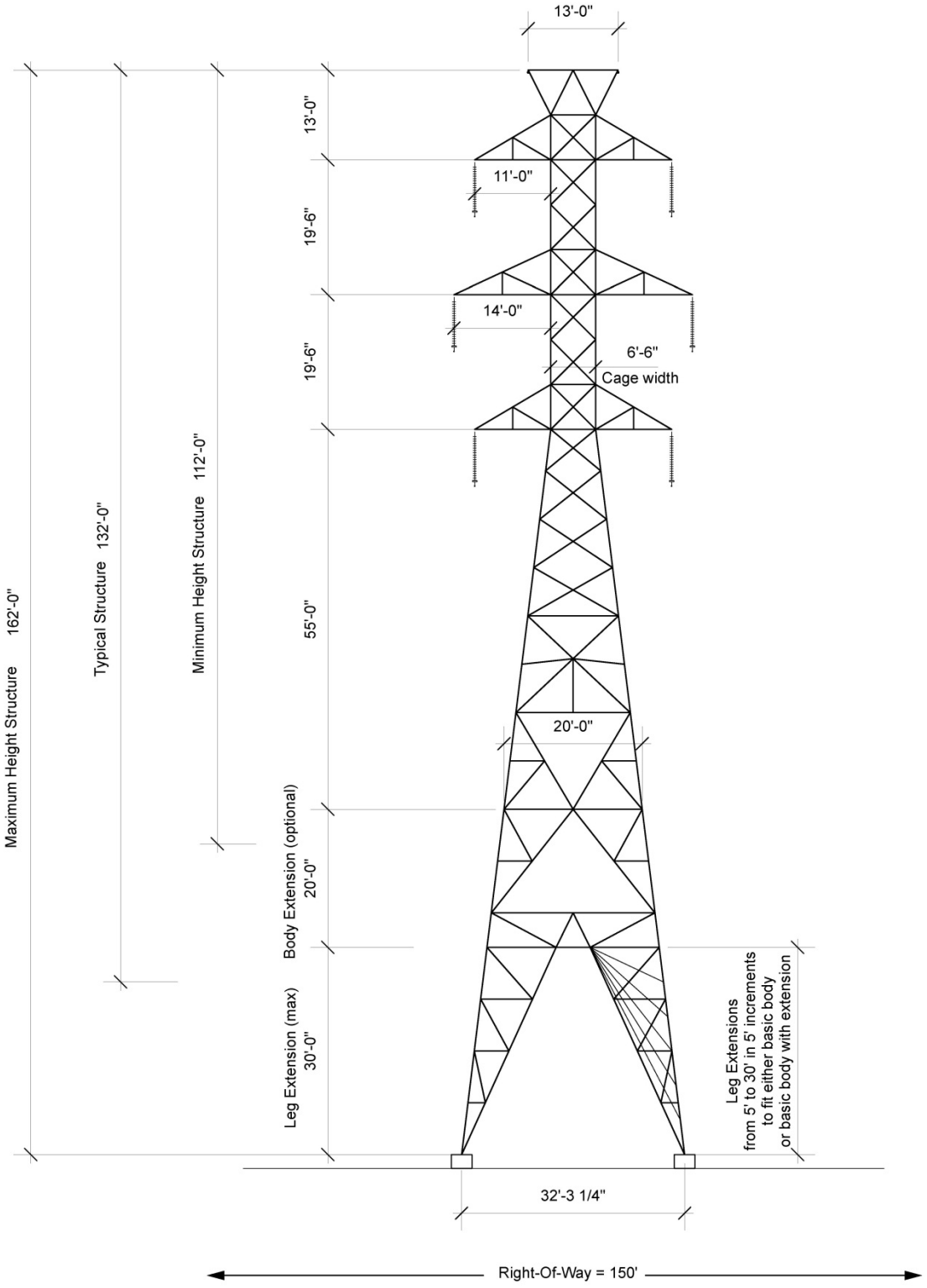


Exhibit 2-16
Typical 230 kV Single-Circuit Wood H-Frame Structure

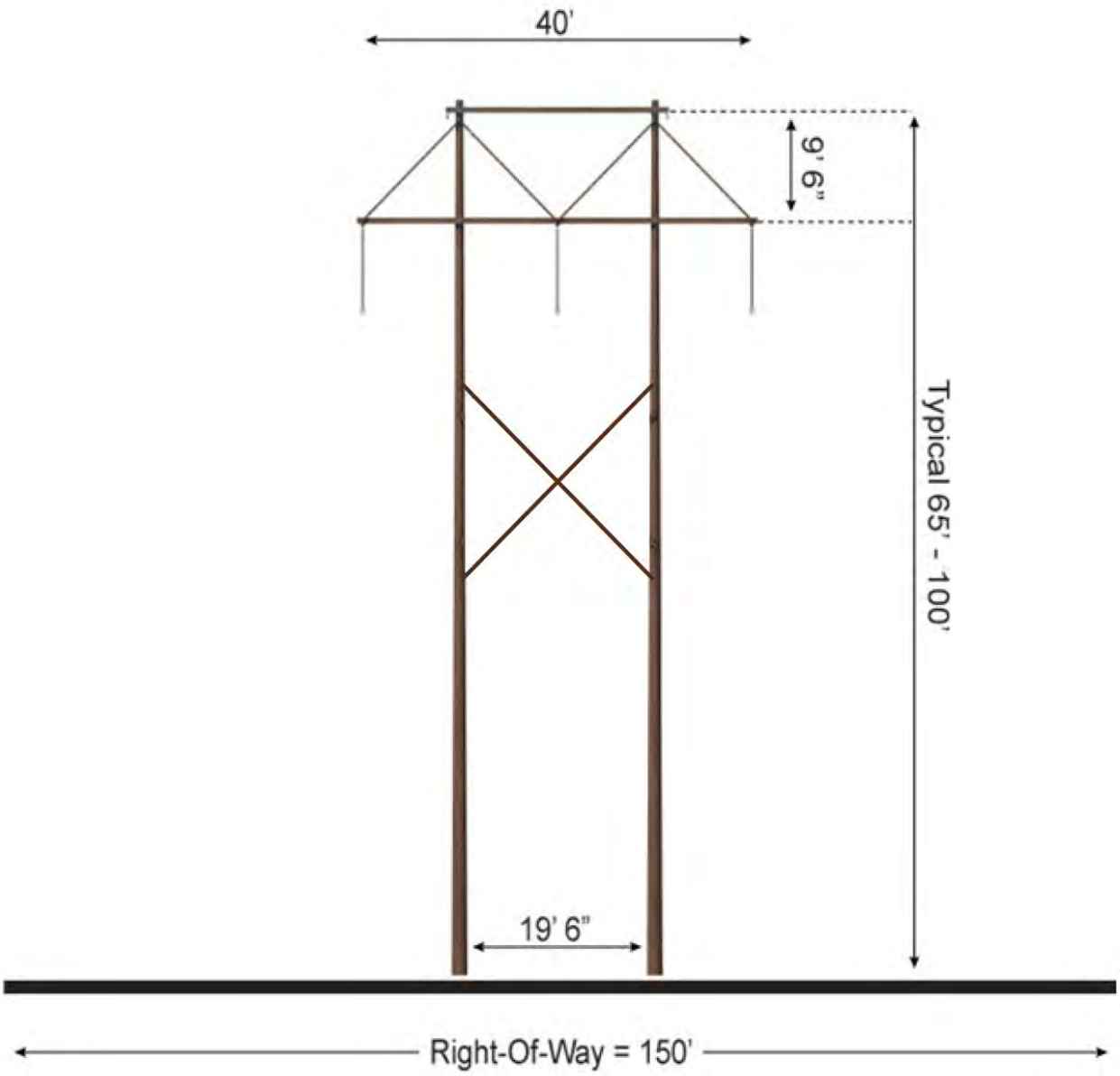


Exhibit 2-17
Typical 230 kV 3-Pole Wood Large Angle Deadend Structure

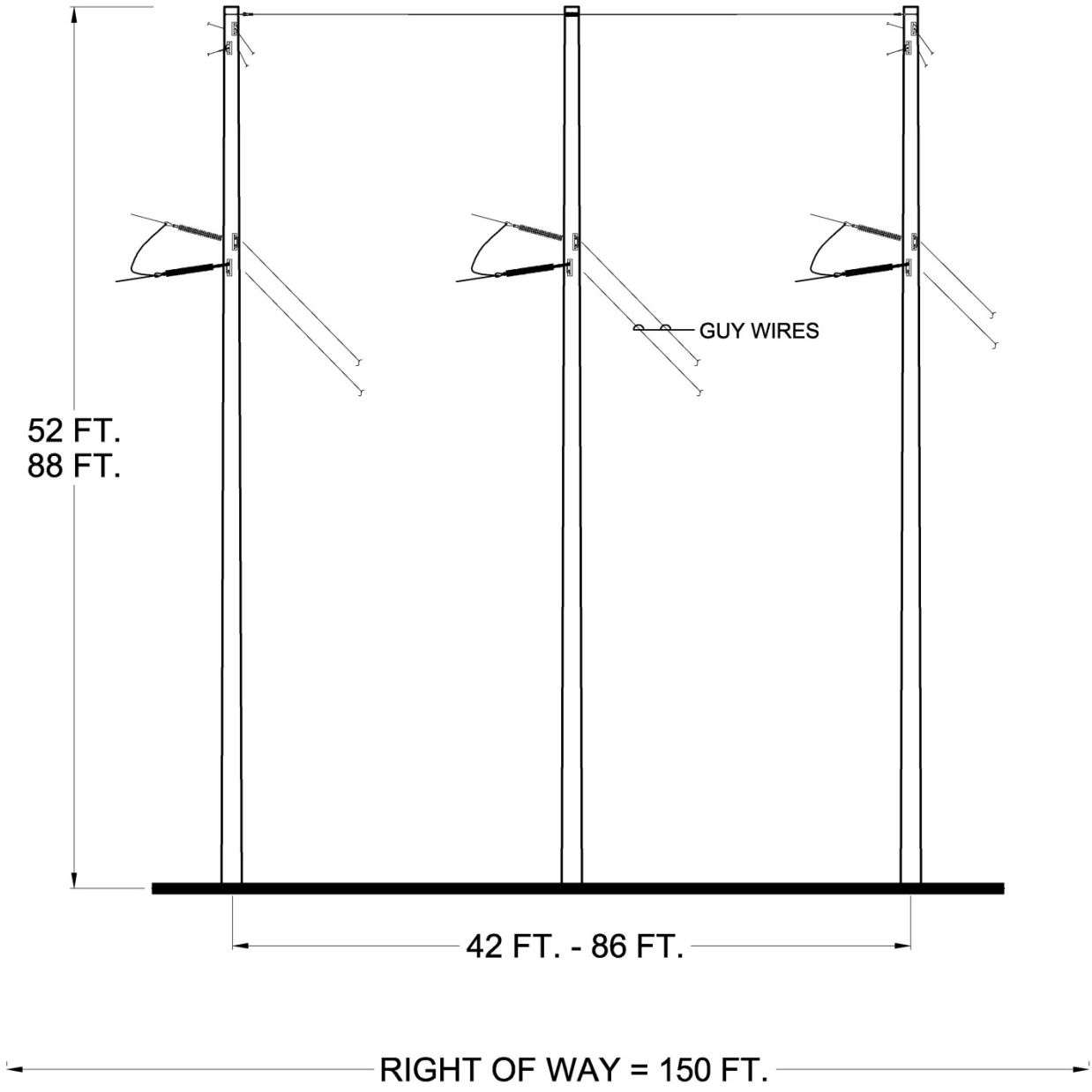
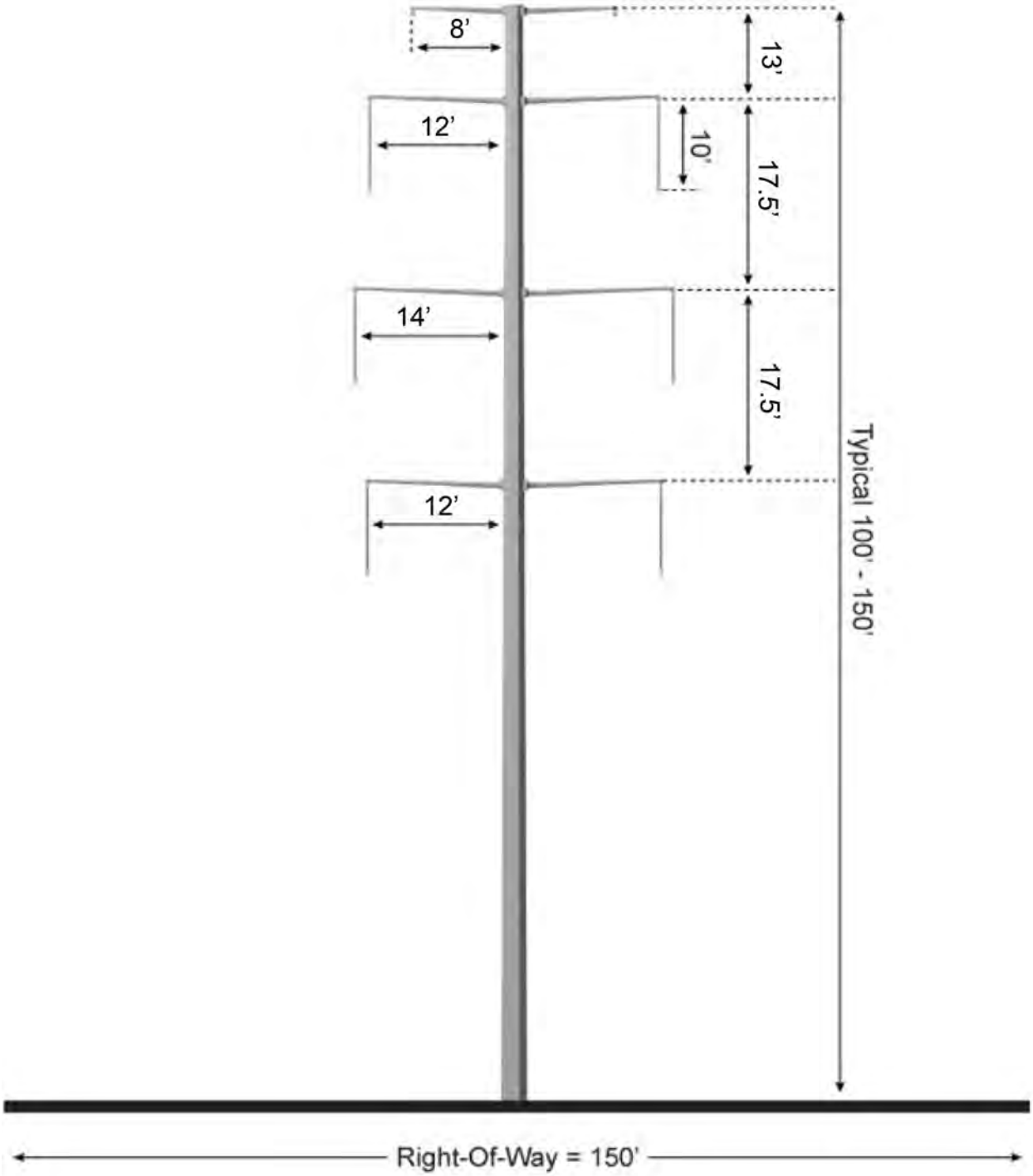


Exhibit 2-18
Typical 230 kV Double-Circuit Steel Mono-Pole Structure



Depending on the proximity of the structures to airports and the structure heights, aerial marker balls or aircraft warning lighting may be required for the shield wires or structures per Federal Aviation Administration (FAA) regulations. In addition, bird diverters would be installed on the transmission line where the route crosses the La Plata and Animas Rivers.

