CHAPTER 3 – AFFECTED ENVIRONMENT

3.1 INTRODUCTION

Chapter 3 includes a description of the environment and resources that have the potential to be affected by the alternatives described in Chapter 2, as well as the current condition of each resource and the relevant characteristics that may be subject to impacts from the Project. Environmental resource baseline information is presented to allow the comparison of potential impacts that could result from the action alternatives and the No Action alternative.

Resources that may be affected by the Project have been carried forward for analysis in this EIS and are discussed in chapters 3 and 4. These resources and land management programs were selected based on federal regulatory requirements and policies, concerns of lead and cooperating agencies, and/or issues identified during scoping, and include:

- Climate and Air Quality
- Earth Resources
  - Geology
  - Minerals
  - Soils
- Paleontological Resources
- Water Resources
- Biological Resources
  - Vegetation
  - Noxious and Invasive Weeds
  - Wildlife
  - Special-status Species
- Wildland Fire Ecology and Management
- Cultural Resources
- Visual Resources
- Land Use and Recreation Resources
- Special Designations
- Wilderness
- Social and Economic Conditions
- Environmental Justice
- Health and Safety/Hazardous Materials (EMF, noise)

Information on the existing condition of each of the resources was compiled from the most recent data available—published and unpublished reports, land use plans, maps, and agency databases. Resource inventories were developed in sufficient detail for the areas within the study corridors to assess the potential impacts that could result from the proposed Project. (A study corridor is the area surrounding the Project alternative centerlines in which a detailed inventory of existing conditions was completed.) While the focused impact analyses specifically address impacts to the affected environment within study corridors, resource data have also been collected outside of the study corridors to indicate regional context. Field reconnaissance was conducted to review baseline resource conditions where needed, and to verify land use and visual resources data. Following the initial inventory effort, federal, state, and land and resource management agencies were contacted to refine and verify or supplement information, and to solicit information regarding issues, concerns, policies, and regulations. The width of the study corridors along the alternative routes differs for each of the resource disciplines, depending on the area that potentially could be affected (Table 3-1).

Table 3-1. Study Corridors by Resource	
Resource[1]	**Study Corridor Width (miles)[2]**
Earth Resources	2
Paleontological Resources	2
Water Resources	—
• Streams, springs, wells, bodies of water	1,200 (feet)
• Unique or impaired waters	0.5
Biological Resources	8
Wildland Fire Ecology and Management	2
Cultural Resources	—
• Class I Archaeological Survey	0.25
• National Registered Historic Properties and other areas[3]	6
Visual Resources	6
Land Use, Recreation, Special Designations	6
Health and Safety/Hazardous Materials	0.2

[1] Analysis of air quality, wilderness, lands with wilderness characteristics, and wilderness study areas is based on regional study area data. Social and economic data in the Project area is based on county and statewide data.
[2] Study corridor width includes specific area of resource analysis. For display purposes, a 6- or 8-mile-wide corridor is shown on the resource maps in the Map Volume.
[3] Includes national parks and monuments, and state register properties

To facilitate the analysis of alternative routes, study corridors are centered on a line referred to as the "reference centerline," which approximates the right-of-way location. The precise location of the right-of-way centerline would be determined through engineering surveys of the selected route prior to transmission line construction. Study corridors include the areas surrounding the eastern and western termini of the Project. Ancillary facilities would be located within the study corridor associated with each alternative route or subroute, which are included as components of the impact assessment. The precise locations of access roads and ancillary facilities, including substations, regeneration stations, and temporary construction areas within the study corridors would be determined prior to construction.

Resource data were assessed along route segments called links. Where appropriate, the resource discussions in this chapter refer to the links shown on the resource maps to provide a geographic reference to the resource data. Resource data are shown on the maps in the Map Volume (figures M1-1 through M10-4).

3.2 CLIMATE AND AIR QUALITY

3.2.1 Introduction, Methods, and Regulatory Framework

3.2.1.1 Introduction

This section describes the climate and baseline air quality conditions existing in the portions of New Mexico and Arizona traversed by the proposed Project, including the types of pollutants and regulations that would apply to construction and operations.

Climate refers to the long-term average and range of weather conditions that prevail at any given place. Climatological "normal" conditions are defined as a 30-year average of weather, most often described in terms of temperature and precipitation.

The Southwest climate is arid to semiarid and warm, with temperatures ranging widely on both daily and seasonal scales. In winter, when easterly storm tracks originating over the Pacific Ocean shift over the region, the Southwest can receive widespread precipitation. The North American monsoon brings summer moisture from a combination of oceanic sources into the Southwest by July, resulting in thunderstorms when local conditions cause air masses to rise (Sheppard et al. 1999).

Precipitation in the Southwest has varied sharply in the past, at timescales ranging from annual to multi-decadal. Past temperature of the Southwest has also varied annually and on decadal scales. There has been a recent upward trend of temperatures, to a point outside the range of variation of past temperature, as reconstructed from tree rings (*ibid*).

Air quality monitoring networks operate in urban and rural areas throughout New Mexico and Arizona, to inform the public about local air quality conditions and to help the regulatory agencies identify sources of air pollution. Various agencies (state, federal, and local), companies, individuals, and organizations collect ambient air quality monitoring data at carefully chosen, representative physical locations. Monitors are sited to determine ambient concentrations of both criteria and hazardous air pollutants. Networks also monitor the nature and causes of visibility impairment in Class I areas (areas where only a small amount of air quality deterioration is allowed) in both states.

3.2.1.2 Methods

Instrumental measurement of temperature and precipitation in the Southwest dates back to the middle to late 1800s. Today, more than 200 cooperative stations in New Mexico and 240 in Arizona gather and report temperature and precipitation data in the Project study area; in addition, the National Weather Service operates one station in Arizona in the area traversed by the subroutes. Automated stations, many at high elevation, monitor levels of precipitation (Sheppard et al. 1999).

One method used in reporting climate data relies on dividing states into climate divisions. A climate division is defined as "a region within a state that is reasonably homogenous with respect to climatic and hydrologic characteristics." Climate divisions of the Southwest generally follow patterns of mean annual precipitation (*ibid*).

Information on current climate in the Project study area was obtained from monitoring station summaries accessed through the Western Regional Climate Center (WRCC) website. Information regarding air quality monitoring in New Mexico and air quality monitoring sites in Arizona was obtained online (New Mexico Environment Department [NMED] 2011a and Arizona Department of Environmental Quality [ADEQ] 2011a, respectively). Current and historical ambient air quality data are available through both sites. Arizona also publishes an annual air quality monitoring summary that includes the stations operated by the ADEQ (2011b) and the data from county and federal sites that operate in the state.

3.2.1.3 Regulatory Framework

Federal

Responsibility for administering and enforcing rules and regulations pertaining to air quality in the Project study area is shared between federal, state, tribal, and county jurisdictions. Regulations and standards to implement the requirements of the federal Clean Air Act are set by the EPA. While the EPA retains authority for certain air quality rules, including most pertaining to emission standards for mobile sources, many requirements are delegated to states and, in some cases, to tribal governments that are treated in the same manner as states.

The EPA has set National Ambient Air Quality Standards (NAAQS) (Table 3-2) for air pollutants considered harmful to public health and the environment. Ambient standards regulate the amount of contaminants in the air due to all sources. Standards have been set for six criteria pollutants: carbon monoxide (CO), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), ozone (O_3), lead, and particulate matter (PM). There are two types of standards: primary standards set to protect public health, and secondary standards set to protect public welfare, including damage to buildings, animals, and vegetation.

Table 3-2. Ambient Air Quality Standards

Pollutant/ Averaging Period	National		Arizona		New Mexico
	Primary Standards	Secondary Standards	Primary Standards	Secondary Standards	Primary Standards
CO: 8 hour	9 ppm (10 mg/m^3)(1)	—	9 ppm (10 mg/m^3)(1) (2)	—	8.7 ppm
CO: 1 hour	35 ppm (40 mg/m^3)(1)	—	35 ppm (40 mg/m^3)(1)(2)	—	13.1 ppm
NO_2: Annual arithmetic mean	0.053 ppm (100 μg/m^3)	Same as Primary	0.053 ppm (100 μg/m^3) (2)	Same as Primary	0.05 ppm
NO_2: 24 hour	—	—	—	—	0.10 ppm
NO_2: 1 hour	100 ppb (188.7 μg/m^3)(3)	—	—	—	—
SO_2: Annual arithmetic mean	0.03 ppm (80 μg/m^3)	—	0.03 ppm (80 μg/m^3)(2)	—	0.02 ppm
SO_2: 24 hour	0.14 ppm (365 μg/m^3)(1)	—	0.14 ppm (365 μg/m^3)(1)(2)	—	0.10 ppm
SO_2: 3 hour	—	0.5 ppm (1,300 μg/m^3)(1)	—	0.5 ppm (1,300 μg/m^3)(1)(2)	—
SO_2: 1 hour	75 ppb (196.4 μg/m^3) (4)	—	—	—	—
O_3: 8 hour(5) (2008 standard)	0.075 ppm	Same as Primary	0.08 ppm(2)	Same as Primary	—
O_3: 8 hour(6) (1997 standard)	0.08 ppm	Same as Primary			
O_3: 1 hour(7)	0.12 μg/m^3	Same as Primary	0.12 μg/m^3	Same as Primary	—
Lead: Rolling 3-month average(8) (2008 standard)	0.15 μg/m^3	Same as Primary	—	—	—
Lead: Quarterly	1.5 μg/m^3	Same as Primary	1.5 μg/m^3(2)	Same as Primary	—

Table 3-2. Ambient Air Quality Standards					
Pollutant/ Averaging Period	**National**		**Arizona**		**New Mexico**
	Primary Standards	**Secondary Standards**	**Primary Standards**	**Secondary Standards**	**Primary Standards**
average[8] (1978 standard)					
PM_{10}: Annual arithmetic mean	—	—	50 μg/m^3[2]	Same as Primary	—
PM_{10}: 24 hour[9]	150 μg/m^3	Same as Primary	150 μg/m^3[2]	Same as Primary	—
$PM_{2.5}$: Annual arithmetic mean[10]	12.0 μg/m^3	Same as Primary	15.0 μg/m^3[2]	Same as Primary	—
$PM_{2.5}$: 24 hour[11]	35 μg/m^3	Same as Primary	65 μg/m^3[2]	Same as Primary	—
TSP: Annual geometric mean	—	—	—	—	60 μg/m^3
TSP: 30 day	—	—	—	—	90 μg/m^3
TSP 7 day	—	—	—	—	110 μg/m^3
TSP: 24 hour	—	—	—	—	150 μg/m^3
H_2S: 1 hour	—	—	—	—	0.010 ppm[1]
Total reduced sulfur: 0.5 hour	—	—	—	—	0.003 ppm

Notes:
[1] Not to be exceeded more than once per year.
[2] Pinal County and Pima County ambient standards are the same as the AAAQS.
[3] To attain this standard, the 3-year average of the 98th percentile of the daily maximum 1-hour average at each monitor within an area must not exceed 100 ppb (effective January 22, 2010).
[4] Final rule signed June 2, 2010. To attain this standard, the 3-year average of the 99th percentile of the daily maximum 1-hour average at each monitor within an area must not exceed 75 ppb.
[5] To attain this standard, the 3-year average of the fourth highest daily maximum 8-hour average O_3 concentrations measured at each monitor within an area over each year must not exceed 0.075 ppm (effective May 27, 2008).
[6] [a] To attain this standard, the 3-year average of the fourth highest daily maximum 8-hour average O_3 concentrations measured at each monitor, within an area over each year, must not exceed 0.08 ppm. (b) The 1997 standard, and the implementation rules for that standard, will remain in place for implementation purposes as the EPA undertakes rulemaking to address the transition from the 1997 O_3 standard to the 2008 O_3 standard.
[7] [a] The EPA revoked the 1-hour O_3 standard in 1997 in all areas, although some areas have continuing obligations under that standard (anti-backsliding). (b) The standard is attained when the expected number of days per calendar year with maximum hourly average concentrations above 0.12 ppm is less than or equal to one.
[8] Final rule signed October 15, 2008. The 1978 lead standard remains in effect until one year after an area is designated for the 2008 standard (designations were finalized in November 2011), except that in areas designated nonattainment for the 1978 standard, the 1978 standard remains in effect until implementation plans to attain or maintain the 2008 standard are approved.
[9] Not to be exceeded more than once per year, on average over 3 years.
[10] To attain this standard, the 3-year average of the weighted annual mean PM2.5 concentrations from single or multiple community-oriented monitors must not exceed 12.0 μg/m^3.
[11] To attain this standard, the 3-year average of the 98th percentile of 24-hour concentrations at each population-oriented monitor within an area must not exceed 35 μg/m^3 (effective December 17, 2006).
H_2S = Hydrogen sulfide
mg/m^3 = Milligrams per cubic meter
$PM_{2.5}$ = Particulate matter less than 2.5 micrometers
PM_{10} = Particulate matter less than 10 micrometers
ppm = Parts per million
ppb = Parts per billion
TSP = Total suspended particulates
μg/m^3 = micrograms per cubic meter
Source: EPA 2011a
www.nmcpr.state.nm.us/nmac/parts/title20/20.002.0003.htm. Accessed 1/31/2011.
www.azsos.gov/public_services/Title_18/18-02.htm#Article_2. Accessed 1/31/2011.

Areas that do not meet the NAAQS are designated as nonattainment. Previously designated nonattainment areas that have since reached attainment are referred to as attainment areas with a maintenance plan (attainment/maintenance), or simply as maintenance areas. More stringent air quality regulations apply in these areas. Portions of the route groups that would traverse any nonattainment or maintenance area require a general conformity analysis (see Section 3.2.4).

Ambient air quality standards have not been established for hazardous air pollutants, which are instead regulated on an emission basis by National Emission Standards for Hazardous Air Pollutants (NESHAP). NESHAP regulate emissions from specified emission units and source types. The Project is not expected to use equipment subject to these requirements.

Sensitive areas, such as certain national parks and wilderness, have been designated under the federal Clean Air Act as Class I areas. Class I areas are areas of special national or regional natural, scenic, recreational, or historic value for which federal regulations provide special protection with respect to air quality degradation. There are a total of 21 Class I areas in New Mexico and Arizona.

Regional haze reduces long-range visibility over a wide region. Haze is caused by fine particles and their precursors in the air that are so small they settle out only very slowly. In 1999, the EPA announced the Regional Haze Rule, which calls for state and federal agencies to work together to improve visibility in designated Class I areas, including several in the general area traversed by the Project route groups. States are required to demonstrate reasonable progress towards the national visibility goal established in 1977 by the Clean Air Act, which is "the prevention of any future, and the remedying of any existing impairment of visibility in mandatory class I Federal areas which impairment results from man-made air pollution." The national goal is to restore natural visibility conditions in Class I areas by the year 2064.

The Western Regional Air Partnership (WRAP) is a voluntary partnership of states, tribes, federal land managers, local air agencies, and EPA that was originally chartered to develop the technical and policy tools needed by western states, including Arizona and New Mexico, and tribes to comply with EPA's regional haze regulations. The organization was re-chartered in 2009. The new charter shifts the emphasis from policy work to technical work. It also shifts the focus from regional haze to a broader one-atmosphere, multi-pollutant approach to western air quality issues.

State

The New Mexico Air Quality Control Act is codified in the New Mexico Statutes Annotated (NMSA), Chapter 74, Article 2. Rules pertaining to air quality in New Mexico are found in Title 20, Chapter 2 of the New Mexico Administrative Code (NMAC), which is administered by the NMED – Air Quality Bureau, in all areas of the state except Bernalillo County and tribal lands. Bernalillo County is a separate jurisdiction for air quality and, in working with the EPA, has the same status as a state.

In Arizona, air quality statutes are codified in Arizona Revised Statutes (ARS), Title 49, Chapter 3. Air quality regulations in Arizona are codified in the Arizona Administrative Code (AAC), Title 18, Chapter 2. Three Arizona counties (Maricopa, Pima, and Pinal) have their own

air pollution control programs and operate pursuant to agreements with the ADEQ, whose Air Quality Division is responsible for regulating air quality in most of the remainder of the state. In general, federal air quality requirements on tribal lands are administered directly by the EPA. However, the GRIC, located just to the northwest of the proposed western terminus of the Project, has recently received approval from the EPA to implement its own air quality program.

In addition to the NAAQS established by the EPA, both New Mexico and Arizona have additional ambient air quality standards that apply within their jurisdictions: the New Mexico Ambient Air Quality Standards and Arizona Ambient Air Quality Standards, respectively (see Table 3-2).

3.2.2 Regional Overview

3.2.2.1 New Mexico

Climate

New Mexico has a mild, arid, or semiarid continental climate characterized by light precipitation totals, abundant sunshine, low relative humidity, and a relatively large annual and diurnal temperature range. Its climate is varied due to the state's diverse topographic features, including high plateaus, mountain ranges, canyons, valleys, and normally dry arroyos. The principal sources of moisture for the scant rains and snows that fall on the state are the Pacific Ocean, 500 miles to the west, and the Gulf of Mexico, 500 miles to the southeast. The highest mountains have climate characteristics common to the Rocky Mountains (WRCC 2011a).

New Mexico is divided into eight climate divisions based on topographic features. The Project route groups are generally confined to three of the eight climate divisions: the Central Highlands, Central Valley, and Southern Desert (Sheppard et al. 1999).

Air Quality

Most areas of New Mexico have been designated as attainment or unclassifiable with respect to the NAAQS. Unclassifiable means that the area lacks sufficient air quality monitoring data to determine whether the ambient standards have been attained. From a regulatory standpoint, unclassifiable areas are treated as attainment areas.

New Mexico has several small, localized areas that are either designated nonattainment, or were formerly nonattainment and now have a maintenance plan (see Section 3.2.4.1). In addition, Luna County, which the proposed Project may cross, and Doña Ana County, which is included in the study area, have fugitive dust problems that are subject to Natural Events Action Plans (NEAP) (see Section 3.2.4.1).

There are nine Class I areas in New Mexico. However, because emissions from Project activities would be temporary and localized to the immediate vicinity of the Project, only those Class I areas located closest to such activities are of concern. These areas include the White Mountain Wilderness in southern Lincoln County, located approximately 30.4 miles from the closest Project alternative, and the Bosque del Apache NWR in south-central Socorro County, located

between 1.8 and 3.2 miles from the closest Project alternate routes (NMED 2011b). (See Existing Land Use and Special Designation Map M 10-1E and M 10-1W for locations of Class I areas.)

3.2.2.2 Arizona

Climate

Arizona has three main topographical areas: (1) a high plateau averaging between 5,000 and 7,000 feet in elevation in the northeast; (2) a mountainous region oriented southeast to northwest, with maximum elevations between 9,000 and 12,000 feet about mean sea level; and (3) low mountain ranges and desert valleys in the southwestern portion of the state. The higher elevations of the state average between 25 and 30 inches of precipitation (rain plus melted snow) annually, while the desert valleys may average as low as 3 to 4 inches per year (WRCC 2011b).

The state is divided into seven climate divisions, of which the Project route groups would traverse only two: the South Central division (including Pinal County) and the Southeast division (including Cochise, Graham, Greenlee, and Pima counties) (Sheppard et al. 1999).

Air Quality

Arizona has a number of nonattainment and maintenance areas in the counties that the Project route groups would traverse (see Section 3.2.4.2).

There are 12 Class I areas in Arizona, 4 of which are located near any Project route alternatives or substations. The proposed transmission line routing lies to the north of both the Chiricahua National Monument (located between 16.7 and 31 miles from the nearest Project route alternatives) and the Chiricahua Wilderness (located approximately 24 to 28 miles from the nearest Project route alternatives) in Cochise County. The Galiuro Wilderness Area (located 2.4 to 15 miles from the nearest Project route alternatives) in Graham County, and both the East and West Units of Saguaro National Park in Pima County are situated in the general vicinity of proposed route group locations (EPA 2011b). The Saguaro National Park East Unit is 4.3 to 35 miles from the nearest Project route alternatives, while the West Unit is located between 1 and 31 miles from various Project route alternatives. (See Existing Land Use and Special Designation Map M 10-1E and M 10-1W for locations of Class I areas.)

3.2.3 Climate

3.2.3.1 New Mexico

During the summer, daytime temperatures often exceed 100 degrees Fahrenheit at elevations below 5,000 feet; while the average monthly maximum temperatures during July (the warmest month) range from slightly above 90 degrees Fahrenheit at the lower elevations to the upper 70s at higher elevations. The warmest days often occur in June, before the thunderstorm season sets in. During July and August, afternoon convective storms tend to decrease solar insolation, lowering temperatures before they reach their potential daily high. A preponderance of clear skies and low relative humidity permits rapid cooling after sundown (WRCC 2011a).

January is the coldest month, with average daytime temperatures that range from the mid-50s in the southern and central valleys to the mid-30s at higher elevations. Temperatures below freezing are common in all sections of the state during the winter. The freeze-free season ranges from more than 200 days in the southern valleys to less than 80 days in the northern mountains (*ibid*).

Average annual precipitation ranges from less than 10 inches over much of the southern desert and the Rio Grande and San Juan valleys, to more than 20 inches at higher elevations; and varies widely from year to year. Summer rains fall almost entirely during brief, often intense thunderstorms.

New Mexico (as well as Arizona) is at the northern fringe of the area affected by the Southwest Monsoon, also known as the North American Monsoon. The monsoon season, characterized by a shift in winds from a southwesterly to a more southeasterly direction, brings a rapid increase in rain in June to southern Mexico, migrating to the southwestern United States in early July. The monsoon season typically ends around mid-September in New Mexico. New Mexico receives 30 to 50 percent of its yearly precipitation between July and September. Winter is the driest season, except for areas west of the Continental Divide. Much of the winter precipitation falls as snow in the mountain areas, but may occur as either rain or snow in the valleys[1] (*ibid*).

Annually, New Mexico receives 75 to 80 percent of possible sunshine. Relative humidity ranges from an average of 65 percent at sunrise to near 30 percent in mid-afternoon; however, afternoon humidity in warmer months is often less than 20 percent and occasionally as low as 4 percent (*ibid*).

Relatively strong winds may accompany frontal activity during late winter and spring months, exceeding 30 miles per hour (mph) for several hours. High winds may also occur in advance of thunderstorms. Spring is considered the windy season. Dust storms can occur during windy periods in dry or drought-affected areas (*ibid*).

Potential evaporation in New Mexico is much greater than average annual precipitation. Periods of recent extreme meteorological drought in the Project study area have been noted in the mid-1930s and in 1947 in the Central Highlands, as well as statewide in the 1950s (*ibid*). Another period of severe drought has affected the region more recently, beginning in 2000. This most recent drought was characterized by warmer temperatures than the 1950s drought, which resulted in widespread mortality to certain types of vegetation (such as piñons) and numerous wildfires (Owen 2008; Guido 2010).

As of July 2012, over 75 percent of the contiguous United States was suffering from some degree of drought or abnormally dry conditions. In New Mexico, much of the southeast quarter of the state was experiencing extreme drought conditions, with most of the project area in severe to moderate drought (WGA 2012). Monsoon rains eased the drought situation somewhat during the latter part of the summer and the National Weather Service's projected outlook expected

[1] www.climas.arizona.edu/sw-climate/monsoon. Accessed September 27, 2012.

drought conditions to continue through the fall, with above normal precipitation for the winter 2012-2013 season[1].

The influence of climate on agriculture is of major importance. Less than 4 percent of the state is under cultivation, with approximately one-third of this area being irrigated, primarily in the southern valleys. Short-season dry land summer crops are grown in some small areas in the Central Highlands. Winter grains require favorable moisture conditions from early fall throughout winter and spring, and short-season row and feed crops depend on summer showers to produce a yield. Stored surface water for irrigation, used principally for cotton, truck and feed crops, and fruit and nuts, depends on adequate winter snows in the mountains of both the northern part of the state and southern Colorado for its initial source (*ibid*).

Livestock raising is the most extensive agricultural pursuit; more than one-half of the state is pastureland. Sufficient moisture usually falls, providing for the growth of good range forage. Because of the mild climate, livestock can live on the open range throughout the year (*ibid*).

3.2.3.2 Arizona

High temperatures are common throughout the summer months at the lower elevations, with temperatures well above 100 degrees Fahrenheit in the desert areas. Extremes occur between day and night temperatures; at times with a 50 to 60 degree Fahrenheit difference between minimum and maximum daily temperatures during the drier months. Lower desert valleys sometimes have several years in succession without freezes (WRCC 2011b).

Precipitation throughout Arizona is governed to a great extent by elevation and season. From November through March, storm systems from the Pacific Ocean cross the state, at times bringing heavy snows to the central and northern parts. Gradual melting of this snow during the spring serves to maintain a supply of water in the state's principal rivers (*ibid*).

Summer rainfall begins early in July, usually lasting until mid-September, and occurs in the form of thunderstorms. Arizona is at the northern fringe of the area affected by the Southwest Monsoon. The monsoon season typically ends around mid-September in Arizona, and the state receives 30 to 50 percent of its yearly precipitation between July and September. The heaviest monsoon thunderstorms are usually found in mountainous regions of the central and southeastern portions of the state[2] (*ibid*).

A large portion of Arizona is classed as arid to semiarid; long periods may occur with little or no precipitation. The air is generally dry and clear, with low relative humidity and a high percentage of sunshine (humidity is low when compared to most other states). Due to high temperatures, dryness of the air, and a high percentage of possible sunshine (86 to 92 percent average), evaporation rates in Arizona are high (*ibid*).

Arizona has experienced significant recent drought conditions. As of July 2012, extreme drought affected the northeast and southwest corners of the state, while the area traversed by Project

[1] www.srh.noaa.gov/productview.php?pil=DGTEPZ. Accessed September 27, 2012.
[2] http://www.climas.arizona.edu/sw-climate/monsoon. Accessed September 27, 2012.

route groups was in severe drought. Monsoon rains eased conditions somewhat during the latter portions of the summer (WGA 2012), with 2012 monsoon rainfall totals generally above normal. The National Weather Service outlook projects a greater chance of above normal precipitation from September through November 2012[1].

Heavy thunderstorms during July and August at times cause flooding, resulting in considerable local damage. The heaviest rains are associated with hurricanes that dissipate as they reach land and occur on average once every 10 years. High winds accompanying heavy thunderstorms during July and August sometimes reach peak gusts of approximately 100 mph in local areas (*ibid*). Such winds can cause blinding dust storms in dry or drought-stricken areas.

3.2.4 Air Quality

3.2.4.1 New Mexico

Grant County is located in southwestern New Mexico. In 1978, the area around the Phelps Dodge Corporation's Hurley smelter/concentrator facility (located in Hurley, New Mexico) was designated nonattainment for SO_2. However, Grant County has not experienced an exceedance of the SO_2 NAAQS since the mid-1970s. The Hurley smelter was closed in 2002 and demolition began in 2005. In September 2003, the EPA approved a redesignation request and maintenance plan for the Grant County nonattainment area. The Grant County maintenance area is located well to the north of any of the Project route group locations (approximately 30 to 40 miles).

Luna County is located in southwestern New Mexico, and has an arid continental climate. Moderate to strong winds of late winter and spring can bring blowing dust. In 2003, violations of the federal standard for PM occurred, requiring the creation of a Luna County NEAP to avoid designation as a nonattainment area. The NEAP for Luna County focuses on the control of man-made sources of dust. Portions of Route Groups 1 and 3 will traverse Luna County.

Doña Ana County (located in the south-central section of the state) borders El Paso, Texas and Ciudad Juarez, Mexico. None of the Route Groups would traverse the county, but certain alternatives would be located less than 10 miles west of the county boundary. The county has historically had air quality problems, including PM and O_3 pollution. There is presently one nonattainment area within Doña Ana County. Anthony, New Mexico, which lies on the border of Texas and New Mexico, is a PM_{10} nonattainment area (so designated by the EPA in 1991).

In recent years, Doña Ana County has not met federal ambient air quality standards for PM_{10}. High levels of PM_{10} are largely due to dust storms throughout the area; however, man-made dust sources are on the rise as Doña Ana becomes more populated. In December 2000, a NEAP for the county was submitted to the EPA, with a focus on controlling man-made sources of wind-blown dust.

In 1995, the EPA declared a 42-square-mile region in the southeast corner of Doña Ana County (including Sunland Park and adjacent areas) as a marginal nonattainment area for the 1-hour ozone standard. The 1-hour ozone standard was revoked by the EPA in 2004, with the adoption

[1] www.srh.noaa.gov/productview.php?pil=DGTTWC. Accessed September 27, 2012.

of a new 8-hour ozone standard; Sunland Park was redesignated to maintenance for this new standard. In March 2008, the federal government lowered the NAAQS for ozone from 0.08 parts per million (ppm) to 0.075 ppm.

For more information regarding New Mexico nonattainment and maintenance areas, see the NMED website.

3.2.4.2 Arizona

An SO_2 nonattainment area in Morenci in Greenlee County was redesignated to attainment/maintenance in 2004, after the copper smelter responsible for the nonattainment designation was dismantled in 1995. This area lies well north of any of the Project route group locations (approximately 25 to 30 miles).

The Douglas area, in southern Cochise County, has both a moderate PM_{10} nonattainment area and a former SO_2 nonattainment area that was redesignated as attainment/maintenance in 2006. Project route groups are located well to the north of both of these areas (approximately 30 to 40 miles).

Ajo (Pima County) has both a PM_{10} nonattainment area and an SO_2 attainment/maintenance area. The Ajo area lies well to the west of any Project route groups (approximately 80 to 100 miles).

The Phoenix metropolitan area, including portions of Maricopa and Pinal counties, is designated nonattainment for the 1997 8-hour O_3 and the PM_{10} NAAQS; and portions of Maricopa County are designated attainment/maintenance for CO. In addition, the EPA has recently concurred with the state of Arizona regarding designation of the Phoenix metropolitan area as nonattainment with the 2008 8-hour O_3 NAAQS (EPA 2011c). None of the proposed Project route groups will traverse these nonattainment or maintenance areas (approximately 25 to 30 miles from Pinal Central Substation).

The Rillito area (Pima County) is designated nonattainment for PM_{10}. The major stationary source in the area is the Arizona Portland Cement Company. Other sources include construction, unstabilized river banks, agriculture, unpaved roads, and unstabilized road shoulders. In 2006, the EPA determined the Rillito nonattainment area had met the PM_{10} standard and qualified for redesignation to attainment; in 2008, a maintenance plan and request for redesignation was submitted to the EPA. Portions of Route Group 4 would traverse the Rillito PM_{10} nonattainment area.

The San Manuel area (Pinal County) is a designated attainment/maintenance area for SO_2. The San Manuel smelter permits were cancelled in March 2005, and the area was redesignated from nonattainment to maintenance in 2008. Portions of Route Group 4 would traverse this attainment/maintenance area.

Tucson (Pima County) was redesignated from nonattainment to attainment/maintenance for CO in 2000. The original nonattainment designation was primarily due to vehicular emissions, which have decreased over time as federal tailpipe emissions standards have been strengthened. Portions of Route Group 4 would traverse the Tucson CO attainment/maintenance area.

The Hayden area (Gila and Pinal counties) includes both PM_{10} and SO_2 nonattainment areas. In the late 1980s, contributors to exceedances of PM_{10} in the area were the copper ore unloading, crushing, and conveying activities at the Ray Unit crushing plant, and road dust. Ambient monitoring data reveal that the Hayden area has met the 24-hour and annual PM_{10} standards for the last several years. The SO_2 nonattainment designation was due to a copper smelting stack and fugitive emissions. The ADEQ has requested redesignation to attainment/maintenance, for which EPA action is pending. Portions of Route Group 4 would be located just south of the Hayden PM_{10} nonattainment and SO_2 nonattainment areas (approximately 5 to 10 miles).