2.2.1.5 Overhead Ground Wires

Overhead ground wires would be installed to protect the 230 kV transmission line from lightning strikes. Current from lightning strikes is transferred from the overhead ground wires into the ground. The overhead ground wire system would contain two wires. The wires would be installed on top of the structures to protect the transmission line below. One of the wires, called an optical ground wire, includes optics in the wire that serve as a communication system to transfer information between Tri-State's facilities along the fiber path. The information transferred is required for system control, monitoring, and operation. The second wire is called a shield wire. The shield wire protects the transmission line from lightning strikes, but does not provide a communications function.

What are overhead ground wires?

Overhead ground wires protect the transmission line from lightning strikes. The overhead ground wire system for the SJBEC Project would contain one or two wires, depending on the structure type. The wires are installed on the top of the structures to protect the transmission line below.

2.2.2 Substations

Substations and associated equipment would be built as part of the proposed SJBEC Project. The SJBEC Project includes building two new substations and expanding the existing Iron Horse Substation. Descriptions of the proposed substations are provided below.

2.2.2.1 Three Rivers Substation (near the Shiprock Substation)

Western's existing Shiprock Substation is located approximately 12 miles west of Farmington, near the town of Waterflow, New Mexico, just off of US 64. It is located on a section of BLM land near the San Juan Generating Station. Construction of the new Three Rivers Substation would take place just outside and northeast of the existing Shiprock Substation. The Three Rivers Substation would be built on BLM land that is reserved for Western's use.

The Three Rivers Substation would include 345 kV and 230 kV line connections with the Shiprock Substation, a 345 kV to 230 kV transformer, 345 kV and 230 kV breakers and switches, and associated electrical and communications equipment. Site preparation would include grading, fencing, grounding, and construction of foundations. Exhibit 2-19, Typical 230-kV Substation, shows a typical 230 kV substation with multiple line connections.

The following equipment would be installed at Western's existing Shiprock Substation so it could be connected to the Three Rivers Substation: a 345 kV and a 230 kV power circuit breaker, one 230 kV disconnect switch, and associated control equipment.

Exhibit 2-19
Typical 230 kV Substation

The existing Shiprock Substation is situated on 26 acres. The proposed Three Rivers Substation would be built near the Shiprock Substation on 20 acres.

2.2.2.2 Kiffen Canyon Substation

A new transmission substation would be constructed on BLM-managed land north of the existing City of Farmington Glade Tap Substation, just north of New Mexico Highway 574. The substation would include a phase-shifting 230 kV transformer, 230 kV breakers, switches, and associated electrical and communications equipment. Site preparation would include grading, fencing, grounding, and construction of foundations. The proposed Kiffen Canyon Substation would be 23 acres.

2.2.2.3 Iron Horse Substation

The LPEA-operated Iron Horse Substation (located approximately one mile west of Colorado Highway 172 near Ignacio) would be expanded to accommodate equipment for the new 230 kV transmission line terminus. Project-related construction at the Iron Horse Substation would include expanding the substation footprint to connect the new 230 kV transmission line to this substation. The substation would be expanded to include a 230 kV to 115 kV transformer, 230 kV breakers, switches, and associated electrical and communications equipment. The existing access road would be used to reach the site.

The existing Iron Horse Substation is situated on 2.5 acres. The existing Iron Horse substation would be expanded to include an additional 3.5 acres, bringing the total substation size to 6 acres.

2.2.3 Access Roads

Roads enable access to the right-of-way and structure sites for both construction and long-term maintenance of the transmission line and substations. Because access roads must bear the weight of and endure heavy construction vehicle use, existing access roads may need to be upgraded to ensure adequate and safe access for construction and maintenance activities. Relevant road construction criteria for the affected agencies and landowners will be outlined in the Final Plan of Development (POD). The Final POD will document plans for the construction, rehabilitation, and maintenance of the access roads, including general locations of access roads and construction methods based on site-specific conditions.

What is a Plan of Development (POD)?

A POD provides engineering, design, and Environmental Protection Measures (EPMs) associated with a proposed transmission line project. A POD also serves as the foundation for the right-of-way grant and covers requirements for right-of-way authorization under the Federal Land Policy and Management Act. The POD will be updated to reflect final project design, EPMs, and requirements identified through NEPA and permitting processes.

The SJBEC Project would use existing access routes wherever available and practical to keep new road construction to a minimum. To the extent possible, existing roads and two-track trails would be used in their present condition without improvements. New or improved access roads would be widened or constructed to a roadway width of 20 feet and a right-of-way width of 30 feet required for construction and long-term operation of the transmission line. Exceptions could be made in areas with sensitive resources where the right-of-way could be less than 30 feet. Sometimes additional right-of-way would be required because of conditions such as challenging topography or drainages. In these cases, access road right-of-way could reach a maximum width of 50 feet, though the footprint of the roadway surface would be 20 feet.

Tri-State maintains an improvement classification for all access roads in its system. These improvement levels are as follows:

- Existing roads (roads that require no improvement)
- Improvement Level I (overland access)
- Improvement Level II (minor grading)
- Improvement Level III (moderate to heavy grading)
- Surface water crossings

Tri-State is requesting the right-of-way grant include access for future maintenance and operation of the transmission line. Access roads would be required on private land, BLM-managed land, state land, and SUIT lands. In certain areas, it could be necessary to block roads after construction to restrict future access for the general public and other undesired uses. Such areas would be identified through negotiations with the affected agencies or private landowners. Methods for road closure or management may include installing locking gates or obstructing the path with earthen berms or boulders. Blocked access routes would have the ability to be reopened, when necessary, for maintenance and emergency repairs.

2.2.4 Proposed Right-of-Way

Tri-State is requesting a transmission right-of-way width of 150 feet from various public and private land owners. Increased right-of-way width may be required in a small number of locations to accommodate rough terrain or engineering requirements. In addition, Tri-State will request right-of-way for areas where substations or access roads are proposed. The right-of-way width for access roads depends on the improvement level required. The minimum right-of-way width for access roads is 30 feet and maximum right-of-way width is 50 feet, though exceptions could be made in areas with sensitive resources. The permanent road surface will be approximately 20 feet. The remaining area in the right-of-way (either 10 or 30 feet) may be temporarily affected due to cut and fill and associated drainage features.

Tri-State would additionally acquire temporary use permits for construction activities occurring on federal, state, and tribal lands both within and outside the areas permitted under the right-of-way grant. Temporary work areas would include staging areas, material storage areas, a helicopter fly yard, helicopter staging areas, pulling and splicing sites, work areas at each structure site, and guard structures.

During construction, temporary permission would be required from affected agencies or private landowners for staging areas and material storage. During operation, SJBEC Project maintenance activities would be restricted to the permitted rights-of-way on private and public lands (this includes the transmission line

corridor, access roads outside of the right-of-way, substations, and communication facilities).

2.2.4.1 Line Crossings

The SJBEC Project will require crossing other electrical transmission and distribution lines, pipelines, US and state highways, and local and tribal roads. The location of existing transmission and other linear facilities relative to the final transmission route, topographical constraints, and any utility corridor buffer constraints that may exist would dictate the number and location of crossings. The proposed line crossings will be coordinated with each facility owner or manager, and Tri-State will obtain the required licenses, permits, or agreements and will comply with owner requirements to cross these facilities in a manner that avoids or minimizes effects.

2.2.5 Preconstruction Activities

Preconstruction activities for the SJBEC Project are described below. These include contractor and agency coordination, preconstruction surveys, and geotechnical investigation.

2.2.5.1 Contractor and Agency Coordination

Before construction begins, a preconstruction kickoff meeting will be conducted to introduce the contractors and their field representatives, discuss schedules, and identify each agency's point of contact and responsibilities. All supervisory construction personnel will be instructed on sensitive environmental resources, Environmental Protection Measures (EPMs), and mitigation measures.

2.2.5.2 Preconstruction Surveys

Ground survey and staking would be performed to locate structure centers, structure references, right-of-way boundaries, new access routes, and temporary work areas. In addition, required preconstruction cultural, paleontological, and biological resource surveys would be conducted.

2.2.5.3 Geologic Investigation

Detailed geologic evaluation and geotechnical investigations would be performed as part of preconstruction activities in conjunction with final engineering. These investigations would be done to evaluate potential geologic and geotechnical hazards (such as

ground conditions, soil types, depth to bedrock, depth to water, and soil strength properties) and determine specific requirements for foundation design and construction.

For these investigations, the engineering geologist would evaluate fault lines, landslide-prone areas, steep slopes, and unstable soils to identify potential hazards, primarily at structure sites. Geologic review and evaluation would also be performed in the immediate vicinity of the proposed structure sites. The geotechnical engineer and geologist would prepare a report that includes recommendations that may alter the final design or identify construction methods to stabilize the site or off-site areas to avoid hazards or minimize potential effects. All geologic and geotechnical field studies would be coordinated with the appropriate land management agencies, and the appropriate permits would be obtained.

Geotechnical investigations would be performed in the field to evaluate soils strength and bearing capacity, which is necessary for determining proper structure foundations. This effort would include field investigations at readily accessible proposed structure site locations along the proposed transmission line route. The drilling program would consist of drilling borings (6 to 8 inches in diameter up to 50 feet deep) from which soil or bedrock samples would be taken for laboratory testing and analysis. Soil borings would be performed with rubber-tired or low-impact drill rigs using approved access routes and methods in accordance with agency requirements and applicable mitigation measures. The typical drilling time at each site is approximately half a day. Work areas are typically 40 by 40 feet in size. Once drilling is completed at each site, holes would be backfilled with the drilled materials. Any remaining soils would be spread at the site. The size of excess soil spreading is small and typically would not exceed a 10- by 10-foot area. No open holes would be left unattended, and all holes would be backfilled prior to leaving the site.

2.2.6 Construction

Due to the broad scope of construction, the varied nature of construction activities, and the geographic diversity of area, Tri-State may construct multiple segments concurrently using multiple contractors. It is estimated that construction would begin in 2015 and that the line would be in service by the end of 2016 or early 2017. Construction is expected to take approximately 18 to 24 months to complete.

The estimated number of potential workers and types of equipment required to construct the proposed transmission line, substations and communication facilities is shown in Exhibit 2-20, Personnel and Equipment for Construction of the Proposed Transmission Line, and Exhibit 2-21, Personnel and Equipment Required for Substation Construction.

Exhibit 2-20
Personnel and Equipment for Construction of the Proposed Transmission Line

Activities	Crew Size	Equipment Type
Survey crew	2 crews (2 people)	Pickup truck
Geologic and geotechnical investigations	1 crew (3–5 people)	Soil boring truck, pickup truck
Vegetation clearing and trimming	4 crews (3–4 people each)	Pickup truck, chipper, brush hog (cutter), roller chopper, buncher, masticators, backhoe, haul truck, and other forestry equipment
Road construction crew	2 crews (2–3 people each)	Pickup truck, D-6 bulldozer, road grader, dump truck
Foundation installation crew	6 crews (4–6 people each)	Digger derrick, concrete truck, crane, pickup truck, bobcat
Anchor installation	1 crew (3 people)	Bobcat, pickup truck
Structure haul crew	2 crews (1–4 people each)	Pole trailer or helicopter, pickup truck, flatbed truck with crane
Structure assembly crews	8–10 crews (4–6 people each)	Crane, bucket truck, pickup truck, boom truck
Structure erection crews	4–6 crews (4–6 people each)	Crane, bucket truck, helicopter, pickup truck
Wire installation crew	1 crew (16–21 people)	Tensioner, bucket truck, pickup truck, helicopter, small bulldozer, boom truck, reel trailers, wire-pulling truck
Post-construction cleanup	2 crews (2–4 people each)	Pickup truck, road grader
Revegetation	2 crews (3–6 people each)	Pickup truck, seeding equipment

Note: The above table reflects estimated personnel and equipment requirements. Final requirements will be determined based on final design and construction sequencing.

Exhibit 2-21
Personnel and Equipment Required for Substation Construction

Activities	Crew Size	Equipment Type
Survey crew	1 crew (2 people)	Pickup truck
Site development – civil work crew	1 crew (6 people)	Road grader, fence tensioner, 4-wheelers, and bobcat
Fence installation crew	1 crew (4 people)	Bobcat
Equipment foundation crew	1 crew	Concrete truck, digger derrick, crane
Cable trench, conduits, and station grounding crew	1 crew (2 people)	Bobcat
Steel structure and bus installation crew, ancillary buildings construction crew, equipment assembly and erection crew	1 crew (8–10 people)	Crane, digger derrick
Power equipment assembly and wiring crew	2 crews (2–4 people each)	Bobcat, crane
Communications construction crew	1 crew (2 people)	–
Wire installation crew	1 crew (2 people)	–
Post-construction cleanup	1 crew (2 people)	Dump truck

Note: The above table reflects estimated personnel and equipment requirements. Final requirements will be determined based on final design and construction sequencing.

In addition, construction of the transmission lines and substations would require water, mostly for dust control and for the concrete needed to build transmission line structure and substation foundations. In most cases, concrete will be obtained from a local vendor. If a concrete batch plant is needed at a construction staging area, water would be required. The required water would be procured from municipal sources, from commercial sources, or under a temporary water use agreement with landowners holding existing water rights. No new water rights would be required.

Construction activities for the SJBEC Project are described below. These include access road construction, equipment staging, vegetation clearing, site preparation, installing structure foundations, erecting support structures, stringing conductors and overhead ground wire, substation construction, cleanup and restoration, and revegetation.

2.2.6.1 Access Road Construction

Typically, new access roads or improvements to existing access roads will be constructed using a bulldozer or grader, possibly followed by a roller to compact and smooth the ground. Access

roads will be constructed to drain properly, maintain natural drainage patterns, and minimize erosion potential. A stormwater management plan will be prepared to avoid and minimize potential effects to water quality. Construction activities will not occur when weather or other conditions increase potential environmental effects to unacceptable levels, as determined by the agencies. Such conditions can arise during heavy rains or high winds.

Surface Water Crossings

Disturbance within jurisdictional waters of the US would occur as part of the SJBEC Project. This work would be completed under the terms of Clean Water Act (CWA) Section 404 and Section 401 permits, which govern activities within any jurisdictional water of the US. Where applicable, Tri-State would follow BLM's, SUIT's, or the affected agency's standards for designing roads and water crossings.

2.2.6.2 Equipment Staging

Construction of the SJBEC Project would begin with the establishment of staging areas. The staging areas would serve as field offices; reporting locations for workers; parking space for vehicles and equipment sites for material storage, fabrication and assembly; areas for equipment maintenance; and as a location for concrete batch plants, if needed. Approximately five staging areas, up to 20 acres each, would be needed to construct the project. Staging areas would be located near improved, existing roads and in previously disturbed areas with minimal vegetation, where feasible. Preconstruction surveys for cultural, natural, and paleontological resources would be completed prior to establishing staging areas.

In addition, a fly yard for helicopter operations would be located along the route where helicopter construction is planned and would occupy approximately 10 to 20 acres. The fly yard would be used for material storage and erecting structure sections prior to transport for installation. Fueling trucks, maintenance trucks, and operations crews would be based in the fly yard. In addition, up to 25 temporary one-acre sites would be needed to support helicopter operations when stringing the transmission line. These temporary sites would typically be located adjacent to access roads and would provide a place for the helicopter to set down and refuel.

Appropriate dust control, fire prevention, and pollution prevention measures would be implemented at these construction yards.

2.2.6.3 Vegetation Clearing

Within the SJBEC Project area, vegetation clearing and trimming would be required at helicopter fly yards, within the transmission line right-of-way, access roads, and possibly staging areas. Clearing for the transmission right-of-way would be done in accordance with NERC guidelines and Tri-State's Integrated Vegetation Management Plan. Any vegetation or trees that are cleared would be disposed of as directed by the affected agency or landowner. Options could include stacking the material, lopping and scattering the material, creating brush piles, or providing woody debris as firewood.

2.2.6.4 Site Preparation

Clearing individual structure sites may be required to install the structures. The type of equipment used to clear individual structure sites would be determined based on topography and site conditions. Typically this is done using a bulldozer or other equipment to blade the required area. At each 230 kV structure location, an area approximately 150 by 200 feet would be needed for construction laydown, tower assembly, and erection. After line construction is complete, all areas not needed for normal transmission line maintenance, including fire and personnel safety clearance areas, would be graded to blend as well as possible with the natural contours and would be revegetated as required.

Additional equipment may be required if solid rock is encountered at a structure location. Rock hauling, hammering, or blasting may be required to remove the rock. Excess rock that is too large in size or volume to be spread at the sites would be hauled away and disposed of at approved sites or at a location specified by the affected agency or landowner.

2.2.6.5 Install Structure Foundations

Each new 230 kV support structure would require the installation of concrete piers. First, one to four holes would be excavated for each structure (depending on the type of structure). The holes would be drilled using truck- or track-mounted augers of various sizes depending on the diameter and depth requirements of the hole to

be drilled. Each concrete pier foundation typically extends 0.5 to 3 feet above the ground.

Excavations for transmission line structures on the SJBEC Project are expected to encounter hard rock, typically sandstone. Blasting will most likely be required to complete the required excavations. The construction contractor will be required to prepare a blasting plan for the SJBEC Project that will be included in the Final POD. The blasting plan will be consistent with all requirements of the Bureau of Alcohol, Tobacco, and Firearms; Department of Homeland Security; BLM; and BIA. The blasting plan will address the types of explosives; storage, security, and general use of explosives; the contractor's proposals for compliance with agency requirements; and the general concepts proposed to achieve the desired excavations. In addition, the blasting plan will address proposed methods for controlling fly rock, providing blasting warnings, and use of non-electrical blasting systems. The contractor will be required to maintain explosive logs during construction.

A blasting plan for the SJBEC Project might include the following details for blasting a hole for a directly embedded pole or concrete foundation. An example is provided in Exhibit 2-22, Typical Blast Hole Pattern for Wood Poles.

1. Drill a single 3-inch-diameter center hole, which will not be loaded with explosives.
2. Drill three 1.75-inch-diameter holes about 6 to 8 inches from center on a triangular pattern.
3. Drill four 1.75-inch-diameter holes equally spaced on the perimeter of the excavation.
4. Typical drill depth will be 10 to 11 feet and the diameter will typically be 30 to 36 inches—all dependent on pole size.
5. The 1.75-inch-diameter holes will be loaded with explosives from the bottom up to about 3.5 to 4 feet from the surface.

6. Each hole will have four to six charges separated vertically by PVC pipe sections.
7. The seven charged holes will be detonated in sequence with 25 millisecond delays between holes.

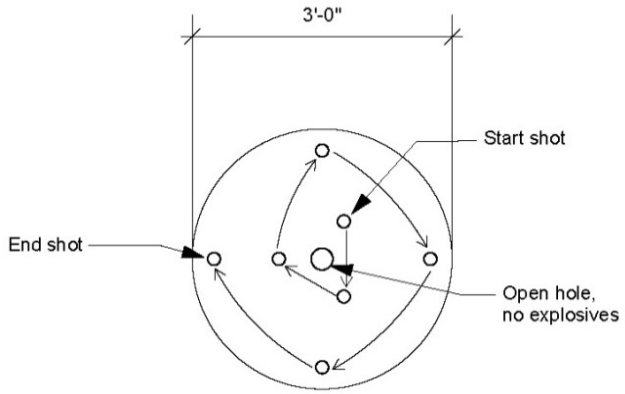
The goal of the blast pattern shown in Exhibit 2-22 would be to break the rock toward the center hole while leaving the material in situ with no fly rock. Truck-mounted, heavy-duty auger equipment would then be used to remove the cracked rock from the hole.

Blasting near buildings, structures, facilities, and other resources susceptible to vibration or air blast damage will be carefully planned by the contractor and Tri-State and controlled to eliminate the possibility of damage to such facilities and structures. For example, patterning the explosives inward to the open center hole, along with possible matting of the shot hole, limits ground acceleration and vibrations to ensure peak particle velocities at potentially sensitive resources will not exceed 0.75 inch per second per BLM Manual H-3150-1, Onshore Oil and Gas Geophysical Exploration Surface Management. When used, blasting will take place between sunrise and sunset and will be brief in its duration (milliseconds). Rock anchoring or micropile systems will be used in areas where site access is limited or where adjacent structures or potentially sensitive resources could be damaged as a result of blasting or rock hauling activities.

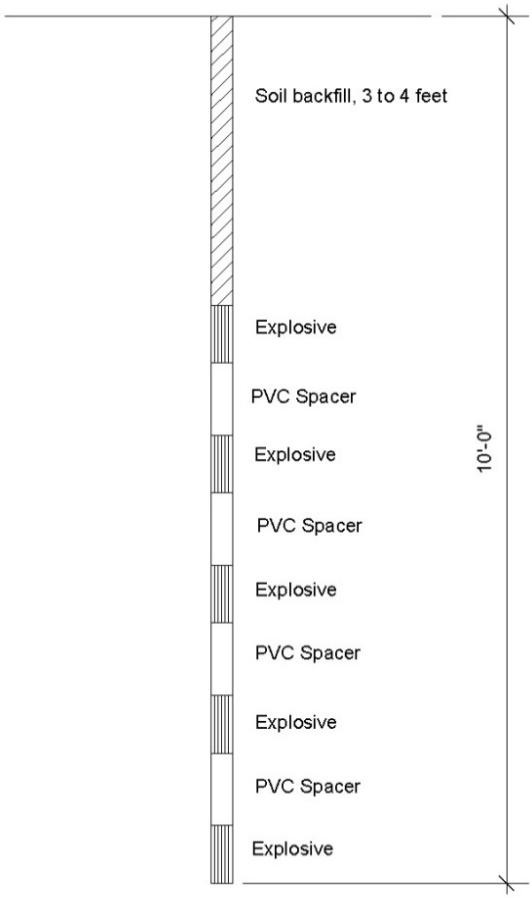
In wet areas with soft, caving soils, slurry excavation may be used. Slurry excavation involves drilling underwater (or with a drilling mud slurry) and using the water or slurry pressure to prevent the excavation from caving in. The water or slurry is then pumped out as the concrete is placed and disposed of according to the stormwater pollution prevention plan (SWPPP).

Steel rebar and anchor bolt cages will be installed after excavation and prior to structure installation. These cages are designed to strengthen the structural integrity of the foundations and will be assembled at the nearest SJBEC Project construction yard and delivered to the structure site via flatbed truck or helicopter (if necessary). These cages will be inserted in the holes prior to pouring concrete.

Exhibit 2-22
Typical Blast Hole Pattern for Wood Poles



Plan View
Typical Blast Hole



Profile View
Typical Blast Hole

2.2.6.6 Erect Support Structures

The 230 kV steel lattice, steel mono-pole, wood H-frame, and wood or steel three-pole support structures would be assembled on site, except where helicopters are needed. Helicopters may be used to deliver construction workers, equipment, and materials to structure sites; for structure placement; and for hardware installation. In addition, wire stringing will be done using a helicopter.

When helicopter construction methods are employed, helicopter construction activities would be based at a fly yard. Prior to installation, each tower structure would be assembled in multiple sections at the fly yard. Tower sections or components would be assembled by weight based on the lifting capacity of the helicopter in use. After assembly at the fly yard, the tower sections would be attached, with cables, to the helicopter and airlifted to the structure location. Upon arrival at the structure location, the section would be placed directly onto the foundation or atop the previous structure section. Guide brackets attached on top of each section would assist in aligning the stacked sections. Once aligned correctly, line crews would climb the structures to bolt the sections together permanently.

When ground-based construction methods are employed, steel lattice, steel mono-pole, wood H-frame, and wood or steel three-pole support structures and associated hardware for each structure would be delivered to the site by trucks and flatbed trailers. Structures would be assembled on the ground at the site. The assembled structure or assembled structure sections would be lifted onto the concrete piers, placed in the previously drilled holes (direct embedded structures), or placed on top of previously placed structure sections. The crane would move along the right-of-way to the next location.

2.2.6.7 String Conductors and Overhead Ground Wire

Conductor, shield wire, and optical ground wire would be placed on the transmission line support structures by a process called stringing. Stringing would be done primarily by helicopter for the proposed route. The first step would be to install insulators and hardware (if not already installed on the structures during ground assembly) and stringing sheaves.

Additionally, temporary clearance structures (also called guard structures) would be placed where required (areas such as highway crossings), prior to stringing any transmission lines. The temporary clearance structures are typically two vertical wood poles with a third wood pole, placed horizontally between the vertical poles, and are erected at road crossings or crossings with other energized electrical and communication lines to prevent contact during stringing activities. Bucket trucks may also be used to provide temporary clearance.

Once the stringing sheaves and temporary clearance structures are in place, the initial stringing operation would commence with the pulling of a lightweight sock line through the sheaves along the same path the transmission line would follow. The sock line would be pulled through the stringing sheaves by helicopter. A helicopter would pull the sock line and hover at each structure to thread the sock line through the stringing sheaves. The sock line would be attached to a larger diameter steel cable, known as the hard line. The sock line would be used to pull the hard line through the stringing sheaves. The hard line would be attached to the conductor, shield wire, or optical ground wire to pull them through the sheaves. Following the initial stringing operation, conductors and shield wires would be tensioned to achieve the correct amount of sag (tension) between support structures.

Pulling and tensioning sites for 230 kV construction would be required approximately every 2 to 3 miles along the right-of-way. Each site would require an area of approximately 150 by 600 feet to accommodate required equipment. To the extent practicable, pulling and tensioning sites will be located within the right-of-way. Depending on topography, minor grading may be required at some sites to create level pads for equipment.

At the tangent and small angle structures, the conductors would be attached to the insulators using clamps to suspend the conductors from the bottom of the insulators. At the larger angle deadend structures, the conductors are cut and attached to the insulator assemblies at the structure, deadending the conductors.

2.2.6.8 Cleanup and Refueling Procedures

Construction sites, staging areas, material storage yards, helicopter fly yards, and access roads will be kept in an orderly condition throughout the construction period. Approved enclosed refuse containers will be used throughout construction areas. Refuse and trash will be removed from the sites and disposed of in an approved manner. Oils or chemicals will be hauled to a disposal facility authorized to accept such materials. Open burning of construction trash will not be allowed.

The contractor will implement standard refueling procedures for heavy equipment that is left on the right-of-way for long periods of time such as cranes, blades, dozers, and drill rigs. This equipment will be refueled in place. As a rule, no personal or light duty vehicles will be allowed to refuel on the right-of-way. Standard EPMs regarding refueling are provided in Exhibit 2-23, Environmental Protection Measures.

2.2.6.9 Substation Construction

Preparation and construction at the substation sites would require the following:

- Conducting survey work, geotechnical drillings, and soil resistivity measurements
- Assessing area to ensure drainage patterns are maintained and the area is prepared to manage stormwater in accordance with the project SWPPP
- Clearing and grading
- Constructing access roads
- Building staging and storage yards
- Placing and compacting structural fill to serve as a subbase under the foundations for equipment
- Installing subsurface grounding rods
- Installing subsurface control conduits
- Constructing oil spill containment facilities
- Erecting fencing

- Building the facility (foundations, structure and equipment, power equipment assembly, conductors)
- Conducting site cleanup and revegetation, as necessary

Substation construction is expected to take approximately 5 months at each of the substation sites and would be constructed during the 18- to 24-month construction period for the SJBEC Project.

2.2.7 Post-Construction Activities

Post-construction activities include cleanup and restoration and revegetation as described below.

2.2.7.1 Cleanup and Restoration

After construction, all surplus building equipment, lumber, refuse, fencing, and other building materials would be removed. The right-of-way would be restored as near to its original condition as practicable when construction is complete.

Disturbed areas not required for permanent access and maintenance areas around structures would be restored and revegetated as required by the property owner or land management agency. All practical means would be made to restore the land to its original contour and to restore natural drainage patterns along the right-of-way.

2.2.7.2 Revegetation

Temporarily disturbed areas (i.e., all areas scarred, defaced, or damaged as a result of construction) will be regraded, shaped, and smoothed to contours close to the original or naturally appearing contours to avoid increased erosion and washouts. Slope stabilization and soil loss prevention techniques will be identified in a SWPPP. All disturbed areas on BLM-managed lands will be seeded with native grass/brush species compatible with surrounding vegetation. Seed mixture, season, and rate of application guidelines will be followed, as specified by BLM on BLM-managed lands. On state, SUIT and private lands, reclamation and re-seeding will be done according to the landowner's specifications.

Tri-State will be responsible for managing treatable weed populations that are propagated as the result of construction activities within the limits of the right-of-way. Tri-State will consult with the authorized BLM officer, or other landowners, to plan acceptable weed control measures for treatable noxious weed infestations within the limits of the right-of-way. The need to treat along with the treatment methods will be determined based on species type and density in surrounding areas. All seed mixes utilized for seeding of disturbed areas will be certified weed-free. All mulch materials utilized for interim revegetation activities will also be certified weed-free. Tri-State will furnish the BLM with proof of weed-free equipment for transmission line reconductoring and operation and maintenance activities. Tri-State and its contractors will clean all off-road equipment before entering the project right-of-way and access routes. Cleaning will remove all dirt and plant parts and material that may carry noxious weed seeds into the project area. If noxious weeds are identified within the transmission line right-of-way or along newly constructed access roads during operation and maintenance activities, Tri-State will consult with BLM on appropriate treatment or control measures. Any use of herbicides will be determined in consultation with the agency or landowner and will comply with federal and state laws governing their proper use, storage, and disposal.

2.2.8 Operation and Maintenance Activities

Operation and maintenance activities will include the following activities described below—routine maintenance, access road maintenance, vegetation management and weed control, substation maintenance, emergency maintenance, fire protection, and termination and restoration.

Operation and maintenance activities will be conducted in accordance with the Final POD, right-of-way grant stipulations, and landowner requirements. In addition, when conducting maintenance activities, Tri-State will implement EPMs listed in Exhibit 2-23 that are applicable to maintenance activities. The EPMs would be implemented to the greatest extent feasible during emergency maintenance activities. In an emergency situation, Tri-State would do whatever is necessary to get power restored.

Tri-State would notify the affected agency or landowner of emergency maintenance activities as soon as possible to follow up on any needed reclamation or effects to the natural and built environment.

2.2.8.1 Routine Maintenance

Routine maintenance activities will be conducted on a regular basis. The following are examples of routine maintenance activities:

- Routine air patrols from a helicopter to inspect for structural and conductor defects, conductor clearance problems, and vegetation hazards.
- Routine ground patrols to inspect structural and conductor components. Patrols are typically conducted year round as conditions permit. Follow-up maintenance is scheduled depending on the severity of the problem—either as soon as possible or as part of routine scheduled maintenance.
- Climbing structures to inspect hardware or to make repairs. Using a bucket truck to perform conductor maintenance.
- Cathodic protection surveys to check the integrity and function of anodes and ground beds.
- Vegetation clearing to trim or remove tall shrubs and trees to ensure adequate ground-to-conductor clearances and to minimize outages or fire risk.
- Testing and treating wood poles to minimize rotting and structural degradation. Wood pole inspections and treatments occur on a 15-year cycle. Poles are inspected and treated by injecting them with preservatives.
- Access road maintenance includes blading to improve surface conditions; removing large rocks, vegetation, and debris; maintaining and repairing erosion control and water drainage systems; and repairing roads after damage from washouts or slumping. Road repairs will be scheduled as a result of line inspections or will occur in response to an emergency situation.
- Reduction of fuel loads (such as vegetation removal) around poles in fire-prone areas.

- Installation of bird protection devices, bird perch discouragers, and relocation or removal of bird nests, as needed.
- Follow-up restoration activities, such as seeding, noxious weed control, and erosion control.
- Miscellaneous damage repair from the failure of conductor splices, lightning strikes, wildfires, high winds, ice, or vandalism.
- Structure repair and replacement.

2.2.8.2 Emergency Maintenance

Emergency situations are those conditions that may result in imminent or direct threats to public safety or that threaten or impair Tri-State's ability to provide power to its customers or the grid. The following are examples of potential emergency situations:

- Lightning strike or wildfire, resulting in burning of wood pole structures.
- Breaking or imminent failure of cross arms or insulators, potentially causing conductor failures.
- Vandalism to structures or conductors from shooting or other destructive activities.