In 2009, the EPA designated the western portion of Pinal County as a nonattainment area for $PM_{2.5}$. Pinal County and the ADEQ subsequently submitted recommendations regarding the boundaries for the nonattainment area, and the EPA finalized designation of a portion of western Pinal County as nonattainment for $PM_{2.5}$ in February 2011 (ADEQ 2011a). Both the Pinal Central Substation and Route Group 4 would be located approximately 19 miles or more to the east of the western Pinal County $PM_{2.5}$ nonattainment area. In May 2012, the EPA designated much of the western half of Pinal County to nonattainment for the 1987 24-hour PM_{10} NAAQS (EPA 2012). Ambient monitors located within this area routinely record concentrations two to three times the level of the standard. A small portion of Route Group 4 and the Pinal Central Substation are located within the new nonattainment area.

For more information regarding Arizona's nonattainment and maintenance areas, see the ADEQ website.

3.2.5 Climate Variability

According to David S. Gutzler (2004), climate variability and change exert profound influences on agriculture, natural ecosystems, wildfires, tourism, and water resources. Climate is determined by fixed or slowly varying factors that modulate weather. The primary factor is the intensity of sunlight, Earth's orbital geometry, and latitude. In addition to the sun's radiation, Earth's surface receives infrared radiation from the atmosphere above. The intensity of infrared radiation is determined by cloud cover, humidity, and the atmospheric concentrations of infrared-absorbing trace gases (greenhouse gases [GHG] such as CO_2 [carbon dioxide]).

Other climatic conditions vary depending on longitude, including the distribution of oceans and continents, continental topography, and land surface cover.

The Project area lies within a latitude zone that encompasses many of the world's deserts. This zone owes its arid character to a global circulation system called the Hadley Cell, which generates a belt of subsiding air that tends to suppress clouds and precipitation. In addition, New Mexico and Arizona's remoteness from oceanic moisture sources acts to keep the climate dry.

Average weather can vary systematically from year to year. Such variability in climate is associated with changes in ocean temperatures that modulate storm tracks and moisture transport for entire seasons or years. Slow variations in ocean temperature and currents, especially in the Pacific Ocean, are a major cause of wintertime climate variability across North America.

The El Niño cycle is the best known and best understood example of annual variability. El Niño is characterized by a tongue of anomalously warm Pacific Ocean surface water that extends

along the equator westward from the South American coast. It pulls the North Pacific atmospheric jet stream, and the storm track associated with it, southward and eastward, with increased precipitation over the southwestern United States. The mirror-image cold phase, La Niña, has the opposite effect; pushing the jet stream northward and leaving Arizona and New Mexico drier than normal. Extreme warm and cold phases tend to occur several years per decade, reaching maximum amplitude in the Northern Hemisphere's winter season.

Recent research suggests that longer, multi-decadal fluctuations in the northern Pacific Ocean also affect precipitation across southwestern North America. Northern Pacific Ocean temperatures seem to vary more slowly than tropical El Niño-related anomalies. This Pacific Decadal Oscillation tends to regulate the effects of El Niño; a negative Pacific Decadal Oscillation brings greater drought to the Southwest, while a positive phase brings wet decades.

Evidence of decade-scale climate variability during the past 1,000 years has recently come to light through examination of annual growth rings in ancient trees. One of the major results of recent tree ring analysis is the discovery of southwestern drought cycles, with intermittent severe droughts recurring every 50 to 100 years.

Forming a backdrop to the Southwest's climate variability are constant climatic shifts that occur over longer time scales. For example, over the past several decades the statewide average temperature in New Mexico has been on a fairly steady rise, with every year since 1992 being warmer than the 1971-2000 climatological average value. On the other hand, the early years of the twentieth century, as well as the 1960s and early 1970s, were generally somewhat cooler than average. The current warming trend is observed across much of the world, consistent with the prevailing hypothesis that such warming can be attributed at least partly to worldwide increases in GHGs in the atmosphere.

3.2.6 Summary of Inventory Results

The following sections present the most representative climate and existing air quality data for each route group.

3.2.6.1 Route Group 1: SunZia East Substation to Midpoint Substation

Table 3-3 summarizes climate statistics for representative locations along each of the subroutes, proceeding in a northeast to southwest direction.

Air quality data are often sparse in nonurban areas or in areas with good air quality. As a result, it is difficult to obtain representative data for many of the route group areas. Of the counties in New Mexico traversed by the various route groups, only Grant and Luna have air quality data available. Several of the monitors are sited in areas of known poor air quality that are not adjacent to the proposed transmission line routes.

Table 3-3. Climate Statistics for Route Group 1: SunZia East Substation to Midpoint Substation													
Climate	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Annual**
Note: Temperatures shown in degrees Fahrenheit. Precipitation and snowfall shown in inches.													
Subroute 1A/1A1/1A2 – North River Crossing													
Socorro, New Mexico (Lat: 34.08, Lon: -106.88, Elev: 1,398 m)													
Average Maximum Temperature	52.3	58.9	66.9	74.9	83.3	90.8	91.7	89.1	83.6	73.3	61.1	50.9	73.1
Average Minimum Temperature	21.9	26.1	31.7	38.7	47.4	54.6	60.7	59.4	51.2	39.7	28.9	22.0	40.3
Average Total Precipitation	0.49	0.30	0.50	0.41	0.58	0.60	1.62	2.03	1.55	1.09	0.54	0.55	10.26
Average Total Snowfall	0.3	0.8	0.4	0	0	0	0	0	0	0.3	0.4	3.5	5.7
Truth or Consequences, New Mexico (Lat: 33.14, Lon: -107.23, Elev: 1,336 m)													
Average Maximum Temperature	56.7	62.5	69.0	77.5	86.6	95.4	95.4	92.3	87.4	77.1	65.3	55.5	76.8
Average Minimum Temperature	27.4	31.6	37.3	44.5	54.1	63.5	67.0	65.1	58.4	46.8	34.6	27.3	46.5
Average Total Precipitation	0.46	0.37	0.33	0.23	0.36	0.84	2.04	2.10	1.62	1.13	0.60	0.85	10.93
Average Total Snowfall	1.2	0.1	0.1	0	0	0	0	0	0	0	0.3	1.9	3.6
Deming, New Mexico (Lat: 32.25, Lon: -107.75, Elev: 1,311 m)													
Average Maximum Temperature	58.1	63.2	70.4	78.6	87.3	95.3	94.6	91.9	87.8	78.3	66.5	57.2	77.5
Average Minimum Temperature	27.1	30.4	35.2	41.6	50.2	59.0	64.3	63.1	56.4	45.0	33.2	27.3	44.5
Average Total Precipitation	0.53	0.60	0.32	0.34	0.25	0.53	1.99	2.00	1.17	0.94	0.67	0.90	10.24
Average Total Snowfall	0.8	0.5	0.1	0.1	0	0	0	0	0	0	0.1	0.5	2.1
Subroute 1B1/1B2/1B3 – San Antonio Crossing													
Bingham 2 NE, New Mexico (Lat: 33.91, Lon: -106.35, Elev: 1,692 m)													
Average Maximum Temperature	50.6	56.0	63.4	71.5	80.8	89.5	90.1	87.2	82.0	71.8	59.4	50.2	71.1

Table 3-3. Climate Statistics for Route Group 1: SunZia East Substation to Midpoint Substation													
Climate	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Annual**
Note: Temperatures shown in degrees Fahrenheit. Precipitation and snowfall shown in inches.													
Average Minimum Temperature	22.5	26.1	30.9	37.2	46.5	55.2	60.3	59.5	52.6	41.4	30.2	22.4	40.5
Average Total Precipitation	0.52	0.66	0.57	0.46	0.60	0.94	2.48	2.40	1.46	1.39	0.69	0.74	12.91
Average Total Snowfall	1.4	1.7	1.2	0.1	0	0	0	0	0	05	0.2	2.4	8.5
Truth or Consequences, New Mexico: See Subroute 1A – North River Crossing													
Deming, New Mexico: See Subroute 1A – North River Crossing													
Source: National Climatic Data Center 2011 (period of record: 1981-2010)													

Table 3-4 summarizes the most recent available air quality data in southern New Mexico that may be applicable to the transmission line route groups. It presents the highest and second highest measured values at the designated monitor, as well as the annual average measured concentrations for pollutants with an annual averaging period. Note that no CO or lead data are available in these counties. The EPA finalized designations with respect to the 2008 revised lead standard in November 2011; no areas within New Mexico are considered nonattainment with those standards. Similarly, there are no CO nonattainment areas in the Project study area.

Table 3-4. New Mexico Air Quality Data						
Location	**Year**	**Pollutant**	**Averaging Period**	**First Maximum**	**Second Maximum**	**Annual Average**
Deming (Luna County)	2010	O_3	8-hour	0.064 ppm	0.060 ppm	—
Hurley (Grant County)	2010	O_3	8-hour	0.078 ppm	0.071 ppm	—
Las Cruces/Doña Ana County	2010	Ozone	8-hour	0.068 ppm	0.067 ppm	—
Santa Teresa/Doña Ana County	2010	Ozone	8-hour	0.067 ppm	0.065 ppm	—
Deming (Luna County)	2010	NO_2	1-hour	27 ppb	25 ppb	—
			Annual	—	—	0.011 ppm
Santa Teresa/Doña Ana County	2010	NO_2	1-hour	43 ppb	43 ppb	—
			Annual	—	—	0.014 ppm
Hurley(Grant County)	2010	SO_2	1-hour	3 ppb	2 ppb	—
			3-hour	0.001 ppm	0.001 ppm	—
			24-hour	0.001 ppm	0.001 ppm	—
			Annual	—	—	0.0002 ppm
Deming (Luna County)	2010	PM_{10}	24-hour	43 $\mu g/m^3$	33 $\mu g/m^3$	—
			Annual	—	—	17.0 $\mu g/m^3$
Silver City (Grant County)	2010	PM_{10}	24-hour	30 $\mu g/m^3$	26 $\mu g/m^3$	—
			Annual	—	—	15.4 $\mu g/m^3$

Table 3-4. New Mexico Air Quality Data						
Location	**Year**	**Pollutant**	**Averaging Period**	**First Maximum**	**Second Maximum**	**Annual Average**
Hurley (Grant County)	2010	PM_{10}	24-hour	26 μg/m^3	20 μg/m^3	—
			Annual	—	—	11.7 μg/m^3
Anthony/Doña Ana County	2010	PM_{10}	24-hour	45 μg/m^3	40 μg/m^3	—
			Annual	—	—	24.2 μg/m^3
Sunland Park/Doña Ana County	2010	PM_{10}	24-hour	62 μg/m^3	48 μg/m^3	—
			Annual	—	—	24.4 μg/m^3
Silver City (Grant County)	2010	$PM_{2.5}$	24-hour	11.8 μg/m^3	11.2 μg/m^3	—
			Annual	—	—	4.3 μg/m^3
Sunland Park/Doña Ana County	2010	$PM_{2.5}$	24-hour	50.2 μg/m^3	47.8 μg/m^3	—
			Annual	—	—	8.8 μg/m^3
Las Cruces/Doña Ana County	2010	$PM_{2.5}$	24-hour	14.5 μg/m^3	8.3 μg/m^3	—
			Annual	—	—	4.5 μg/m^3
Source: EPA 2011d						

3.2.6.2 Route Group 3: Midpoint Substation to Willow-500 kV Substation

Climate statistics are summarized for representative locations along subroutes 3A and 3B, proceeding in a northeast to southwest direction. Air quality data in southwest New Mexico applicable to Route Group 3 are presented in Table 3-5. Air quality data in Arizona are scarce outside urban areas and areas with known poor air quality.

Table 3-5. Climate Statistics for Route Group 3: Midpoint Substation to Willow-500 kV Substation													
Climate	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Annual**
Note: Temperatures shown in degrees Fahrenheit. Precipitation and snowfall shown in inches.													
Subroute 3A/3A2 – North													
Deming, New Mexico. See Subroute 1A – North River Crossing													
Lordsburg 4 SE, New Mexico (Lat: 32.31, Lon: -108.65, Elev: 1,294 m)													
Average Maximum Temperature	59.7	64.5	71.5	80.1	89.6	97.6	97.2	94.2	90.2	80.3	68.5	58.7	79.4
Average Minimum Temperature	24.5	27.2	31.4	37.5	47.3	56.9	63.4	62.1	54.5	42.2	30.1	24.4	41.9
Average Total Precipitation	0.91	0.83	0.74	0.34	0.34	0.51	2.08	2.19	1.15	1.14	0.87	1.23	12.33
Average Total Snowfall	0.6	0.7	0.1	0	0	0	0	0	0	0	0.1	1.5	3.0
Bowie, Arizona (Lat: 32.31, Lon: -109.52, Elev: 1,157 m)													
Average Maximum Temperature	61.0	65.6	72.1	80.3	89.1	97.5	97.2	94.1	90.6	80.9	69.5	60.5	79.9
Average Minimum Temperature	30.8	34.3	38.9	44.8	52.9	61.7	66.7	65.5	59.3	48.0	36.5	30.3	47.6
Average Total Precipitation	1.07	0.86	0.59	0.29	0.40	0.40	2.24	2.13	1.02	1.14	0.79	1.17	12.10
Average Total Snowfall	0.1	0.1	0.1	0	0	0	0	0	0	0	0	0.6	0.9
Subroute 3B – South													
Same as Subroute 3A/3A2 – North													
Source: National Climatic Data Center 2011 (period of record: 1981-2010)													

Table 3-6 presents the highest and second highest measured values at the designated monitor, as well as the annual average measured concentrations for pollutants with an annual averaging period. No lead data are available in these counties. The EPA finalized designations with respect to the 2008 revised lead standard in November 2011; no areas within Arizona are considered nonattainment with those standards. However, monitoring requirements associated with the 2008 lead standards prompted the state of Arizona to install lead monitoring networks in late 2011 that will provide data in future years. Lead monitors were located in the Miami area (Gila County) and the Hayden area (near the border of Gila and Pinal counties), to monitor specific sources of lead. A third monitor was located in Maricopa County, to monitor lead in the Phoenix metropolitan area.

Table 3-6. Arizona Air Quality Data

Location	Year	Pollutant	Averaging Period	First Maximum	Second Maximum	Average
Chiricahua National Monument (Cochise County)	2010	O_3	8-hour	0.074 ppm	0.072 ppm	—
22nd and Craycroft (Tucson, Pima County)	2010	O_3	8-hour	0.068 ppm	0.067 ppm	—
Tucson Fairgrounds (Pima County)	2010	O_3	8-hour	0.074 ppm	0.072 ppm	—
Casa Grande Airport (Pinal County)	2010	O_3	8-hour	0.071 ppm	0.070 ppm	—
22nd and Craycroft (Tucson, Pima County)	2010	Nitrogen oxides	1-hour	63.7 ppb	58.3 ppb	—
			Annual	—	—	.027 ppm
22nd and Craycroft (Tucson, Pima County)	2010	SO_2	1-hour	14 ppb	11 ppb	—
			3-hour	0.006 ppm	0.005 ppm	—
			24-hour	0.002 ppm	0.001 ppm	—
			Annual	—	—	0.002 ppm
Douglas Red Cross (Cochise County)	2010	PM_{10}	24-hour	83 μg/m^3	81 μg/m^3	—
			Annual	—	—	32.5 μg/m^3
Corona de Tucson (Pima County)	2010	PM_{10}	24-hour	31 μg/m^3	29 μg/m^3	—
			Annual	—	—	13.2 μg/m^3
Ajo (Tucson, Pima County)	2009	PM_{10}	24-hour	42 μg/m^3	34 μg/m^3	—
			Annual	—	—	20 μg/m^3
Mammoth (Pinal County)	2010	PM_{10}	24-hour	46 μg/m^3	38 μg/m^3	—
			Annual	—	—	14.7 μg/m^3
Casa Grande Downtown (Pinal County)	2010	PM_{10}	24-hour	136 μg/m^3	101 μg/m^3	--
			Annual	—	—	39.4 μg/m^3

Table 3-6. Arizona Air Quality Data						
Location	**Year**	**Pollutant**	**Averaging Period**	**First Maximum**	**Second Maximum**	**Average**
Pinal County Housing Complex (Pinal County)	2010	PM_{10}	24-hour	128/130/1761 μg/m^3 [a]	102/111/182 μg/m^3 [a]	—
			Annual	—	—	42.7/43.7/57.7 μg/m^3 [a]
Cowtown Road (Pinal County)	2010	$PM_{2.5}$	24-hour	39.5 μg/m^3	27.1 μg/m^3	—
			Annual	—	—	12.3 μg/m^3
Douglas Red Cross (Cochise County)	2010	$PM_{2.5}$	24-hour	13.0 μg/m^3	9.6 μg/m^3	—
			Annual	—	—	6.3 μg/m^3
22nd and Craycroft (Tucson, Pima County)	2010	CO	1-hour	2.0 ppm	—	—
			8-hour	1.1 ppm	0.9 ppm	—
[a] Three monitors at this location Source: EPA 2011d						

3.2.6.3 Route Group 4: Willow-500 kV Substation to Pinal Central Substation

Table 3-7 summarizes climate statistics for representative locations along the subroutes of Route Group 4, proceeding in a northeast to southwest direction. (Air quality data for the area traversed by Route Group 4 is shown in Table 3-6.)

Table 3-7. Climate Statistics for Route Group 4: Willow-500 kV Substation to Pinal Central Substation													
Climate	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Annual**
Note: Temperatures shown in degrees Fahrenheit; precipitation and snowfall shown in inches.													
Subroute 4A – North of Mt. Graham													
Bowie, Arizona: See Subroute 3A1/3A – North													
Safford, Arizona (Lat: 32.82, Lon: -109.68, Elev: 900 m)													
Average Maximum Temperature	60.7	65.2	71.7	80.4	90.1	98.5	98.2	95.7	92.3	82.6	70.1	60.0	80.5
Average Minimum Temperature	29.5	32.8	38.3	44.7	53.3	61.9	68.4	67.2	60.0	48.1	36.2	29.1	47.5
Average Total Precipitation	0.76	0.75	0.62	0.29	0.25	0.29	1.50	1.91	1.02	0.87	0.54	0.87	9.67
Average Total Snowfall	0.2	0.3	0	0	0	0	0	0	0	0	0	0.2	0.7
San Manuel, Arizona (Lat: 32.60, Lon: -110.63, Elev: 1,055 m)													
Average Maximum Temperature[1]	60.2	64.3	70	77.9	87.5	96.8	97	94.1	90.6	81.2	69.1	61.1	79.1

Table 3-7. Climate Statistics for Route Group 4: Willow-500 kV Substation to Pinal Central Substation													
Climate	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Annual**
Note: Temperatures shown in degrees Fahrenheit; precipitation and snowfall shown in inches.													
Average Minimum Temperature[1]	34.5	37	41.2	46.5	55	65	69.7	67.3	63.3	53.2	41.6	35.6	50.8
Average Total Precipitation	1.19	1.26	0.99	0.40	0.39	0.25	2.55	3.04	1.26	0.90	0.69	1.11	14.03
Average Total Snowfall	0.5	0.3	0	0.1	0	0	0	0	0	0	0	0.3	1.2
Casa Grande, Arizona (Lat: 32.89, Lon: -111.71, Elev: 428 m)													
Average Maximum Temperature	69.2	73.0	79.2	88.0	97.2	105.9	107.1	105.1	101.0	90.3	78.0	67.9	878.5
Average Minimum Temperature	38.0	40.8	45.4	51.2	59.6	68.0	76.1	75.3	68.3	55.7	43.8	37.0	55.0
Average Total Precipitation	0.86	0.93	1.03	0.27	0.20	0.18	0.90	1.72	0.73	0.52	0.56	1.14	9.04
Average Total Snowfall	0	0	0	0	0	0	0	0	0	0	0	0	0
Subroute 4B – Sulphur Springs Valley													
Bowie, Arizona: See Subroute 3A – North													
Fort Grant, Arizona (Lat: 32.62, Lon: -109.94, Elev: 1,478 m)													
Average Maximum Temperature	56.3	59.5	66.9	75.0	84.4	93.3	91.4	90.0	87.3	78.3	67.2	56.4	75.6
Average Minimum Temperature	31.7	33.2	40.3	44.7	53.4	61.7	63.8	63.0	60.6	47.9	40.7	32.1	47.8
Average Total Precipitation	1.40	1.24	1.19	0.35	0.49	0.37	2.43	2.71	1.62	1.02	0.75	1.03	14.60
Average Total Snowfall[1]	0.6	0.6	0.6	0.5	0	0	0	0	0	0	0.3	0.9	3.5
San Manuel, Arizona: See Subroute 4A – North of Mt. Graham													
Casa Grande, Arizona: See Subroute 4A – North of Mt. Graham													
Subroute 4C1/4C2/4C2c – San Pedro Valley													
Subroute 4C1 – East of San Pedro River to Pinal Central Substation Subroute 4C2 – West of San Pedro River to Pinal Central Substation													
Bowie, Arizona: See Subroute 3A – North													
Willcox, Arizona (Lat: 32.26, Lon: -109.85, Elev: 1,272 m)													
Average Maximum Temperature	61.2	65.1	71.4	79.0	87.6	95.6	95.7	92.8	89.9	80.3	69.6	60.2	79.1

Table 3-7. Climate Statistics for Route Group 4: Willow-500 kV Substation to Pinal Central Substation													
Climate	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Annual**
Note: Temperatures shown in degrees Fahrenheit; precipitation and snowfall shown in inches.													
Average Minimum Temperature	28.4	31.2	35.0	40.2	48.5	57.0	64.7	63.7	56.5	44.4	33.4	27.5	44.3
Average Total Precipitation	1.09	0.93	0.68	0.33	0.39	0.46	2.61	2.53	1.18	1.16	0.71	1.25	13.32
Average Total Snowfall	0.8	1.0	0.1	0	0	0	0	0	0	0	0.1	0.7	2.7
San Manuel, Arizona: See Subroute 4A – North of Mt. Graham													
Casa Grande, Arizona: See Subroute 4A – North of Mt. Graham													
Subroute 4C3 – Tucson													
Bowie, Arizona: See Subroute 3A – North													
Benson 6 SE, Arizona (Lat: 31.88, Lon: -110.24, Elev: 1,125 m)													
Average Maximum Temperature	63.2	66.4	71.7	79.2	88.3	97.0	95.9	92.7	90.5	81.5	71.5	63.0	80.1
Average Minimum Temperature	27.5	30.0	34.3	40.6	48.5	56.9	64.9	64.1	57.6	44.4	33.0	27.3	44.2
Average Total Precipitation	0.72	0.68	0.64	0.35	0.22	0.47	2.81	3.04	1.28	0.96	0.49	1.04	12.70
Average Total Snowfall[1]	0.1	0	0	0	0	0	0	0	0	0	0	0	0.1
Tucson WFO, Arizona (Lat: 32.23, Lon: -110.95, Elev: 742 m)													
Average Maximum Temperature	64.9	68.2	73.9	81.5	90.8	99.1	98.9	96.9	94.1	84.2	73.0	64.4	82.6
Average Minimum Temperature	41.6	44.2	48.4	54.7	63.5	71.7	75.7	74.6	70.5	59.2	48.0	40.8	57.8
Average Total Precipitation	0.97	0.93	0.77	0.36	0.17	0.21	2.34	2.24	1.18	0.86	0.62	0.97	11.62
Average Total Snowfall	0.2	0	0	0	0	0	0	0	0	0	0	0.1	0.3
Casa Grande, Arizona: See Subroute 4A – North of Mt. Graham													

Source: Unless otherwise noted, National Climatic Data Center 2011
[1] San Manual, AZ temperature data and Fort Grant, AZ snowfall data: WRCC 2011c.
Period of record 1981-2010 except San Manual temperature (6/1/1954-9/30/2011) and Fort Grant, AZ snowfall (1/1/1900-10/31/2011)

3.3 EARTH RESOURCES

3.3.1 Introduction, Methods, and Regulatory Framework

This section presents an overview of the geology, geological hazards, mineral resources, and soil resources that occur within the Project study area. The earth resources maps (see Map Volume) display all earth resources within a 6-mile-wide study corridor; however, the extent of the data used for the analysis inventory and impact assessment is described for each of the resources in the following sections.

Based on the results of preliminary research, the public scoping process, and consultation with the BLM, the following earth resources and other areas of concern were identified:

- Wind and water erosive soils in the Rio Grande, Sulphur Springs, and San Pedro river valleys
- Active mines and mining claims
- Fissures located near the Pinal Central Substation
- Geological hazards between Aravaipa Canyon and Safford
- Designated Prime or Unique Farmland soils

3.3.1.1 Methods

Information for geological hazards was obtained from scientific literature, including publications, maps, GIS data, and discussions with agency specialists at the BLM, U.S. Geological Survey (USGS), New Mexico Bureau of Geology and Mineral Resources (NMBGMR), and Arizona Geological Survey (AZGS). Geological formations, earthquake epicenters, Quaternary faults, fissures, and percent slope were recorded and mapped using GIS. These data sets were analyzed within study corridors that are 2 miles wide.

The purpose of the mineral resource inventory was to identify areas with active mining claims, mining material sites, oil and gas leases, and geothermal resources. Information for the inventory was obtained from scientific literature, including publications, maps, and discussions with agency specialists at the BLM, USGS, NMBGMR, AZGS, and state land departments of New Mexico and Arizona. Additional information was obtained from other federal and state sources, including the Arizona Department of Mines and Minerals, and the New Mexico Resource GIS program. The mineral resources inventory was conducted using the BLM and USGS' Geocommunicator service and LR2000 database. The Geocommunicator provides geospatial data based on the LR2000 database in the form of GIS-ready, downloadable data files. These publicly available information storehouses provide maps and detailed descriptions of mineral resource extraction efforts in operation on federally owned or controlled land. Searches for a wide number of mineral resources were conducted using these databases, including active mining claims; mineral resource localities; and leases for oil, gas, coal, and geothermal resources. The results of these searches were compiled into a GIS that included the Project study area, to determine which mineral resource localities might be impacted by Project routes. Results were analyzed within 2-mile-wide study corridors.

Soil survey data were derived from the Soil Data Mart[1] of the Natural Resources Conservation Service (NRCS), a division of the U.S. Department of Agriculture (USDA). Data include the spatial and tabular GIS data necessary to create maps of the soil resources within the Project study area. Soil survey data are available from two different databases: the State Soil Geographic database (STATSGO) and the Soil Survey Geographic database (SSURGO). STATSGO surveys are mapped at a smaller scale than SSURGO surveys, and cover an entire state; SSURGO surveys typically cover county-sized areas. The soil surveys used in this EIS were compiled as part of the SSURGO database, which maximizes the detail and accuracy of the soil resource inventory. Twenty-one completed, individual SSURGO soil surveys (7 in New Mexico and 10 in Arizona) provide large-scale coverage of the Project study area, ranging in scale from 1:20,000 to 1:63,630 (Table 3-8). The STATSGO surveys for New Mexico and Arizona provide smaller-scale coverage (1:250,000) of areas that are not covered by SSURGO surveys. SSURGO data gaps within the Project study area are largely restricted to land administered by the USFS in New Mexico and Arizona; however, none of the current routes crosses USFS land. Another data gap is present in southwestern Graham County, Arizona. As currently mapped, approximately 70 miles of alternative routes cross lands that are not covered by the SSURGO database. This area is currently being mapped by the Tucson office of the NRCS, which is providing provisional data as it becomes available, as part of soil survey AZ673. In these areas, data from the STATSGO databases will be used in place of the missing SSURGO data. Data sets were analyzed within 2-mile-wide study corridors.

The Redington and Winkelman NRCDs and the Cascabel Working Group (Cascabel Working Group 2010a, b) provided additional data that describes environmental conditions within the San Pedro River and Aravaipa Creek watersheds. The information was reviewed and found to be generally consistent with data from the NRCS.

Table 3-8. SSURGO Soil Surveys in the Project Study Area

Survey Number	Year	Survey Area
New Mexico		
NM023	2009	Hidalgo County
NM029	2006	Luna County
NM612	2008	Valencia County – Eastern Part
NM660	2008	Sierra County
NM662	2008	Grant County
NM664	2008	Socorro County
NM674	2009	Torrance County
NM690	2009	Doña Ana County
Arizona		
AZ659	2008	Pinal County – western part
AZ661	2009	Eastern Pinal and Southern Gila counties
AZ662	2008	Safford area; parts of Graham County
AZ663	2009	Gila-Duncan area; parts of Graham and Greenlee counties

[1] http://soildatamart.nrcs.usda.gov/

Table 3-8. SSURGO Soil Surveys in the Project Study Area		
Survey Number	**Year**	**Survey Area**
AZ664	2008	San Simon area; parts of Cochise, Graham, and Greenlee counties
AZ665	2008	Willcox area; parts of Cochise and Graham counties
AZ666	2009	Cochise County – northwest part
AZ668	2008	Tucson-Avra Valley; parts of Pima County
AZ669	2008	Pima County – eastern part
AZ703	2008	Tohono O'odham Nation; parts of Maricopa, Pima, and Pinal counties
AZ673	In Progress	Southwestern Graham County

3.3.1.2 Regulatory Framework

Federal

The NEPA, FLPMA, and Farmland Protection Policy Act of 1981 (FPPA) serve as the primary federal legislation requiring the assessment and mitigation of potential impacts to geological resources, including mineral and soil, on federally administered land. The NEPA (42 USC 4321-4347) directs federal agencies, including the BLM, to assess impacts, adverse and otherwise, to the environment. The FLPMA incorporated the Mining Law of 1872 with several provisions to aid in managing resources on public land, and provides for management and mitigation of adverse impacts on federal land by protecting "the quality of scientific, scenic, historical, ecological, environmental, air and atmospheric, water resource, and archaeological values" (PL 94-579). The FPPA (PL 97-98, Subtitle I of Title XV, Sec. 1539-1549) requires the assessment of impacts to farmland, namely the conversion of farmland to nonagricultural purposes.

Additional federal legislation that requires assessment and mitigation includes:

- Mineral Leasing Act of 1920 (30 USC 181) – changed the development of deposits, such as coal, petroleum, and natural gas, from claim staking to leasing
- Mineral Materials Act of 1947 (30 USC 601) and the Multiple Surface Use Mining Act of 1955 (30 USC 611-615) – provided provisions for the mining, disposal, and sale of materials, such as sand and gravel (BLM 2010d)
- Multiple Mineral Development Act of 1954 (30 USC Chapter 12, 521) – permits the use of public land for both mining operations and leasing operations
- Geothermal Steam Act of 1970 (30 USC Chapter 23) – allows for the leasing of geothermal resources on public land

State

New Mexico

The Minerals Group of the NMSLO is responsible for leases on state land for commodities such as sand and gravel, limestone, coal, and geothermal resources. NMSA Title 19, Chapter 2, includes applicable laws for governing minerals, mines, and leases on New Mexico state land.

Arizona

The ASLD is responsible for mining activities and mineral resources on state land. ARS Titles 12, 27, and 37 are the applicable state laws for governing minerals, mines, leases, and geothermal resources on Arizona state land.

3.3.2 Regional Overview

3.3.2.1 New Mexico

In New Mexico, the Project study corridors are within the Chihuahuan Desert ecoregion, which includes a large range of subregions such as basins and playas, lava malpais or badlands, grasslands, and the floodplain of the Rio Grande (Griffith et al. 2006).