The transmission system and substations would be remotely managed and monitored by Tri-State from control rooms at its operation center. Electrical outages or variations from normal operating protocols would be sensed and reported at these operation centers. Substations would be equipped with remote monitoring, proximity alarms, and, in some cases, video surveillance.

In the event of an emergency, Tri-State must respond as quickly as possible to fix the problem, safeguard human health, prevent damage to the environment, and restore power. In most cases, the equipment required to carry out emergency repairs is similar to the equipment needed to conduct routine maintenance. As soon as an incident is detected, control room dispatchers would notify the responsible operations staff in the area(s) affected, and crews and equipment would be organized and dispatched to respond to the

incident. Tri-State would notify the affected agency or landowner of emergency maintenance activities as soon as the emergency was addressed or as soon as practicable. Follow-up actions and additional reporting requirements would be coordinated with the affected agencies and landowners as necessary.

2.2.8.3 Access Road Maintenance

Tri-State would maintain new access roads and existing access roads that are open to the public or shared by others commensurate with use. Typical repairs would include grading; repair of access roads and work areas; spot repair of sites subject to flooding or scouring removal of rock, vegetation, and debris; construction or maintenance of appropriate erosion control measures; and gate repair in areas where access roads are gated. Required equipment may include a grader, backhoe, pickup truck, and a cat-loader or bulldozer. Repairs to the right-of-way will be scheduled as a result of line inspections or will occur in response to an emergency situation.

2.2.8.4 Vegetation Management and Weed Control

Maintaining adequate clearance between vegetation and conductors is essential to safe and reliable operation of the transmission line. In addition, vegetation management would be needed to maintain access roads and keep substation areas free of vegetation. The right-of-way areas for the SJBEC Project include a variety of vegetation types, including grasslands, sagebrush, low-elevation shrubland, pinon-juniper woodlands, aspen forests, oak shrublands, ponderosa pine forests, and conifers. Vegetation management would generally be scheduled according to maintenance cycles (5- or 10-year cycles), depending on the amount and type of vegetation. Trees with the potential to grow or fall into the transmission right-of-way, access roads, or substations would be removed. Compatible vegetation such as low-growing species would not be removed. Vegetation would be removed as needed to keep substations free of vegetation for safety. Weed and vegetation treatment would occur annually at a minimum.

In accordance with Tri-State's transmission vegetation management program, vegetation that poses a hazard to reliable operation of the transmission line and substations would be removed, where

necessary, based on current or expected vegetation height and underlying terrain. According to NERC FAC-003-1, Requirement R1.2.1, the minimum clearance distance between vegetation and conductors for a 230 kV transmission line is 18 feet. Vegetation removal would be accomplished primarily through mechanical means, though herbicides may be used in some selected areas with agency or private landowner approval.

Under the requirements of a right-of-way grant, Tri-State is responsible for controlling noxious weed species that result or will result from the construction, operation, and maintenance of the improvements authorized under the grant. Therefore, a noxious weed control strategy would be developed in coordination with affected agencies prior to construction to reduce the opportunity for weeds to invade new areas and to minimize the spread of weeds within the SJBEC Project area.

2.2.8.5 Substation Maintenance

Substation monitoring and control functions would be performed remotely by Tri-State from its operation center. SJBEC Project substations would not be staffed; however, a remotely monitored security system would be installed. Maintenance activities would include equipment testing, equipment monitoring and repair, emergency and routine procedures for service continuity, preventive maintenance, maintaining drainage improvements and substation access roads, and stabilizing soils. Routine operations activities would typically occur monthly, and a major maintenance inspection would take place once a year.

2.2.8.6 Fire Protection

All federal, state, and county laws, ordinances, rules, and regulations pertaining to fire prevention and suppression would be strictly adhered to. All personnel would be advised of their responsibilities under the applicable fire laws and regulations. Tri-State would regularly inspect the transmission line for fire hazards.

If Tri-State becomes aware of a fire that is on or threatening BLM-managed lands or other lands where the SJBEC Project is located, it would notify the appropriate agency contact. Specific safety measures would be implemented during construction of the

transmission line in order to prevent fires and to ensure quick response and suppression in the event a fire occurs. Typical practices to prevent fires during construction and maintenance or repair activities include brush clearing prior to work, stationing a water truck at the job site to keep the ground and vegetation moist in extreme fire conditions, enforcing red flag warnings, providing fire behavior training to all pertinent personnel, keeping vehicles on or within designated roads or work areas, and providing fire suppression equipment and emergency notification numbers at each construction site.

2.2.8.7 Termination and Restoration

The term of the BLM right-of-way grant to allow use of federal land would be limited to 50 years. At the end of the 50-year BLM lease, Tri-State would need to renew its lease. If at some point in the future, the facility is no longer required, the transmission line would be removed from service. Prior to removal, a termination and restoration plan covering planned activities would be prepared by Tri-State for review and approval.

2.2.9 Environmental Protection Measures

EPMs are design features that are specific means, measures, or practices that reduce or eliminate effects of a proposed action. These measures, in some cases, are sufficient for meeting environmental policy and regulatory requirements. In some cases, additional specific mitigation may be required to offset project effects.

Exhibit 2-23, provides a list of measures and design features that will be incorporated into the project and are expected to be adopted as requirements for right-of-way grants. This table is organized by major resource topics and identifies the phases during which each measure would be implemented. These and other measures will be reviewed, revised, and developed further to reduce effects associated with specific resource concerns and will be included in the Draft and Final EIS, the Record of Decision (ROD), and the Final POD.

Tri-State will work with the affected agencies and private landowners to implement the EPMs as appropriate for the SJBEC Project to avoid and minimize potential effects to resources.

Exhibit 2-23
Environmental Protection Measures

No.	Topic	Description of Measure	Phase
General Measure			
1	Compliance with agency stipulations and ROD	The SJBEC Project will be planned, constructed, and operated in accordance with the ROD, the right-of-way grant stipulations, and requirements of other permitting agencies.	P, C, O
2	Compliance with laws and regulations	Tri-State and contractors will comply with all applicable environmental laws and regulations. Applicable laws and regulations may include, but are not limited to, the CWA Section 303(d) and Section 404; the Endangered Species Act, Section 7; the National Historic Preservation Act, Section 106, the Native American Graves Protection and Repatriation Act. Compliance with all applicable laws and regulations will be documented in the Final POD.	P, C, O
3	Mitigation monitoring plan	The Final POD will include mitigation monitoring requirements that will address how each mitigation measure, required by permitting agencies in their respective decision documents and permits, will be monitored for compliance.	P
4	Environmental and cultural training	Prior to and throughout construction, the contractor will instruct all personnel on the protection of livestock, cultural, ecological, and other natural resources including: (a) federal and state laws regarding antiquities and plants and wildlife, including collection and removal; (b) the importance of these resources; and (c) the purpose and necessity of protecting them.	P, C
5	Electrical conductivity	Tri-State will apply necessary mitigation where possible to eliminate problems of induced currents and voltages onto conductive objects sharing the same right-of-way to meet the appropriate National Electrical Safety Code and to the mutual satisfaction of parties involved.	C, O
Project Design, Access, and Construction			
6	Design, general	The Final POD will display the location of project infrastructure (such as towers, access roads, substations) and will include mitigation measures to be implemented for site-specific and resource-specific environmental effects.	P
7	Design, aviation	Towers, conductors, and ground wires will be marked with high-visibility devices where required by governmental agencies (FAA). Tower heights will be less than 200 feet to avoid the need for aircraft obstruction lighting.	P, C, O

P = Preconstruction, C=Construction, and O = Operation

Exhibit 2-23
Environmental Protection Measures

No.	Topic	Description of Measure	Phase
Project Design, Access, and Construction (Continued)			
8	Design, minerals and mining	Tri-State will work with affected oil, gas, and mine operators during project design, construction, and operations on a case-by-case basis. In general Tri-State will: • Contact all affected operators in the study area to explain the project, and • Work with operators to identify areas that may require special design considerations on a case-by-case basis. This could include conducting field visits with operators, identifying pipelines that may require cathodic protection (due to proximity to the transmission line), or specific design considerations if they are located under or near access roads; or identifying areas where subsidence may be a concern. As part of these discussions, best management practices and standard operating procedures would be identified on a case-by-case basis, as well as measures that would be implemented to minimize effects to operators during construction. Tri-State would continue to work with operators throughout construction and operation of the project. In addition, to ensure the integrity and safe operation of Tri-State's transmission structures, substations, and access roads, the BLM or other land managing agencies would inform Tri-State of any applications for work within the SJBEC right-of-way and provide Tri-State with an opportunity to provide input to development plans within the right-of-way to minimize potential conflicts.	P, C, O
9	Design, geology	As part of preconstruction activities, Tri-State will perform detailed geologic evaluation and investigations to evaluate potential geologic and geotechnical hazards and design the project to avoid and minimize potential geotechnical risks such as slope failure, unstable soils, and landslide risks. In addition, soil would be sampled if potentially contaminated soils were observed during the preconstruction geotechnical investigation.	P
10	Design	In designated areas, structures will be placed to avoid sensitive features where feasible, such as, but not limited to, threatened or sensitive plants, riparian areas, water courses, and cultural sites to avoid or minimize effects to sensitive features.	P, C
11	Construction, access	Prior to construction, Tri-State or its contractors would develop a construction traffic management plan in consultation with affected land owners. This includes working with the Colorado Department of Transportation to incorporate appropriate measures and obtain approval for construction of the transmission line across US 550. It also includes obtaining crossing permits as required by state, county, and local requirements and developing a plan for installing warning signs where construction activities would cross a recreational trail.	P
12	Construction, access	All construction access outside the right-of-way will be restricted to pre-designated access, contractor-acquired access, or public roads.	C, O

P = Preconstruction, C=Construction, and O = Operation

Exhibit 2-23
Environmental Protection Measures

No.	Topic	Description of Measure	Phase
Project Design, Access, and Construction (Continued)			
13	Construction, general	Stream and waterway crossings will be designed to minimize effects to surface waters and to ensure the long-term viability of the crossing in compliance with federal, state, and local regulations. All construction and maintenance activities will be conducted in a manner that will minimize disturbance to vegetation, drainage channels, and stream banks. All existing roads will be left in a condition equal to their condition prior to the construction of the transmission line. Towers will be sited with a minimum distance of 200 feet from perennial streams wherever possible.	P, C
14	Construction, cleanup	During construction, the right-of-way will be free of non-biodegradable debris. Slash will be left in place or disposed of in accordance with requirements of the affected agency or private landowner.	C, O
15	Construction, cleanup	Except for permanent survey markers and material that locate proposed facilities, stakes, pins, rebar, spikes, and other material will be removed from the surface and within the top 15 inches of the topsoil as a part of final cleanup. Fences on right-of-way will be removed where necessary and replaced to the original condition or better when the work is finished. Where existing fences are removed to facilitate the work, temporary fence protection for lands adjacent to the right-of-way will be provided at all times during construction. Such temporary fence protection will be adequate to prevent public access to restricted areas. Temporary fencing constructed on the right-of-way will be removed by the contractor as part of the clean-up operations prior to final acceptance of the completed work.	C, O
16	Construction, restoration	Tri-State or its contractors would repair or reconstruct existing roads or trails if they were damaged by construction activities associated with the SJBEC Project.	C, O
17	Construction, restoration	In construction areas where ground disturbance is substantial or where recontouring is required, surface restoration will occur as required by the landowner or land management agency for erosion control. The method of restoration will normally consist of, but not be limited to, returning disturbed areas back to their natural contour, reseeding (if required), installing cross drains for erosion control, and placing water bars in the road. All areas on BLM lands that are temporarily disturbed as a part of the construction or maintenance of the proposed transmission line will be seeded, to 70 percent of existing cover, where practicable, with a seed mixture appropriate for those areas. The BLM will prescribe a seed mixture that fits each range site.	C, O
18	Construction, restoration	Watering facilities (such as tanks, natural springs, developed springs, water lines, and wells) will be repaired or replaced, if damaged or destroyed by construction activities, to their pre-disturbed condition as required by the landowner or land management agency.	C, O
19	Construction, restoration	Merchantable forest products will either be removed or stacked at locations determined by the land management agency.	C, O

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Exhibit 2-23

Environmental Protection Measures

No.	Topic	Description of Measure	Phase
Groundwater, Surface Water, and Wetlands			
20	Groundwater	A dewatering permit will be obtained from the appropriate agencies if required for construction dewatering activities.	P
21	Surface water, drainage crossings	If necessary, low water crossings will be designed and constructed in a manner that will prevent any blockage or restriction of the existing channel.	P, C, O
22	Water quality	A buffer strip of vegetation, width determined on a case-by-case basis, will be left between areas of surface disturbance and riparian vegetation.	P, C, O
23	Water quality	Tri-State will identify all streams in the vicinity of the proposed project sites that are listed as impaired under Section 303(d) of the CWA and will develop a management plan to avoid, reduce, or minimize adverse effects to those streams if the SJBEC Project could affect these areas.	P
24	Water quality	Runoff from excavated areas, construction materials or wastes (including truck washing and concrete washes), and chemical products such as oil, grease, solvents, fuels, and pesticides will be controlled and contained. Excavated material or other construction material will not be stockpiled or deposited near or on stream banks, ditches, irrigation canals, or other areas where runoff could affect the environment.	C
25	Water quality	Washing concrete trucks or disposing excess concrete in any ditch, canal, stream, or other surface water will not be permitted. Concrete wastes will be disposed of in accordance with all federal, state, and local regulations.	C
26	Wetlands	Transmission structures and access roads will be routed outside of wetland areas to the greatest extent feasible.	P, C
Vegetation and Soils Management			
27	Reclamation and noxious weeds	The Final POD will include a reclamation and noxious weed management plan, which will be approved by the appropriate agency prior to the issuance of a right-of-way grant. The noxious weed management plan will be developed in accordance with appropriate land management agencies' standards, consistent with applicable regulations and agency permitting stipulations for the control of noxious weeds and invasive species (Executive Order 3112). Included in the noxious weed plan will be stipulations regarding construction, restoration, and operation.	P, C, O
28	Vegetation and soil, construction	Clearing, grading, and other disturbance of vegetation and soil will be limited to the minimum area required.	C, O
29	Vegetation, construction	In construction areas where recontouring is not required, vegetation will be left in place wherever possible, and original contour will be maintained to avoid excessive root damage and allow for resprouting.	C
30	Vegetation	For safe operation of the transmission line and substations, vegetation removal will be limited to areas that would create a threat to the electrical reliability of the transmission line or substations or would impede access for safe operations. Except for dangerous vegetation, which is defined as vegetation that could grow in, fall in, blow in, or be a fuel loading hazard in the right-of-way, no clearing would be performed outside of the limits of the right-of-way.	O

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Exhibit 2-23
Environmental Protection Measures

No.	Topic	Description of Measure	Phase
Vegetation and Soils Management (Continued)			
31	Vegetation, removal	Clearing will be performed so as to minimize marring and scarring the countryside and to preserve the natural beauty to the maximum extent possible.	C, O
32	Vegetation, treatment	Use of pesticides and herbicides shall comply with applicable federal and state laws.	C, O
33	Soils, drainage and erosion control	A SWPPP will be prepared for the SJBEC Project and will be included as part of the Final POD. Implementation of the SWPPP will manage erosion and provide adequate drainage around structure and tower sites. Excavated material will be spread around the site from where it was excavated.	C, O
34	Soils, construction	No construction or routine maintenance activities will be performed when the soil is too wet to adequately support construction equipment. If such equipment creates ruts in excess of 6 inches deep, the soil will be deemed too wet to work.	C, O
35	Soils, construction	Grading will be minimized by driving overland within work areas whenever possible.	C, O
36	Soils, restoration	In newly disturbed temporary work areas, the soil will be salvaged and will be distributed and contoured evenly over the surface of the disturbed area after construction is completed. The soil surface will be left rough to help reduce potential wind erosion.	C, O
37	Soils, restoration	Topsoil removed during construction will be stockpiled and used in reclamation.	C
Biological Resources			
38	Biological, special status species	Special status species or other species of particular concern will be considered in accordance with management policies set forth by appropriate land-management agencies. This will entail conducting surveys for plant and wildlife species of concern along the proposed transmission line route and associated facilities as agreed upon by the responsible land-management agencies. In cases where such species are identified, appropriate action will be taken to avoid adverse effects to the species and its habitat and may include monitoring and altering the placement of roads or towers, where practicable.	P, C, O
39	Biological, special status species	The Final POD will include biological stipulations provided by the BLM and the USFWS, which will identify measures to avoid, minimize, or mitigate effects to special status species.	P, C, O
40	Biological, special status species	Prior to the start of construction, Tri-State will provide training to all contractor and subcontractor personnel and others involved in construction activities where there is a known occurrence of protected species or habitat in the construction area. Sensitive areas will be considered avoidance areas. Prior to any construction activity, avoidance areas will be marked on the ground and maintained through the duration of the contract. Tri-State will remove markings during or following final inspection of the project.	P, C

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Exhibit 2-23
Environmental Protection Measures

No.	Topic	Description of Measure	Phase
Biological Resources (Continued)			
41	Biological, special status species	If evidence of an ESA-listed species is found in the project area, the contractor will immediately notify the appropriate land management agencies and provide the location and nature of the findings. The contractor will stop all activity within 200 feet of the protected species or habitat.	C
42	Biological, special status species	Tri-State will comply with any and all environmental protection and mitigation measures identified by the USFWS, BLM, BIA, and SUIT in the Section 7 consultation, regarding federally listed, candidate, proposed species.	P, C, O
43	Biological, migratory birds	Given the scope of the proposed project, it is likely that avoiding construction during the avian breeding season is not possible. Prior to construction during the avian breeding season, Tri-State will coordinate appropriate mitigation measures with the BLM, BIA, SUIT, and USFWS.	P, C
44	Biological, wildlife	Seasonal restrictions may be implemented in specific areas as required by permitting and land management agencies to mitigate effects to wildlife. With the exception of emergency repair situations, right-of-way construction, restoration, maintenance, and termination activities in designated areas will be modified or discontinued during sensitive periods (such as nesting and breeding periods) for candidate, proposed threatened and endangered, or other sensitive animal species, as required by permitting and land management agencies. The Final POD will incorporate the seasonal restrictions and stipulations contained in the ROD. A seasonal restriction of November 1 through March 31 and a 0.5-mile buffer will be implemented for the bald eagle roost located near the Iron Horse substation. Other seasonal restrictions that may apply in locations to be determined on a case-by-case basis include: • Migratory Birds – May 15 through July 31 • Southwestern Willow Flycatcher and Yellow-Billed Cuckoo – May 1 through August 31 • Peregrine and Prairie Falcons – March 1st through June 30 • Bald Eagle – November 1 through March 31 • Golden Eagle – February 1 through June 30 • Western Burrowing Owl – April 1st through August 15 (In New Mexico)	P, C, O
45	Biological, wildlife and livestock	Tri-State will repair holes created by construction of transmission structures to avoid and minimize effects to wildlife and livestock.	C
46	Biological, raptors	The transmission line design will consider the Avian Power Line Interaction Committee's suggested practices for avian protection on power lines.	P, C
47	Biological, raptors	Tri-State will follow BLM, Colorado Parks and Wildlife, and USFWS guidelines for raptor protection during the breeding season (Migratory Bird Executive Order 13186, January 10, 2001).	P, C, O

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Exhibit 2-23
Environmental Protection Measures

No.	Topic	Description of Measure	Phase
Cultural Resources – Historic, Archaeological, Tribal			
48	Cultural resources, mitigation	In consultation with the appropriate land management agencies and state historic preservation officers (SHPOs) specific measures for cultural resources will be developed and implemented to mitigate any identified adverse effects. These may include SJBEC Project modifications to avoid adverse effects, monitoring construction activities, data recovery, or other efforts.	P, C
49	Cultural resources, tribal consultation	The SJBEC Project will be built and operated in accordance with all laws, policies, and regulations pertaining to consultations with federally recognized tribes.	P, C, O
50	Cultural resources, construction	Prior to and throughout construction, all construction personnel will be instructed on the protection of cultural resources, including the provisions of federal, state, and tribal laws regarding cultural resources, including prohibition of collection and removal; and the importance of these resources and the purpose and necessity of protecting them.	P, C
51	Cultural resources, construction	If a contractor or Tri-State discovers any previously unidentified historic or prehistoric cultural resources during construction or operation, then work in the vicinity of the discovery will be suspended, and the discovery would be promptly reported to the affected agency. The affected agency will then specify what action is to be taken. If there is an approved “discovery plan” in place for the SJBEC Project, then the plan will be executed. In the absence of an approved plan, the affected agency will evaluate the significance of the discovery and consult with the appropriate land managing agency and SHPO in accordance with 36 CFR § 800.11.	C, O
52	Cultural resources, construction	If in its construction or operations a contractor or Tri-State damages, or is found to have damaged, any previously documented or undocumented property, excluding “discoveries” as noted above, the contractor or Tri-State agrees to cover expenses to have a permitted cultural resources consultant prepare and execute an approved data recovery plan.	C, O
Paleontological Resources			
53	Paleontology, construction	If paleontological material (fossils) is observed during construction or operations, Tri-State or contractor shall immediately contact the BLM. Tri-State shall cease any construction or operations that would result in the destruction of such objects. Further investigation would dictate site-specific measures for salvage of any significant paleontological resources.	C, O
54	Paleontology, construction	Preconstruction surveys of areas having a high potential to contain paleontological material will be conducted as required the land managing agency or landowner. If paleontological material is found, Tri-State would work with the land managing agency or landowner to remove the material prior to construction.	P, C

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Exhibit 2-23
Environmental Protection Measures

No.	Topic	Description of Measure	Phase
Land Use and Visual Resources			
55	Land use, agriculture	On agricultural land, the right-of-way will be aligned, in so far as practicable, to reduce the effects to farm operations and agricultural production. Similarly, temporary construction and maintenance activities would be located to minimize disturbance to livestock, where practicable.	P, C, O
56	Land use, agriculture	In cultivated agricultural areas, soil compaction caused by construction activities will be decompacted as required by landowners. Construction activities will occur so as to minimize effects to agricultural operations.	C
57	Land use, access	Fences, gates, or other natural barriers to livestock will be repaired or replaced by Tri-State or Tri-State's contractor to their original predisturbed condition as required by the agency or private landowner if they are damaged or destroyed by construction or maintenance activities. Temporary gates will be installed only with the permission of the agency or private landowner and will be restored to their original predisturbed condition following construction. Cattle guards will be installed where new permanent access roads cut through fences, at the request of the affected agency, to prevent escape of livestock.	C, O
58	Land use, access	Tri-State is responsible to contact the grazing lessees prior to crossing any fence on public land or any fence between public and private land, and to offer the lessees an opportunity to be present when the fence is cut to ensure the fence is adequately braced and secured.	P, C, O
59	Land use, access	Tri-State will establish and maintain appropriate closure devices in consultation with the BLM to minimize unauthorized public access on roads created specifically for Tri-State access to the transmission line and substations.	P, C, O
60	Visual resources, design	Non-specular conductors will be used to reduce visual effects.	P, C, O
61	Visual resources, access roads	The alignment of any new access roads will follow the designated area's landform contours where practical, providing that such alignment does not additionally affect resource values. This will minimize ground disturbance and reduce scarring (visual contrast).	P
62	Visual resources, construction	No paint or permanent discoloring agents will be applied to rocks, vegetation, structures, and fences to indicate survey or construction activity limits.	P, C, O
63	Visual resources, restoration	Tri-State may be required to reconstruct rock rims as near as possible to the original condition.	C, O
Air Quality			
64	Construction	As part of the Final POD, Tri-State would develop and implement a fugitive dust control plan that would, at a minimum, include EPMs 65 to 70 listed below.	P, C
65	Construction	The contractor and subcontractors will be required to have and use air emissions control devices on construction machinery, as required by federal, state, or local regulations or ordinances.	C, O
66	Construction	All trucks hauling soil, sand and other loose material would be covered.	C, O

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Exhibit 2-23
Environmental Protection Measures

No.	Topic	Description of Measure	Phase
Air Quality (Continued)			
67	Construction	Tri-State will minimize dust using means satisfactory to the affected agency.	C, O
68	Construction	When appropriate, windbreaks will be installed at the windward sides of construction areas.	C, O
69	Construction	Tri-State will suspend excavation and grading activity when winds (instantaneous gusts) exceed 25 miles per hour.	C, O
70	Construction	Exposed stockpiles of dirt and sand will be enclosed, covered, or will have non-toxic soil binders applied.	C, O
Noise			
71	Corona	Transmission line materials will be designed to minimize effects from corona. The proposed hardware and conductor will limit the audible noise, radio interference, and TV interference due to corona. Tension will be maintained on all insulator assemblies to assure positive contact between insulators, thereby avoiding sparking. Caution will be exercised during construction to avoid scratching or nicking the conductor surface which may provide points for corona to occur.	P, C, O
72	Operation	Tri-State will respond to complaints of line-generated radio or television interference by investigating the complaints and implementing appropriate mitigation measures. The transmission line will be patrolled on a regular basis so that damaged insulators or other line materials that could cause interference are repaired or replaced.	O
Public Health and Safety			
73	Safety standards	The SJBEC Project will be designed, constructed, and operated to meet or exceed the requirements of the National Electrical Safety Code, US Department of Labor, Occupational Safety and Health Standards, and Tri-State's requirements for safety and protection of landowners and their property.	P, C, O
74	Blasting	The Final POD will include a blasting plan, which will identify methods and mitigation measures to minimize the effects of blasting, where applicable. The blasting plan will document the proposed methods to achieve the desired excavations, proposed methods for blasting warning, use of non-electrical blasting systems, and provisions for controlling fly rock, vibrations and air blast damage.	P, C
75	FAA regulations	The SJBEC Project will be designed to comply with FAA regulations, to avoid potential safety issues associated with proximity to airports, military bases or training areas, or landing strips.	P, C, O
76	Maintenance	The transmission line will be regularly patrolled and properly maintained in compliance with applicable safety codes.	O

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Exhibit 2-23

Environmental Protection Measures

No.	Topic	Description of Measure	Phase
Hazardous Materials, Waste, and Wastewater Management			
77	Storage and removal	Tri-State will provide a Hazardous Materials Management Plan. Hazardous material shall not be drained onto the ground or into streams or drainage areas. Totally enclosed containment would be provided for all trash. All construction waste, including trash and litter, garbage, other solid waste, petroleum products, and other potentially hazardous materials would be removed to a disposal facility authorized to accept such materials.	C, O
78	Hazardous materials, vehicles	Vehicle refueling and servicing activities would be performed in the right-of-way or in designated construction zones located more than 300 feet from wetlands and streams. Spill preventative and containment measures or practices would be incorporated as needed.	C, O
79	Hazardous materials, spills	Tri-State will provide a spill prevention notification and cleanup plan. The SJBEC Project will comply with all applicable federal, state, and local regulations, and will include: spill prevention measures, notification procedures in the event of a spill, employee awareness training, and commitment of manpower, equipment, and materials to respond to spills, if they occur.	P, C, O
Fire Protection			
80	Fire protection	A fire protection plan would be developed and approved by the affected agency prior to the issuance of a right-of-way grant. Tri-State or its contractors would: • Implement and follow the fire protection plan approved by the affected agency. • Operate all internal and external combustion engines on federally managed lands per 36 CFR 261.52(j), which requires all such engines to be equipped with a qualified spark arrester that is maintained and not modified.	P, C, O
Additional Considerations			
81	Mitigation	Tri-State will consider additional compensatory, off-site, or other mitigation for permanently disturbed areas or areas where such mitigation could successfully compensate for remaining unavoidable effects to a particular resource.	P, C, O

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2.3 Alternatives Considered but Eliminated

2.3.1 Introduction

A collaborative and comprehensive process was used to develop and consider a range of alternatives for the SJBEC Project. The alternatives development process included public engagement through NEPA scoping meetings, tribal consultation, agency coordination, and cooperating agency participation. Exhibit 2-24, Alternatives Development Process, identifies the studies, opportunities for public input and formal NEPA scoping, and outcomes of the analysis completed throughout the alternatives development process. The alternatives development process included looking at the electrical system and transmission line routes.

Exhibit 2-24
Alternatives Development Process

Phase	Studies/Public Involvement	Purpose	Outcome
Electrical System Alternatives	Alternatives Evaluation Study (Appendix A)	• Evaluate solutions to meet electrical system needs. This analysis included evaluating transmission line and non-transmission line alternatives.	• Established that electrical system needs would be met by building a new 230 kilovolt (kV) transmission line between the Shiprock and Iron Horse Substations.
Transmission Line Corridor and Route Development	Macro Corridor Study (Appendix B)	• Identify possible transmission corridor segments by soliciting input from the public, gathering data, and determining constraints and opportunities for siting a transmission line.	• Identified 36 preliminary transmission line corridor segments.
	• Route Refinement Report (Appendix C) • Additional Analysis of Alternatives A Through F (Appendix D)	• Develop transmission line alternatives from the corridor segments identified in the Macro Corridor Study and solicit public input on the alternatives.	• Identified 55 route segments based on corridor segments established in the Macro Corridor Study. • Refined the 55 route segments to 26 based on input from the public and key stakeholders. Identified and analyzed six possible preliminary routes (Alternatives A through F), identified a preliminary preferred route (Alternative D).
NEPA Scoping	Environmental Assessment (EA) Scoping	• Begin the NEPA process and collect input on issues and alternatives to consider in the EA.	• Collected public input for EA scoping and determined that an EIS would be needed.
	EIS Scoping	• Collect input on alternatives and issues to consider in the EIS	• Collected public and agency input on the alternatives and issues to be addressed in the EIS.

Electrical system needs were assessed in an Alternatives Evaluation Study (Appendix A). Through this study, it was determined that the best way to meet electrical system needs was to build a transmission line from the Shiprock Substation to the Iron Horse Substation. Electric system alternatives considered but eliminated are summarized in Section 2.3.2, Electrical System Alternatives.

Once an electrical system solution was identified, transmission line corridors and routes were identified and evaluated by collecting data and engaging the public and key stakeholders. Transmission line corridors were identified and evaluated in a Macro Corridor Study (Appendix B). Once the corridors were identified, six specific routes (Alternatives A, B, C, D, E, and F) were developed and analyzed in a Route Refinement Report (Appendix C). These six alternatives were analyzed in greater detail in Additional Analysis of Alternatives A through F (Appendix D). Alternative routes considered but eliminated are summarized in Section 2.3.3, Transmission Line Corridors and Route Development.

Appendices A, B, C, and D

Appendix A, Alternatives Evaluation Study evaluates the options of adding generation capacity, managing demand, or building alternative transmission line configurations.

Appendix B, Macro Corridor Study identifies transmission line corridors for the SJBEC Project.

Appendices C and D explain how transmission line routes were identified, refined, and evaluated.

2.3.2 Electrical System Alternatives

Different solutions to meeting electrical system needs were assessed in the Alternatives Evaluation Study. The following alternatives were considered for meeting the established system needs:

- Adding generation capacity in lieu of a transmission line
- Managing demand in lieu of a transmission line
- Building new transmission lines

The remainder of this section summarizes the systemwide alternatives considered, the analysis conducted, and the conclusions of the analysis.

2.3.2.1 Adding Generation Capacity In Lieu of a Transmission Line

Utilities often consider using conventional gas-fired, simple cycle combustion turbines (SCCT) as the most economical way to add generation capacity to meet load increases. Tri-State considered adding SCCT to serve the electrical system needs within La Plata County. In the San Juan Basin area, the electrical load factor in the LPEA service area is high because existing electrically driven

compressors and artificial lift units in the area are used about 95 percent of the time. Furthermore, the performance of a combustion turbine is highly dependent on air density and mass flow of the air intake to the compressor. Anything that affects the gas turbine's ability to "breathe" affects performance.