In the Project study area, the Rio Grande Valley runs from the Socorro area south through El Paso, Texas. The Rio Grande lies within the Rio Grande Rift, a zone of faults that stretches from Mexico to the Colorado-New Mexico state line. The rift began approximately 24 million years ago as a series of topographically closed basins that filled with aeolian, alluvial, and volcanic deposits between the Miocene and Pleistocene epochs (Bartolino and Cole 2002).

Southwestern New Mexico is typical of the Basin and Range Province (Fenneman 1931), consisting of several basins separated by mountains. The basins are filled with Pliocene-Pleistocene alluvium, and several have old playas.

- The Animas Basin – near Lordsburg, is a remnant of the Pleistocene Lake Animas (Hawley et al. 2000). It is bounded by the Peloncillo Mountains to the west and the Animas and Pyramid Mountains to the east. The Animas Basin extends from Mexico northward to an area northwest of Lordsburg (Reeder 1957).
- The Mimbres Basin – is bounded by the Black Range to the north, the Goodsight Mountains and West Potrillo Mountains to the east, and the Cedar Mountain Range to the west; the southern boundary extends into Mexico (Hanson et al. 1994). It consists of rocks ranging in age from Precambrian to Quaternary.
- The Gila River Valley – near Duncan, is part of the Mexican Highland physiographic subdivision. The Mexican Highland runs from southeastern Arizona to north-central New Mexico and includes Pliocene-Pleistocene alluvial and lacustrine deposits in the basins, and Proterozoic through Cenozoic rocks in the mountains (Connell et al. 2005).

3.3.2.2 Arizona

Southeastern Arizona is also typical of the Basin and Range Province physiographic range, having wide basins separated by mountain ranges (Fenneman 1931). The San Simon Valley is one of these basins, which began forming approximately 17 million years ago and is filled with more than 10,000 feet of fluvial, playa, and lacustrine deposits ranging in age from Miocene to Pleistocene (Houser et al. 2004). The Peloncillo Mountains, northeast of the San Simon Valley, consist mostly of Tertiary volcanic rocks. The Pinaleño Mountains to the west consist predominantly of granitic rocks of Precambrian age (*ibid*). West of the Pinaleño Mountains is the

Sulphur Springs Valley. As in southwestern New Mexico, old playas representing ancient lake beds are found in this area, such as the Willcox Playa.

The San Pedro River/Santa Cruz River area consists of several valleys separated by mountain ranges. The San Pedro River enters Arizona from Mexico just west of Naco, and travels northward to Benson and Mammoth, eventually joining the Gila River near Hayden. The San Pedro River Valley was formed during the late Miocene between 14 and 6 million years ago (Lindsay 1984) and contains basin-filling sediment ranging in age from late Miocene to Pleistocene. The Galiuro Mountains, east of the San Pedro River, consist mostly of Miocene volcanic rocks, although Upper Jurassic through Paleocene sedimentary rocks are present as well. The Santa Cruz River valley was formed approximately 17 million years ago and also consists of basin-fill deposits of Miocene to Pleistocene age (Gettings and Houser 1997). The Santa Rita Mountains lie east of the Santa Cruz River in Santa Cruz and Pima counties. They have a complex geological history dating back to the Precambrian, with sedimentary, volcanic, and intrusive rocks found there. West of the Santa Cruz River are the Tumacacori and Sierrita mountains, which consist of Mesozoic rocks that overlie Paleozoic bedrock (AZGS 2000).

Southern Pinal County is also part of the Basin and Range Province, containing alternating mountain ranges and basins, including the Picacho Mountains, east of Eloy; the Santa Cruz River, south of the Picacho Mountains and Eloy; a broad valley that ends with the Tortolita and Suizo mountains and Durham Hills, to the east; followed by Falcon Valley and another series of small mountains and peaks. The valleys contain sediment that has accumulated between the late Miocene and Pleistocene.

3.3.3 Geology and Geological Hazards

3.3.3.1 Geology

The Paleozoic geological units crossed by the Project subroutes include the Abo, Hueco, Colina, Sly Gap, Lake Valley, Caballero, McKelligan, San Andreas, Yesa, and Ranchero formations; Madera and Peccha groups; Glorieta Sandstone; and Aleman and Cutter dolomite (Table 3-9). These geological units represent marine rocks associated with the ancient west coast of the North American continent (AZGS 2000; Scholle 2003).

The Mesozoic (Triassic, Jurassic, and Cretaceous periods) geological units crossed by the Project subroutes include the Tres Hermanos, McRae, Fort Crittenden, and Shellenberger Canyon formations; Mancos Shale; and Bisbee, Mesa Verde, and Colorado groups. These rocks include terrestrial and marine environments (AZGS 2000; Scholle 2003).

The Tertiary (Paleocene, Eocene, Oligocene, Miocene, and Pliocene epochs) geological units crossed by the Project subroutes include the Quiburis, Mineta, St. Davids, Camp Rice, Popotosa, Baca, Palm Park, and Palomas formations; and 111 Ranch Beds. The Tertiary is characterized by mountain-building events, continuing from the late Cretaceous, that allowed the neighboring valleys to fill with sediment (AZGS 2000; Scholle 2003).

Quaternary geological units within the Project study area include surficial alluvium and colluvium, surficial older alluvium and colluvium, aeolian deposits, and basalt of Pleistocene to Recent age (approximately 1.8 million years ago to the present) (AZGS 2000; Scholle 2003).

Table 3-9. Geological Units in the Study Corridors

Geological Age	Geological Units	Lithology
Quaternary	Terrace and alluvial deposits	Sand, gravel, and silt
Quaternary	Surficial older alluvium and colluvium	Sand, gravel, and silt
Pliocene	St. Davids Formation, 111 Ranch Beds, Gila Group, Camp Rice Formation, Palomas Formation, Tesuque Formation, Santa Fe Group	Mudstone, marl, tuff, lacustrine limestone, sandstone, conglomerate
Miocene	Quiburis Formation, Mineta Formation (possibly upper Oligocene), San Manuel Formation, Popotosa Formation	Mudstone, sandstone, conglomerate, tuff
Eocene	Baca Formation, Palm Park Formation	Mudstone, sandstone, claystone, conglomerate
Oligocene-Miocene volcanic	Unnamed	Volcanic rocks, rhyolitic rocks, silicic volcanic rocks, andesite, basalt
Cretaceous	Shellenberger Canyon Formation, Bisbee Group, Mancos Shale, Tres Hermanos Formation, McRae Formation, Mesa Verde Group, Colorado Group, Fort Crittenden Formation	Mudstone, siltstone, sandstone, shale
Triassic	Dakota Formation, Morrison Formation	Mudstone, limestone, sandstone
Permian	Abo Formation, Hueco Formation, Robledo Mountains Formation, San Andreas Formation, Yesa Formation, Glorieta Sandstone	Mudstone, siltstone, sandstone
Pennsylvanian	Panther Sheep Formation, Magdalena Group, Bar B Formation	Shale, conglomerate, limestone
Mississippian	Escabrosa Limestone, Paradise Formation, Caballero Formation, Lake Valley Formation, Ranchero Formation	Limestone, mudstone, sandstone
Devonian	Percha Formation, Martin Formation, Sly Gap Formation	Limestone, dolomite, mudstone
Ordovician	Cutter Formation, Aleman Formation, McKelligan Formation	Dolomite, limestone
Paleozoic	Unnamed	Metamorphic rocks
Sources: AZGS 2000; Scholle 2003		

3.3.3.2 Geological Hazards

Geological hazards in the Project study area generally consist of seismicity (earthquakes), Quaternary faults (ground rupture due to displacement), fissures (due to subsidence), and flooding. Each type of geological hazard is discussed in detail below.

Seismicity (Earthquakes)

Earthquakes are the surface expression of large energy releases that result from motion along faults. The USGS maintains archives of all earthquakes of detectable magnitude, and have made this data set available to the public since 1973. Seismicity is measured by the USGS as the probability of a certain degree of ground-shaking in terms of the percentage of acceleration due

to gravity (9.8 m/s^2), and the probability that an area will be affected by an earthquake (Peterson et al. 2008). Seismicity data and maps are available from the Geologic Hazards Team, a unit of the USGS Earthquake Hazard Program (USGS 2010).

The Rio Grande Valley (Rio Grande Rift) is the only area near the Project with measurable seismicity. The USGS considers the Rio Grande Valley between Socorro and Albuquerque to be the most seismically active area in New Mexico, having half of the state's larger earthquakes (magnitude 4.5 or greater). The most recent large earthquake in New Mexico occurred on February 21, 2010, in the southeastern corner of New Mexico near Artesia. Another recent earthquake with a magnitude 4.2 occurred on December 19, 2005, near Carlsbad. According to the USGS, earthquakes with magnitudes of 4.9 or less do not typically cause damage to structures[1].

In Arizona, very little seismic activity occurs in the southern half of the state. The largest earthquake detected in southern Arizona was a 7.2 magnitude event that occurred along the Pitaycachi fault near Sonora, Mexico. The earthquake, as experienced in Tucson, was rated a VII on the Modified Mercalli Intensity Scale (McGarvin 1987). Faults in the area of the 1887 Sonora earthquake epicenter have an estimated recurrence interval of 3,000 to 4,000 years.

Quaternary Faults

Quaternary faults are the most recent faults and are considered still active; therefore, they are more likely at some point in the future to have ground rupture, displacement, and/or earthquakes along their length than faults of pre-Quaternary age. The Project crosses several Quaternary fault zones. In New Mexico, the main areas for these faults in the Project study area are along the Rio Grande Valley and a region on both sides of the New Mexico-Arizona state line. In Arizona, Quaternary faults can be found west of the Santa Rita Mountains in Pima County, and west of Benson along the San Pedro River Valley.

Subsidence and Fissures

Subsidence is the gradual settling or sudden sinking of the ground due to subsurface movement. The principal causes of subsidence are aquifer-system compaction, drainage of organic soils, underground mining, hydrocompaction, natural compaction, sinkholes, and thawing of permafrost[2]. Five areas are actively subsiding within the Project area—one in New Mexico and four in Arizona, along the Santa Cruz River and near Green Valley (Arizona Department of Water Resources [ADWR] 2010). According to the NMBGMR, there are currently no GIS data available to measure the amount of subsidence in the actively subsiding Mimbres Basin in New Mexico.

In Arizona, the USGS and AZGS have identified several areas in southern Arizona with existing fissures. A fissure is a crack in the ground that can be thousands of feet in length and hundreds of feet deep. They can be related to ground subsidence, where rapid depletion of aquifers and

[1] http://earthquake.usgs.gov/learn/topics/mag_vs_int.php
[2] http://water.usgs.gov/ogw/subsidence

down-dropping of the water table have occurred (Allison and Shipman 2008). According to the AZGS most fissures in Arizona are a result of subsidence (Slaff 1993). There are several large areas of subsidence with numerous fissures located east and west of I-10, in the area around Picacho and Eloy. One area with a concentration of fissures was identified within the Project study area near the proposed Pinal Central Substation.

Flooding

The 100-year floodplain was used in order to determine where flooding may be a hazard to the Project. A 100-year floodplain is defined as an area that will be inundated by a flood event having a 1 percent chance of being equaled or exceeded in any given year[1]. There are 100-year floodplains throughout the Project area, mostly associated with rivers and their tributaries, ephemeral washes, and some man-made irrigation canals. For the New Mexico portion of the Project, GIS data were available for Grant and Luna counties only. No GIS data were available for the Rio Grande. For Luna County, there are several areas along the Mimbres River, its ephemeral tributaries, and several other ephemeral washes that are within a 100-year floodplain. For Grant County, there are several small 100-year floodplain areas associated with small ephemeral washes. For Arizona, Federal Emergency Management Agency (FEMA) data were available for Cochise, Graham, Pima, and Pinal counties. In Graham and Cochise counties, there are 100-year floodplains located in the Project study area along the San Simon River and its ephemeral tributaries. There are several areas with 100-year floodplains in Aravaipa Canyon and Sulphur Springs valley near Willcox, associated with numerous ephemeral washes and man-made canals. The San Pedro and Santa Cruz rivers and their tributaries also have numerous 100-year floodplains associated with them. Localized areas of flooding, due to heavy rains, can occur in other areas not represented in the 100-year floodplains mapped by FEMA.

3.3.4 Mineral Resources

The mineral resources inventory for the Project presents an overview of the mineral resources, mining, and geothermal resources, and identifies the presence and location of these resources and the areas of possible occurrence within the Project study area. Mineral resources include locatable, leasable, and salable resources. Locatable minerals include a broad category of economically important minerals, such as precious and base metals (e.g., gold, silver, and lead); fissionable products (e.g., uranium); and industrial minerals. Certain gemstones may also be considered locatable minerals. Leasable resources include oil, natural gas, coal, geothermal resources, phosphorous, sodium, sulfur, and potassium. Salable mineral resources are typically used for construction and industrial purposes and include sand, gravel, stone, pumice, and cinder. Under the Materials Act of 1947, salable mineral resources are referred to as mineral materials. Mineral material resources may be acquired from federally owned or controlled land via free-use permit, by competitive bid, or by negotiated contract. Mineral materials extracted by utilization of a free-use permit cannot be sold.

[1] http://www.fema.gov/plan/prevent/floodplain/nfipkeywords/flood_zones.shtm

3.3.4.1 New Mexico

Mineral resources can be found throughout the Project study area. Within New Mexico, 48 mining districts are present in the Project study area, most of which are for mining metals (McLemore et al. 2005). Numerous sand and gravel pits, several coal fields, several industrial mineral districts, and one uranium-mining district are also present. Two non-producing oil and gas leases are located northwest of Lordsburg and north of Deming; and one oil-producing and gas lease is located east of Bingham, southwest of the proposed SunZia East Substation. Although there are coal fields present within the Project study area in New Mexico, there are no active coal leases or mines. Almost the entire Project study area in New Mexico is within an area of known or potential geothermal resources, including 50 geothermal wells and springs. This large geothermal resource area extends from the eastern margin of the Rio Grande Rift to the New Mexico-Arizona border.

3.3.4.2 Arizona

In Arizona, 28 mining districts containing metals, precious metals, and minerals are present in the Project study area. The largest of these mining districts is in the San Manuel area. The San Manuel copper mine was once considered one of the largest copper mines in the world, but has been closed since 2003 and is now under reclamation. Other notable mining districts are located south of Tucson (San Xavier Mission area), an area southwest of Benson, and areas west and southwest of Willcox. Numerous sand and gravel pits are also present, with high concentrations along the Santa Cruz River. There are several operations that mine zeolite/chabazite, northeast of the Bowie townsite. The Project study area also includes five geothermal areas. No coal or oil and gas leases occur in the Arizona portion of the Project study area.

3.3.5 Soil Resources

The soil resource inventory presents an overview of soils that are susceptible to water and wind erosion and designated Prime or Unique Farmland. The Project area is dominated by three of the main soil groups: mollisols, entisols, and aridisols. Mollisols, typically associated with grasslands, occur in the eastern part of the Project area in New Mexico; whereas entisols (poorly developed soils with little to no structure) and aridisols (arid environment soils) occur throughout the Project area.

The proposed Project centerlines in New Mexico are restricted to the Chihuahuan Desert's ecoregion, which includes a large range of subregions such as basins and playas, lava malpais or badlands, grasslands, and the floodplain of the Rio Grande. The soils of the basins and playas formed in broad, shallow-sloped basins that currently contain or have contained playa lakes, whose soils are generally moderately to highly susceptible to wind erosion. The soils of the Chihuahuan grasslands typically exhibit moderate susceptibilities to both water and wind erosion and include designated Prime or Unique Farmland soils along Animas Creek and the Mimbres River.

The proposed Project centerlines in Arizona pass through the Madrean Archipelago ecoregion in the southeastern part of the state and the Sonoran Basin and Range at the western terminus of the route. Within the Madrean Archipelago region, the soils exhibit a wide range of characteristics

from moderate to high susceptibilities, to water erosion in river and stream bottoms, to high susceptibilities to wind erosion on playa plains. Designated Prime or Unique Farmland soils in the Madrean Archipelago are present along rivers such as the San Simon and San Pedro and in the vicinity of Willcox Playa. Within the Sonoran Basin and Range region, the soils exhibit moderate to high susceptibilities to water erosion along the Santa Cruz River, and moderate to high susceptibilities to wind erosion north of Tucson and east of the western terminus of the Project. Designated Prime or Unique Farmland soils in the Sonoran Basin and Range region are present near the western terminus of the route southeast of Casa Grande.

3.3.5.1 Erosion Susceptibility

Soil susceptibilities to water and wind erosion were assessed based on NRCS standards assigned to SSURGO-level soil map units. A soil map unit's susceptibility to water erosion is represented by the experimentally determined factor "K," which includes 14 classes ranging from 0.0 to 0.64, with increasing values corresponding to greater susceptibilities to water erosion. K factor is separated into two versions; K_f for the fine fraction of the surface soil (less than 2.0 mm in diameter), and K_w for the whole soil. K_f typically has an elevated value relative to K_w, because K_w is likely to include a rocky component that armors the surface soil against erosion by rainfall impact or surface flow. Soils assigned a K_w value of 0.40 or greater are highly susceptible to water erosion; whereas soils assigned a K_w value between 0.20 and 0.40 are moderately susceptible to water erosion. Soils assigned a K_w value less than 0.20 are slightly susceptible to water erosion. The susceptibility of a soil map unit to wind erosion is represented by the soil's wind erodibility group (WEG), which can range from 1 to 8. Soil map units assigned to a WEG of 1 or 2 are highly susceptible to wind erosion; soil map units assigned to a WEG of 3, 4, or 4L are moderately susceptible to wind erosion; soil map units assigned to a WEG of 5, 6, or 7 are slightly susceptible to wind erosion; and soil units assigned to a WEG of 8 are not susceptible to wind erosion.

Soils that are highly susceptible to water erosion occur within the Project area and are mostly restricted to the river valleys of the Rio Grande, San Pedro River, and Santa Cruz River. Areas of soils that are highly susceptible to wind erosion are common in New Mexico, but rare in Arizona. These soils are present in the Jornada del Muerto, in the areas to the southwest of the WSMR, and in the playa lakebeds in western New Mexico and eastern Arizona.

3.3.5.2 Designated Prime or Unique Farmland

Prime or Unique Farmlands are defined by the USDA (2011) as:

…land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops, and is also available for these uses (the land could be cropland, pastureland, rangeland, forest land, or other land, but not urban built-up land or water). It has the soil quality, growing season, and moisture supply needed to economically produce sustained high yields of crops when treated and managed, including water management, according to acceptable farming methods.

Prime Farmland includes, but is not limited to, grain, forage, fiber, oilseed, sugar beets, sugarcane, vegetables, tobacco, orchard, vineyard, and fruit crops. Unique Farmland is "land

other than Prime Farmland that is used for the production of specific high value food and fiber crops," and includes citrus, tree nuts, olives, cranberries, fruit, and vegetables (*ibid*). Farmlands of Statewide Importance are designated by state-level offices of the NRCS. They are often nearly qualified to be Prime Farmlands and economically produce high yields of crops. Within the Project study area, designated farmland soils include areas designated as Prime Farmland (if irrigated), Farmland of Statewide Importance, Farmland of Unique Importance, and Prime Farmland (if irrigated) and Protected from Flooding.

Areas with soils that have been designated as Prime or Unique Farmland are intermittently present throughout the Project study area, with major concentrations along the southern reaches of the Rio Grande Valley, within the Animas and Mimbres valleys, the Santa Cruz River Valley, and the vicinity of the western Project terminus at the Pinal Central Substation.

3.3.5.3 Biological Soil Crusts

Biological soil crusts are "a type of thin (<1cm), desiccation-tolerant microbial mat of cyanobacteria, subsequently colonized by mosses and lichens, living at the soil surface in drylands" (Bowker and Belnap 2008). They are susceptible to impacts related to surface-disturbing activities, including grazing, OHV use, and construction.

Bowker and Belnap (2008) established a method for mapping soil areas that have the greatest potential to support biological soil crusts. These three soil types include gypsiferous soils, noncalcareous sandy soils, and limestone-derived soils. Gypsiferous soils contain at least 10 percent gypsum, noncalcareous sandy soils have 5 percent or less calcium carbonate and are between 50 and 75 percent sand, and limestone-derived soils are directly derived from limestone bedrock.

Gypsiferous soils are rare within the Project area, occurring in small concentrations near the eastern terminus of the Project in Lincoln County, New Mexico. Noncalcareous sandy soils, while more common than gypsiferous soils within the Project area, are still rare. The greatest concentration of noncalcareous sandy soils is near the western terminus of the Project in Pinal County, Arizona and includes the Denure-Dateland complex, on 0 to 3 percent slopes and the Bucklebar-Hayhook complex, on 1 to 10 percent slopes. A second concentration of noncalcareous sandy soils is present to the east of Lordsburg and includes the Berin and Mohave soils and the Bluepoint-Onite association. The Project area crosses rare limestone geological units or soils derived from limestone in Pima County, Arizona.

3.3.5.4 Desert Pavements

Desert pavements are formed over long periods of time via deflation lag where fine particles are removed by wind, leaving behind pebbles and cobbles too large to be transported by wind or local overland water flows. These surfaces are typically stable over very long periods of time and are most likely to occur on previously undisturbed low-slope surfaces in arid environments. Desert pavements may be present within the Project area where disturbances from impacts such as grazing or construction have not previously occurred.

3.3.5.5 Clay and Sand Soils

Soils that are strongly skewed towards either clay (greater than 40 percent) or sand (between 50 and 75 percent) textures could potentially pose a hazard for access road stability. Clay soils have a greater potential to exhibit shrink/swell characteristics that could destabilize road surfaces. Clay soils are rarely crossed by the BLM-preferred alternative along Route Group 3 in Arizona and include such soil units as the Guest silty clay and Hantz complex. Loose sand soils may have low-bearing strength resulting in difficulty in maintaining access roads that support construction equipment transportation. Very sandy soils are crossed intermittently by the BLM-preferred alternative throughout the Project area, with the greatest concentration along Route Group 3.

3.3.6 Summary of Inventory Results

3.3.6.1 Route Group 1: SunZia East Substation to Midpoint Substation

The inventory results are summarized below. Resource inventory for geological hazards and mineral resources is listed in Table 3-10 and Table 3-11, and presented on Figure M 3-1E (see Map Volume). The resource inventory for soil resources is listed in Table 3-12 and presented on Figure M 3-2E (see Map Volume).

Subroute 1A1 – North River Crossing

Geological Hazards

Subroute 1A1 crosses several Quaternary faults in the Rio Grande Rift Valley. In particular, Link E133 crosses the West Joyita Fault Zone, which forms the eastern margin of the Rio Grande Rift in a narrow part of the rift known as the Socorro Constriction. In addition, links E180 and E200 cross the Socorro Canyon Fault Zone, which forms the western margin of the Rio Grande Rift. Several earthquakes have been recorded in the last 100 years for the Socorro area, an indication that this area is seismically active. These earthquakes ranged between 4.0 and 6.0 in magnitude. The seismicity mapping by the USGS shows this area as having a 2 percent chance in 50 years of exceedance of a 20% g peak acceleration earthquake[1]. Farther south, Link A161a crosses the Milligan Gulch Fault Zone and the Black Hill Fault. Several areas with 100-year floodplains are located along links A440 and A530. There are no FEMA data available for 100-year floodplains north of Luna County for the Project study area.

Table 3-10. Geological Hazards along Route Group 1

Subroute	Quaternary Faults (miles)	Slopes > 35%	Slopes 15%–35%	100-year Floodplain
1A1	2.3	0.5	36	2.2
1A2	2.3	0.7	28	2.2
1A	1.9	0.5	34	2.2
1B1	2.3	0.4	28	2.2
1B2	2.3	0.4	25.8	2.2
1B3	2.3	0.4	27.4	2.2

[1]http:earthquake.usgs.gov/earthquakes/states/new_mexico/hazards.php

Mineral Resources

There are four mines and four areas with active mining claims located within the study corridor of Subroute 1A1; two of the active mining-claim areas are crossed by the subroute centerline. Three of the mines are located in the Magdalena Mountains, west of Socorro, and are for extracting metals and precious metals. The others are scattered throughout the subroute. The two active mining claims crossed by the centerline are located along links A330a and A330b, west of Truth or Consequences.

Table 3-11. Mines and Mineral Resources Crossed by Each Subroute Centerline along Route Group 1

Subroute	Active Mines in Study Corridor	Miles of Active Mines Crossed by Centerline	Coal Resources in Study Corridor	Miles of Coal Resources Crossed by Centerline	Active Mining Claims in Study Corridor	Miles of Active Mining Claims Crossed by Centerline	Oil and Gas Leases in Study Corridor	Miles of Oil and Gas Leases crossed by Centerline
1A1	4	0	0	0	4	1.6	0	0
1A2	4	0	0	0	4	1.6	0	0
1A	4	0	0	0	4	1.6	0	0
1B1	2	0	2	2.1	5	0.1	0	0
1B2	2	0	1	2.1	5	2.1	3	6.7
1B3	3	0	1	1.3	5	2.1	1	6.3

Soil Resources

Subroute 1A1 crosses soils that are highly susceptible to water erosion, namely the Witt-Penistaja association located on the southwest flank of the Gallinas Mountains, the Gila clay loam located along the Rio Grande, and the Doña Ana-Tres Hermanos association located along Willow Spring Draw and north of the Goodsight Mountains. This subroute crosses soils that are highly susceptible to wind erosion, including the Berino-Doña Ana and Campana-Yesum associations located east of the Rio Grande, and Brazito loamy fine sand located along Palomas and Las Animas creeks. Designated Prime or Unique Farmland soils are crossed; namely the Harvey loam, Witt loam, and Witt clay loam along Link E84.

Table 3-12. Miles of Soil Limitations along Route Group 1

Subroute	High Water Erosion Potential	High Wind Erosion Potential	Moderate Water Erosion Potential	Moderate Wind Erosion Potential	Prime Farmland Soils
1A1	10.9	4.7	88.6	84.8	3.8
1A2	15.6	2.7	87.0	80.5	4.0
1A	9.2	7.5	82.9	86.0	0.6
1B1	10.5	21.6	95.2	96.0	0.0
1B2	16.6	19.9	79.7	82.1	0.0
1B3	13.5	18.8	74.5	75.4	0.0

Subroute 1A2 – BLM Preferred Alternative

Geological Hazards

Geological hazards along Subroute 1A2 are similar to those along Subroute 1A1.

Mineral Resources

Mineral resources along Subroute 1A2 are similar to those along Subroute 1A1.

Soil Resources

Subroute 1A2 crosses soils that are similar to those along Subroute 1A1, but would cross greater areas of soils with high susceptibility to water erosion along Link E86a and E86b.

Subroute 1A – North River Crossing

Geological Hazards

Geological hazards along Subroute 1A are similar to those along Subroute 1A1.

Mineral Resources

Mineral resources along Subroute 1A are similar to those along Subroute 1A1.

Soil Resources

Subroute 1A crosses soils that are similar to those along Subroute 1A1, except along links A22 and E80c. Subroute 1A would cross similar areas of soils that are highly or moderately susceptible to water erosion and would cross greater areas of soils that are highly or moderately susceptible to wind erosion at the northeastern end of the Jornada del Muerto, which Subroute 1A1 avoids. Subroute 1A would cross fewer areas of designated Prime or Unique Farmland soils than Subroute 1A1.

Subroute 1B – San Antonio Crossing

Geological Hazards

Geological hazards along Subroute 1B are similar to those along Subroute 1A1.

Mineral Resources

There are two mines and five areas of active mining claims located within the study corridor of Subroutes 1B1, 1B2, and 1B3. All of the subroute centerlines would cross at least three of the active mining-claim areas. Coal resource areas are located in the Jornada del Muerto and Carthage coal fields, southeast of Socorro (links A90 and A111). Three oil and gas leases are located west of the SunZia East Substation (links A30, A40, and A50).

Soil Resources

The 1B subroutes cross soils that are highly susceptible to water erosion. These soils include the Witt-Penistaja association along Subroute 1B1, the Rance-Tanbark silt loam along subroutes 1B2 and 1B3, and the Yesum very fine sandy loam and Anthony variant sandy clay loam along all 1B subroutes, which cross extensive regions of soil that are highly susceptible to wind erosion in the Jornada del Muerto area (Penistaja-Clovis fine sands and Campana-Yesum association). They also cross designated Prime or Unique Farmland soils in the same areas as those crossed by Subroute 1A.

Local Alternative and Crossover Links for Route Group 1

The local alternative links for subroutes 1A and 1B1 (Gran Quivira area) do not cross any mines or faults. No FEMA data are available for the local alternative links and crossover links for Route Group 1.

Within 1 mile of their centerline, local alternative links for subroutes 1A, 1B1, 1B2, and 1B3 (A161b, A260, A361, A430, and A481) have one mine along Local Alternative Link A161b and seven mines along Local Alternative Link A260. Local Alternative Link A260 has three faults within 1 mile of the centerline, and Local Alternative Link A430 has one fault. Links A430 and A481 cross 100-year floodplains.

A single crossover link, A70, is available for subroutes 1B2 and 1B3. Crossover Link A70 does not cross any soils that are highly susceptible to water erosion, but does cross 5.2 miles of soils that are moderately susceptible to water erosion. This link also does not cross any soils that are highly susceptible to wind erosion, but does cross 2.9 miles of soils that are moderately susceptible to wind erosion. Crossover Link A70 does not cross any designated Prime or Unique Farmland soils.

3.3.6.2 Route Group 3: Midpoint Substation to Willow-500 kV Substation

Resource inventory for geological hazards and mineral resources is listed in Table 3-13 and Table 3-14. The resource inventory for soil resources is listed in Table 3-15.

Subroute 3A2 – BLM Preferred Alternative

Geological Hazards

Subroute 3A2 crosses only one Quaternary fault; the Gold Hill Fault Zone located along Link B120b. Subroute 3A2 crosses numerous washes and channels that contain 100-year floodplains. Most of these floodplains are associated with the Mimbres and San Simon rivers, but numerous smaller ephemeral streams and washes have areas within 100-year floodplains. There were no FEMA data available for Hidalgo County.

Table 3-13. Geological Hazards along Route Group 3				
Subroute	**Quaternary Faults (miles)**	**Slopes > 35%**	**Slopes 15%-35%**	**100-year Floodplain**
3A2	0.5	0.3	1.0	6.2
3A	0.5	0.3	1.2	10
3B	0	0	3.1	6

Mineral Resources

Subroute 3A2 has 8 mines and 7 Active Mining Claims within its study corridor, none of which is crossed by the centerline. Subroute 3A2 has seven areas of active mining claims in the study corridor, 3.9 miles of which are crossed by the centerline. Subroute 3A2 crosses the Fluorite Ridge and Lordsburg Mesa mining districts in New Mexico and a zeolite mining district in Arizona. Subroute 3A2 has one oil and gas lease in the study corridor, 4.0 miles of which are crossed by the centerline.

Table 3-14. Mines and Mineral Resources Crossed by Each Subroute Centerline along Route Group 3								
Subroute	**Active Mines in Study Corridor**	**Miles of Active Mines Crossed by Centerline**	**Coal Resources in Study Corridor**	**Miles of Coal Resources Crossed by Centerline**	**Active Mining Claims in Study Corridor**	**Miles of Active Mining Claims Crossed by Centerline**	**Oil and Gas Leases in Study Corridor**	**Miles of Oil and Gas Leases Crossed by Centerline**
3A2	8	0	0	0	7	3.9	1	4
3A	6	0	0	0	7	3.9	1	4
3B	17	0	0	0	3	2.9	0	0

Soil Resources

Subroute 3A2 crosses soils that are highly susceptible to water erosion, as well as soils that are highly susceptible to wind erosion; namely the Berino and Mohave soils along B90 northwest of Deming, the Berino loamy sand along Link 121 northwest of Lordsburg, and the Bluepoint-Gothard complex along Link B160d. Designated Prime or Unique Farmland soils that are crossed by Subroute 3A2 include the Stellar-Mohave association along Link B120b east of Lordsburg.