The altitude of the San Juan Basin is approximately 6,500 feet above mean sea level, which requires the application of a 0.65 derating factor per General Electric reference manuals. Because of such derating factors, installations above 4,000 feet above mean sea level become decreasingly cost effective. The result is that larger and more expensive combustion turbine units are required to provide the equivalent output. Additional backup capacity could also be needed due to reliability concerns. Because of this, if SCCT units were used to meet the load requirements in the San Juan Basin area, multiple units would be needed to allow for outages and routine maintenance.

SCCT generation may create concerns regarding effects to local air quality. If air quality effects require that SCCT generation be physically located away from the loads, then the electrical system, by necessity, would require the construction of new transmission lines from the generation source to the load area. In this situation, SCCT is not technically feasible because it would not replace the need for transmission line construction and would instead require additional transmission support.

With the above considerations, the installation of SCCT generation to serve the forecasted LPEA load was investigated. Three configurations and three different combustion turbine units were evaluated. The least expensive turbine option was estimated to cost $327 million, and the most expensive option was estimated to cost $474 million. Considering capital costs only, it was determined that adding generation in La Plata County is not an economically feasible alternative, particularly when compared to the transmission options discussed below in Section 2.3.2.3, Alternative Transmission Line Configurations. The lowest capital cost generation alternative substantially exceeds the highest capital cost transmission option. That cost differential increases when

integrating fuel costs and combustion turbine operation and maintenance expenses.

In summary, the option of adding generation capacity using an SCCT system was eliminated as an alternative to a new transmission line because:

- It would be technically infeasible—it would not replace the need for transmission line construction but would require additional transmission support.
- It would be economically infeasible.

The possibility of adding generation capacity by using renewable generation resources (such as wind and solar) was also considered, since this approach might avoid the air quality concerns cited above for SCCT systems. These renewable energy resources are intermittent in nature and are not always available. Therefore, for this particular application that requires consistent generation, implementation was considered to be remote and speculative. Furthermore, installing intermittent generation resources does not meet the reliability requirements included in the proponent's objectives discussed in Section 1.3, Proponent's Project Objectives.

2.3.2.2 Managing Demand In Lieu of Building a Transmission Line

Utilities use demand-side management to encourage consumers to modify their patterns of electricity use, including how much they use and when. The goal of managing demand is to more efficiently use the electrical system network and to reduce the need for investments in the electrical system where feasible. Tri-State has implemented demand-management programs designed to be compatible with the primary loads in the San Juan Basin. They have been in place for a number of years and have helped to minimize the amount of energy used and the load at the time of system peak demand (a system must be designed to meet peak demand). Tri-State's individual member-systems also have energy efficiency and demand-side management programs in place. All three of the members serving the San Juan Basin offer consumers appliance use information, energy use information, conservation guides, web-based conservation strategies and links, web-based energy

calculators, free energy audits and conservation programs, compact fluorescent programs, and time-of-use rates. Each also has strategies in place to reduce the amount of energy lost from transmitting and distributing electricity and participates through Tri-State in research efforts with the Electric Power Research Institute and the Cooperative Research Network.

Tri-State performed a comprehensive end-use energy efficiency demand-side management demand response study across its entire system. This study examined the technical, economic, practical, and actual energy and demand reduction potential. The study measured potential in discrete geographic regions, such as the San Juan Basin, and identified those programs and measures that will have the most value to the member-consumers of Tri-State. For certain loads, this sometimes requires installing expensive communications and metering equipment and upgrading distribution infrastructure. These investments are underway. Tri-State is working with its members to support smart grid expansion, which will support additional demand response.

As described above, Tri-State and its members have been managing demand and will continue to do so in the future. This alternative was dropped from further evaluation because it is remote and speculative that total system peak load in the San Juan Basin can be sufficiently reduced to effectively meet the load forecasts and solve existing transmission deficiencies, particularly since demand management relies on consumer behavior and is out of Tri-State's control.

2.3.2.3 Alternative Transmission Line Configurations

The Alternatives Evaluation Study[2] indicated that an additional transmission line needs to be built to increase the load-serving capability and avoid degrading the transfer capability between southern Colorado and New Mexico. Various transmission configurations were considered, such as 345 kV lines to serve increased load requirements in southwestern Colorado, but it was determined that 230 kV would be sufficient to meet required loads

[2] Tri-State 2012

for less cost. In general, 345 kV lines cost about 60 percent more than 230 kV lines.

The following four 230 kV transmission system alternative configurations were studied:

- Shiprock–Kiffen Canyon–Iron Horse
- Ojo East–Turley–Chama–Iron Horse
- San Luis Valley–Chama–Iron Horse
- Curecanti–Montrose–Nucla–Florida River

Exhibit 2-25, Comparison of Transmission Line Alternatives, compares these transmission routes by their projected length, ability to meet load growth, and construction costs. A discussion of each of the transmission line alternatives is provided below.

Exhibit 2-25
Comparison of Transmission Line Alternatives

	Length (miles)	Capability	Total Cost
Shiprock–Kiffen Canyon–Iron Horse	68	250 MW	$180,885,000
Ojo East–Turley–Chama–Iron Horse	110	250 MW	$195,650,000
San Luis Valley–Chama–Iron Horse	172	250 MW	$214,789,000
Curecanti–Montrose–Nucla–Florida River	201	100 MW	$256,412,000

Source: Tri-State 2012

Shiprock–Kiffen Canyon–Iron Horse

The Shiprock–Kiffen Canyon–Iron Horse line is by far the shortest route. It is 42 miles shorter than the next comparable alternative, and would have a much smaller footprint and would create less disturbance than the other alternatives. It is expected that because less area would be affected, that the Shiprock–Iron Horse line would have fewer overall effects to the natural and human environment. In addition, the Shiprock–Iron Horse line is estimated to be the lowest cost alternative.

Ojo East–Turley–Chama–Iron Horse

This transmission line alternative consists of tapping the Public Service Company of New Mexico's (PNM) 345 kV line near Gavilan, New Mexico, and constructing a 345 to 230 kV substation

at that location. A 230 kV transmission line would be built north to a new substation near the intersection of Pounds Mill Road and US 64. At Pounds Mill Substation, a 115 kV transmission line would serve the Dulce-Chama area, and the 230 kV line would continue west to the vicinity of Turley, New Mexico, and then north toward Ignacio, Colorado (and the Iron Horse Substation). Improvements at the Turley Substation would be needed.

The Ojo East–Iron Horse line would provide about the same transfer capability as the Shiprock–Iron Horse line, which would be beneficial to the TOT 2A path. It would, however, increase loads on a different WECC-rated path in northern New Mexico known as the NM2 path. The Ojo East–Iron Horse line also appeared to be a less desirable solution than the Shiprock–Iron Horse line based on discussions with PNM planning personnel. They stated it would require a new tap on PNM's northern New Mexico 345 kV transmission system, which is already limited in its available transmission capacity. Because this alternative would require increasing loads on an already restricted system, this alternative was dropped because its implementation is remote and speculative.

In addition, the Ojo East–Iron Horse line would be 42 miles longer than the Shiprock–Iron Horse line, and would, therefore, have a larger footprint and create more disturbance. This alternative was dropped because it would cause unnecessary and undue degradation of the environment, which is contrary to BLM's objective to grant right-of-way in a manner that protects natural resources and prevents unnecessary and undue degradation of the environment. In addition, the Ojo East–Iron Horse line is estimated to cost more than the Shiprock–Iron Horse line without providing additional benefits.

San Luis Valley–Chama–Iron Horse

This transmission line alternative consists of building a radial 230 kV line originating at the San Luis Valley Substation north of Alamosa, Colorado. The line would generally extend south from that location to the Colorado border and then proceed west to a new substation located near Chama, New Mexico. At the new Chama Substation, transformers would serve the Dulce-Chama area. The 230 kV line would continue in a westerly direction to the

vicinity of Trujillo, Colorado, where a transformer would be the source for a new 115 kV line connecting to Tri-State's Pagosa Substation. A capacitor bank would be installed at the Trujillo Substation. Tri-State's existing Pagosa-Bayfield 115 kV line would be modified to accommodate power flow from the Trujillo transformer. The 230 kV line would continue west to terminate in the Iron Horse Substation.

This alternative would require an additional 104 miles of transmission line development than the Shiprock–Iron Horse line, and would, therefore, have a larger footprint and create more disturbance. This alternative was dropped because it would cause unnecessary and undue degradation of the environment, which is contrary to the BLM's objective to grant right-of-way in a manner that protects natural resources and prevents unnecessary and undue degradation of the environment.

The San Luis Valley–Iron Horse line would provide about the same amount of power transfer capability as the Shiprock–Iron Horse line. As shown previously in Exhibit 2-25, however, the San Luis Valley–Iron Horse line would be substantially similar in purpose and function to other alternatives considered, but at a much higher cost without providing additional benefits.

Curecanti–Montrose–Nucla–Florida River

This transmission line alternative consists of building a new radial 230 kV line extending westerly from the Curecanti Substation located east of Montrose, Colorado, past Tri-State's South Canal, Nucla, Cahone, and Empire Substations to terminate at a new 230/115 kV substation near LPEA's Florida River Substation west of Ignacio, Colorado. The 230 kV line would be constructed in an existing 115 kV transmission line corridor on new transmission structures. The existing 115 kV substations would be converted to 230 kV. South of the Empire Substation, the 230 kV line would be a double-circuit line to maintain the 115 kV source serving the Lost Canyon, Durango, Hesperus, and Florida River Substations. In addition, a capacitor bank would be installed at the Empire Substation to reduce line impedances so that power could flow into the LPEA service area.

This alternative would require an additional 133 miles of transmission line development than the Shiprock–Iron Horse line, and would, therefore, have a larger footprint and create more disturbance. This alternative was dropped because it would cause unnecessary and undue degradation of the environment, which is contrary to the BLM's objective to grant right-of-way in a manner that protects natural resources and prevents unnecessary and undue degradation of the environment.

In addition, the Curecanti–Florida River line would offer significantly less power transfer capability than other alternatives considered. As shown in Exhibit 2-25, the Curecanti–Florida River line would be substantially similar in purpose and function to other alternatives considered, but at a much higher cost substantially without providing additional benefits.

2.3.3 Transmission Line Corridors and Route Development

2.3.3.1 Macro Corridor Study

A Macro Corridor Study was conducted to identify opportunities and constraints for siting transmission line corridor segments between the Shiprock and Iron Horse Substations. Transmission line corridors were identified in the Macro Corridor Study by:

- Defining the study area
- Collecting and evaluating best publicly available land use and resource data
- Completing an opportunities and constraints analysis based on best available land use and resource data
- Identifying transmission line corridor segments based on opportunities and constraints for transmission line siting

The details of the Macro Corridor Study are provided in Appendix B, Macro Corridor Study. Exhibit 2-26, Opportunity, Avoidance, and Exclusion Areas, summarizes the results of the Macro Corridor Study and shows areas identified as opportunities, avoidance, and exclusion zones based on the developed criteria and resource data. Based on this analysis, 36 corridor segments were identified as possible opportunities for locating possible

transmission line routes. These 36 corridor segments were available for public review and comment at EA scoping meetings held on October 7 and 8, 2009, in Farmington, New Mexico, and Ignacio, Colorado. EA scoping is discussed in additional detail in Section 1.8.1, EA Scoping.

2.3.3.2 Route Refinement Process

After EA scoping and the Macro Corridor Study were completed, corridor segments were refined to develop transmission line routes. This work is documented in Appendix C, Route Refinement Report, and is summarized in this section. Additional analysis of identified routes is contained in Appendix D. The route refinement process included:

- Refining corridor segments (as shown on Exhibit 2-26)
- Developing routing objectives
- Collecting and evaluating land use and resource data
- Inviting public and stakeholder input
- Developing and evaluating routes

Refining Corridor Segments

As part of route refinement, some of the 36 corridor segments identified in the Macro Corridor Study were modified or removed from further consideration based on public comment from EA scoping meetings, agency and tribal input, detailed data review, and extensive field reconnaissance. In some areas, corridor segments representing favorable locations for a transmission line were added. The corridor modifications that resulted are summarized in Table 1, Corridor Segment Modification Tracking, of Appendix A, Corridor and Route Modification Descriptions, of the Route Refinement Report (Appendix C of this EIS). A total of 43 corridor segments was considered, and 22 were removed due to conflicts with existing land uses; habitat concerns for sensitive, threatened, or endangered species; adverse effects to river and riparian areas; or a greater potential for adverse effects to undisturbed areas. The remaining 21 corridor segments were carried forward for further analysis in the route refinement process.

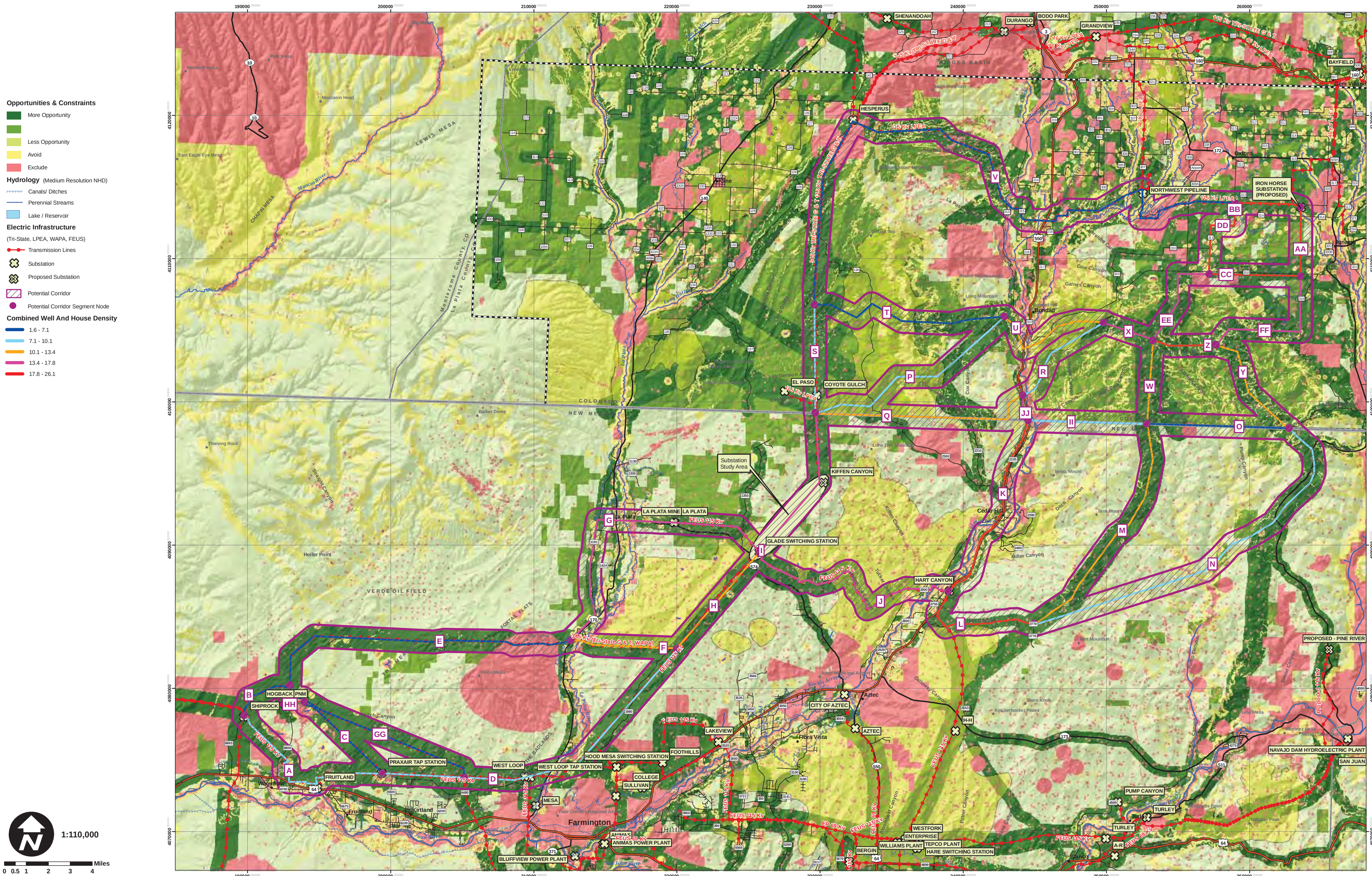


Exhibit 2-26 Opportunity, Avoidance, and Exclusion Areas

Developing Routing Objectives

Next, routing objectives were developed based on input received from agencies, stakeholders, and past transmission line routing experience. The routing objectives were used as the primary tool for identifying preliminary routes. The routing objectives are provided in Table 3.3-1 of the Route Refinement Report and are summarized below. The routing objectives focused on the following:

Appendix C, Route Refinement Report

Table 3.3-1 of the Route Refinement Report provides a complete listing of the routing objectives.