Table 3-15. Miles of Soil Limitations along Route Group 3					
Subroute	**High Water Erosion Potential**	**High Wind Erosion Potential**	**Moderate Water Erosion Potential**	**Moderate Wind Erosion Potential**	**Prime Farmland Soils**
3A2	4.7	20.7	58.1	53.8	13.4
3A	4.7	19.6	64	53.3	13.4
3B	0.2	18.3	93.8	57.4	27.8

Subroute 3A – North

Geological Hazards

Geological hazards along Subroute 3A are similar to those along Subroute 3A2. However, Subroute 3A crosses more miles of 100-year floodplain than Subroute 3A2.

Mineral Resources

Subroute 3A has fewer mines within its study corridor than 3A2, but has the same number of active mining claims. The Subroute 3A centerline crosses no active mines, but crosses active mining claims totaling a distance of 3.9 miles. Subroute 3A crosses the Fluorite Ridge and Lordsburg Mesa mining districts in New Mexico.

Soil Resources

Soil resources along Subroute 3A are the same as those along Subroute 3A2 from the Midpoint Substation through Link B121. From Link B160a to the Willow Substation, Subroute 3A crosses a shorter distance of soils that are highly susceptible to wind erosion, including the Bluepoint-Gothard complex, and a slightly longer distance of soils that are moderately susceptible to water or wind erosion. Subroute 3A crosses the same areas of soils designated Prime or Unique Farmland as Subroute 3A2.

Subroute 3B – South

Geological Hazards

Subroute 3B does not cross any known Quaternary faults. Also, Subroute 3B crosses fewer 100-year floodplains than either Subroute 3A2 or Subroute 3A.

Mineral Resources

Subroute 3B crosses three areas of active mining claims totaling a distance of 2.9 miles; no active mines are crossed by this subroute. Subroute 3B would cross the Fluorite Ridge, Lordsburg, and Kimball mining districts in New Mexico, and a zeolite mining district in Arizona.

Soil Resources

Subroute 3B crosses fewer areas of soils that are highly susceptible to water erosion than subroutes 3A2 and 3A, but crosses more areas of soils that are highly susceptible to wind erosion than subroutes 3A2 and 3A, including the Pintura-Berino complex and Bluepoint-Onite association along Link B110a west of Deming. Subroute 3B crosses more areas of designated Prime or Unique Farmland soils than subroutes 3A2 and 3A, including the Stellar-Mohave and Bucklebar-Sonoita-Continental association along Link B110b southeast of Lordsburg.

Crossover Links for Route Group 3

Two crossover links, B111 and B140, are available for subroutes 3A and 3B; these links do not cross any known Quaternary faults. Crossover Links B111 and B140 do cross several small 100-year floodplain areas. Crossover Link B111 does not cross any soil highly susceptible to water erosion, but it does cross 3.2 miles of soil moderately susceptible to water erosion. This crossover link does not cross any soil highly susceptible to wind erosion, but it does cross 4.3 miles of soil moderately susceptible to wind erosion. Crossover Link B111 does not cross any soil that has been designated as Prime or Unique Farmland. Crossover Link B140 crosses 2.9 miles of soil highly susceptible to water erosion and 4.3 miles of soil moderately susceptible to water erosion. This crossover link also crosses 3.1 miles of soil highly susceptible to wind erosion and 4.2 miles of soil moderately susceptible to wind erosion. Crossover Link B140 crosses 1.5 miles of soils that have been designated as Prime or Unique Farmland.

3.3.6.3 Route Group 4: Willow-500 kV Substation to Pinal Central Substation

Resource inventory for geological hazards and mineral resources is listed in Table 3-16 and Table 3-17, respectively. The resource inventory for soil resources is listed in Table 3-18 and Table 3-19.

Subroute 4A – North of Mt. Graham

Geological Hazards

Subroute 4A crosses two Quaternary faults: the Safford Fault Zone along Link B153a and the Whitlock Wash Fault at Link C173, located east of Mammoth on the eastern side of the San Pedro River Valley. Subroute 4A crosses three fissures located along Link C850, as well as numerous areas with 100-year floodplains. A majority of these areas is associated with the San Simon and San Pedro rivers and their tributaries.

Table 3-16. Geological Hazards along Route Group 4

Subroute	Quaternary Faults (miles)	Slopes > 35%	Slopes 15%–35%	100-year Floodplain
4A	1.3	8.8	21.6	6
4B	0.1	7.6	25.8	7
4C1	0.1	3.3	21.9	8
4C2	0	3.3	24.9	9
4C2c	0	2.6	23.3	8.8
4C3	0	1.9	14.9	29

Mineral Resources

There are seven areas of active mining claims and two mines located within the study corridor of Subroute 4A, with five of these active mining claims crossed by the subroute centerline. These active mining-claim areas are located northeast of Mammoth in the Galiuro Mountains, and west of Mammoth where copper and other metals are mined.

Table 3-17. Mines and Mineral Resources Crossed by Each Subroute Centerline along Route Group 4				
Subroute	**Active Mines in Study Corridor**	**Miles of Active Mines Crossed by Centerline**	**Active Mining Claims in Study Corridor**	**Miles of Active Mining Claims Crossed by Centerline**
4A	2	0.2	7	19.4
4B	2	0.4	7	19.4
4C1	2	0.2	3	10.1
4C2	1	0.1	2	16.4
4C2c	1	0.1	2	16.4
4C3	5	0.2	1	13.5

Soil Resources

Subroute 4A only rarely crosses soils that are highly susceptible to water or wind erosion; namely, the Haplogypsids-Whitecliff-Badlands complex (water erosion) and Cascabel soils (wind erosion). This subroute crosses designated Prime or Unique Farmland soils in the San Pedro River Valley (Glendale-Hantz complex) unique to subroutes 4A and 4B, and in the vicinity of the planned Pinal Central Substation (Toltec fine sandy loam), which are common to all of the Route Group 4 subroutes.

Table 3-18. Soil Limitations along Route Group 4 (in miles)					
Subroute	**High Water Erosion Potential**	**High Wind Erosion Potential**	**Moderate Water Erosion Potential**	**Moderate Wind Erosion Potential**	**Prime Farmland Soils**
4A	0.2	0.4	66.4	56.5	7.6
4B	3.6	0.4	73.2	68.8	26.8
4C1	3.2	0.2	69.6	64.3	13.4
4C2	2.7	1.6	75.8	77.8	12.8
4C2c	2.6	1.8	75.0	76.1	12.8
4C3	2.3	6.7	95.2	73.0	40.4

Subroute 4B – Sulphur Springs Valley

Geological Hazards

Geological hazards along Subroute 4B are similar to those along Subroute 4A. Subroute 4B crosses numerous areas with 100-year floodplains. A majority of these areas is associated with Sulphur Springs Valley, Aravaipa Canyon, and the San Pedro River and its tributaries.

Mineral Resources

Mineral resources along Subroute 4B are similar to those along Subroute 4A.

Soil Resources

Subroute 4B crosses very similar soils to those of Subroute 4A, with the exception of the eastern portion of the subroute in Sulphur Springs Valley, where Subroute 4B crosses limited areas of soils that are highly susceptible to water or wind erosion. Subroute 4B also crosses designated Prime or Unique Farmland soils, including the Tubac sandy clay loam and Pima loam.

Subroute 4C2c – BLM Preferred Alternative

Geological Hazards

Subroute 4C2c does not cross any known Quaternary faults. This subroute crosses 8.8 miles of 100-year floodplains largely in the San Pedro River Valley.

Mineral Resources

Subroute 4C2c crosses 0.1 mile of active mines and 16.4 miles of active mining claims.

Soil Resources

Subroute 4C2c crosses 2.6 miles of soils that are highly susceptible to water erosion, including the Ripsey-Rock outcrop complex along Link C450 west of Mammoth; 1.8 mile of soils that are highly susceptible to wind erosion, including the Cascabel, Quiburi, and Typic Fluvaquents along Link C441 on the west side of the San Pedro River Valley; and 12.8 miles of designated Prime or Unique Farmland soils, including the Pima and McAllister loams along Link C110 in Sulphur Springs Valley and in the vicinity of the Pinal Central Substation, which are common to all of the Route Group 4 subroutes.

Subroute 4C1 – East of San Pedro River

Geological Hazards

Subroute 4C1 crosses a single Quaternary fault on the east side of the San Pedro River Valley. This subroute crosses 8.0 miles of 100-year floodplains, largely in the San Pedro River Valley.

Mineral Resources

Subroute 4C1 crosses two active mines over 0.2 mile and three active mining claim areas over 10.1 miles.

Soil Resources

Subroute 4C1 crosses 3.2 miles of soils that are highly susceptible to water erosion, including soils similar to Subroute 4C2c and soils such as the Haplogypsids-Whitecliff-Badlands complex along Link C660 where this subroute crosses the San Pedro River. It also crosses 0.2 mile of soils that are highly susceptible to wind erosion and crosses designated Prime or Unique Farmland soils.

Subroute 4C2 – West of San Pedro River

Geological Hazards

Subroute 4C2 crosses similar geological hazards as those crossed by Subroute 4C2c.

Mineral Resources

Subroute 4C2 would cross the same mineral resource areas that would be crossed by Subroute 4C2c.

Soil Resources

Subroute 4C2 crosses 2.7 miles of soils similar to Subroute 4C2c that are highly susceptible to water erosion; 1.6 miles of soils similar to Subroute 4C2c that are highly susceptible to wind erosion; and 12.8 miles of designated Prime or Unique Farmland similar to those crossed by Subroute 4C2c.

Subroute 4C3 – Tucson

Geological Hazards

Subroute 4C3 does not cross any Quaternary fault. Subroute 4C3 crosses the greatest amount (29.0 miles) of 100-year floodplain of the Route Group 4 subroutes. This is associated with the alignment of this subroute along washes and streams in the vicinity of Tucson.

Mineral Resources

Subroute 4C3 would cross five active mines over 0.2 mile and one area of active mining claims over 13.5 miles.

Soil Resources

Subroute 4C3 crosses 2.3 miles of soils that are highly susceptible to water erosion, including the Contention-Whitecliff complex along Link F40a in the San Pedro River Valley; 6.7 miles of soils that are highly susceptible to wind erosion, including the Durazo coarse sand association along Link F40A; and the greatest amount of designated Prime or Unique Farmland soils (40.4 miles) of any Route Group 4 subroute, including the Mohall loam along C810a, Sonoita-Tubac complex along Link 540, and Anthony sandy loam along Link 510.

Local Alternative and Crossover Links for Route Group 4

Geological Hazards

Three fissures are located along links C860 and C890, near the Pinal Central Substation site. Crossover Link C502, for Subroutes 4A, 4B, and 4C1, crosses one Quaternary fault. No other local alternative link or crossover link for Route Group 4 crosses a fault or fissure.

Local Alternative Link C790, for 4A, 4B, and 4C1, crosses several 100-year floodplains. Crossover links C500, C502, and C174, for 4A, 4B, and 4C1 cross several 100-year floodplains.

Local alternative links C860 and C870 (Pinal Central Substation) cross several 100-year floodplains. Crossover Link C671, for 4A, 4B, 4C1, and 4C2, crosses one 100-year floodplain.

Local alternative links C260 and C261 (Winchester Substation) cross two 100-year floodplains. Local Alternative Link C680 (Tortolita Substation) crosses one 100-year floodplain.

All of the local alternative links for Subroute 4C3 (Pantano/Rillito) and the Tortolita Substation cross 100-year floodplains, except for Link C812.

Local alternative links C90, C121, and C211 for Subroutes 4C1, 4C2, and 4C3 cross several 100-year floodplains.

Mineral Resources

There are four mines located within the study corridor for the Pantano-Rillito local alternative (links F40b, F51, F60a, F81a, and F81b), none of which would be crossed by the centerline. Local Alternative Link C790 crosses one active mining-claim area. Four local alternative links—C72, C90, C121, and C211—are available for subroutes 4C1, 4C2, and 4C3. No other local alternative links or crossover links for Route Group 4 have impacts to mineral resources.

Soil Resources

Local Alternative Link C790 for Subroutes 4A, 4B, and 4C1 would cross 8.7 miles of soil moderately susceptible to water erosion and wind erosion; it would not cross soils designated Prime or Unique Farmland.

Local Alternative Link C692 is available for Subroute 4C1. This alternative link crosses 1.0 mile of soils that are moderately susceptible to water erosion. Local Alternative Link C692 crosses 3.6 miles of soils that are moderately susceptible to wind erosion. No designated Prime or Unique Farmland is affected by this alternative. Five local alternative links—C72, C90, C121, C211, and C790—are available for subroutes 4C1 and 4C2; whereas five crossover links—C500, C501, C502, C174, and C671—are available for subroutes 4A, 4B, 4C1, and 4C2. The soil limitations along these local alternative and crossover links are listed in Table 3-19.

Table 3-19. Soil Limitations along Local Alternative Links for Routes 4C1 and 4C2 and Crossover Links for Routes 4A or 4B/4C1 or 4C2 (in miles)

Link	High Water Erosion Potential	High Wind Erosion Potential	Moderate Water Erosion Potential	Moderate Wind Erosion Potential	Prime Farmland Soils
C72	0	0	0	0	0
C90	0	0	0.8	0.8	0.8
C121	0	0	3.0	3.0	3.0
C211	0	0	0.5	2.0	0
C790	0	0	8.7	8.7	0
C500	0	0	3.9	0	0

Table 3-19. Soil Limitations along Local Alternative Links for Routes 4C1 and 4C2 and Crossover Links for Routes 4A or 4B/4C1 or 4C2 (in miles)					
Link	**High Water Erosion Potential**	**High Wind Erosion Potential**	**Moderate Water Erosion Potential**	**Moderate Wind Erosion Potential**	**Prime Farmland Soils**
C501	0	0	0	0.5	0
C502	0	0	0.1	0	0
C174	0	0	0.8	0.5	0
C671	0	0	4.6	3.7	0

Local Alternative Link C812 is available for Subroute 4C3. This alternative link crosses 3.2 miles of soil moderately susceptible to water erosion and 2.5 miles of soil moderately susceptible to wind erosion. Local Alternative Link C812 also crosses 2.3 miles of soils that have been designated Prime or Unique Farmland.

The Winchester Substation local alternative crosses 3.4 miles of soils that are moderately susceptible to water erosion. It crosses 0.7 mile of soils that are highly susceptible to wind erosion and 4.3 miles of soils that are moderately susceptible to wind erosion. No soils that have been designated as Prime or Unique Farmland are crossed by this local alternative.

The soils along the Pantano-Rillito local alternative are generally similar to those along Subroute 4C3, with the exception that susceptible soils are crossed along the Pantano Wash rather than along the Santa Cruz River. The Pantano-Rillito local alternative crosses 0.5 mile of soils that are highly susceptible to water erosion and 5.5 miles of soils that are moderately susceptible to water erosion. It also crosses 3.4 miles of soils that are highly susceptible to wind erosion and 19.7 miles of soils that are moderately susceptible to wind erosion, as well as 4.1 miles of soils that have been designated as Prime or Unique Farmland.

The Tortolita Substation local alternative crosses 5.9 miles of soils that have been designated as Prime or Unique Farmland, including the Denure sandy loam and Dateland fine sandy loam.

The Pinal Central Substation local alternative crosses 9.5 miles of soils that are moderately susceptible to water erosion and 9.0 miles of soils that are moderately susceptible to wind erosion. It also crosses 4.7 miles of soils that have been designated as Prime or Unique Farmland, including the Gilman fine sandy loam, La Palma fine sandy loam, and Casa Grande fine sandy loam.

3.4 PALEONTOLOGICAL RESOURCES

3.4.1 Introduction, Methods, and Regulatory Framework

3.4.1.1 Introduction

Paleontological resources are any fossilized remains, traces, or imprints of organisms preserved in Earth's crust, which provide information about the history of life on Earth. Fossils include bones, teeth, shells, leaves, wood, and trackways originally buried in sedimentary deposits. Paleontological resources include not only the actual fossils, but the sedimentary deposits as

well. General concern regarding potential effects on paleontological resources was expressed during agency and public scoping for the Project.

Paleontological resources occurring on federal and state lands are afforded protection by federal and state law and regulation. Protection for paleontological resources includes requirements for the (1) assessment of areas containing significant paleontological resources that could be directly or indirectly impacted, damaged, or destroyed by development prior to, and as a consequence of, authorization of ground-disturbing activities; and (2) formulation and implementation of measures to mitigate potentially adverse impacts, including permanent preservation of the discovered sites and/or permanent preservation of salvaged materials at federal- and state-approved institutions.

Based on the results of preliminary research, the public scoping process, and consultation with the BLM, the following paleontological resources and other areas of concern were identified:

- Numerous fossil localities representing several formations, particularly in the vicinity of the Rio Grande Valley (e.g., Camp Rice, Santa Fe Group, Palomas Formations)
- Fossiliferous 111 Ranch Beds and the fossiliferous Quiburis and St. David formations

3.4.1.2 Methods

Information for the paleontological inventory was obtained from a review of scientific literature and from record searches at paleontological institutions (Table 3-20). A review of relevant published and unpublished geological and paleontological reports, and of museum paleontological locality records was conducted. The New Mexico Museum of Natural History and Science, Arizona Museum of Natural History, and the BLM were contacted for a record search of any known paleontological localities within 1 mile of the centerline of the proposed transmission lines. Other agencies contacted regarding paleontological resources for the Project include the USGS, AZGS, and Arizona State Museum (ASM). Geological mapping is primarily from Scholle (2003) and the AZGS (2000). A search for paleontological localities within the Project study area was also conducted using records from the (1) Paleobiology Database[1], operated by the University of California, Santa Barbara; (2) MioMap Database, operated by the University of California Museum of Paleontology at Berkeley; and (3) FaunMap Database, operated by the Illinois State Museum. The Paleobiology Database provides collection-based occurrence and taxonomic data for marine and terrestrial animals and plants of any geological age[2]. MioMap is a GIS that records mammal taxa, localities, and associated data for the Miocene to Pleistocene epochs in the western United States[3]. FaunMap is a database that records the late Quaternary distribution of mammals in the United States[4]. No paleontological localities are displayed on Figure M 4-1 (see Map Volume), because of the sensitive nature of paleontological locality information.

[1] Available at http://paleodb.org
[2] http://paleodb.org/cgi-bin/bridge.pl
[3] www.ucmp.berkeley.edu/miomap
[4] www.museum.state.il.us/research/faunmap/aboutfaunmap.html

Table 3-20. Institutions that Contributed to the Paleontological Record Search		
Institution	**Number of Localities within 1 Mile of Centerline**	**Date Searched**
BLM Safford District Office	0	11/12/09
Paleobiology Database, University of California Santa Barbara	0	6/5/09
MioMap mapping project, University of California Museum of Paleontology	3	2/12/10
University of California Museum of Paleontology Database	0	3/02/10
Arizona Museum of Natural History	0	3/25/10
New Mexico Museum of Natural History and Science	24	10/8/09
Arizona State Museum	0	5/14/10
FaunMap, Illinois State Museum	0	8/01/10

Information regarding the geological units and known fossil localities in the region were used to identify the paleontological potential within 1 mile of the centerline. Paleontological potential levels have been assigned by the BLM to each geological unit, using the Potential Fossil Yield Classification (PFYC) system that was adopted by the BLM in 2007, for assessing paleontological potential on federal land. The PFYC is a five-tiered system that classifies geological units based on the relative abundance of vertebrate fossils or scientifically significant invertebrate or plant fossils and their potential to be adversely impacted; with a higher class number indicating a higher potential. This classification system is applied to the geological formation, member, or other distinguishable map unit, preferably at the most detailed mappable level. This approach was followed in recognition of the direct relationship that exists between paleontological resources and the geological units within which fossils are entombed. By knowing the geology of a particular area and the fossil productivity of particular geological units that occur in the area, it is possible to predict where fossils will likely be found. Each class is defined below.

Class 1. Very Low Potential. Geological units not likely to contain recognizable fossils. These units include igneous, metamorphic, and Precambrian rocks.

Class 2. Low Potential. Sedimentary geological units not likely to contain vertebrate fossils or scientifically significant nonvertebrate fossils. These units include aeolian, diagenetically altered sediment, and Holocene deposits.

Class 3. Moderate or Unknown Potential. Fossiliferous sedimentary geological units where fossil content varies in significance, abundance, and predictable occurrence; or sedimentary units of unknown fossil potential. Class 3 is divided into two parts:

Class 3a. Moderate Potential. Units are known to contain vertebrate fossils or scientifically significant nonvertebrate fossils, but these occurrences are widely scattered. Common invertebrate or plant fossils may be found in the area.

Class 3b. Unknown Potential. Units exhibit geological features and preservational conditions that suggest significant fossils could be present, but little information about the paleontological resources of the unit or area is known. This may indicate

that the unit or area is poorly studied and that field surveys may uncover significant fossils.

Class 4. High Potential. Geological units that contain a high occurrence of significant fossils. Vertebrate fossils or scientifically significant invertebrate or plant fossils are known to occur and have been documented, but may vary in occurrence and predictability.

Class 5. Very High Potential. Highly fossiliferous geological units that consistently and predictably produce vertebrate fossils, or scientifically significant invertebrate or plant fossils.

3.4.1.3 Regulatory Framework

Federal and state governments have enacted legislation providing for varying degrees of protection for paleontological resources. The Society of Vertebrate Paleontology (SVP) regards paleontological resources as "nonrenewable scientific and educational resources that, along with their accompanying contextual data, constitute part of our natural heritage" (SVP 2009). This paleontological resource inventory was conducted in accordance with the regulations that are applicable to the paleontological resources within the Project study area. As the Project study area is located on federal, state, and private lands, an approved right-of-way is required for the Project; therefore, all of the regulations discussed below must be adhered to throughout.

Federal

The American Antiquities Act of 1906 and the Paleontological Resources Preservation Act of 2009 (PRPA) serve as the primary federal legislation that provides for the protection and conservation of paleontological resources occurring on federally administered lands. The American Antiquities Act (16 USC 431 433) provides for protection of both historic and prehistoric items on federal lands. The PRPA was enacted as part of the 2009 Omnibus Public Land Management Act, and codifies specific protection for vertebrate fossil resources and scientifically significant plant and invertebrate fossil resources on federal lands. The PRPA created criteria for the issuance of paleontological collection permits and directed the U.S. Secretary of the Interior to ensure paleontological resources discovered on federal lands are properly curated into the collections of approved repository institutions. Other laws may also apply in special circumstances.

The BLM policy for addressing potential impacts to paleontological resources on lands they administer also applies, which is included in the following documents: (1) *Paleontological Resource Management Handbook* (H-8270); (2) *General Procedural Guidance for Paleontological Resource Management* (H-8270-1); (3) *Potential Fossil Yield Classification System for Paleontological Resources on Public Lands* (Instruction Memorandum [IM] 2008-009); and (4) *Assessment and Mitigation of Potential Impacts to Paleontological Resources* (IM 2009-011).

State

The Trust Land Archaeology Department of the NMSLO states that paleontological resources are among the many assets the Commissioner of Public Lands is responsible for on state trust lands. All assets are protected from unauthorized appropriation, damage, removal, or use.

Arizona State legislature (41-841) states: "On lands owned or controlled by this state or any agency of this state a person shall not knowingly excavate in or upon any historic or prehistoric ruin, burial ground, archaeological or vertebrate paleontological site, or site including fossilized footprints, inscriptions made by human agency or any other archaeological, paleontological or historical feature, except when acting as a duly authorized agent of an institution or corporation referred to in section 41-842."

Professional Standards

SVP has established professional best practices for vertebrate paleontologists, along with more specific guidelines for the assessment and mitigation of adverse impacts to significant, nonrenewable, paleontological resources. These standards and best practices were developed by SVP in cooperation with federal and state agencies. SVP Bylaws Article 12: Code of Ethics, sections 1 and 4 state:

> "Section 1: It is the responsibility of vertebrate paleontologists to strive to ensure that vertebrate fossils are collected in a professional manner, which includes the detailed recording of pertinent contextual data, such as geographic, stratigraphic, sedimentologic, and taphonomic information."
>
> "Section 4: Scientifically significant fossil vertebrate specimens, along with ancillary data, should be curated and accessioned in the collections of repositories charged in perpetuity with conserving fossil vertebrates for scientific study and education (e.g., accredited museums, universities, colleges, and other educational institutions)."

These standards establish the protocol for the assessment and mitigation of impacts to paleontological resources. SVP (1995) summarizes its expectations for professional paleontologists operating on assessment and mitigation projects as the following:

> "Vertebrate fossils are significant nonrenewable paleontological resources that are afforded protection by federal, state, and local environmental laws and guidelines. The potential for destruction or degradation by construction impacts to paleontological resources on public lands (federal, state, county, or municipal) and land selected for development under the jurisdiction of various governmental planning agencies is recognized. Protection of paleontological resources includes: (a) assessment of the potential property to contain significant nonrenewable paleontological resources that might be directly or indirectly impacted, damaged, or destroyed by development, and (b) formulation and implementation of measures to mitigate adverse impacts, including permanent preservation of the

site and/or permanent preservation of salvaged materials in established institutions."

3.4.2 Regional Overview

The Project lies mostly within the Basin and Range Physiographic Province, which is characterized by parallel, north-south trending mountain ranges separated by desert basins (Fenneman 1931). The eastern margin of the Basin and Range Province, a physiographic region in New Mexico, is located along the Rio Grande Rift. Because of its large scale, the Project traverses a number of geological formations and geological features (Table 3-21). The geological (rock) units within the Project study area range in age from the Paleozoic to Quaternary, and preserve a record of the great changes that have occurred in western North America; ranging from a marine environment during the Permian, to marine and terrestrial environments during the Cretaceous, to large lakes and their associated river systems and periods of uplifting during the Miocene and early Pliocene, and finally to a basin-filling period during the late Pliocene and Pleistocene. These geological units and their paleontological resources are described in detail below, for New Mexico and Arizona.

Table 3-21. Geological Units and Paleontological Resources in the Study Corridors

Geological Age	Geological Unit	Fossils Found in the Project Study Area	Number of Localities within 1 Mile	PFYC	Paleontological Sensitivity
Quaternary	Younger terrace and alluvial deposits, Otero Formation	Mastodon, mammoth, gomphothere, horse, bison, camel, carnivore, tortoise, bird, mollusks, rodents	1	2	Low
Late Pliocene-Early Quaternary	Camp Rice Formation, Sierra Ladrones Formation, Palomas Formation	Reptiles, birds, rabbit, carnivores, horse, peccary, camel, gomphothere	17	4	High
Pliocene	111 Ranch Beds, Gila Group, St. David Formation, Palomas Formation, Santa Fe Group	Gomphotheres, carnivores, horse, camel, peccary, rabbit, rodents, glyptodonts, birds, reptiles, sloth, llama, antilocaprid, felid, trackways	1	4	High
Miocene	Quiburis Formation, Mineta Formation, Popotosa Formation	Canids, bear, felids, rodents, rabbits, horse, camel, antilocaprid, oreodont, rhinoceros	0	3-4	Moderate or Unknown to High
Eocene	Baca Formation, Palm Park Formation, El Rito Formation	Rhinoceros, titanotheres, reptile, horse, creodont	0	4-5	High to Very High
Cretaceous	Tres Hermanos Formation, Mancos Shale, Chinle Group, Dakota Group, McRae Formation, Bisbee Group, Mesa Verde Group, Colorado Group	Invertebrates, dinosaur, turritellids, plants, ammonites, shark, bivalves	4	2-5	Low to Very High

Geological Age	Geological Unit	Fossils Found in the Project Study Area	Number of Localities within 1 Mile	PFYC	Paleontological Sensitivity
Triassic	Moenkopi Formation, Chinle Group	Capitosaurid, Unionids, Archosaur, reptilian bones	4	5	Very High
Paleozoic	Abo Formation, Hueco Formation, Colina Formation, Madera Group, Yeso Formation, San Andres Formation, Peccha Group, Sly Gap Formation, Lake Valley Formation, Caballero Formation, Aleman Dolomite, McKelligan Formation, Yesa Formation, Cutter Dolomite, Glorieta Sandstone	Fusulinids, brachiopods, conodonts, shark, gastropods, trilobites, crinoids, coral, vertebrate trackways	2	2-3	Low to Moderate or Unknown
From sources listed in Table 3-20					

3.4.3 Paleontological Potential and Fossil Localities

3.4.3.1 New Mexico

The Rio Grande Valley within the Project study area is located between the Socorro area and El Paso, Texas, to the south. The Rio Grande lies within the Rio Grande Rift, which is a zone of faults that stretches from Mexico north to the Colorado-New Mexico state line. The Rio Grande Rift began forming approximately 24 million years ago and was initially a series of topographically closed basins that eventually filled with aeolian, alluvial, and volcanic deposits from the Tertiary through the Holocene (Bartolino and Cole 2002). Along the Rio Grande Valley are rocks that range in age from the Pliocene to the Holocene. Farther east and west of the Rio Grande Valley are scattered outcrops that range in age from the Paleozoic to Miocene.

Southwestern New Mexico is typical of the Basin and Range Province; it consists of several basins separated by mountains. The basins are filled with Pliocene-Pleistocene alluvium, and several have old playas. The Animas Basin, near Lordsburg, is a remnant of the Pleistocene Lake Animas (Hawley et al. 2000). The Mimbres Basin, which consists of rocks ranging from Precambrian to Quaternary in age, is bounded by the Black Range to the north, the Goodsight Mountains and West Potrillo Mountains to the east, and the Cedar Mountain Range to the west; its southern boundary extends into Mexico (Hanson et al. 1994). The Gila River Valley, near Duncan, is part of the Mexican Highland physiographic subdivision, which runs from southeastern Arizona to north-central New Mexico and includes Pliocene-Pleistocene alluvial and lacustrine deposits in the basins and Proterozoic through Cenozoic rocks in the mountains (Connell et al. 2005).

In New Mexico, 29 paleontological localities were found within the 2-mile-wide study corridors (as listed in Table 3-21), including a wide range of taxa from different time periods. The earliest fossil localities in the Project study area are Mississippian in age and come from the Keating

Formation in Hidalgo, Luna, and Grant counties. Brachiopods, corals, blastoids, bryozoans, trilobites, and gastropods have been found in the Keating Formation (Armstrong 1970). These fossils are from the Paleozoic Era (543 to 250 million years ago), when much of New Mexico was covered by a shallow sea. Tracks of Permian tetrapods have been found in the Abo and Hueco formations in southern New Mexico (Lucas et al. 1995; Braddy 1998; Cook et al. 1998; Lucas et al. 1998). Rocks of Triassic age near Carthage have produced dinosaur and invertebrate fossils (Lucas et al. 2000; Spielmann and Lucas 2009). The Bisbee Group of Cretaceous age has produced ammonites and bivalves in southwestern New Mexico (Lucas and Estep 1998). Plesiosaur teeth were reported from the Tres Hermanos Formation of Cretaceous age on the Sevilleta Grant north of Socorro (Spielmann and Lucas 2006). Ceratopsian dinosaur material was found in the McRae Formation of Cretaceous age east of Elephant Butte Reservoir (Lucas et al. 1998). The centrum of a mosasaur, a type of marine reptile, and associated coral were found in the Mancos Shale of Cretaceous age near Truth or Consequences.