- Land use – Route the transmission line through areas with compatible land uses.
- Transportation – Parallel existing roads, where feasible.
- Land cover – Route the transmission line through shrubland, grassland, cropland, and agricultural land and avoid routing the transmission line through forested areas.
- Existing utility infrastructure – Route the line near existing transmission and distribution lines.
- Cultural and historic resources – Avoid potential effects to cultural and historic resources.
- Biological resources – Reduce potential effects to avian species and threatened and endangered wildlife and plant species habitat.

Collecting and Evaluating Land Use and Resource Data

Once the routing objectives were developed, existing resource and land use data were gathered to create maps to supplement the GIS information used in the Macro Corridor Study. Specific data sets that were collected are listed in Section 3.4, Data and Field Review, of the Route Refinement Report, and data maps are located in Appendix B, Resource Maps, of the Route Refinement Report. Data collected fall into the broad categories below:

Appendix C, Route Refinement Report

Section 3.4 of Appendix C lists the specific data sets that were collected to help identify possible route segments for transmission line routing. Appendix B of the Route Refinement Report contains the maps that show possible route segments and known resources such as land uses, residential areas, and wildlife and plant habitat.

- Cultural and historic resources
- Wildlife and plant habitat
- Water resources
- Jurisdictions

- Residences
- Land cover
- Land use and land use sensitivities
- Geologic formations and soils
- Communications facilities
- Fossil fuel extraction areas
- Transportation
- Utilities

Inviting Public and Stakeholder Input

Throughout 2010, meetings and field visits were held with agencies and stakeholders to develop specific route segments. In addition to BLM-sponsored scoping meetings, three route refinement workshops were conducted to discuss preliminary routes with the public, agencies, and industrial operators. These meetings were held on September 21 and 22, 2010, in Farmington and Aztec, New Mexico, and Ignacio, Colorado.

Common themes from the public and agency representatives included concerns with:

- Visual effects
- Property value loss
- Electromagnetic fields
- Proximity to residences
- Noise
- Effects to wildlife
- Effects to recreation

Colorado Parks and Wildlife, the New Mexico Department of Game and Fish, the BLM, and the SUIT preferred routes that created the least amount of disturbance. They preferred routes that limited effects to existing land uses and would parallel existing transmission lines, disturbed areas, or roadways. Commenters

preferred that the routes be constructed away from populated areas, and many people preferred the use of previously disturbed areas. People also provided specific comments on individual route segments.

As a result of the comments received during the route refinement workshops and additional investigation, 55 alternative route segments were identified. The 55 route segments were refined to 26, based on public and stakeholder comments and field reconnaissance. The list of segments considered and the rationale for removing segments is provided in Appendix A, Table 2, Route Segment Modification Tracking, of the Route Refinement Report. In general, segments were removed due to conflicts with existing land uses; habitat concerns for sensitive, threatened, or endangered species; adverse effects to river and riparian areas; or a greater potential for adverse effects to undisturbed areas.

Developing and Evaluating Routes

After the route refinement workshops, the 26 route segments were assembled into six routes, A through F. The key features of Alternatives A through F are shown in Exhibit 2-27, Key Features of Alternatives A Through F. Exhibit 2-28, Alternatives A Through F, shows the location of the alternatives evaluated.

Exhibit 2-27

Key Features of Alternatives A Through F

	Alternative	A	B	C	D	E	F
	Total Length (miles)	**67.72**	**68.59**	**64.52**	**65.41**	**66.76**	**67.65**
Length Following Existing Disturbance	Miles paralleling transmission lines	15.99	15.99	28.48	28.48	24.49	24.49
	Miles paralleling pipelines	14.68	19.28	5.52	10.12	5.29	9.89
	Miles paralleling roads	17.13	14.23	14.43	11.63	13.38	10.48
	Miles paralleling linear disturbance	42.93	44.48	44.22	45.76	39.13	40.67
Land Ownership	Miles crossing BLM lands	22.61	22.61	25.88	25.88	35.61	35.60
	Miles crossing SUIT lands	13.09	14.46	13.09	14.46	7.03	8.41
	Miles crossing New Mexico State Lands	3.02	3.02	3.95	3.95	3.78	3.78
	Miles crossing private lands	28.99	28.5	21.59	21.12	20.34	19.86
Land Use	Miles crossing BLM-managed SDAs[1] or ACECs[2]	16.66	16.66	11.48	11.48	26.29	26.29

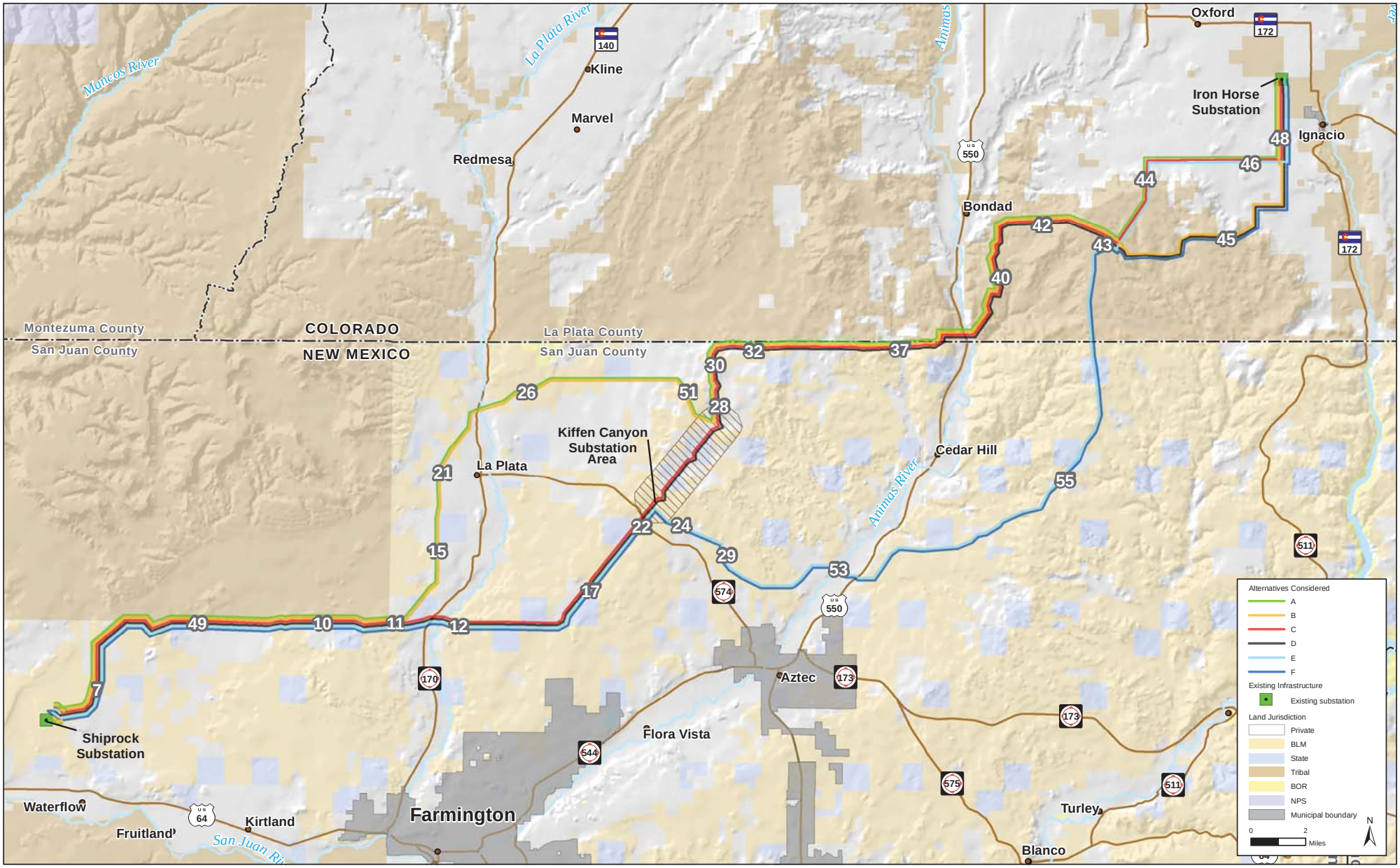
Exhibit 2-27
Key Features of Alternatives A Through F

	Alternative	A	B	C	D	E	F
Socioeconomics	Miles crossing subdivisions	0.52	0.41	0.12	0	0.12	0
	Number of subdivisions crossed by centerline	2	1	1	0	1	0
	Residences within 150–300 feet of centerline	5	1	5	1	4	0
	Total residences within 0.25 mile of centerline	61	35	64	38	132	106
Visual Resources	Miles crossing Class II VRM[3] areas	1.75	1.75	0	0	0	0
	Miles paralleling scenic byways	0	0	0	0	0.47	0.47
	Number of scenic byway crossings	0	0	0	0	1	1

[1] *SDA – Special Designated Area*
[2] *ACEC – Area of Critical Environmental Concern*
[3] *VRM – Visual Resource Management, Data reference GIS BLM 2013a*

The six routes (Alternatives A, B, C, D, and F) were compared and evaluated based on land use, environmental, and engineering factors including the length following existing linear features; land use; residential and agricultural effects; and proximity to visual, biological, recreational, and cultural resources. One route, Alternative D was identified as a preliminary preferred alternative. The five routes and the preliminary preferred alternative were shown to the public to receive input as part of EIS public scoping meetings held on March 16 and 17, 2011, in Farmington and Aztec, New Mexico, and Ignacio, Colorado. During the scoping meetings, commenters expressed preferences for specific segments or routes, and many people expressed a preference for the preliminary preferred route.[3] No route segments were modified as a result of comments received during scoping meetings. Additional information about the EIS scoping meetings is provided in Section 1.8.2, EIS Scoping, and Section 1.9, Issues Raised During Scoping.

[3] BLM 2011



Source: GIS BLM 2012, GIS CDOT and SJC 2012, GIS Tri-State 2013

Exhibit 2-28 Alternatives A through F

After considering a range of factors, five routes (Alternatives A, B, C, E, and F) were dropped from further evaluation as discussed below. Alternative D was brought forward and served as the basis for the action alternatives.

Alternative A

Exhibit 2-28 shows Alternative A. Alternative A is approximately 68 miles long and is comprised of Route Segments 7, 49, 10, 11, 15, 21, 26, 51, 28, 30, 32, 37, 40, 42, 43, 44, 46, and 48. Alternative A was eliminated from further evaluation in this EIS for the reasons summarized below.

Route Segments 15, 21, and 26

Alternative A would use Route Segments 15, 21, and 26. This routing combination was dropped for reasons cited below:

- **Land Use and Effects to Visual Resources** – Alternative A would cross the Thomas Canyon Recreation/Wildlife Area, and the East La Plata Wildlife Area as shown in Exhibit 2-29, BLM Special Designated Areas. Currently there are no existing transmission lines and supporting infrastructure in these areas as shown in Exhibit 2-30, Existing Transmission Lines. Adding a transmission line in this area would affect views, recreational users, and could result in habitat fragmentation. In the Thomas Canyon Recreation/Wildlife Area and the East La Plata Wildlife Area, the transmission line and associated supporting infrastructure would not be consistent with existing land uses in the area. In the Thomas Canyon Recreation/Wildlife Area a transmission line would not be consistent with BLM's management objectives, which include managing the area for the optimal combination of primitive recreation opportunities and wildlife protection.[4] Similarly for the East La Plata Wildlife Area, the transmission line and associate supporting infrastructure would not be consistent with the BLM's management objectives of managing the area to protect and preserve big game habitat.[5] Additionally, adding a transmission line in this area would not be consistent with the BLM's VRM

Appendix D, Additional Analysis of Alternatives A through F

Appendix D contains additional information and analysis regarding the BLM's land use objectives for SDAs and visual resource objectives.

[4] BLM 2003

[5] BLM 2003

Class II objectives in the Thomas Canyon Recreation/Wildlife Area, which require retaining the existing character of the landscape.

- **Residential Effects and Concerns** – Alternative A crosses a subdivision in Route Segment 26. Several residents located in Route Segments 15, 21, and 26 were opposed to the transmission line being located in these areas due to possible effects to properties, views, and public health.[6]
- **Likelihood of Effects to Wildlife and Plant Resources.** As described above for land use, the Thomas Canyon Recreation/Wildlife Area and the East La Plata Wildlife Area have desirable wildlife habitat that is protected under the RMP. Adding a transmission line in this area would not be consistent with the BLM's management objectives in this area. Furthermore, the New Mexico Department of Fish and Game submitted a comment letter during EIS scoping[7] that indicated a preference to avoid Route Segments 15, 21, 26, and 51 because of possible effects to various wildlife and avian species including big game, mule deer, Gunnison prairie dog, and bald eagle.

Route Segments 44 and 46

Alternative A would use Route Segments 44 and 46. This routing combination was dropped for reasons cited below:

- **Residential Effects** – Route Segments 44 and 46 are used for Alternatives A, C, and E. These route segments were dropped because they would add a new transmission line in an area that contains a subdivision and are located within 0.25 mile of 29 residences. By comparison, Route Segments 43 and 45 used for Alternatives D and F do not cross a subdivision, and have three residences located within 0.25 mile. Because of this, Alternatives A, C, and E would cause undue and unnecessary effects to the human environment.

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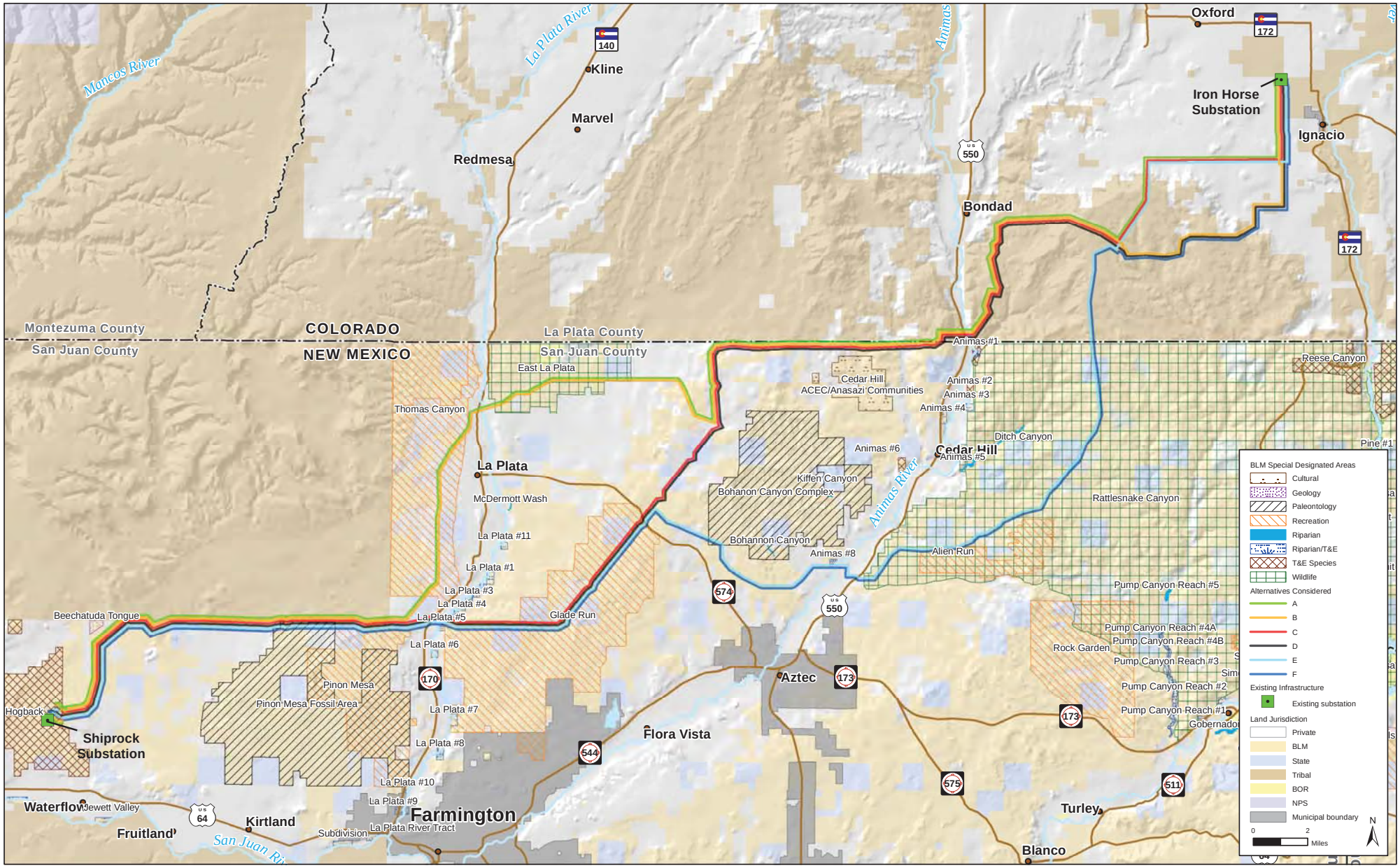
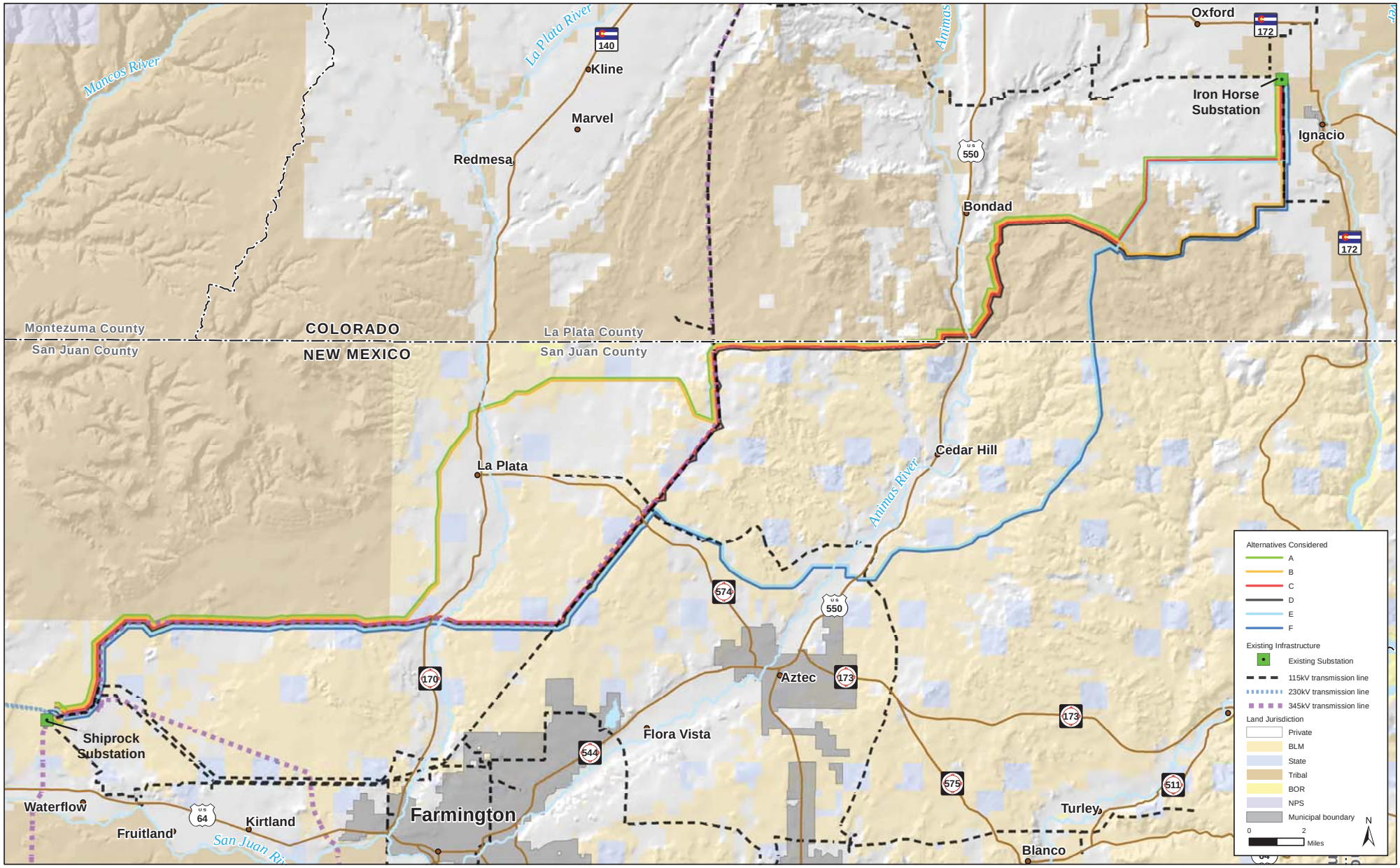
[6] BLM 2011

[7] BLM 2011



Source: GIS BLM 2012, GIS CDOT and SJC 2012, GIS Tri-State 2013

Exhibit 2-29 BLM Special Designated Areas



Source: GIS BLM 2012, GIS CDOT and SJC 2012, GIS Tri-State 2013, GIS Tetra Tech 2010

Exhibit 2-30 Existing Transmission Lines

- **Greater Likelihood for Effects to Wildlife and Their Habitat** – Route Segments 44 and 46 associated with Alternatives A, C, and E have a greater potential to affect wildlife species than Route Segments 43 and 45, associated with Alternatives D and F. Segments 44 and 46 cross mule deer and elk severe winter range areas for a greater distance than Segments 43 and 45. Segments 44 and 46 cross 5.01 miles of mule deer severe winter range as compared to 3.63 miles for Segments 43 and 45. For elk severe winter range, Segments 44 and 46 cross 3.69 miles as compared to 3.64 miles for Segments 43 and 45. In an EIS scoping letter, the Colorado Division of Wildlife (now called Colorado Parks and Wildlife)[8] expressed a preference for routing the line along Route Segments 43 and 45 over Route Segments 44 and 46 since Route Segments 43 and 45 are more heavily disturbed from existing roads and would have fewer effects to wintering deer and elk. Because of this, Alternatives A, C, and E would cause unnecessary and undue effects to the natural environment.

Appendix C, Route Refinement Report

Appendix D, Comparative Route Segment Matrix, in the Route Refinement Report documents the number of miles of elk and mule deer habitat that could potentially be affected by each route segment.

- **Requires More Disturbance than Segments 43 and 45** – Segments 44 and 46 use the existing LPEA poles for a shorter distance (approximately 3 miles) than Segments 43 and 45 (approximately 4.5 miles). This means that Segments 44 and 46 would disturb more area than Segments 43 and 45. The existing LPEA poles can accommodate both the existing LPEA and new SJBEC Project transmission lines. This eliminates the need to add poles and construct new access in the area. Because of this, Alternatives A, C, and E would cause undue and unnecessary effects to the human and natural environment.

Other Factors Considered

In addition to the considerations discussed above, Alternatives A and B would be located adjacent to existing transmission lines for 15.99 miles as compared to 28.48 miles for Alternatives C and D, or 24.49 miles for Alternatives E and F. To the extent feasible, an effort has been made to locate the transmission line and associated access

[8] BLM 2011

roads to minimize effects to land use, landowners, viewsheds, and to biological and cultural resources.

In conclusion, the BLM dropped Alternative A from further consideration because it:

- Is inconsistent with the BLM's management objectives for the Thomas Canyon Recreation/Wildlife Area and East La Plata Wildlife Area.
- Is inconsistent with VRM Class II objectives for the Thomas Canyon Recreation/Wildlife Area.
- Would cause unnecessary and undue effects to the human and natural environment because it would place a transmission line in two subdivisions where a transmission line does not currently exist, would affect protected wildlife habitat areas and big game habitat for mule deer and elk, and would require more disturbance to undisturbed areas than other alternatives considered.

Alternative B

Exhibit 2-28 shows Alternative B. Alternative B is approximately 69 miles long and consists of Route Segments 7, 49, 10, 11, 15, 21, 26, 51, 28, 30, 32, 37, 40, 42, 43, 45, and 48. The reasons why Alternative B was eliminated from further evaluation in this EIS are summarized below. Similar to Alternative A, Alternative B uses Route Segments 15, 21, and 26, which was eliminated for reasons discussed above in the Alternative A section.

Specifically, the BLM dropped Alternative B from further consideration because it:

- Is inconsistent with the BLM's management objectives for the Thomas Canyon Recreation/Wildlife Area and East La Plata Wildlife Area.
- Is inconsistent with VRM Class II objectives for the Thomas Canyon Recreation/Wildlife Area.
- Would cause unnecessary and undue effects to the human and natural environment because it would place a transmission line in a subdivision where a transmission line does not currently exist, would affect protected wildlife habitat areas and big game habitat

Appendix D, Additional Analysis of Alternatives A through F

Appendix D contains additional information and analysis regarding the BLM's land use objectives for SDAs and visual resource objectives.

for mule deer and elk, and would require more disturbance to undisturbed areas than other alternatives considered.

Alternative C

Exhibit 2-28 shows Alternative C. Alternative C is approximately 65 miles long and is comprised of Route Segments 7, 49, 10, 11, 12, 17, 22, 27, 28, 30, 32, 37, 40, 42, 43, 44, 46, and 48. The reason why Alternative C was eliminated from further evaluation in this EIS is summarized below.

Appendix C, Route Refinement Report

Appendix D, Comparative Route Segment Matrix, in the Route Refinement Report shows the number of residences and subdivisions within each route segment.

Alternative C uses Route Segments 44 and 46. This routing was eliminated for reasons discussed for Alternative A. The BLM dropped Alternative C because it:

- Would be substantially similar in design to another alternative analyzed (Alternative D)
- Would cause unnecessary and undue effects to the human and natural environment because it would place a transmission line in a subdivision where a transmission line does not currently exist, would affect protected wildlife habitat areas and big game habitat for mule deer and elk, and would require more disturbance to undisturbed areas than other alternatives considered.

Alternative E

Exhibit 2-28 shows Alternative E. Alternative E is approximately 67 miles long and is comprised of Route Segments 7, 49, 10, 11, 12, 17, 22, 24, 29, 54, 55, 44, 46, and 48. The reasons why Alternative E was eliminated from further evaluation in this EIS are summarized below.

Route Segments 24, 29, 53, and 55

Alternative E places the proposed transmission line on Route Segments 24, 29, 53, and 55. This route is often referred to as the southern Animas River crossing. The southern Animas River crossing used for Alternative E was dropped for reasons cited below:

- **Land Use** - Alternative E would cross the BLM's Rattlesnake Canyon Wildlife Area as shown in Exhibit 2-29. The transmission line and associated supporting infrastructure would not be consistent with existing land uses in the area. That is, there are no existing transmission lines and supporting infrastructure within most of the SDA as shown in Exhibit 2-30. The transmission line would represent a new use that would

Appendix D, Additional Analysis of Alternatives A through F

Appendix D contains additional information and analysis regarding the BLM's land use objectives for SDAs and visual resource objectives.

not be consistent with the BLM's land use objectives to support increases in potential wildlife areas.

- **Residential Effects** – Many comments were received during EIS scoping[9] stating concerns with possible residential effects along Route Segments 24, 29, 53, and 55. These segments are within 0.25 mile of 79 residences, as documented in Appendix D of the Route Refinement Report. Residents near the southern Animas River crossing were strongly opposed to the use of Route Segment 53 because it crosses active agricultural land and would be visible to many residents northeast of Aztec. In addition, residents were concerned about property effects and possible health effects from electromagnetic fields. Many residents in this area stated they prefer a route that uses a northern Animas River crossing in Colorado. The BLM did not receive any comments opposing the northern Animas River crossing.
- **Floodplain, Riparian, and Wildlife Effects** – Alternative E crosses the Animas River at a location that would require placing multiple structures in the river's floodplain and riparian areas. Placing structures in the river's floodplain and riparian areas would affect habitat and biological resources. Specific comments were received from the BLM regarding the use of Segment 55. The BLM was concerned with potential effects to wildlife including further fragmentation of the Rattlesnake Canyon Wildlife Area. In addition, the New Mexico Department of Game and Fish expressed a preference for routes that would use the northern Animas River crossing over a route that would use the southern river crossing and the Arkansas Loop Road and pipeline corridor.[10] The New Mexico Department of Game and Fish expressed concern that a route using the southern crossing would impact wildlife habitat for deer, elk, and turkey as well as projects designed to improve habitat for those species. Additionally, there was concern that a route through this vicinity could affect areas with high densities of protected wildlife species.

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[9] BLM 2011

[10] BLM 2011

- **Conflicts with Existing Oil and Gas Infrastructure –** Alternatives E and F largely follow the Arkansas Loop Road and pipeline corridor. Locating the transmission line along other existing infrastructure is preferred; however, in this case it is difficult to locate a transmission line directly adjacent to the existing pipeline corridor located in Route Segment 55 due to the congestion of existing oil and gas infrastructure. Spacing constraints with existing gas wells and other infrastructure would require the route to be located as much as 0.5 mile away from the established corridor, resulting in additional disturbance and minimizing the benefits of co-location.

Route Segments 44 and 46

Alternative E would also follow Route Segments 44 and 46. This routing combination was dropped for reasons discussed for Alternative A.

Other Factors Considered

Alternative E is adjacent to existing transmission lines for 24.49 miles as compared to 28.48 miles for Alternative D. To the extent feasible, an effort has been made to locate the proposed transmission line and associated access roads to minimize effects to land use, landowners, viewsheds, and to biological and cultural resources.

In conclusion, the BLM dropped Alternative E from further consideration because it:

- Is inconsistent with the BLM's management objectives for the Rattlesnake Canyon Wildlife Area.
- Would cause unnecessary and undue effects to the human and natural environment because it would place a transmission line in a subdivision and other residential areas where a transmission line does not currently exist; would affect protected wildlife habitat areas, floodplains, riparian areas, and big game habitat for mule deer and elk; and would require more disturbance to undisturbed areas than other alternatives considered.

Alternative F

Exhibit 2-28 shows Alternative F. Alternative F is approximately 68 miles long and is comprised of Route Segments 7, 49, 10, 11, 12, 17, 22, 24, 29, 53, 55, 45, and 48. Alternative F uses Route Segments 24, 29, 53, and 55. This routing was eliminated for reasons discussed for Alternative E. The BLM dropped Alternative F from further consideration because it:

- Is inconsistent with the BLM's management objectives for the Rattlesnake Canyon Wildlife Area.
- Would cause unnecessary and undue effects to the human and natural environment because it would place a transmission line in residential areas where a transmission line does not currently exist; would affect protected wildlife habitat areas, floodplains, riparian areas, and big game habitat for mule deer and elk; and would require more disturbance to undisturbed areas than other alternatives considered.