The Baca and Hart Mine formations of Eocene age have produced Tertiary mammals, including titanotheres, rodents, horse, primates, and reptiles (Massing 1977; Lucas et al. 1981; Lucas and Williamson 1993; Prothero et al. 2004). An oreodont was found in the Popotosa Formation of Miocene age within the Bosque del Apache NWR, south of San Antonio (Morgan et al. 2009). The Camp Rice Formation of late Blancan age near Tonuca Mountain has produced fossil tortoise, birds, carnivores, horse, peccary, camel, and gomphothere (Morgan et al. 1998). The Palomas Formation of Blancan age near Socorro and Elephant Butte Reservoir has produced fossil horse, gomphothere, mastodon, antilocaprid, tortoise, camel, sloth, rodent, tapir, and reptiles (Tedford 1981; Lucas and Morgan 1999; Morgan et al. 2011). The Gila Group of late Pliocene age at Pearson Mesa near the New Mexico-Arizona state line in Hidalgo County has produced tortoise, sloth, felids, rodents, horse, peccary, camel, glyptodont, and gomphothere (Morgan and Lucas 2003).

There are numerous Pleistocene vertebrate localities scattered throughout each county in the Project study area, including cave sites in the southern portion of New Mexico (Harris 2005; Morgan and Lucas 2003).

3.4.3.2 Arizona

Southern Arizona is also typical of the Basin and Range Province, having wide basins separated by mountain ranges. One of these basins, the San Simon Valley, began forming approximately 17 million years ago and is filled with more than 10,000 feet of fluvial, playa, and lacustrine deposits ranging in age from Miocene to Pleistocene (Houser et al. 2004). The Peloncillo Mountains, northeast of the San Simon Valley, are mostly composed of Tertiary volcanic rocks. The Pinaleño Mountains to the west are predominantly Precambrian granitic rocks (*ibid*). West of the Pinaleño Mountains is Sulphur Springs Valley. As in southwestern New Mexico, old playas are found in this area. The Willcox Playa represents a remnant of the ancient Pleistocene Lake Cochise.

The area of the San Pedro and Santa Cruz rivers consists of several valleys separated by mountain ranges. The San Pedro River enters Arizona from Mexico just west of Naco, and travels northward to the towns of Benson and Mammoth, eventually emptying into the Gila River near Hayden. The San Pedro River Valley was formed during the late Miocene between

14 and 6 million years ago (Lindsay 1984). The valley is filled with basin-fill sediment ranging in age from late Miocene to Pleistocene. The Galiuro Mountains, east of the San Pedro River, consist mostly of Miocene volcanic rock, although Upper Jurassic through Paleocene sedimentary rock is present as well. Aravaipa Canyon lies north and east of the Galiuro Mountains. The Santa Cruz River valley was formed approximately 17 million years ago (Gettings and Houser 1997) and also consists of basin-fill deposits Miocene to Pleistocene in age. The Santa Rita Mountains lie east of the Santa Cruz River in Santa Cruz and Pima counties; they have a complex geological history dating to the Precambrian, with sedimentary, volcanic, and intrusive rock found there. West of the Santa Cruz River are the Tumacacori and Sierrita mountains, which consist of Mesozoic rock that overlies Paleozoic bedrock.

In Arizona, 3 paleontological localities were found within 1 mile of the centerline; 22 paleontological localities were found in the Project study area. These localities include a wide range of time periods and taxa. The smaller number of recorded fossil localities in Arizona, within 1 mile of the centerline, could be a result of a lack of a database for Arizona, such as that maintained by the New Mexico Museum of Natural History and Science for New Mexico.

The oldest rock formations containing fossils in southern Arizona are of Paleozoic age, with invertebrates and fish. This is a period in time when southern Arizona was sometimes covered by shallow seas. No Paleozoic fossil localities were found within 1 mile of the Project centerline in Arizona.

The oldest fossil land vertebrates in southern Arizona are Cretaceous in age. Iguanodontid dinosaurs have been found in the Empire, Whetstone, and Santa Rita mountains, southeast of Tucson (Moore and Miller 1960; McCord 1997; Lucas and Heckert 2005). A hadrosaur dinosaur have been found in the Bisbee Group of Cretaceous age in the Tucson Mountains (Lucas et al. 2005).

Two fossil localities of Miocene age near Mineta Ridge and Teran Wash in Pima County have produced rhinoceros teeth and footprints (Chew 1952; Lucas and Morgan 2005). The fossilized footprints are within 1 mile of the centerline of Link C266. Two fossil localities in the Quiburis Formation of Miocene age near Redington have produced fossil carnivore, rabbit, rodent, horse, camel, and mastodon material (Lindsay and Tessman 1974; Jacobs 1977; Morgan and White 2005). Several fossil localities in the St. David Formation of Pliocene age near Benson have produced fossil sloth, carnivore, felid, rabbit, rodent, horse, peccary, camel, cervid, and gomphothere material (Gidley 1926; Gazin 1942; Downey 1968; Lammers 1970; Lindsay and Tessman 1974; Lindsay et al. 1990). The St. David Formation extends farther north and is crossed by the alternative routes. Several fossil localities in the 111 Ranch Beds of Pliocene age in San Simon Valley in Graham County have produced fossil sloth, carnivore, glyptodont, bat, rabbit, rodent, horse, tapir, peccary, camel, cervid, antilocaprid, and gomphothere material along with track sites (Knechtel 1938; Wood 1962; Galusha et al. 1984; Tomida 1987; McCord et al. 2002; Pasenko 2007; Thrasher 2007).

Two Pleistocene fossil localities were found within 1 mile of the centerline for the subroutes in Arizona near Links C246 and B160B. Numerous other Pleistocene fossil localities occur throughout the study area in Arizona (Mead et al. 2005). A mastodon skull and several mammoth bones have been found in an area between the Bowie townsite and Safford, in Pleistocene

alluvium (Tegowski and White 2000; Pasenko 2012). Several Pleistocene localities are also known from the Willcox Playa (ancient Lake Cochise), containing mammoth, bison, camel, and horse material (Bryan and Gidley 1926; Saunders 1970; Mead et al. 2005). There are Pleistocene localities throughout the San Pedro River Valley in Cochise, Pima, and Pinal counties that contain mammoth, mastodon, horse, camel, and bison material. Nineteen documented mammoth sites are located along the San Pedro River Valley and its tributaries in Arizona (Haury et al. 1953; Haury et al. 1959; Hemmings and Haynes 1969; Saunders 1970; Cannon and Meltzer 2004; Haynes 2007). More than 25 percent of known mammoth sites in Arizona are found along the San Pedro River Valley and its tributaries (Saunders 1970). These 19 mammoth sites are found as far south as the Mexico border and as far north as Pinal County, Arizona; cumulatively, they contain at least 35 individual mammoths. Associated with the mammoths are fossils of mastodon, bison, camel, horse, dire wolf, peccary, and tapir. In addition, mammoth tracks were discovered at Murray Springs. In general, the mammoth sites are found in Pleistocene alluvial and lacustrine deposits. Similar Pleistocene deposits have been found throughout the San Pedro River Valley, including the Cerros Negros mammoth locality in southeastern Pinal County (*ibid*). Although Pleistocene alluvium is generally categorized with a PFYC of 2, given the high presence of fossil localities along the San Pedro River Valley, it is possible a chance discovery could be made during the construction phase of the Project.

Four Pleistocene mammoth localities along the San Pedro River Valley in southern Cochise County have cultural associations: Lehner Ranch, Murray Springs, Naco, and Escapule. These localities are interpreted to be kill sites, where ancient people killed and processed mammoths and other large land mammals (megafauna) approximately 13,000 years ago. Artifacts found at these sites include projectile points, bifaces, utilized flakes, tertiary flakes, cores, and tools made from bison and mammoth bone. At Murray Springs and the Lehner Site, hearths were discovered. The term "Clovis" was given to this type of Paleoindian, stone-age technology; named after a mammoth kill site located near Clovis, New Mexico. The mammoth kill sites are important because they represent the most direct evidence of human predation on extinct mammoths and other large land mammals that lived 13,000 years ago. A majority of the mammoth sites along the San Pedro River Valley represent a time during the late Pleistocene when much of the megafauna (e.g., mammoth, mastodon, ground sloth, glyptodont, dire wolf, saber-toothed cat, American lion, American cheetah, camel, and horse) were going extinct in North America. The San Pedro River Valley has the densest concentration of early Paleoindian sites with extinct megafaunal remains in North America (Cannon and Meltzer 2004), and probably in South America as well.

3.4.4 Potential Fossil Yield Classification

3.4.4.1 New Mexico

In New Mexico, geological units with a PFYC of 4 or 5 within the study corridors include the Paleocene Nacimiento Formation; Eocene Baca, Palm Park, and El Rito formations; Miocene Popotosa Formation; Pliocene Palomas Formation and Santa Fe Group; and Pliocene/Pleistocene Camp Rice and Sierra Ladrones formations. Geological units that have a PYFC of 3 include the Paleozoic Abo Formation, Cretaceous Tres Hermanos and McRae formations, and Chinle and Mesa Verde groups.

3.4.4.2 Arizona

In Arizona, geological units with a PFYC of 4 or 5 within the study corridors include the Miocene Quiburis Formation, and the Pliocene 111 Ranch beds, Gila Group, and St. David Formation. In Arizona, only the Mineta Formation has a PFYC of 3.

3.4.5 Summary of Inventory Results

The paleontological inventory results are summarized below and in Table 3-21. The paleontological resource inventory is illustrated on Figure M 4-1 (see Map Volume).

Table 3-22. Summary of Paleontological Resource Inventory Data

Alternative Route	Paleozoic Localities	Mesozoic Localities	Cenozoic Localities	Total Number Localities
Route Group 1: SunZia East Substation to Midpoint Substation				
North River Crossing	2	0	16	18
San Antonio Crossing	0	8	1	9
Route Group 3: Midpoint Substation to Willow-500 kV Substation				
North San Simon Basin	0	0	1	1
South San Simon Basin	0	0	0	0
Route Group 4: Willow-500 kV Substation to Pinal Central Substation				
North of Mt. Graham	0	0	0	0
Sulphur Springs Valley	0	0	0	0
San Pedro Valley	0	0	1	1
Tucson/I-10 Corridor	0	0	1	1
I-10 East – Pantano/Rillito	0	0	0	0

3.4.5.1 Route Group 1: SunZia East Substation to Midpoint Substation

Subroute 1A1 – North River Crossing

Subroute 1A1 begins at the SunZia East Substation and proceeds west along links E82, E84, and E85 through the Gran Quivira area. From there, the subroute continues west along links E101a, E101b, and E133, and eventually crosses the Rio Grande at Link E180. From there it proceeds south along links E211, A161, A161, and eventually A260, near Elephant Butte Reservoir. Subroute 1A1 then continues south to Midpoint Substation. Subroute 1A1 has 18 fossil localities within 1 mile of the centerline (see Table 3-22); including two Permian localities in the Abo Formation (PFYC of 2), along Link E101a/b, that have produced fossil invertebrates, plants, and vertebrate tracks. Two localities are in the Blancan Sierra Ladrones Formation (PFYC of 4) along link E180. These localities contain a fossil proboscidean tusk, horse teeth, horse postcrania, and a camel phalanx. The remaining 14 localities are in the Blancan Palomas Formation (PFYC of 4) along Link E180, and contain numerous fossil horse teeth and postcrania, an antilocaprid metatarsal, and a llama metatarsal.

Subroute 1A2 – BLM Preferred Alternative

Subroute 1A2 is similar to 1A1 throughout most of the route except between the SunZia East Substation and the Rio Grande, where Subroute 1A2 takes a more northern route along E86a and E86b. The fossil localities that are found within 1 mile of the centerline for 1A2 are the same as for 1A1, due to the shared links.

Subroute 1A – North River Crossing

Subroute 1A is similar to 1A1 throughout most of the route, except near the SunZia East Substation where Subroute 1A begins on a slightly more southern route along E80c, and uses instead the more western Link A270 in the Elephant Butte Reservoir area. The fossil localities that are found within 1 mile of the centerline for 1A1 are the same as for 1A, because of the shared links.

Subroute 1B – San Antonio Crossing

Subroute 1B1 begins at the SunZia East Substation along the same links as 1A1, but at Link E80d it proceeds south along links E90 and A90, before proceeding west across the Rio Grande. Subroute 1B1 utilizes Link A270 in the Elephant Butte Reservoir area. Subroute 1B2 is similar to 1B1 except at the beginning near the SunZia East Substation, where it begins along a more southern route using links A30, A50, and A60. Subroute 1B2 also utilizes Link A270 in the Elephant Butte Reservoir area. Subroutes 1B1 and 1B2 do not use Link E180, and as a result has fewer fossil localities within 1 mile of the centerline than does 1A1.

Subroutes 1B1 and 1B2 have 9 fossil localities different than 1A1 (see Table 3-22). Eight of these fossil localities are Mesozoic in age and are located within close proximity to Link A111. Two of these Mesozoic localities are within the Moenkopi Formation of Triassic age and contain fossil capitosaurids. Two other Mesozoic localities are within the Chinle Group of Triassic age and contain archosaur and reptile fossils. Four of the Mesozoic localities are within the Mancos Shale and Greenhorn Limestone of Cretaceous age. The last of the 9 localities is located along Link A112 in the Sierra Ladrones Formation of Pleistocene age, and contains fossil turkey, horse, and camel.

The local alternative links (E81, E83, E82, E84, and E85) for 1B1 (Gran Quivira area) do not have any fossil localities within 1 mile of the centerline.

The local alternative links for 1A, 1B1, 1B2, and 1B3—A161b, A260, A361, A430, A481—do not have any fossil localities within 1 mile of the centerline.

3.4.5.2 Route Group 3: Midpoint Substation to Willow-500 kV Substation

Subroute 3A2 – BLM Preferred Alternative

Subroute 3A2 begins at the Midpoint Substation and proceeds west through the Deming area along links B60 and B90. From there it continues west along links B120a and B120b approaching the Lordsburg area, and then on to links B121, B160a, B160d, and B160c. There is

one fossil locality within 1 mile of this subroute located along Link B160d, which includes a camel ulna, a turtle shell fragment, and unidentifiable bone fragments. This fossil locality was found in sediments correlative to the 111 Ranch Beds.

Subroute 3A – North

Subroute 3A is similar to 3A2, but utilizes Link B160b instead of B160d. There is one fossil locality within 1 mile of this subroute located along Link B160b, which is the same as the one reported along Subroute 3A2.

Subroute 3B – South

Subroute 3B begins at the Midpoint Substation and proceeds west to Lordsburg along links B60, B80, B110a, B110b, and B112, generally south of subroutes 3A2 and 3A. Subroute 3B continues west-northwest to the Willow Substation along links B150a, B150b, B151, and B170. There are no known fossil localities within 1 mile of this subroute.

Crossover links B111 and B140, available for Route Group 3, do not have any fossil localities within 1 mile of the centerline.

3.4.5.3 Route Group 4: Willow-500 kV Substation to Pinal Central Substation

Subroute 4A – North of Mt. Graham

Subroute 4A proceeds north from the Willow-500 kV Substation along Link B153a, east of the Pinaleño Mountains. At a point north of the Pinaleño Mountains, Subroute 4A heads west along links B153b and C170, crosses the San Pedro River at Link C592, and continues west along links C595, C620, C760, and C780, eventually reaching the Pinal Central Substation. There are no recorded fossil localities within 1 mile of the centerline for Subroute 4A.

Subroute 4B – Sulphur Springs Valley

Subroute 4B proceeds west from Willow-500 kV Substation along links C71, C72, and C90. It continues north along links C130a and C130b, west of the Pinaleño Mountains. Beginning at Link C173, Subroute 4B is common to 4A. There are no recorded fossil localities within 1 mile of the centerline for Subroute 4B.

Subroute 4C2c – BLM Preferred Alternative

Subroute 4C2c proceeds west from the Willow-500 kV Substation along links C71, C71a, and C110, and continues southwesterly along C212, C260, and A261, where it eventually crosses the San Pedro River. From there it continues northward along links C201, C441, and C450. Subroute 4C2c proceeds west along Link C661 in the San Manuel/Oracle area, continues west to the Tortolita Substation, and then heads north along Link C820, eventually reaching the Pinal Central Substation. One fossil locality is located within 1 mile of the centerline for Subroute

4C2c at Link C201. This locality contains a fossil mammoth found in Pleistocene alluvium, which has a PFYC of 2.

Subroute 4C1 – East of San Pedro River

Subroute 4C1 is similar to 4C2c at the beginning and the end of the subroute, except that 4C1 proceeds northward, east of the San Pedro River along links C301, C331, C361, and C470. Subroute 4C1 crosses the San Pedro River south of subroutes 4A and 4B, and north of Subroute 4C2c, at Link C510. There are no recorded fossil localities within 1 mile of the centerline for Subroute 4C1.

Subroute 4C2 – West of San Pedro River

Subroute 4C2 is similar to 4C2c, except between links C212 and C441 where 4C2 varies slightly along a more northern segment that includes links C270, C271, C266, and C276. There is one recorded fossil locality within 1 mile of the centerline for Subroute 4C2.

Subroute 4C3 – Tucson

Subroute 4C3 is similar to 4C2c from the Willow Substation through Link C261. From there Subroute 4C3 continues southwesterly along links F40a, F600, F60b, F82, F80, and F11 as it approaches the Tucson area. Here it continues northwesterly along links F112, F510, and F540 before reaching the Tortolita Substation. From there it proceeds north along links C816, C817, and C820 before turning west and reaching the Pinal Central Substation.

Local Alternative Link C201 has one fossil locality within 1 mile of the centerline. No other local alternative links or crossover links have fossil localities within 1 mile of the centerline.

3.5 WATER RESOURCES

3.5.1 Introduction, Methods, and Regulatory Framework

3.5.1.1 Introduction

This section presents an overview of the surface water and groundwater resources within the Project study area that may be affected by construction and operations of the proposed Project. Water resources include rivers, streams, lakes, other water bodies, groundwater, aquifers, wells, and springs.

Based on the results of preliminary research, the public scoping process, and consultation with the BLM, the following water resource issues were identified:

- Aravaipa Creek, Rio Grande, San Pedro River, and associated perennial and intermittent streams
- Water wells around the Tucson Sole Source Aquifer, and parallel to the Santa Cruz River

3.5.1.2 Methods

Information for the water resources inventory was obtained from the scientific literature and from government agencies and institutions, including the BLM, USFS, EPA, USFWS, USGS, New Mexico Office of the State Engineer, and the ADWR. Specific water resources were inventoried within a study corridor that is 2 miles wide (1 mile on either side of the centerline). Because of the large scale of the Project, the water resource maps show resources within a 6-mile-wide study corridor for each alternative, including watersheds, perennial and intermittent streams, lakes and reservoirs, sole source aquifers, springs, and wells. Within these study corridors, perennial and intermittent streams, water bodies, springs, and wells were identified for impact assessment within 600 feet of the Project centerline; whereas unique or impaired waters were identified for impact assessment within 0.25 mile of the Project centerline. The distance of a 0.25 mile was used for impaired and outstanding waters, since this is the minimum distance used by the ADEQ for discharges to impaired waters involving construction-related activities and possible permitting. There are no current policies or regulations for BLM or state lands in New Mexico or Arizona regarding construction activities and distance to streams or rivers. Six-hundred feet was used as a conservative measure to identify water resources that could be impacted by the Project.

Based on the National Hydrography Dataset obtained from the USGS, the Project crosses hundreds of intermittent streams. As a result, a sample of 20 percent of the intermittent streams was used to estimate the amount of disturbance for streams and jurisdictional waters. The width of these streams was measured using ArcGIS, providing an average width for each alternative route. This width was then used to calculate acreage of disturbance based on the access model.

3.5.1.3 Regulatory Framework

Federal

The Federal Water Pollution Control Act of 1972 (33 USC 1251-1387) is more commonly known as the CWA of 1977, after major amendments to the Act in that year. The objective of the CWA, as amended, is to restore and maintain the chemical, physical, and biological integrity of the nation's waters. Individual sections of the CWA maintain and protect the nation's water resources. The following sections of the Act may influence the construction and operations of the Project.

Section 302: Water Quality Related Effluent Limitations. Under Section 302, water quality standards designated by the state-set levels of allowable pollutants are called Total Maximum Daily Loads (TMDL). This pollutant allotment criterion is designated for a specific water body relative to its particular usage (e.g., recreation, water supply, aquatic life, agriculture). A water quality criterion (numeric pollutant concentrations and narrative requirements) is also designated to protect particular resource uses. If the Project has the potential to add pollutants to a particular water resource, it may be necessary to mitigate impacts to avoid exceeding the TMDL.

Section 303: Water Quality Standards and Implementation Plans, Designation of Impaired Waters. Water bodies not meeting state-mandated water quality standards are presented to the EPA for designation as impaired waters and issuance of federal protection under a TMDL.

Impaired waters that may potentially be affected by the Project are subject to limitations set forth by the TMDL issued for a particular impaired water. If there is a high probability that the Project will affect an impaired water, modification to the National Pollutant Discharge Elimination System (NPDES) construction general permit could be required.

Section 319: Effluent Limitations from Nonpoint Sources. Nonpoint source pollution management, under Section 319 of the CWA, was created following the 1987 amendments to the Act. Section 319 regulates the discharge of pollutants from various sources, which culminate to reduce water quality standards set by the state. If the Project has the potential to add nonpoint source pollutants to a particular resource protected by a TMDL, it may be necessary to mitigate impacts and potentially require the Project to be included into the TMDL permit.

Section 401: Water Quality Certification. An application for a federally permitted activity that may result in a discharge into Waters of the United States must obtain a 401 Certification from the state with jurisdiction, certifying the action will not violate state or federal water quality standards. In New Mexico, the 401 Certificate is issued by the New Mexico Pollutant Discharge Elimination System (NMPDES); in Arizona, the 401 Certificate is issued by the Arizona Pollutant Discharge Elimination System (AZPDES).

Section 402: National Pollutant Discharge Elimination System. The states of New Mexico and Arizona have been delegated permit authority over the federal NPDES and each maintains the NMPDES and AZPDES, respectively, which regulate water quality standards specifically by issuing and monitoring construction related permits.

Section 404: Dredge or Fill in Waters of the United States. The CWA regulates the dredging or filling of any material into Waters of the United States under the regulatory jurisdiction of the USACE. If the Project requires the dredge or fill in a Water of the United States as defined in the CWA, it may be necessary to obtain a federal permit to conduct the work. Waters of the United States are defined as waters that are "currently used or were used in the past or may be susceptible to use in interstate or foreign commerce, including all waters subject to the ebb and flow of the tide and all interstate waters including interstate wetlands" (33 CFR Part 328.3). An assessment of jurisdictional waters would be performed prior to construction. The inventory for the FEIS was conducted as described in Section 3.5.1.2.

EO 11990: No Net Loss of Wetlands. This EO directs federal management agencies to: (1) provide leadership and to take action to minimize the destruction, loss, or degradation of wetlands; (2) preserve and enhance the natural and beneficial values of wetlands; and (3) avoid direct or indirect support of new construction in wetlands, unless there are no practicable alternatives to such construction and the proposed action includes all practicable measures to minimize any harm done. This Project was sited so that there are no wetlands in the Project study area; therefore, this regulation is identified but is not further discussed.

Safe Drinking Water Act. The Safe Drinking Water Act (SDWA) is the main federal law that ensures the quality of drinking water. It was originally passed by Congress in 1974 to protect public health by regulating the nation's public drinking water supply. The law was amended in 1986, and again in 1996. Many actions are required to protect drinking water and its sources, which include rivers, lakes, reservoirs, springs, and groundwater wells. Under the SDWA, the

EPA sets the standards for drinking water quality and oversees the states, localities, and water suppliers who implement those standards; the SDWA does not regulate private wells that serve fewer than 25 individuals (EPA 2004a). The SDWA also mandates that a groundwater wellhead protection program be developed by each state to protect groundwater resources that serve as sources for public drinking water. Section 1424(e) authorized the development of the Sole Source Aquifer Program. A sole source aquifer, as defined by the EPA, is one "that supplies at least 50 percent of the drinking water consumed in the area overlying the aquifer. These areas may have no alternative drinking water source(s) that could physically, legally and economically supply all those who depend on the aquifer for drinking water" (EPA 2011e).

State

New Mexico Water Quality Control Commission. Protection of water resources in New Mexico for federal and state regulations is implemented at the state level through the New Mexico Water Quality Control Commission (NMWQCC). The responsibilities of the NMWQCC include the CWA, wellhead protection program, and the Sole Source Aquifer Program of the SDWA (§74-6-3.E, NMSA 1987).

Arizona Department of Water Resources. The ADWR enforces the Arizona groundwater code and surface-water rights, and oversees the use of surface and groundwater resources (including sole source aquifers) under state jurisdiction. The ADEQ has established the Wellhead Protection Program as a guide to prevent contamination of groundwater.

3.5.2 Regional Overview by Watershed

The Project lies mostly within the Basin and Range Province (Fenneman 1931). Within this province, the Project crosses one large principal aquifer system: the Basin and Range Aquifer. In New Mexico, this large principal aquifer includes the Rio Grande Aquifer system (Anning et al. 2009). Both systems are composed mostly of basin-fill, which consists of unconsolidated to consolidated gravel, sand, silt, and clay overlying consolidated rock (Robson and Banta 1995). In New Mexico, the Project crosses both systems; in Arizona, it lies completely within the larger Basin and Range Aquifer. In general, groundwater levels for areas within the Project study area range from 0 to more than 400 feet below ground surface. Surface water, represented by numerous perennial and intermittent rivers and streams, shows a strong relationship to seasonal trends in temperature and precipitation. Each watershed within the Project study area consists of several basins that contain numerous rivers, streams, and washes, most of which are not perennial throughout their length (Table 3-23).

3.5.2.1 New Mexico

There are eight watersheds within the study corridors in New Mexico. The Rio Grande-Albuquerque Watershed is located within an area from just north of Albuquerque to an area south of Socorro. The Middle Rio Grande-Albuquerque Watershed encompasses 959 square miles, and its annual precipitation ranges between 8 and 20 inches (Middle Rio Grande-Albuquerque Reach Watershed Group 2008). The Rio Grande flows throughout most of its length, but flow has declined considerably due to irrigation for agriculture. The Rio Grande is listed on the state's Impaired Waters List.

Table 3-23. Regional Surface-Water Features within the Study Corridors		
Watershed	**Main River**	**Perennial Streams or Washes Crossed by Alternative Routes**
New Mexico		
Rio Grande-Albuquerque	Rio Grande	Arroyo del Veranito, Nogal Arroyo, Torreon Arroyo
Tularosa Basin		None
Jornada del Muerto		Arroyo Seco, Chupadera Arroyo
Elephant Butte Reservoir	Rio Grande	Rock Creek, Spikey Arroyo, Indian Creek, Alamosa Creek
Caballo	Rio Grande	Cuchillo Negro Creek, Palomas Creek, Cañada Honda, Salado Creek, King Arroyo, Las Animas Creek, Seco Creek, Greyback Arroyo, Greenhorn Arroyo, Percha Creek
El Paso-Las Cruces	Rio Grande	Montoya Arroyo, Tierra Blanca Creek, Oak Spring Creek, Jaralosa Creek, Berrenda Creek
Mimbres River	Mimbres River	Walnut Creek
Animas Valley		None
Arizona		
San Simon		San Simon River, Dial Wash, Willow Spring Wash, Owl Wash
Willcox Playa		Bee Canyon Wash, Wood Canyon, Martin Wash, Sacaton Wash
Middle Gila	Gila River	Bogart Wash, Florence Casa Grande Canal, Suffering Wash, Tom Mix Wash, Coronado Wash, Parker Wash
Upper Gila-San Carlos Reservoir	Gila River	Stockton Wash, Ash Creek, Bear Springs Wash, Underwood Wash
Upper Santa Cruz	Santa Cruz River	Big Wash
Lower Santa Cruz	Santa Cruz River	None
Rillito		Rillito River, Pantano Wash, Cienega Creek, Tanque Verde Wash
Upper San Pedro River	San Pedro River	Ash Creek
Lower San Pedro River	San Pedro River	Whitlock Wash, Bloodsucker Wash, Camp Grant Wash, Fourmile Creek, Right Prong Fourmile Creek, Squaw Creek, Aravaipa Creek, Big Wash, Teran Wash, Pool Wash, Paige Creek, Palomas Wash
Source: USGS 2009; New Mexico Water Resources Research Institute 2010a; ADWR 2009, 2010		

The Jornada Del Muerto Watershed begins north of Bingham, New Mexico, and Highway 380; and continues south to an area where it is bordered by the Oscura and San Andreas mountains to the east. A portion of the WSMR is covered by this watershed. The Jornada del Muerto Watershed covers approximately 3,344 square miles (New Mexico Water Resources Research Institute 2010b).

The Elephant Butte Reservoir Watershed encompasses an area from just north of San Marcial, south to Truth or Consequences, and northwest to include the San Mateo Mountains. The Caballo Watershed begins at Truth or Consequences and continues south to the southern tip of Caballo Lake. The Caballo Reservoir is bordered on the east by the Caballo Mountains and extends northwest and west, including the Salado Mountains.

The El Paso-Las Cruces Watershed begins at the southern tip of Caballo Lake and has an irregular shape continuing south along I-25 and the Rio Grande, through Las Cruces and El Paso.

The Mimbres Watershed is centered on Deming and includes the western-most portion of Doña Ana County and most of Luna County, and extends south into Mexico. The Mimbres Watershed headwaters are in the Black Range on the west- and south-facing slopes. From there, it flows south toward Deming, where it intermittently flows aboveground and eventually reaches Mexico. A portion of the Mimbres River is perennial within Grant County (Hanson et al. 1994).

The Animas Valley Watershed is centered on Lordsburg, but continues south, in a narrow band almost to the Mexico border where it is bordered by the Peloncillo Mountains to the west and the Animas and Pyramid mountains to the east. This watershed includes parts of Luna, Grant, and Hidalgo counties.

3.5.2.2 Arizona

There are nine HUC-8 watersheds within the study corridors in Arizona. The Upper Gila River Watershed includes portions of Graham and Greenlee counties, and extends as far south as Safford and the Pinaleño Mountains. It extends northwest to include the San Carlos Reservoir. The Upper Gila River Watershed ranges in elevation from 2,990 to 10,028 feet; it receives 12 inches of rain annually (ADEQ 2008a).

The Willcox Playa Watershed is centered on the Willcox Playa, with its northern boundary bordered by the Pinaleño Mountains to the east and the Winchester and Galiuro mountains to the west. This watershed encompasses 1,911 square miles and averages between 11 and 21 inches of annual precipitation (ADWR 2009).

The Middle Gila River Watershed begins at the Coolidge Dam in the San Carlos Indian Reservation, and extends west through areas around Eloy, Coolidge, Picacho Peak State Park, and the southern Phoenix metropolitan area, and continues to Gila Bend. The watershed extends farther north of Phoenix, including areas around Dewey, Wickenburg, and Salome. The Middle Gila River Watershed encompasses 12,250 square miles and ranges in elevation between 1,100 and 7,400 feet. The watershed receives approximately 13 inches of rainfall annually (ADEQ 2008a). All of the rivers and streams within the Middle Gila River Watershed are intermittent, although there are some reaches of each that are considered perennial. The smaller streams are ephemeral.

The Lower San Pedro River Watershed begins near Dudleyville, Arizona, just south of Highway 177; and continues south along the San Pedro River through the area around San Manuel and east of the Santa Catalina Mountains, and as far south as North Cascabel Road near the junction of the San Pedro River and Redrock Creek. This watershed includes portions of Pinal, Graham, Pima, and Cochise counties. The Lower San Pedro River Watershed averages between 14 and 32 inches of annual precipitation (Arizona Water Atlas 2009). Aravaipa Creek enters the San Pedro River north of Mammoth, Arizona. The Upper San Pedro River Watershed begins at the southern boundary of the Lower San Pedro River Watershed, north of Benson, and continues south along the San Pedro River into Mexico.

The Lower Santa Cruz River Watershed includes the area around the Tortolita Substation and the area around Marana. The Upper Santa Cruz Watershed begins northeast of Tucson between the Santa Catalina Mountains to the southeast and the Picacho Mountains to the northwest. From there, it follows the Santa Cruz River through Tucson, south through Green Valley and into Mexico. Both Lower and Upper Santa Cruz River watersheds encompass approximately 11,100 square miles and range in elevation from 1,100 to 9,156 feet. They receive approximately 15 inches of rain annually (ADEQ 2008a). Major tributaries for this mostly ephemeral river include Rillito Creek, Cañada del Oro, and Big Wash. The Upper Santa Cruz Basin covers 4,616 square miles (Coes et al. 2002), and its basin-fill is generally more than 3,000 feet thick. The depth to groundwater ranges from 30 to 300 feet below ground surface, with shallower groundwater level located south of an "inferred fault" north of Tubac (*ibid*).

The Rillito Watershed is a small watershed between the Lower and Upper San Pedro River watersheds to the east, and the Upper Santa Cruz Watershed to the west. This watershed includes areas around the Santa Catalina Mountains, and south between the Whetstone Mountains to the east and the Empire Mountains to the west.

There are 11 named bodies of water within the study corridors, and numerous unnamed bodies of water within the study corridors (Table 3-24). These 11 bodies of water are small, man-made reservoirs or tanks used to collect and store water for subsequent municipal and agricultural use. There are no natural bodies of water in the study corridors.

Table 3-24. Named Bodies of Water within the Study Corridors

State	Body of Water	Link
New Mexico	Joe Pankey Reservoir Number 2 McDougal Tank H Bierner Number 2 Reservoir Barksdale Tank Cup Tank Big Tank	A260 A60 A270 B110a A330b B121
Arizona	Gilman Tank Dean Tank Seven Cross Tank Clemans Tank Rattlesnake Tank	C90 B150a B153b C840 C690

3.5.3 Regional Overview by Groundwater Area

3.5.3.1 New Mexico

The study corridor crosses the large Rio Grande Aquifer system, which encompasses 70,000 square miles and flows through Colorado, New Mexico, and Texas. The Rio Grande Aquifer system in New Mexico is part of the Basin and Range Aquifer and "consists of a network of hydraulically interconnected aquifers in basin-fill deposits located along the Rio Grande Valley and nearby valleys" (Robson and Banta 1995). The Rio Grande Aquifer system is composed of numerous basins in New Mexico, six of which are crossed by the study corridors. These Declared Underground Water Basins, as defined by the New Mexico Office of State Engineer,

are the Tularosa, Middle Rio Grande, Lower Rio Grande, Mimbres, Lordsburg, and Animas basins. Also included in the study corridors is the Hot Springs Artesian (Noftsker 2005). The Lower Rio Grande Basin begins in El Paso, Texas, and extends north to the southern extent of the Elephant Butte Reservoir. The Lower Rio Grande basin contains mostly basin-fill alluvial deposits. The Middle Rio Grande hydrogeological region continues from the Elephant Butte area in Socorro County, northward to Cochiti in Sandoval County. The Rio Grande is the major drainage for both the Lower and Middle Rio Grande basins (Robson and Banta 1995).

The Middle Rio Grande's southern boundary is commonly defined, by some, as ending near San Acacia, New Mexico (Bartolino and Cole 2002); whereas others extend its southern boundary to the Elephant Butte area (Hawley 2001). The Middle Rio Grande Basin covers approximately 3,060 square miles; encompassing parts of Santa Fe, Sandoval, Bernalillo, Valencia, Socorro, Torrance, and Cibola counties (Bartolino and Cole 2002). For the study corridors, this includes an area north of Socorro south to Elephant Butte Reservoir. Like the Lower Rio Grande Basin, the Middle Rio Grande Basin consists of the Santa Fe Group, which varies in thickness from 1,400 to 14,000 feet and is the main water-bearing unit. Groundwater level varies from 2 feet below ground surface near the Rio Grande to 1,180 feet below ground surface beneath West Mesa. The annual precipitation ranges between 7 and 23 inches, and the average annual temperature ranges from 35 degrees Fahrenheit in January to 79 degrees Fahrenheit in July (*ibid*).

The Tularosa Basin, for SunZia, includes the area west of SunZia East Substation and north of the Chupadera Mountains. The Tularosa Basin covers approximately 17,000 square miles and has a mean annual precipitation of 11 inches (Huff 2005).

The small Animas and Lordsburg basins are located within the study corridors in Hidalgo and Grant counties. Several playas are present in these basins, including the ancient Lake Animas (Reeder 1957). The intermittent Animas Creek is the main drainage of the Animas sub-basin. In these basins, groundwater level varies between less than 100 feet below ground surface in areas of perched water, to greater than 200 feet below ground surface in other areas of the basin (*ibid*).

The Mimbres River Basin covers more than 5,000 square miles in Sierra, Luna, Doña Ana, and Grant counties; the southern portion of the basin extends into Mexico. The Mimbres River Basin is bounded by the Black Range to the north; Goodsight, Sierra de las Uvas, and West Potrillo mountains to the east; and Cedar Mountain Range to the southwest. Deming, New Mexico is located approximately in the center of the basin. The Mimbres River is the main drainage in the Mimbres River Basin, and is only perennial at its headwaters north of the Grant-Luna county line. Elevation ranges from 3,700 to 10,011 feet above sea level. The annual precipitation for the Mimbres River Basin is 9 to 24 inches, and the mean monthly temperature at Deming is 41 degrees Fahrenheit in January and 81 degrees Fahrenheit in July. The major uses of water are for agriculture, mineral processing, and the urban water supply. Thirty-three springs and an unknown number of seeps are scattered throughout this basin, commonly as a result of fractured bedrock. The main source of groundwater in the Mimbres River Basin is the bolson-fill aquifer, consisting mostly of the Gila Conglomerate. The bolson-fill varies in thickness from 50 to 3,770 feet; with groundwater level ranging from 7 to 140 feet below ground surface (Hanson et al. 1994).

3.5.3.2 Arizona

The hydrogeological areas in Arizona crossed by the study corridors are the Duncan and Eloy sub-basins; Safford, Willcox, Aravaipa, Lower San Pedro River, and Upper Santa Cruz River basins; and Avra Valley.

The Duncan Sub-basin is near the Arizona-New Mexico state line, which includes that portion of the basin between Duncan and San Simon. The major drainage is the Gila River near Duncan. Elevation ranges between 3,400 and 7,000 feet, and annual precipitation is between 9 and 16.4 inches (New Mexico Water Resources Research Institute 2010a). Groundwater level ranges between 21 and 500 feet below ground surface (Remick 1989) and groundwater flow is to the north. The Duncan Sub-basin, which is part of the Gila River Watershed, lies within parts of Greenlee and Cochise counties in Arizona, and Hidalgo and Grant counties in New Mexico.

The study corridors cross a large portion of the San Simon Sub-basin, which is part of the larger Safford Basin. The area from the Bowie townsite east across the New Mexico state line, and north to an area just south of Safford, is included in the San Simon Sub-basin. This sub-basin covers 1,930 square miles, with basin-fill ranging between 4,000 and 6,400 feet thick (Towne and Rowe 2004). Groundwater level ranges from 1 to 700 feet below ground surface. Groundwater flow is typically from the surrounding mountains to the middle of the basin, but groundwater pumping has lowered the water level in some areas, creating cones of depression that interrupt this movement (*ibid*).

The study corridors cross the northern half of the Willcox Basin, from Willcox north through the Winchester Mountains to the west, and the Pinaleño Mountains to the east. A topographical high at the north end of this basin separates it from the Aravaipa Basin to the north. Elevation ranges between 4,100 and 8,800 feet; and annual precipitation is between 10 and 48 inches. There are five perennial streams in the Willcox Basin, two of which are crossed by the subroute near Bonita (Grant and Big Creek). The USGS has identified as many as 92 springs within the Willcox Basin (ADWR 2010). Groundwater in the Willcox Basin is found in the basin-fill, stream deposits, and lake deposits; and groundwater level ranges from 34 to 649 feet below ground surface, with movement generally toward the Willcox Playa (Towne et al. 2001).

The study corridors for subroutes 4A and 4B cross the Aravaipa Basin from Klondyke southeast, between the Galiuro Mountains to the west and the Pinaleño Mountains to the east. The Aravaipa Basin covers 537 square miles and is drained by Aravaipa Creek, a tributary of the San Pedro River. Groundwater level ranges from 26 to 500 feet below ground surface (ADWR 2009).

The Tucson Active Management Area (AMA) is located in the area north of Oracle. Elevation ranges from 1,770 to 9,400 feet; and annual precipitation ranges between 8 and 38 inches. The Santa Cruz River is the major drainage for the Tucson AMA, but several perennial streams are also present, none of which is within the study corridor. The USGS reports that as many as 187 springs are present in the Tucson AMA (ADWR 2010). Groundwater level is between 4 and 633 feet below ground surface, with groundwater flow in the Oracle area generally toward the west and southwest (*ibid*).

The Eloy Sub-basin is one of several basins in the Pinal AMA, a portion of which is within the study corridor near Casa Grande, Eloy, and Picacho. The eastern boundary for this sub-basin is made up partly by the Picacho Mountains. Like all basins of the Pinal AMA, the Eloy Sub-basin contains up to several thousand feet of basin-fill consisting of sand and gravel (Towne et al. 2008). The Santa Cruz and Gila rivers are the main drainages in the Eloy Sub-basin, both of which are intermittent. There are six springs identified by the USGS within the Pinal AMA (ADWR 2010). Groundwater level is between 24 and 660 feet, with groundwater flow generally toward the Eloy-Casa Grande area (*ibid*). The Santa Cruz Sole Source Aquifer is the only one present within the study corridor, and is located in and around the greater Tucson area (EPA 2011e).

3.5.4 State-listed Impaired Waters and Unique or Outstanding Waters

There are three state-listed impaired waters in the study corridor. The first is along the Rio Grande from San Marcial to Rio Puerco; the second is along the Rio Grande in the Elephant Butte and Caballo Reservoir area; and the third is Percha Creek, from the perennial reaches of Caballo River to the middle fork (Table 3-25). The Mimbres River is considered impaired along several reaches, but the portion that is crossed by the alternative routes is considered not impaired. An impaired water is defined by the EPA as a body of water too polluted or otherwise degraded to meet water quality standards set by states, territories, or authorized tribes (Section 303(d) of the CWA). Impaired waters can be caused by point sources and nonpoint sources. Point sources are usually from a direct source to a lake, river, or stream, such as industrial or sewage treatment plants. Nonpoint sources come from different sources, usually caused by rainfall or snowmelt moving over and through the ground, picking up pollutants that are eventually deposited in lakes, rivers, and streams. These types of pollutants include (1) fertilizers, herbicides, and insecticides from agricultural lands; (2) oil, grease, and toxic chemicals from urban runoff; (3) sediment from improperly managed construction sites or eroding stream banks; (4) salt from irrigation practices; (5) acid drainage from mines; (6) bacteria and nutrients from livestock, pet wastes, or faulty septic tanks; and (7) atmospheric deposition or hydromodification (EPA 2010a).

There were no impaired waters in Arizona that are within the SunZia study corridor, but the San Pedro River south of Benson and north of Aravaipa Creek is attaining impaired status due to *E. coli* (ADEQ 2010). The closest link to an impaired area of the San Pedro River is Link F40a, which is approximately 1.6 miles from the impaired area.

Table 3-25. Impaired Waters within Study Corridor

Water Bodies	Links	Causes of Impairment
Rio Grande from San Marcial at USGS Gage to Rio Puerco, and in the Elephant Butte and Caballo Reservoir Area	E180, A140	Aluminum, *E. coli*
Percha Creek from perennial reaches at Caballo Reservoir to M Fork	A330b	Sedimentation/Siltation
Source: EPA 2011f; NMED Surface Water Quality Bureau 2010		

An Outstanding Natural Resource Water or, in Arizona, Outstanding Arizona Water (OAW) was originally called "unique waters" and is defined as:

> A surface water that is perennial, free-flowing, has water quality that meets or is better than applicable water quality standards, and meets on or both of the following: (1) The surface water is of "exceptional recreational or ecological significance," or (2) threatened or endangered (T & E) species are known to be associated with the water body and maintenance and protection of existing water quality is essential to the maintenance of the threatened or endangered species or the surface water provides critical habitat (AAC. R18-11-112[D]) (ADEQ 2011b).

3.5.4.1 New Mexico

According to the NMED, there are no outstanding waters listed for New Mexico within the Project area (NMED 2011c). The closest Outstanding Waters are in the Gila National Forest northeast of Lordsburg, and the Cibola National Forest southwest of Socorro, and are avoided by the alternative routes.

3.5.4.2 Arizona

Cienega Creek is an OAW, located in Pima County and southeast of Tucson, that is crossed by Subroute 4C3 (Link F600) and Local Alternative Link F51. Another OAW is Buehman Canyon Creek, which is crossed by Link C441. According to AZDEQ, the section of Buehman Canyon Creek that is considered an OAW is 2,500 feet from the nearest centerline for the Project. OAWs have special protection, including no new or expanded point-source discharge directly to an OAW. A permit is needed to discharge to an upstream tributary of an OAW and is only permitted if existing water quality is maintained. A discharge under Section 404 permit that may affect an OAW also would require a Section 401 water quality certification to ensure existing water quality is maintained and protected.

3.5.5 Summary of Inventory Results

The water resource inventory results are summarized below and shown on Figure M 5-1 (see Map Volume).

3.5.5.1 Route Group 1: SunZia East Substation to Midpoint Substation

Route Group 1 subroutes cross or are near many water resources. Most of these subroutes are located along or close to the Rio Grande, a major and regionally important water feature. The Rio Grande is considered impaired in several reaches crossed by all of the alternative routes in Route Group 1. Because of its close proximity to the Rio Grande, this route group crosses a large number of perennial and intermittent streams. Wells and springs are present throughout the study corridors of Route Group 1 subroutes, with local concentrations located in areas of agriculture.

Subroute 1A1 – North River Crossing

Subroute 1A1 proceeds west from SunZia East Substation along links E82, E84, and E85 through the Gran Quivira area, where it crosses several intermittent streams. It proceeds west and eventually crosses the Rio Grande at Link E180 before heading south on the west side of the Rio Grande to the Midpoint Substation. The subroute crosses numerous creeks, washes, and arroyos; some of which are considered perennial streams (Table 3-26). Subroute 1A1 crosses 1 perennial stream and 453 intermittent streams. Most of these streams are located within the Rio Grande Watershed. Subroute 1A1 could impact 37.2 acres of jurisdictional waters. One well is located within the study corridor of Subroute 1A1.

Subroute 1A2 – BLM Preferred Alternative

The impacts to water resources for Subroute 1A2 are similar to those of Subroute 1A1.

Table 3-26. Water Resources within Route Group 1

Subroute	Sole Source Aquifer (miles)	Perennial Streams	Intermittent Streams (miles)	Number of Wells	Number of Springs	Waterbody (miles)
1A1	0	1	453 (14.07)	1	0	0.1
1A2 – BLM Preferred Alternative	0.0	1	462 (14.34)	1	0	0.1
1A	0.0	1	412 (12.25)	3	0	0.1
1B1	0.0	1	391 (11.55)	5	1	0.1
1B2	0.0	1	370 (11.77)	5	1	0.1
1B3	0.0	1	370 (11.77)	2	0	0.1

Subroute 1A – North River Crossing

Subroute 1A varies slightly from 1A1 by using Link E80c, south of Subroute 1A1. Subroute 1A also uses Link A270 rather than A260, in the area west of Elephant Butte Reservoir. As a result of these variances, 1A crosses fewer intermittent streams. Subroute 1A could impact 34.5 acres of jurisdictional waters. Three wells are located within the study corridor of 1A.

Subroute 1B – San Antonio Crossing

Subroute 1B1 is similar to 1A1 except after Link E80d, where it takes a southern route along links E90 and A90. It then proceeds west across the Rio Grande, at which point it proceeds south along the same links as 1A. Subroute 1B1 crosses 391 intermittent streams, and it could impact 32.0 acres of jurisdictional waters. One spring is located within the study corridor of Subroute 1B1, along Link A90. There are five wells located within the study corridor for 1B1.

Subroute 1B2 is similar to Subroute 1B1 for most of its length, except at the beginning near SunZia East Substation where it proceeds along a more southern route through links A30, A50, and A60. Subroute 1B2 could impact 30.3 acres of jurisdictional waters.

Subroute 1B3 is similar to Subroute 1B1 for most of its length, except at the beginning where it utilizes several different links (A40, A41, and A80). Subroute 1B3 could impact 30.3 acres of jurisdictional waters.

Local Alternative and Crossover Links for Route Group 1

The local alternative links for subroutes 1A, 1B1, 1B2, and 1B3 include two links (A161B and A260) that are located within 600 feet of perennial and intermittent streams. Local Alternative Link A161B crosses 23 intermittent streams. Local Alternative Link A260 crosses 93 intermittent streams. These same local alternative links cross perennial streams Spikey Arroyo and Alamosa Creek, 2 unnamed streams, and 124 intermittent streams. Local alternative links A361, A430, and A481 do not cross any perennial or named streams, but do cross several small washes.

Crossover Link A70 crosses eight intermittent streams.

3.5.5.2 Route Group 3: Midpoint Substation to Willow-500 kV Substation

Subroutes for Route Group 3 parallel each other for most of their length. There are two main areas where these subroutes cross perennial and intermittent streams. The first area is west of Deming, New Mexico, where the Mimbres River and its drainages are located; the second area is in Arizona, where these subroutes cross the San Simon River and its drainages. Subroute 3B – South crosses fewer streams than Subroute 3A – North.

Subroute 3A2 – BLM Preferred Alternative

Subroute 3A2 proceeds west from Midpoint Substation along links B60 and B90, where it crosses the Mimbres River. It continues west along links B120a, B120b, and B121. From here it again heads west, entering Arizona in the San Simon Valley area along links B160a, B160d, and B160c. The BLM preferred alternative crosses 213 intermittent streams and would cross 17.5 acres of potential jurisdictional waters. Two wells are located within the study corridor along Subroute 3A2 (Table 3-27).

Subroute 3A – North

Subroute 3A crosses the same intermittent streams as Subroute 3A2, and would impact 17.5 acres of jurisdictional waters.

Table 3-27. Water Resources within Route Group 3

Subroute	Sole Source Aquifer (miles)	Perennial Streams	Intermittent Streams (miles)	Number of Wells	Number of Springs	Waterbody (miles)
3A2 (BLM Preferred Alternative)	0.0	0	213 (3.5)	2	0	0.0
3A	0.0	0	213(3.7)	3	0	0.0

Table 3-27. Water Resources within Route Group 3						
Subroute	**Sole Source Aquifer (miles)**	**Perennial Streams**	**Intermittent Streams (miles)**	**Number of Wells**	**Number of Springs**	**Waterbody (miles)**
3B	0.0	0	198 (4.2)	8	0	2.8

Subroute 3B – South

Subroute 3B crosses fewer intermittent streams than 3A2 and 3A, but has more wells located within its study corridor (see Table 3-27). Subroute 3B could impact 14.0 acres of jurisdictional waters.

Crossover Links for Route Group 3

Of the two crossover links available to subroutes 3A and 3B, Crossover Link B111 crosses 35 intermittent streams and Crossover Link B140 crosses 5 intermittent streams.

3.5.5.3 Route Group 4: Willow-500 kV Substation to Pinal Central Substation

Route Group 4 has five different routes in four distinct areas. Subroute 4C3 crosses the largest number of perennial and intermittent streams, as it crosses the Santa Cruz River twice and closely parallels the river, crossing many of its tributaries. Subroute 4C2 (west of the San Pedro River) crosses a larger number of streams than does Subroute 4C1 (east of the San Pedro River). Subroute 4A crosses a larger number of streams than does Subroute 4B.

Subroute 4A – North of Mt. Graham

Subroute 4A begins at the Willow-500 kV Substation and proceeds north-northeast of the Pinaleño Mountains. Subroute 4A crosses Aravaipa Creek at Link C170 and the San Pedro River at Link C592 (Table 3-28); it crosses 2 perennial streams and 231 intermittent and ephemeral drainages. Subroute 4A would cross an estimated 22.0 acres of potential jurisdictional waters. There are 17 wells and 2 springs located within the study corridor along links B153a, B153b, C170, C178, C173, C620, C780, and C880a. Subroute 4A crosses 21.1 miles of the Santa Cruz Sole Source Aquifer.

Table 3-28. Water Resources along Route Group 4						
Subroute	**Sole Source Aquifer (miles)**	**Perennial Streams (miles)**	**Intermittent Streams (miles)**	**Number of Wells**	**Number of Springs**	**Waterbody (miles)**
4A	21.1	2 (.006)	231 (3.37)	17	2	0.0
4B	21.1	1 (.001)	232 (3.6)	17	3	0.0
4C1	25.4	0	254 (2.8)	28	0	0.0
4C2	42.0	1 (.02)	281 (2.5)	25	0	0.0

Table 3-28. Water Resources along Route Group 4						
Subroute	**Sole Source Aquifer (miles)**	**Perennial Streams (miles)**	**Intermittent Streams (miles)**	**Number of Wells**	**Number of Springs**	**Waterbody (miles)**
4C2c – BLM Preferred Alternative	42.0	1 (.02)	323 (3.3)	11	0	0
4C3	87.6	0	400 (5.6)	169	0	0.2

Subroute 4B – Sulphur Springs Valley

Subroute 4B is similar to Subroute 4A for most of its length. Subroute 4B crosses 1 perennial stream and 232 intermittent and ephemeral drainages. Subroute 4B could impact 23.4 acres of jurisdictional waters.

Subroute 4C2c – BLM Preferred Alternative

Subroute 4C2c proceeds west from the Willow-500 kV Substation along links C71 and C71a through Sulphur Springs Valley. Subroute 4C2 continues southwest where it crosses the San Pedro River along Link C261, and then continues north to the Mammoth area. From there it proceeds west along links C661, C670, and C680 to the Tortolita Substation, proceeds north along Link C820, and eventually west to the Pinal Central Substation. The BLM preferred alternative crosses 1 perennial stream, 323 intermittent streams, and 42 miles of a sole source aquifer. Subroute 4C2c could impact 31.6 acres of jurisdictional waters. There are 11 wells and 2 springs within the study corridor for Subroute 4C2c.

Subroute 4C1 – East of San Pedro River

Subroute 4C1 proceeds west of the Willow-500 kV Substation, utilizing the same Links as 4C2 and 4C2c, but proceeds north, east of the San Pedro River along links C361 and C470. At a point just northeast of Mammoth, Subroute 4C1 continues west across the San Pedro River along links C660 and C661, then heads northwest to the Pinal Central Substation utilizing links C690 through C880. This route crosses 254 intermittent streams and 25.4 miles of a sole source aquifer (see Table 3-28). Subroute 4C1 could impact 25.0 acres of jurisdictional waters. There are 28 wells located within the study corridor along Subroute 4C1.

Subroute 4C2 – West of San Pedro River

Subroute 4C2 is similar to 4C2c except between links C212 and C441, where it proceeds north of Subroute 4C2c. This slight variation results in crossing fewer intermittent streams. Subroute 4C2 could impact 26.5 acres of jurisdictional waters. Subroute 4C2 also has more wells within its study corridor.

Subroute 4C3 – Tucson

Subroute 4C3 begins on a route common with subroutes 4C1 and 4C2, until it reaches Link C212. At this point, Subroute 4C3 continues on a southwesterly course, where it crosses the San Pedro River at Link F40a. At Link F600, Subroute 4C3 heads northwest, where it closely follows the Santa Cruz River. Link F600 crosses the Outstanding Water Cienega Creek. Subroute 4C3 continues to the north-northwest until it reaches Link C817, where it is then common with Subroute 4C2. Subroute 4C3 crosses 400 intermittent streams (more than any other subroute of Route Group 4) and 87.6 miles of a sole source aquifer, and could impact 35.6 acres of jurisdictional waters. There are 169 wells located within the study corridor along Subroute 4C3.

Local Alternative and Crossover Links for Route Group 4

Local Alternative Link C790 is common to subroutes 4A, 4B, and 4C1. Link C790 crosses 11 intermittent streams and 2.1 miles of a sole source aquifer.

The Pinal Central Substation includes local alternative links C860, C870, and C890. Together, these links cross 8 intermittent streams. There are two wells located within 600 feet of the centerline for these links.

Local Alternative Link C692 is available for 4C1. Link C692 crosses 6 intermittent streams and 4.8 miles of a sole source aquifer.

Links C260, C261, and C201 cross 77 intermittent streams. Links F40b, F51, F60a, F81a, and F81b (Pantano-Rillito local alternative) cross 57 intermittent streams. This local alternative crosses 41.4 miles of sole source aquifer, and crosses the Outstanding Water Cienega Creek. There are 148 wells present within the study corridor.

The Tortolita Substation Local Alternative for 4C2 has nine links (C680, C815, C814, C816, C812, C813, C810, C810a, and C817), which cross 35 intermittent streams. There is 0.1 mile of water bodies crossed by the centerline of this subroute. This subroute crosses the Outstanding Water Cienega Creek.

The Tortolita Substation Local Alternative for 4C3 has six links (F40b, F51, F60a, F81a, F81b, and C812), which cross 62 intermittent streams and 1 perennial stream. These links also cross 38.7 miles of a sole source aquifer and are within 600 feet of 52 wells.

The Pantano/Rillito local alternative links for 4C3 include F40b, F51, F60a, F81a, and F81b; which include all links for the Tortolita Substation local alternative links for 4C3 (minus C812), representing 0.4 less mileage of intermittent streams that are within 600 feet of the centerline.

Four local alternative links (C72, C90, C121, and C211) are available for subroutes 4C1, 4C2, and 4C3. These links are located within 600 feet of perennial streams for 2.8 miles and intermittent streams for 6.2 miles. There are six wells located within 600 feet of these Links.

There are four crossover links available for 4A, 4B, and 4C1 (C500, C501, C502, and C174). These links are located within 600 feet of intermittent streams for 3.0 miles.

Crossover Link C671 is available for 4A, 4B, 4C1, and 4C2. This link is located within 600 feet of intermittent streams for 1.0 mile and crosses 0.1 mile of a wetland.

3.6 BIOLOGICAL RESOURCES

3.6.1 Introduction, Methods, and Regulatory Framework

3.6.1.1 Introduction

This section includes documentation and discussion of vegetation, wildlife, special-status species, and invasive species occurring in the 8-mile-wide study corridor (4 miles on either side of the reference centerline). Figures showing individual corridor links referenced in the text are found in the Map Volume.

Based on results of the public scoping process and in consultation with BLM resource specialists and cooperating agencies, the following areas of concern were identified with regard to biological resources:

- Migratory bird corridors at the Rio Grande and San Pedro River valleys
- Critical habitat for the Southwestern Willow Flycatcher along the Rio Grande and San Pedro River
- Critical habitat for the Rio Grande Silvery Minnow in the Rio Grande
- Critical habitat for ESA-listed fish in Cienega Creek, and Aravaipa, Hot Springs, and Redfield canyons
- Riparian habitat areas along major waterways: Rio Grande; Aravaipa and Cienega creeks; Pantano Wash; and San Pedro, Santa Cruz, and Rillito rivers
- Construction in remote areas with steep terrain, lacking existing access, within the Galiuro Mountains and west of the San Pedro River
- Grasslands and Pronghorn habitat in the northern Sulphur Springs Valley and Allen Flat
- Sandhill Crane roosting and foraging areas in the Sulphur Springs Valley and Willcox Playa
- Special-status species and riparian habitat within the Cienega Creek Natural Preserve
- Sonoran Desert Tortoise habitat in Arizona
- Pima pineapple cactus habitat in Pima County, Arizona

3.6.1.2 Methods

Preliminary review for the potential presence of special-status species included primary literature, regional references, publicly released county lists of species from wildlife management agencies, and direct contact from wildlife management agencies for all counties that fall within the study corridor (Doña Ana, Grant, Hidalgo, Lincoln, Luna, Otero, Sierra, Socorro, Torrance, and Valencia counties in New Mexico; and Cochise, Graham, Greenlee, Pima, and Pinal counties in Arizona). Sources for agency-managed data included the USFWS Southwest Region Ecological Services office, AZGFD Heritage Data Management System, and New Mexico Department of Game and Fish (NMDGF) – Biota Information System of New Mexico (BISON-M). The review also included GIS information provided by the USGS, USFWS, and New Mexico and Arizona offices of the BLM, NMDGF, and AZGFD.

Subsequent to the initial review, a focused review was conducted for the study corridor and each Project link, and the potential for presence of special-status species occurring within the vicinity of each link was evaluated. Approximately 700 special-status species were reviewed, with 269 species determined to have some potential for occurring within a study corridor that included a 4-mile buffer on either side of all proposed Project subroutes. A biological technical report that addresses all special-status species potentially occurring within the vicinity of this Project was produced and is incorporated as Appendix B1 of this document.

Direct agency input was solicited from the Las Cruces, Socorro, Safford, and Tucson field offices of the BLM, NMDGF, AZGFD, USFWS, and independent researchers familiar with some of the special-status species reviewed. Independent avian surveys were conducted at Project alternative crossings of the Rio Grande in New Mexico, during the winters of 2009-2010 and 2010-2011, by ornithologists at the University of New Mexico (Appendix B2). While none of the Project route groups crosses National Forest land, some of the subroutes are less than 1 mile from National Forest boundaries. Due to this proximity, the mobility of wildlife, and the potential for overlap of USFS sensitive plant species distributions onto adjacent land, USFS sensitive species were included in the Project review. Project scoping and other comments were reviewed, and appropriate information has been incorporated into this EIS.

Vegetation communities occurring within the study corridor are shown on Figure M 6-1 (see Map Volume). Vegetation data were obtained from the Resource Geographic Information System (RGIS) (New Mexico) and Arizona Land Resource Information System (ALRIS). Plant scientific and common names used in this document are referenced to the USDA Plants Database[1].

3.6.1.3 Regulatory Framework

Federal Laws

Federal legislation applicable to biological resources within the study corridor includes the NEPA (42 USC § 4321, et seq.; 40 CFR § 1500.1, et seq.); ESA (16 USC 460, et seq.), as amended; MBTA (16 USC 703, et seq.); BGEPA (16 USC 668); Sikes Act (16 USC §670g, et seq.); Fish and Wildlife Coordination Act (16 USC §662, et seq.); FLPMA (43 USC §1701); Federal Water Pollution Control Act Amendments of 1972 ([CWA] 33 USC §1251 et seq.); Carlson-Foley Act (PL 90-583); BLM Manual 6840 (Special-Status Species Management); and EO 13112 (Invasive Species).

- NEPA requires the federal government to assess the environmental impacts of most major federal actions, which includes actions undertaken (1) on federal land, (2) by a federal agency, (3) with federal funds, or (4) where the federal government will be issuing a permit.
- The ESA authorizes the USFWS to protect plant and wildlife species and the habitats on which these species depend. It requires federal agencies to ensure that their actions

[1]http://plants.usda.gov/index.html

(including permitting) are not likely to jeopardize the continued existence of a listed species or result in the destruction of the species' habitat.

- The MBTA protects more than 1,000 bird species native to North America and Hawaii by making it illegal to take, possess, import, export, transport, sell, purchase, barter, or offer for sale any listed bird, or the parts, nests, or eggs of such a bird. Provisions are given for regulated hunting and limited other activities, such as research and conservation.
- The BGEPA prohibits any form of possession or take (including many types of disturbance) of Bald and Golden Eagles. Certain exceptions for tribal cultural uses apply (16 USC 668-668c).
- The Sikes Act requires the military and federal land management agencies to coordinate with state wildlife agencies in the development of comprehensive plans for the conservation of wildlife. These plans may restrict uses of federal land, or require a plan amendment to allow an otherwise restricted use. The BLM will coordinate plan development and plan amendments with the state wildlife agency.
- The Fish and Wildlife Coordination Act requires consultation with the USFWS and state fish and wildlife agencies where the "waters of any stream or other body of water are proposed or authorized, permitted or licensed to be impounded, diverted...or otherwise controlled or modified" by any agency under a federal permit or license. Consultation is to be undertaken for the purpose of "preventing loss of and damage to wildlife resources."
- The FLPMA requires that public land be managed in a manner "...that will provide food and habitat for fish and wildlife and domestic animals; and that will provide for outdoor recreation and human occupancy and use; and that federal land management agencies provide meaningful public involvement with state and local agencies on land use decisions."
- The Federal Water Pollution Control Act requires compliance with state regulatory agencies responsible for Section 402 permits. The NMED Groundwater Pollution Prevention Section of the Ground Water Quality Bureau administers reviews and approves groundwater Discharge Permits for discharges that have the potential to impact groundwater quality, pursuant to Subparts III and V of the Water Quality Control Commission (WQCC) regulations (20.6.2 NMAC). In Arizona, permits are administered by the ADEQ under authority of the EPA. Projects may also require an AZPDES and/or a Stormwater Runoff permit from the ADEQ.
- The Carlson Foley Act directs federal land management agencies to destroy noxious plants growing on land under their jurisdiction, and provides a legal framework for reimbursement of expenses to state or local agencies for weed control on federal land.
- BLM Manual 6840 provides policy and guidance, consistent with applicable laws and regulations, for the conservation of special-status species and the ecosystems upon which they depend. Special-status species are defined as those "which are proposed for listing, officially listed as threatened or endangered, or are candidates for listing as threatened or endangered under the provisions of the ESA; those listed by a State in a category such as threatened or endangered implying potential endangerment or extinction; and those designated by each State Director as sensitive."

- EO 13112 requires that federal agencies prevent the introduction and spread of invasive species, detect and respond rapidly to control such species, monitor invasive species populations, and restore native species and habitat conditions in ecosystems that have been invaded. In addition, the order requires that a federal agency "not authorize, fund, or carry out actions that it believes are likely to cause or promote the introduction or spread of invasive species."

State Laws

New Mexico

- The NMDGF is granted authority under Chapter 17, NMSA 1978, to regulate the take of fish and wildlife in New Mexico, and to manage those species and their habitat. For all game species, the state game commission establishes open and closed seasons, bag limits, and other rules relating to the take of those species.
- The New Mexico Wildlife Conservation Act of 1978 (NMSA 1978 § 17-2-37, et seq.) is administered by the NMDGF. The New Mexico Wildlife Conservation Act is the legal framework for establishing lists of species considered threatened or endangered within the state of New Mexico. ESA-listed species may be included in the list of state identified species, as appropriate. The Act requires the state to conduct a biennial review of the status of each designated threatened and endangered species, and requires the development of a recovery plan for each state-listed species. The Act provides for the purchase of land and support of research to meet recovery plan goals. The director of the NMDGF is the ultimate authority for the law; and enforcement is provided by conservation officers, county sheriffs, and the New Mexico State Police.
- Plant resources in New Mexico are covered under the 1985 New Mexico Endangered Plant Species Act (NMSA 1978 § 75-6-1), and are administered by the Forestry Division of the New Mexico Energy, Minerals, and Natural Resources Department.

Arizona

- Wildlife in Arizona is managed as trust property of the state by the AZGFD, as provided for in Chapter 17 of the ARS and by the Arizona Game and Fish Commission. Chapter 17 of the ARS provides authority to the Commission to set seasonal restrictions, bag limits, rules regarding methods of take, as well as other rules and regulations regarding fish and wildlife harvest, and to provide for proactive management of game and non-game fish and wildlife.
- The State of Arizona has no threatened and endangered species laws. The Arizona Game and Fish Commission provides protection for individual species of vulnerable conservation status by setting bag limits for species and through regulation of hunting seasons, including permanent hunting season closure for sensitive species.
- The Arizona Native Plant Law (ARS § 3-901-907) is administered by the Arizona Department of Agriculture (ADA), and lists plants protected under the law. The ADA defines four categories of protected native plants: Highly Safeguarded, Salvage Restricted, Salvage Assessed, and Harvest Restricted. The Highly Safeguarded category

is the highest category of protection provided for native plants in Arizona, and includes all species that are candidates for ESA listing. "Permits applicable to highly safeguarded native plants may be issued only for collection for scientific purposes or for the noncommercial salvage of highly safeguarded native plants whose existence is threatened by intended destruction, or by their location or by a change in land usage, and if the permit may enhance the survival of the affected species" (ARS 3-906 C). The remaining three categories allow plants to be moved or harvested, provided that ADA regulations are complied with. ADA jurisdiction over protected plants includes all lands within the state; but since native plants occurring on private land are the property of the landowner, their removal requires only that the ADA be notified prior to their removal. Movement of all ADA-listed plants must be conducted under permit, with tags and seals affixed to all plants prior to transport. The ASLD requires compensation for the loss to development of any individual ADA-listed plants on Arizona State Trust Land, and requires a compensation fee per acre for native vegetation, including all plants not ADA-listed.

3.6.2 Regional Overview

3.6.2.1 Ecological Overview

The Project area lies within the southern and eastern boundaries of the Basin and Range Province. The Basin and Range Province is a physiographic region characterized by mostly parallel, north-south trending mountain ranges separated by valleys filled with alluvial soils (Fenneman 1931), and transitions into the Great Plains in eastern New Mexico. A large area of uplift in the northern and western portion of New Mexico, and the northern and eastern portion of Arizona, is part of the Colorado Plateau. Because of its large scale, the Project traverses a number of geological formations and geological features that have had long-term effects on evolution and ecology within the biomes that occur in the area.

Significant aquatic resources in the study corridor, which support a wide variety of plants and endemic and migratory wildlife, include the Rio Grande and its reservoirs, the San Pedro River and numerous tributaries, waters of ephemeral playas, and several cienegas and spring habitats.

3.6.2.2 Climate

Climate in the vicinity of the study corridor is generally arid or semiarid, with variations in precipitation and temperature regulated by elevation and physiographic structure. There is a wide elevation range within the region. Elevations in the vicinity of the New Mexico portion of the study corridor vary from approximately 4,145 feet on the Lordsburg Playa to a high of 8,615 feet at Gallinas Peak west of Corona, New Mexico, near the proposed SunZia East Substation. In Arizona, elevations vary from approximately 1,350 feet north of Casa Grande at the Gila River to a high of 10,720 feet at Mount Graham in the Pinaleño Mountains southwest of Safford, Arizona.

Average annual temperatures vary considerably in the region. Generally, for every 1,000-foot increase in elevation, there is a 4-degree Fahrenheit decrease (adiabatic lapse rate) in temperature (Hendricks 1985; Lowe 1964). During the dry period of early summer, daytime high temperatures commonly exceed 100 degrees Fahrenheit. The clear nighttime skies allow daytime

heat buildup to radiate upward, causing the temperature in a single day to vary 25 to 35 degrees Fahrenheit in New Mexico, and as much as 50 to 60 degrees Fahrenheit in the lower deserts in southwestern Arizona (WRCC 2010).

Annual precipitation in the vicinity of the study corridor results from a regional bimodal precipitation pattern of localized, often intense storms during the summer monsoon season (July to mid-September) and Pacific winter storms (November to March), with gentle rains that are typically more widespread and of greater duration. Moisture supporting the summer monsoon comes from the Gulf of Mexico and, to a lesser extent, from the Gulf of California for the Arizona portion of the area (*ibid*). Leftover moisture from tropical hurricanes in both the Atlantic and Pacific often contribute significant amounts of moisture to the area, but this is infrequent and irregular (Lowe 1964). The combination of the dry air, high temperatures, and abundant sunshine results in high evaporation rates in the region (Hendricks 1985; WRCC 2010). Spring and fall are typically dry and hot, and extended droughts, often lasting several years, are not uncommon in the region.

3.6.2.3 New Mexico

The eastern section of the New Mexico portion of the Project is dominated by the Rio Grande Valley. The river flows north to south between similarly oriented mountain ranges. The perennial Rio Grande supplies water that supports the bulk of the human development and major metropolitan areas in the state. It is also a major avian migratory corridor that supports many thousands of wintering birds. Agricultural developments along the river have had substantial impacts on what was once a continuous thread of deciduous riparian habitat through the middle of the state.

The western portion of the Project in New Mexico passes through the southwestern corner of the state, and crosses the continental divide near the Grant-Luna county line. Vegetation on most of this portion of the study corridor is dominated by semidesert grassland habitat. The Lordsburg Playa between Lordsburg, New Mexico and the New Mexico-Arizona border is located in the Animas Valley, a closed basin. The Playa typically holds water only seasonally, from precipitation occurring during the winter rain or summer monsoon seasons.

3.6.2.4 Arizona

The Arizona portion of the Project passes through the region that is dominated by the southern Arizona "Sky Islands" physiography, which is a byproduct of geological metamorphic core complex and subsequent basin and range faulting that occurred between 25 and 10 million years before present. This physiography has significant orographic climatic effects that are a direct influence on the diverse vegetation present in the region, and the attendant wildlife that it supports. The Sky Island effect has driven speciation in a number of groups of organisms that are either of low mobility or lack adaptations that allow movement through the arid intervening valleys, effectively isolating mountain population ranges (Baker 2008; McCormack et al. 2008; Warshall 1994). Perennially flowing waters in the area are limited in number and extent and include the San Pedro River, Aravaipa Creek in the Galiuro Mountains, Cienega Creek, and several reaches of streams at high elevations in the mountains.

3.6.3 Vegetation

Vegetation data for the Project study area (Figure M6-1 see Map Volume) were obtained for New Mexico from RGIS, and for Arizona from ALRIS (University of New Mexico 2010; ALRIS 2010). The vegetation-based biome descriptions for the study corridor given below are primarily from Brown (1982a). Because of the generally small scale of most riparian habitats occurring within the study corridor, these areas were not mapped but have been included in the resource review. Species listed under the ESA and proposed or candidate species are discussed in Section 3.6.6.1.

3.6.3.1 Biomes

Eleven biomes occur within the study corridor, each discussed individually below (Figure M.6-1E/W; see Map Volume). While all of these biomes are present within the overall study corridor, Project subroutes are generally confined to lower elevations and thus may not cross biomes restricted to higher elevations.

Sonoran Desertscrub

The Sonoran Desertscrub biome is divided into two major subdivisions; the Lower Colorado River Valley subdivision and the Arizona Upland subdivision. The subdivisions are primarily separated by a variation in the total effective annual precipitation, and are a byproduct of the bimodal precipitation regime previously mentioned. Soil types are the primary determinant where the subdivisions meet and overlap in south-central Arizona, with the Arizona Upland subdivision restricted to rockier slopes, foothills, and desert mountains. Sonoran Desertscrub is typically bounded on the east by either Chihuahuan Desertscrub or semidesert grassland habitats. In the Project study area, this occurs respectively in the southern and northern segments of the San Pedro River Valley. With milder winters and additional rainfall, the region to the south of the Sonoran Desert merges into Sinaloan Thornscrub habitat, south of the United States-Mexico border. To the west, in southern California and northwestern Arizona, the Sonoran Desert borders the Mohave Desertscrub biome. Sonoran Desertscrub north of the Project study area (near Superior, Arizona) is bounded by areas of interior chaparral, but in the Project study area itself most Sonoran Desertscrub transitions to semidesert grassland as elevation increases. The presence of a variety of xeric-adapted sclerophyllous (having small leaves resistant to water loss) tree species and many species of cacti and other succulents distinguishes the Sonoran Desert from less diverse, shrub-dominated North American desert biomes (Turner 1982).

Lower Colorado River Valley Subdivision

The Lower Colorado River Valley subdivision is the warmer and drier of the two subdivisions of the Sonoran Desertscrub biome. It occurs at lower elevations and typically farther west, where regional geology limits annual precipitation. Precipitation falls mainly during winter from Pacific storms; moisture from monsoonal systems that occur in summer contribute only small amounts to total annual precipitation. Precipitation from monsoon events lessens in areas farther to the north and west from the sources of monsoonal moisture; the Gulf of Mexico and the Gulf of California. Because of the low annual precipitation, vegetation in the Lower Colorado River Valley subdivision is typically open and less diverse, with plant communities often dominated by

creosote bush (*Larrea tridentata*) and burrobush (*Ambrosia dumosa*), or they may occur as essential monocultures of creosote bush over very large areas. Cacti are an important group within this subdivision, but do not dominate as they do in the Arizona Upland subdivision (Turner 1982).

Arizona Upland Subdivision

The Arizona Upland subdivision of Sonoran Desertscrub is a mix of desertscrub and subtropical thornscrub elements. Precipitation is higher than in other North American desert communities, with a notably bimodal pattern. Approximately half of the precipitation occurs in winter, supporting diverse spring annuals; and approximately half falls in a summer monsoon period as heavy, localized thunderstorms. The Arizona Upland subdivision occurs from higher-elevation valley floors typically associated with Sky Island mountain ranges, up to the elevation limit where winter freezes exclude many succulent species. This plant community is best developed on upper bajadas and low montane foothills where proximity to steep, often high mountains results in increased annual precipitation. Small trees or shrubs are a dominant vegetative component, with a high diversity of Fabaceae, including yellow paloverde (*Parkinsonia microphylla*), blue paloverde (*P. florida*), several mesquites (*Prosopis* spp.), desert ironwood (*Olneya tesota*), catclaw acacia (*Acacia greggii*), and whitethorn acacia (*A. constricta*). Cactus diversity is relatively high, and cacti are often dominant or codominant. Prickly pears (*Opuntia* spp.) and chollas (*Cylindropuntia* spp.) may reach very high diversity. Common small or clumped cacti include several species of hedgehog cactus (*Echinocereus* spp.) and pincushion cactus (*Mammillaria* spp.). Larger cacti include the columnar saguaro (*Carnegiea gigantea*) and barrel cacti (*Ferocactus* spp.). Jojoba (*Simmondsia chinensis*), creosote bush, ocotillo (*Fouquieria splendens*), and numerous other shrubs are also present (Turner 1982).

Chihuahuan Desertscrub

Precipitation in Chihuahuan Desertscrub is largely from summer thunderstorms, although occasionally strong Pacific winter storms will reach the region. Dominant shrubs in finer soils include creosote bush, American tarwort (*Flourensia cernua*), and viscid acacia (*Acacia neovernicosa*). Rocky uplands and bajadas are dominated by species of *Agave*, *Yucca*, *Nolina*, and other succulent shrubs. Some prickly pear species are the most common large cacti, but the diversity of small globular cacti is higher in this plant community than any other in North America. Some major cactus genera are *Coryphantha*, *Echinocereus*, *Escobaria*, and *Mammillaria*. Perennial herbaceous plants may be a significant component of the community, and some annuals may occur in response to sufficient winter rains. Chihuahuan Desertscrub gradually intergrades into semidesert grassland with increasing elevation or rainfall (Brown 1982b).

Semidesert Grassland

Semidesert grassland, while dominated by grasses, has high shrub diversity; and in areas with fire suppression or heavy grazing, often converts to desertscrub. Precipitation is slightly greater in summer, and supports the majority of grass growth. Cacti may be common and include several species of cholla and prickly pear as occasional dominant plant species, particularly where

livestock grazing is heavy. Typical grasses include species of grama (*Bouteloua* spp.), three-awn (*Aristida* spp.), tobosa grass (*Pleuraphis mutica*), and others. Mesquite is generally the most dominant shrub species, with creosote bush, *Yucca* species, and the related sotol (*Dasylirion wheeleri*) and beargrasses (*Nolina* spp.), ocotillo, and several other shrubs common in places (Brown 1982c).

Plains and Great Basin Grassland

The western edge of the Plains biome within the study area is largely a shortgrass prairie plant association. Dominant plant species are grasses, including several gramas (*Bouteloua* spp.), galleta grasses (*Pleuraphis jamesi* and *P. rigida*), Plains lovegrass (*Eragrostis intermedia*), and numerous others. Shrubs, chollas, and some prickly pears can be abundant, particularly when facilitated by fire suppression or grazing pressure (Brown 1982d).

Interior Chaparral

Chaparral communities are dominated by evergreen shrubs, which may reach 90 percent ground cover. High shrub cover prevents the establishment of a significant understory of grasses or herbaceous plants, except in early-successional stages and rocky, open patches. Arizona Interior Chaparral is dominated by Sonoran scrub oak (*Quercus turbinella*), along with manzanitas (*Arctostaphylos* spp.), deerbrush (*Ceanothus* spp.), and many others. Interior Chaparral is subject to regular wildfires, and may depend on fire to prevent conversion to forests at the upper elevation limit of the community. Some shrub species depend on fire for germination, and nearly all regenerate post-fire from the root crown (Pase and Brown 1982a).

Great Basin Conifer Woodland

Outside of the Great Basin physiographic province there is a broad band of vegetative communities across the southern Rockies that have origins in the Great Basin proper. Great Basin Conifer Woodland is generally found above grasslands or chaparral, where fire frequency is low but precipitation is insufficient to support development of montane conifer forests. This plant community is typified by the dominance of two small evergreen trees: junipers (*Juniperus* spp.) and piñon pines (*Pinus edulis* and *P. monophylla*), with an understory of mixed shrubs, grasses, and herbaceous plants. Some cacti, particularly *Opuntia* species, also occur (Brown 1982e).

Petran Montane Conifer Forest

Within the study corridor, this plant community only occurs in small areas atop the Santa Catalina, Rincon, Galiuro, and Pinaleño mountains in Arizona. Montane conifer forest in the region is typically dominated by either ponderosa pine (*Pinus ponderosa*), typically in the lower reaches, or mixed conifer forest consisting of white fir (*Abies concolor*), aspen (*Populus tremuloides*), and limber pine (*Pinus flexilis*) at cooler, higher elevations. Lower portions of the ponderosa pine forests may be locally dominated by Gambel oak (*Quercus gambelii*) or New Mexican locust (*Robinia neomexicana*) (Pase and Brown 1982b).

Interior and Sonoran Riparian Woodland

Riparian woodlands are dominated by trees and shrubs dependent on surface water or shallow groundwater, and generally exist as narrow bands along major streams and rivers. The majority of the tree species are (at least regionally) riparian obligates, and do not occur in upland habitats within arid Southwestern biomes. The high productivity and cooler, more humid microclimate within riparian woodlands supports numerous herbaceous plant and wildlife species generally restricted to riparian zones as well.

Riparian plant communities do not change as rapidly with elevation as upland plant communities, as the woodlands provide thermal buffering not present elsewhere and competition for water is generally not a limiting factor. The shift between Interior and Sonoran Riparian Woodland is driven by elevation, although there is much overlap of the vegetative community. Interior Riparian communities are generally found above 3,900 feet elevation, often in montane canyons, while Sonoran Riparian communities surround valley and lowland rivers and streams.

Dominant tree species common to both communities include Fremont cottonwood (*Populus fremontii*), Goodding's willow (*Salix gooddingii*), and velvet mesquite (*Prosopis velutina*). Large stands of velvet mesquite in particular are important components of lowland woodlands in the Southwest. Increasing elevation allows the occurrence of netleaf hackberry (*Celtis laevigata*), Arizona walnut (*Juglans major*), Arizona sycamore (*Platanus wrightii*), Arizona alder (*Alnus oblongifolia*), velvet ash (*Fraxinus velutina*), and others.

Interior and Sonoran Riparian Scrubland

This community occurs as a transition between riparian woodlands and xeroriparian washes, and is present in areas where either disturbance is too great or water may be insufficient to support development of mature forest. Goodding's willow is one of the larger tree species, and several species of mesquite, desert willow (*Chilopsis linearis*), paloverdes (*Parkinsonia* spp.), catclaw acacia, and other native trees and shrubs are present. Some areas of riparian scrubland may have originally been riparian woodland, but have been converted to stands of invading saltcedar (*Tamarix* sp.).

Plains Riparian Wetlands

The Rio Grande and associated tributaries within the study area may support Plains Riparian Wetlands. Tree species in this habitat within the study area include Rio Grande cottonwood (*Populus deltoides wislizeni*), narrowleaf cottonwood (*P. angustifolia*), peachleaf willow (*Salix amygdaloides*), and narrowleaf willow (*S. exigua*).

Xeroriparian Scrubland

Numerous minor, ephemeral washes, found in Sonoran and Chihuahuan Desertscrub into semidesert grassland, do not represent entirely separate plant communities, as there is strong species overlap with surrounding uplands. However, they do represent shifts in species dominance to areas of higher density and productivity of shrub species, many of which may also

be present away from washes. Xeroriparian scrubland varies in its species components regionally and with elevation, but plant density and stature are similar in this biome. Such vegetation is too dense to be considered either desertscrub or strand habitats, and is reasonably qualified as a distinct biome (Minckley and Brown 1982). The increased shelter and food availability in this habitat results in a habitat disproportionately richer than adjacent uplands, and of importance to most wildlife species that are present.

3.6.4 Noxious and Invasive Weeds

Noxious and invasive weeds are identified as a major threat to native ecosystems and multiple-use public land resources. Their impacts include, but are not limited to, adverse effects on productivity, value, and management of publicly administered and private land and water resources; effects to both yield and quality of agriculturally important crops; livestock poisoning; impacts to threatened and endangered species and native biodiversity; adverse effects upon human health as allergens, through poisoning and by harboring plant disease vectors; reduction of water quality and habitat for fish and wildlife in streams, lakes, and reservoirs; interference with electrical power transmission and other utility functions; and detracting from the aesthetic and recreational values of wildlands, parklands, and other areas (DOI 1995).

Waterways, vehicles, and animals are the principal vectors for expansion of noxious and invasive weed species, which can only be adequately controlled when federal, state, county, and private interests work together, usually under a cooperative weed management plan. The Carlson-Foley Act (PL 90-583) and state and county laws hold the federal government responsible for control of designated weeds on federal land and provide direction for their control. Land management agencies typically prepare weed management plans that rely on currently accepted BMPs that can be used at the project level to reduce the occurrence and dispersion of weeds.

The current New Mexico and Arizona Departments of Agriculture and federal noxious weed lists were used as the baseline for review of noxious weed species potentially occurring within the study corridor (New Mexico Department of Agriculture 2009; ADA 2011; USDA 2010). The review was performed using the USDA PLANTS Database (USDA 2011) and the Invasive Plants Atlas (EDDMaps) (University of Georgia 2011) county-level maps to determine the potential for occurrence for each of these noxious weed species; no field surveys were conducted to identify these noxious weeds. Table 3-29 provides a list of noxious weed species known or potentially occurring in the study corridor. Other species of invasive plants, not listed as noxious weeds, may also be present in the study corridor.

Table 3-29. Noxious Weed Species for which Suitable Habitat May be Present within the Study Corridor

Scientific Name	Common Name	Potential for Occurrence		Noxious Status
		New Mexico	Arizona	
Acroptilon repens	Hardheads (Russian knapweed)	moderate	moderate	P, R, B
Aegilops cylindrica	Jointed goatgrass	moderate	low	P, R, C
Ailanthus altissima	Tree of heaven	moderate	moderate (NL)	B
Alhagi maurorum (A. pseudalhagi)	Camelthorn	moderate (NL)	low	A, P, R,

Table 3-29. Noxious Weed Species for which Suitable Habitat May be Present within the Study Corridor				
Scientific Name	**Common Name**	**Potential for Occurrence**		**Noxious Status**
		New Mexico	**Arizona**	
Arundo donax	Giant cane	high	moderate (NL)	WL
Asphodelus fistulosus	Onionweed	moderate	high	NW
Brassica tournefortii	Asian (Sahara) mustard	low	high (NL)	WL
Bromus tectorum	Cheatgrass	high	high (NL)	C
Cardaria draba	Whitetop	high (NL)	high	P, R
Cardaria spp.	Hoary cress	very low	very low (NL)	A
Cenchrus echinatus	Southern sandbur	moderate (NL)	high	P, RG
Cenchrus spinifex (C. incertus)	Field sandbur	high (NL)	high	P, RG
Centaurea melitensis	Maltese star-thistle	high	high (NL)	B
Centaurea solstitialis	Yellow star-thistle (St. Barnaby's thistle)	very low	moderate	A, P, R,
Cichorium intybus	Chicory	low	low (NL)	B
Cirsium arvense	Canada thistle	moderate	NR	A, P
Cirsium vulgare	Bull thistle	moderate	low (NL)	C
Convolvulus arvensis	Field bindweed	high (NL)	high	P, RG
Cuscuta spp.	Dodder	moderate (NL)	moderate	P, R
Diplotaxis tenuifolia	Perennial wall rocket	very low	low (NL)	WL
Elaeagnus angustifolia	Russian olive	high	very low (NL)	C
Eragrostis lehmanniana	Lehmann lovegrass	high (NL)	high (NL)*	*
Euryops multifidus (*E. subcarnosus* ssp. *vulgaris*)	Sweet resinbush	very low (NL)	high	R
Helianthus ciliaris	Texas blueweed	high (NL)	moderate	P, R
Hydrilla verticillata	Hydrilla	low	moderate	NW
Ipomoea spp.**	Morning glory	high (NL)	high	P
Lepidium latifolium	Perennial pepperweed	moderate	very low (NL)	B
Leucanthemum vulgare	Oxeye daisy	moderate	very low (NL)	A
Lythrum salicaria	Purple loosestrife	very low	very low	A, P
Medicago polymorpha	Burclover	low (NL)	high	P, RG
Peganum harmala	Harmal peganum (African rue or Syrian rue)	high	very low	P, B
Pennisetum ciliare	Buffelgrass	low (NL)	high	P, RG
Pennisetum setaceum	Crimson fountaingrass	very low	moderate (NL)	WL
Portulaca oleracea	Little hogweed (Common purslane)	high (NL)	high	P, RG
Tagetes minuta	Wild marigold	very low (NL)	moderate (NL)	NW
Tamarix spp.	Saltcedar	high	high (NL)	C

Table 3-29. Noxious Weed Species for which Suitable Habitat May be Present within the Study Corridor				
Scientific Name	Common Name	Potential for Occurrence		Noxious Status
		New Mexico	Arizona	
Tribulus terrestris	Puncturevine	high (NL)	high	P, RG
Urochloa panicoides	Liverseed grass	moderate	low	NW
Xanthium spinosum	Spiny cocklebur	moderate	low (NL)	WL

P = Prohibited noxious weed (Arizona) – (Prohibited from entry into the state).
RG = Regulated noxious weed (Arizona) – (If found within the state, may be controlled or quarantined to prevent further infestation or contamination).
R = Restricted noxious weed (Arizona) – (If found within the state shall be quarantined to prevent further infestation or contamination).
A = Class A noxious weed (New Mexico) – Class A species are currently not present in New Mexico, or have limited distribution within the state. Preventing new infestations of these species and eradicating infestations is the highest priority.
B = Class B noxious weed (New Mexico) – Class B species are limited to portions of the state. In areas with severe infestations, management should be designated to contain the infestation and stop any further spread.
C = Class C noxious weed (New Mexico) – Class C species are widespread in the state. Management decisions for these species should be determined at the local level, based on feasibility of control and level of infestation.
WL = Watch List (New Mexico) – Watch List species may become problematic, but more data and distributional information is needed.
NW = Federal Noxious Weed List
NL = Species not listed for this state
NR = Neither EDDMaps nor USDA Plants Databases show records for counties within Project area.
*Inclusion requested by BLM Safford Field Office.
**All *Ipomoea* species except the ornamental species *Ipomoea carnea* (Mexican bush morning glory) and *Ipomoea arborescens* (morning glory tree); and the Restricted species *Ipomoea triloba* (three-lobed morning glory), not known to be present in New Mexico or Arizona.
Source: USDA 2011

3.6.5 Wildlife

Due to its great length (approximately 500 miles) and corridor alignment from east to west, the Project area encompasses a wide range of biomes and elevations in Arizona and New Mexico. This geographic and ecological diversity hosts a large suite of vertebrate species that potentially occur within the study corridor. The diversity of each major taxonomic group is briefly discussed below. Species listed as threatened or endangered and those that are proposed or are candidates for listing under the ESA are discussed individually in Section 3.6.6.1; all other special-status species are discussed in the biological technical report (Appendix B1).

3.6.5.1 Mammals

New Mexico

Within the New Mexico portion of the study corridor, a variety of biomes support approximately 74 species of mammals. This includes 1 insectivore, 17 bats, 3 lagomorphs (rabbits and hares), 35 rodents, 13 carnivores, and 4 ungulates (Findley et al. 1975); 1 marsupial, the Virginia Opossum (*Didelphis virginiana*), was likely introduced into New Mexico from eastern North America (Bermudez et al. 1995).

Bats are an important component of the mammalian fauna in the southwestern United States, with a higher number of species than occurs in other areas of the country. In the general Project study area, extensive mining over the last 150 years has created numerous mine shafts and adits that provide roosting habitat for a wide variety of bat species. Bats also occupy numerous caves in the region.

Arizona

The Arizona portion of the study corridor supports a slightly more diverse mammalian fauna than New Mexico, with 86 species potentially present. High vertebrate species richness in this region is, in part, a reflection of its "Sky Islands" physiography-driven speciation, along with a closer connectivity with the Sonoran Desert and Sierra Madre of north-central Mexico. Mammals likely occurring in the Arizona portion of the study corridor include 1 marsupial, 1 insectivore, 23 bat species including the endangered Lesser Long-nosed Bat (*Leptonycteris curasoae yerbabuenae*), 4 lagomorphs, 35 rodents, 17 carnivores, and 5 ungulates. Although introduced into New Mexico and central Arizona, Virginia Opossums in southern Arizona may represent natural range expansion northward of the regional subspecies (*D. v. californica*) from Sonora, Mexico (Babb et al. 2004).

3.6.5.2 Birds

New Mexico

Approximately 259 bird species regularly occur within the New Mexico portion of the study corridor (National Geographic Society 2002). Additional species may occur less frequently, and numerous species reach the northern limits of their range in mountains along the international border outside the study corridor. Bird diversity is high and, to a great extent, associated with the avian flyway along the Rio Grande, which serves as a migratory route for many bird species. Extensive semidesert grassland in southwestern New Mexico provides wintering habitat for a number of prairie-nesting species.

Arizona

Bird diversity in the Arizona portion of the study corridor is naturally high, due to the large number of habitats that occur over a wide elevation range. Migratory species are a significant component of the total bird species diversity in the region, and approximately 267 bird species regularly occur within the study corridor (National Geographic Society 2002). Additional species may be present during migration or as accidentals, or typically occur only at higher elevations in Madrean "Sky Islands." Bird diversity is also enhanced in part due to proximity to Mexico, which contains other biomes within the Madrean and Sinaloan biogeographic provinces such as Sinaloan deciduous forest and thornscrub habitats, with some species ranging into the southern United States.

3.6.5.3 Amphibians

New Mexico

Eleven native amphibian species may occur within the New Mexico portion of the study corridor, including 1 salamander, 3 spadefoots, 4 toads, 1 treefrog, and 2 ranid frogs (Degenhardt et al. 1986). One additional species, the American Bullfrog (*Rana catesbeiana*), an introduced species, occurs widely in both New Mexico and Arizona in most locations that support permanent water.

Arizona

Ten native amphibian species may occur within the Arizona portion of the study corridor, including 3 spadefoots, 5 toads, 1 treefrog, and 1 ranid frog (Brennan and Holycross 2006). Three additional species, the American Bullfrog, Tiger Salamander (*Ambystoma tigrinum*), and Pacific Treefrog (*Pseudacris regilla*), have been introduced into the Arizona portion of the study corridor.

3.6.5.4 Reptiles

New Mexico

Native reptiles are moderately well-represented in the New Mexico portion of the study corridor and may include the following 63 species: 7 turtles, 26 lizards, and 30 species of snakes (Degenhardt et al. 1986). Introduced turtles of several species, often released pets, may be present in urban settings, canals, and other bodies of water in New Mexico and Arizona.

Arizona

There are 67 native reptile species that may occur within the Arizona portion of the study corridor, including 4 turtles, 29 lizards, and 34 species of snakes (Brennan and Holycross 2006). The introduced Mediterranean House Gecko (*Hemidactylus turcicus*) occurs in urban areas within the study corridor.

3.6.5.5 Fish

New Mexico

Perennial aquatic habitats within the New Mexico portion of the study corridor are dominated by the main stem Rio Grande and its man-made Elephant Butte and Caballo reservoirs. These waters support all of the 10 native fish species that occur within the New Mexico portion of the study corridor (Lee et al. 1980). Shallow, ephemeral waters occur in most years on the Lordsburg Playa, but support no fish species due to high salinity and a lack of continuous connectivity with perennial reaches higher in the watershed.

Arizona

There are numerous aquatic habitats that support native fish species in the Arizona portion of the study corridor. Aquatic resources include the San Pedro River, Aravaipa Creek in the Galiuro Mountains, and Cienega Creek. The 10 native fish species present within the Arizona portion of the study corridor all occur in these streams or smaller tributaries (Minckley and Marsh 2009). Reintroduction of native fish has taken place in Turkey Creek, Hot Springs Canyon, and Redfield Canyon, all within the Galiuro Mountains (TNC 2010; USFWS 2005a). The Desert Pupfish (*Cyprinodon macularius*) was extirpated from the study area, and now occurs only through reintroduction in the Galiuro Mountains and elsewhere (AZGFD 2001a; USFWS 2003a).

3.6.5.6 Invertebrates

The evaluation of impacts to invertebrates due to the development of a project is seldom addressed, except for those species that have been identified as special-status species by the federal government or other land management agencies. The regional geography has resulted in high levels of endemism among some invertebrate groups. Many species, including a number of special-status species, are restricted to small areas such as spring complexes, other isolated wetlands, caves, or upper elevations of mountain ranges. Attempts at quantifying numbers of species of invertebrates within a given habitat or region are usually little more than guesswork, as data regarding this element of biota are, for the most part, incomplete.

3.6.6 Special-Status Species

BLM manual 6840 defines special-status species as those that are "proposed for listing, officially listed as threatened or endangered, or are candidates for listing as threatened or endangered under the provisions of the ESA; those listed by a State in a category such as threatened or endangered implying potential endangerment or extinction; and those designated by each State Director as sensitive." This section addresses species listed under the ESA or those proposed or candidates for listing. Due to the large scale of the Project and large number of species present, all other special-status species are addressed in the biological technical report (Appendix B1).

Three additional species are included in Table 3-30 due to special circumstances: the Cactus Ferruginous Pygmy-owl (*Glaucidium brasilianum cactorum*, petitioned as *G. ridgwayi cactorum*); the Arizona Striped Whiptail (*Aspidoscelis arizonae*); and the Chihuahua scurf-pea (*Pediomelum pentaphyllum*). The Cactus Ferruginous Pygmy-owl, formerly listed under the ESA, was delisted in 2006. The species was reviewed for relisting in response to a petition and proposed taxonomic revisions, but the USFWS determined that this is not warranted (USFWS 2011a). However, the species is listed as sensitive by the BLM, and potential habitat is widespread throughout much of the study corridor in Arizona. The Arizona Striped Whiptail and the Chihuahua scurf-pea were included in a 2007 petition to the USFWS for consideration for listing, and are also currently under review. All three of these species potentially occur within the study corridor and have thus been included in the review.

Most special-status species with some potential for occurrence within the study corridor have special status with multiple agencies. Status listings for all of the species reviewed are found in the biological technical report (Appendix B1). The ESA-listed, proposed, or candidate plant and

wildlife species that were identified as occurring or potentially occurring within the study corridor are listed in Table 3-30 and addressed in Section 3.6.6.1, as are the BGEPA-listed Bald Eagle and Golden Eagle. Only those species with potential for occurrence, or with designated critical habitat within the study corridor, are included in the Summary of Inventory Results (Section 3.6.9).

Figure M.6-2E/W (see Map Volume) shows designated and proposed critical habitat for ESA-listed species, as well as the numbers of threatened, endangered, proposed, or candidate species that may occur on each Project link, as determined from existing information or the presence of potential habitat within the known or expected range of the species. Figure M.6-3E/W (see Map Volume) shows the number of all special-status species that may occur on each link, as determined from existing information or the presence of potential habitat within the known or expected range of the species.

3.6.6.1 Endangered Species Act and Bald and Golden Eagle Protection Act

Table 3-30 includes species listed under the BGEPA and ESA, as well as species proposed or candidates for ESA listing, that are known to occur within the study corridor or for which suitable habitat may be present.

Table 3-30. Species Addressed by the Endangered Species Act and Bald and Golden Eagle Act that May Occur in the Study Corridor

Common Name Scientific name	Designated Critical Habitat	Potential (NM)	Potential (AZ)	Status
Mammals				
Lesser Long-nosed Bat *Leptonycteris curasoae yerbabuenae*	None	Moderate	Present	E, NMT, WSC, SGCN (NM), PVS
Mexican Long-nosed Bat *Leptonycteris nivalis*	None	Very low	Very low	E, NME, SGCN (AZ, NM)
New Mexico Meadow Jumping Mouse *Zapus hudsonius luteus*	N/A	Low	None	C, NME, BLMS (AZ, NM), FS, WSC, SGCN (AZ, NM)
Mexican Gray Wolf *Canis lupus baileyi*	None	Very low	Very low	E (NEP), NME, WSC, SGCN (AZ, NM)
Jaguar *Panthera onca*	Proposed (Outside Study Corridor)	Very low	Very low	E, WSC, SGCN (AZ, NM)
Ocelot *Leopardus* (*Felis*) *pardalis*	None	None	Low	E, WSC, SGCN (AZ)
Jaguarundi *Herpailurus yagouaroundi tolteca*	None	None	Very Low	E

Table 3-30. Species Addressed by the Endangered Species Act and Bald and Golden Eagle Act that May Occur in the Study Corridor				
Common Name Scientific name	**Designated Critical Habitat**	**Potential (NM)**	**Potential (AZ)**	**Status**
Birds				
Golden Eagle *Aquila chrysaetos*	N/A	Present	Present	BGEPA; SGCN (NM)
Bald Eagle *Haliaeetus leucocephalus*	N/A	Present	Present	DM, NMT, BGEPA; SC; BLMS (AZ); FS; WSC; SGCN (NM); BCC
Northern Aplomado Falcon *Falco femoralis septentrionalis*	None	Present	Low	E (NEP), NME, WSC, SGCN (AZ, NM)
Yuma Clapper Rail *Rallus longirostris yumanensis*	None	None	Low	E, WSC, SGCN (AZ)
Piping Plover *Charadrius melodus*	Outside Study Corridor	Very Low	None	T, NMT
Yellow-billed Cuckoo (Western DPS) *Coccyzus americanus*	N/A	Present	Present	C, BLMS (AZ), FS, WSC, NMS, PVS, SGCN (AZ), BCC
Mexican Spotted Owl *Strix occidentalis lucida*	Within Study Corridor	Moderate	Present	T, WSC, NMS, SGCN (AZ, NM)
Cactus Ferruginous Pygmy-owl *Glaucidium brasilianum cactorum*	N/A	None	Moderate	BLMS (AZ), FS, SC, WSC, SGCN (AZ), PVS
Southwestern Willow Flycatcher *Empidonax traillii extimus*	Within Study Corridor	Present	Present	E, NME, WSC, SGCN (AZ, NM), PVS
Sprague's Pipit *Anthus spragueii*	N/A	Present	Moderate	C, BLMS (AZ), WSC, SGCN (AZ, NM), BCC
Amphibians				
Chiricahua Leopard Frog *Lithobates chiricahuensis*	Outside Study Corridor	Very Low	Very low	T, WSC, NMS, SGCN (AZ, NM), PVS
Reptiles				
Sonoran Desert Tortoise *Gopherus morafkai*	N/A	None	Present	C, BLMS (AZ), FS, SC, WSC, SGCN (AZ)
Arizona Striped Whiptail* *Aspidoscelis arizonae*	N/A	None	Present	SGCN (AZ)
Tucson Shovel-nosed Snake *Chionactis occipitalis klauberi*	N/A	None	High	C, BLMS (AZ), SGCN (AZ), PVS

Table 3-30. Species Addressed by the Endangered Species Act and Bald and Golden Eagle Act that May Occur in the Study Corridor				
Common Name Scientific name	**Designated Critical Habitat**	**Potential (NM)**	**Potential (AZ)**	**Status**
Northern Mexican Garter Snake *Thamnophis eques megalops*	N/A	None	Present	C, NME, BLMS (AZ, NM), FS, WSC, SGCN (AZ, NM), PVS
Fish				
Apache Trout *Oncorhynchus apache*	None	None	Very Low	T, WSC, SGCN (AZ)
Gila Chub *Gila intermedia*	Within Study Corridor	None	Present	E, NME, BLMS (NM), WSC, SGCN (AZ, NM), PVS
Roundtail Chub (Lower Colorado River Basin DPS) *Gila robusta*	N/A	None	Present	C, NME, BLMS (AZ, NM), FS, WSC, SGCN (AZ, NM)
Rio Grande Silvery Minnow *Hybognathus amarus*	Within Study Corridor	Present	None	E, NME, SGCN (NM)
Spikedace *Meda fulgida*	Within Study Corridor	None	Present	E, NME, WSC, SGCN (AZ, NM)
Loach Minnow *Tiaroga cobitis*	Within Study Corridor	None	Present	E, NMT, WSC, SGCN (AZ, NM)
Desert Pupfish *Cyprinodon macularius*	Outside Study Corridor	None	Present	E, WSC, SGCN (AZ), PVS
Gila Topminnow *Poeciliopsis occidentalis*	None	None	Present	E, NMT, WSC, SGCN (AZ, NM), PVS
Invertebrates				
Chupadera Springsnail *Pyrgulopsis chupaderae*	Within Study Corridor	Present	None	E, NME, SGCN (NM)
Socorro Springsnail *Pyrgulopsis neomexicana*	None	Present	None	E, NME, SGCN (NM)
Plants				
Pima Pineapple Cactus *Coryphantha scheeri* var. *robustispina*	None	None	Moderate	E, HS, PVS
Kuenzler's Hedgehog Cactus *Echinocereus fendleri* var. *kuenzleri*	None	Moderate	None	E, NME
Acuña Cactus *Echinomastus erectocentrus* var. *acunensis*	Proposed (Outside Study Corridor)	None	Low	PE, BLMS (AZ), HS, PVS

Table 3-30. Species Addressed by the Endangered Species Act and Bald and Golden Eagle Act that May Occur in the Study Corridor				
Common Name Scientific name	**Designated Critical Habitat**	**Potential (NM)**	**Potential (AZ)**	**Status**
Todsen's Pennyroyal *Hedeoma todsenii*	Outside Study Corridor	Low	None	E, NME
Pecos Sunflower *Helianthus paradoxus*	Outside Study Corridor	Low	None	T, NME
Huachuca Water-umbel *Lilaeopsis schaffneriana* var. *recurva*	Outside Study Corridor	None	Present	E, HS, PVS
Chihuahua Scurf-pea* *Pediomelum pentaphyllum*	N/A	Low	High	NME; BLMS (NM); FS; SC

Status

Endangered Species Act:
E = Endangered
T = Threatened
C = Candidate
PE = Proposed Endangered
DP = Delisted Taxon – Petitioned for re-listing
DM = Delisted Taxon – Population being monitored
DPS = Distinct Population Segment
E (NEP) = Nonessential Experimental Population

USFWS (non-ESA):
BGEPA = Bald and Golden Eagle Protection Act
BCC = Bird Species of Conservation Concern
SC = Species of Concern

BLM:
BLMS = BLM Sensitive Species
Forest Service:
FS = Forest Service Sensitive Species (Region 3)
AZGFD:
SGCN (AZ) = Species of Greatest Conservation Need
WSC = Wildlife Species of Concern
State of New Mexico:
NME = Endangered
NMT = Threatened
New Mexico Department of Game and Fish:
NMS = New Mexico Sensitive Species
SGCN (NM) = Species of Greatest Conservation Need
Arizona Department of Agriculture:
HS = Highly Safeguarded
Pima County, Arizona – Habitat Conservation Plan:
PVS = Priority vulnerable species

Mammals

Lesser Long-nosed Bat (Leptonycteris curasoae yerbabuenae)

The study corridor is near the northern limits of the range of the Lesser Long-nosed Bat as it is currently understood, and contains known roosts. There is the possibility that additional, undocumented roosts could also exist within the study area, as concentrations of agaves that could be used as food sources by this species are widespread in the region. The Lesser Long-nosed Bat is known to be capable of traveling long distances, in the range of 30 to 60 miles (USFWS 1994a) in a single night to forage. The proximity of the southern portion of the study corridor to other known roosts makes it likely that these populations forage within the study corridor regularly. Foraging areas used by the bats vary from year to year in relation to the annual productivity of the cacti and agave blooms.

While using maternity roosts in northern Mexico and southwestern Arizona, Lesser Long-nosed Bats feed primarily on nectar and pollen of columnar cacti blossoms. After the young become

able to fly, the bats move east to higher elevations, where they forage primarily on paniculate agave species (those with branching flower heads) for the remainder of the summer. This is the time when they would be at the highest abundance within the study corridor (Cockrum 1991; Rojas-Martinez et al. 1999). They are also known to use non-paniculate agave species, such as Schott's century plant (*Agave schottii*) (Barbour and Davis 1969), which gives them some flexibility in their foraging. The bats have commonly been recorded visiting hummingbird feeders during summer nights in Tucson (Lowery et al. 2009).

Within the study corridor, suitable foraging habitat for the Lesser Long-nosed Bat is likely to be present in the Arizona Upland subdivision of Sonoran desertscrub in southeastern Pinal County, particularly east of the Picacho Mountains, and east through the Tucson valley. There is a large, disjunct population of saguaros in the San Pedro River Valley that could provide foraging habitat for the species. These areas would likely only be used by small numbers of males and nonbreeding females, since the bulk of the population is at the maternity sites far to the southwest during the saguaro bloom. Late-season foraging is potentially available on paniculate agaves throughout a large portion of the study corridor from the Catalina–Rincon Mountain complex south and east through Arizona, and into far southwestern New Mexico (Cockrum 1991; Rojas-Martinez et al. 1999).

Mexican Long-nosed Bat (Leptonycteris nivalis)

Like the Lesser Long-nosed Bat, the Mexican Long-nosed Bat is a strong flier (Schmidly 1991), capable of flying long distances in a single night to forage. Known Mexican Long-nosed Bat roosts in New Mexico are approximately 45 to 70 miles south of the study corridor, in the Big Hatchet, Animas, and Peloncillo mountains (Bogan et. al 2006); however, an individual Mexican Long-nosed Bat was captured during mist-netting north of the study corridor, near the Grant-Hidalgo county line in New Mexico (M. Ramsey, personal communication). No other information indicates whether an unknown roost is present near the study corridor, or whether the capture represented a vagrant individual. There are no known areas within the portions of the study area (Peloncillo and Pyramid mountains) closest to known roosts for the species that contain large concentrations of agaves that would be attractive to it. The potential for the species occurring within the study corridor is very low, and would likely be limited to small numbers of foraging individuals if food resource patterns resulted in unusual movement patterns for the species.

New Mexico Meadow Jumping Mouse (Zapus hudsonius luteus)

Typical habitats for the New Mexico Meadow Jumping Mouse include marshes, wet meadows, and edges of streams or canals that support a diverse streamside or emergent vegetation. The species occurs in montane meadows at elevations up to nearly 7,000 feet (Morrison 1990). In New Mexico, the Meadow Jumping Mouse is recorded from the Jemez, San Juan, and Sacramento mountains, Bosque del Apache NWR, and several locations in the Rio Grande Valley, including Española, Isleta, Belen, and Socorro (BISON-M 2008). Habitat for the species potentially occurs in the study corridor along the Rio Grande at the San Antonio crossing (Link A140), but no New Mexico Meadow Jumping Mice have recently been recorded outside Bosque del Apache NWR.

Mexican Gray Wolf (Canis lupus baileyi)

Gray Wolves in the Southwest were extirpated from many regions before distribution and subspecific relationships could be fully determined. The Mexican Gray Wolf was present through southeastern and perhaps central Arizona, southern New Mexico, and the Rio Grande Valley to approximately the Big Bend region in Texas, and a broad range throughout the Sierra Madre in Mexico (USFWS 1982). The range of the Mexican Gray Wolf contracted continually through the nineteenth and twentieth centuries; and prior to the eventual capture of the last wild wolves, natural populations were only known from a few locations in the Sierra Madre.

Mexican Gray Wolves were generally found in montane forests; however, prior to increases in grazing and other human activities, they occurred in grasslands in the Southwest as well. Before the introduction of grazing livestock, wolves were primarily predators of medium to large mammals over a large hunting territory; although when opportunity presented itself, other small prey would be taken as well. Wolves are social, and cooperatively hunt and defend territories. Males and females generally mate for life, and reach reproductive age at 2 to 3 years. Litter size for Gray Wolves and captive Mexican Gray Wolves ranges from 3 to 6 in several populations (Mech 1981), but is much lower in wild Mexican Gray Wolves, at 2.1 pups per litter (USFWS 2008a).

The Gila National Forest in New Mexico is designated as a portion of the secondary recovery zone for the Blue Range Wolf Recovery Area. Surrounding areas outside of the Gila National Forest are within the boundary of the nonessential experimental population (NEP), but not the recovery area. Current management direction dictates that wolves dispersing beyond the recovery area boundary will be returned to the area, and those that do so repeatedly may be returned to captivity (USFWS 1998). Management rules relating to the NEP are currently being revised and the policy for removal of wolves outside the recovery area may change over the Project's timeline. However, changes to the overall NEP designation are not being considered, and will not change requirements pursuant to Section 7 consultation for the Project.

No portion of the Project enters the Gila National Forest or the wolf recovery zone, but much of the Project overlaps the established NEP boundary. Wolves are long-range dispersers and may enter the study corridor within the NEP boundary. In 2002, one male Mexican Gray Wolf was tracked moving into the Burro Mountains in Grant County, New Mexico, the closest portion of the recovery area to the Project. It was eventually captured outside the recovery area and returned to captivity (USFWS 2003b). No other Mexican Gray Wolves are regularly using areas near the study corridor (AZGFD 2012); however, Mexican Gray Wolves were reintroduced into northern Mexico (Arizona Daily Star 2011), and the potential exists for individuals to move northward into the United States. If any Mexican Gray Wolves of Mexican origin were to reach the study corridor, they would be within the boundary of the NEP.

Jaguar (Panthera onca)

Jaguar habitat outside of the United States can include nearly all warm Neotropical areas, with the exception of highly arid regions. Tropical rainforest, coastal plains, savannahs, wetlands, and montane canyons and woodlands are heavily used. In the United States, Jaguars were found in varied habitats from western New Mexico through southern Arizona, including Madrean

evergreen woodlands, semidesert grassland, desertscrub, and pine-oak woodland (McCain and Childs 2008; Ortega-Huerta and Medley 1999). However, the largest remaining blocks of suitable habitat are at moderate elevations in a number of mountain ranges near the United States-Mexico border. Male Jaguars have very large home ranges and engage in long-distance dispersal, leading to the occasionally reported individual far outside of the typical breeding range of the species.

Portions of the study corridor in southwest New Mexico and southeastern Arizona coincide with the Jaguar Conservation Emphasis Area (AZGFD and NMDGF 2007). This area was delineated based on GIS modeling that combined species records and habitat considered suitable to support the species, with consideration given to connectivity of habitats from northern Mexico into the southwestern United States (Johnson et al. 2009). All recent Jaguar records in the United States have been of single males and have come from mountains along the border with Mexico; none from within the study corridor. However, individuals could travel farther north into the study corridor in the future. Critical habitat for the Jaguar was proposed in several southeastern Arizona mountain ranges in 2012. No areas within or north of the study corridor were included in the proposal, after the USFWS considered the lack of recent records and barriers to dispersal formed by I-10 and other infrastructure (USFWS 2012a).

Ocelot (Leopardus pardalis)

Ocelots range from the coastal plains and lower Rio Grande Valley of south Texas into northern Argentina. Historically, Ocelots occurred in riparian areas and mountain foothills in Arizona, with a few scattered records in the twentieth century, and along a much greater extent of the Gulf Coast Plains and east Texas into Louisiana. A key habitat feature for the Ocelot is very high shrub cover. More than 95 percent canopy cover is preferred, and less than 75 percent cover is avoided (Harveson et al. 2004; Haines et al. 2006), except possibly at night (Murray and Gardner 1997). In the Southwest, sufficient levels of shrub cover are largely restricted to riparian corridors. Some fragmentation may be tolerated if a network of sufficiently dense patches of dense cover remains (Jackson et al. 2005). Primary food items are likely small mammals and birds; some medium-sized mammals may also be taken (USFWS 1990).

Recent records of Ocelots in Arizona probably represent transient individuals (AZGFD 2004a). Suitable habitat is likely limited to riparian areas such as remnant segments of gallery forest along the San Pedro River that have connectivity with habitat farther south in Mexico; however, successful dispersal within the region would necessitate crossing large areas of lower suitability. An Ocelot was recently documented in Cochise County, Arizona (Sky Island Alliance 2010). The precise location of the sighting is not available, but the sighting could be near or within the southern portion of the study corridor. A dead Ocelot was recovered in 2009 from Gila County, Arizona. If the cat was of wild origin, it would have traveled through the study corridor from Mexico (USFWS 2010a); other recent confirmed or anecdotal sightings have occurred south of I-10 and the study corridor. The potential for the Ocelot occurring within the study corridor is low in Arizona.

Jaguarundi (Herpailurus yagouaroundi tolteca)

The Jaguarundi occurs from South America to extreme southern Texas. No Jaguarundi specimens have been recovered in Arizona or New Mexico (AZGFD 2004b; de Oliveira 1998), but there are numerous anecdotal reports from the Chiricahua and Santa Rita mountains, along the upper San Pedro River, and on the Tohono O'odham Reservation (AZGFD 2004b). Jaguarundis use a variety of habitats throughout their range, but at the northern limits of their range they typically occur in thick often thorny vegetation, in which they hunt and find shelter from predators (Davis and Schmidly 1997; de Oliveira 1998). Potential for the Jaguarundi occurring within the study corridor is very low, and would likely be limited to the crossing area of the San Pedro River in Arizona.

Birds

Golden Eagle (Aquila chrysaetos)

Golden Eagles are widespread in the western United States and can be found in a variety of habitats, but prefer open ground or low hills where visibility is good for hunting (Ehrlich et al. 1988; Glinski 1998). They nest on cliffs, in large or small trees, and sometimes on transmission structures (Glinski 1998). The Golden Eagle feeds primarily on mammals, preferring rabbits and ground squirrels, but also will feed on snakes, birds, and large insects when mammals are unavailable (Ehrlich et al. 1988; Terres 1980; Glinski 1998). Suitable Golden Eagle nesting and foraging habitat is present in portions of New Mexico and Arizona through which the study corridor passes. Nesting records for Golden Eagles in Arizona are widely distributed in the southern portion of the state, and include the general Project study area (Corman and Wise-Gervais 2005). The Golden Eagle is present in the study corridor in both New Mexico and Arizona.

Bald Eagle (Haliaeetus leucocephalus)

The Bald Eagle occurs across nearly all of North America, with the exception of large areas of the Chihuahuan Desert where there are no large permanent water sources. It is also absent from portions of far northern Alaska and Canada. Bald Eagles are opportunistic feeders. Fish make up the majority of their diet, but water birds can also be an important food source (Brown et al. 1991). Bald Eagles also consume mammals, shellfish, and carrion (Hunt 1998; Hunt et al. 1992; Wheeler 2003), particularly in response to decreased fish availability (Driscoll et al. 1999). Foraging success for fish in the Southwest appears to be greatest in small to medium-sized streams and tributaries of larger rivers (Brown 1993).

The Bald Eagle nests near large bodies of water in most of its range in North America, and approximately 50 to 60 resident pairs breed in the Southwest (AZGFD 1996; Phillips et al. 1964). Bald Eagles occur in Arizona at lakes, reservoirs, and along perennial rivers. Large riparian trees (typically sycamore, cottonwoods, or willows) and cliffs are important structures used for nesting and perching, and nests must be within foraging range of rivers or lakes with large fish present.

Bald Eagles regularly occur within the study corridor along the Rio Grande in New Mexico and in the Sulphur Springs Valley in Cochise County, Arizona; and may occasionally be observed elsewhere. They are absent from large areas of the study corridor where permanent water is lacking.

Northern Aplomado Falcon (Falco femoralis septentrionalis)

Aplomado Falcons (*F. femoralis*) historically ranged from the southern tip of South America north to the southwestern United States, where the species occurred at the northern extent of its range (as *F. f. septentrionalis*) in west Texas, south-central New Mexico, and southeastern Arizona (Keddy-Hector 2000). The range of the species rapidly retracted from the United States to Mexico in the late nineteenth century, with only rare sightings through most of the twentieth century prior to recent reintroduction efforts in Texas and New Mexico. The Northern Aplomado Falcon occurs in desert grasslands in North America and prefers open, low-cover areas. The presence of shrubs and stem succulents such as yuccas is important to provide nest locations and support prey species, but areas of generally low ground cover are preferred for foraging (Macias-Duarte et al. 2004; Young et al. 2004). Aplomado Falcons do not construct their own nest, but modify old stick platforms placed in trees by other bird species; particularly those of other raptors or large corvids (Keddy-Hector 2000; Young et al. 2004).

Currently, the Peregrine Fund releases approximately 100 Northern Aplomado Falcons into NEPs in Texas and New Mexico each year, under permit from the USFWS (Peregrine Fund 2009). While the number of successful pairs in New Mexico is still modest, continued releases over time will likely result in an increase in the numbers of this species in southern New Mexico, as has occurred in southern Texas. The nearest release site to the Project is located a few miles west of Deming, New Mexico. A release site east of Bosque del Apache NWR (south of San Antonio, New Mexico) is within 15 miles of links A80 and A111. There is abundant suitable habitat for the Northern Aplomado Falcon in the Project study area from the Sulphur Springs Valley north of Willcox, Arizona, east through the Rio Grande Valley in New Mexico. The potential exists for future colonization or introduction of the falcon in Arizona, although this has not occurred to date.

Yuma Clapper Rail (Rallus longirostris yumanensis)

Yuma Clapper Rails in Arizona breed in freshwater marshes with dense vegetation exceeding 16 inches in height, including cattail (*Typha spp.*) and/or giant bulrush (*Scirpus californicus*). Pond openings, flowing channels, and emergent soils are important elements of suitable habitat for the species. Yuma Clapper Rails have been found in wetlands as small as 0.12 ha (0.3 acre) (Todd 1986).

The potential for the Yuma Clapper Rail occurring within the study corridor in Arizona is low. The only known records in the area are occasional sightings of individuals at Picacho Reservoir near the Pinal Central Substation and western terminus of the Project (AZGFD 2006; Todd 1986). This reservoir is used for surplus agricultural water storage for the San Carlos Irrigation Project and is not perennial, thus developing suitable Clapper Rail habitat only during very wet years.

Piping Plover (Charadrius melodus)

The Piping Plover requires open shoreline habitats suitable for nesting near waters that provide access to invertebrate prey species. Piping Plovers primarily inhabit sparsely vegetated, gravelly beaches, alkali, and sand flat habitats, but are also recorded using shores of reservoirs, lakes, and rivers, and human-modified habitats that include gravel pits and industrial ponds (Elliott-Smith and Haig 2004).

The Piping Plover is a rare spring migrant to New Mexico, reported near the study corridor only at the Bosque del Apache NWR south of Socorro (BISON-M 2008; New Mexico Ornithological Society 2012). There are no other areas within the study corridor where this species is anticipated to occur. Its potential for occurrence in New Mexico is very low.

Yellow-billed Cuckoo (Coccyzus americanus), Western Distinct Population Segment

Western populations of the Yellow-billed Cuckoo nest in dense riparian woodlands, primarily of cottonwood (*Populus fremontii*), willow (*Salix* spp.), and mesquite (*Prosopis* spp.), along riparian corridors in otherwise arid areas (Laymon and Halterman 1989; Hughes 1999). Dense undergrowth may be an important factor in selection of nest sites. Saltcedar-dominated stands are avoided, but saltcedar may be tolerated as a minor component of the understory (Kunzmann et al. 2000). Western Yellow-billed Cuckoos require relatively large tracts of riparian woodland, preferring tracts greater than 100 acres, with tracts less than 25 acres rarely used (Laymon and Halterman 1989). They forage primarily by gleaning insects from vegetation, but they may also capture flying insects (Hughes 1999; Laymon 1998).

The San Marcial reach of the Middle Rio Grande in New Mexico supports one of the most significant remaining populations of this species in the Southwest (Johanson et al. 2006). The San Marcial reach of the river extends from the southern boundary of the Bosque del Apache NWR south to Elephant Butte Reservoir dam, outside the study corridor. The Yellow-billed Cuckoo may also occur along the Rio Grande within the study corridor.

Within Arizona, Yellow-billed Cuckoos are occasionally reported along the San Pedro River, mostly in the southern reaches closer to the Mexico border where the most extensive areas of suitable habitat are present (Corman and Wise-Gervais 2005). They may occur within the study corridor along the Lower San Pedro River, and are most likely to occur in the northern portion of the study corridor where mature riparian vegetation with some dense understory is better-developed closer to the confluence of the San Pedro and Gila rivers. The species also occurs at Aravaipa Canyon in the north end of the Galiuro Mountains, just north of the study corridor (Sky Island Alliance 2005), and at the Cienega Creek Natural Preserve in Pima County.

Mexican Spotted Owl (Strix occidentalis lucida)

The Mexican Spotted Owl prefers old-growth forest in mixed conifer, pine-oak woodland, deciduous riparian, or a combination of these habitats that will support a home range of 1,400 to 4,500 acres (Gutierrez et al. 1995; Ehrlich et al. 1988). Mexican Spotted Owls are usually found in canyons with old-growth forest, but they may also be found in canyons with steep cliffs and relatively little forest habitat, if locations exist with a suitably cool and humid microclimate.

The Mexican Spotted Owl could potentially occur within the study corridor in the north end of the Galiuro Mountains in the vicinity of Aravaipa Canyon. Mexican Spotted Owls also nest in Turkey Creek at the east end of Aravaipa Canyon (BLM 2009a). Critical habitat is designated in several mountain ranges within or near the study corridor in Arizona and New Mexico.

Cactus Ferruginous Pygmy-owl (Glaucidium brasilianum cactorum)

Very few Cactus Ferruginous Pygmy-owls remain in southern Arizona. They no longer occur in most of the areas of suitable habitat in the northern parts of their range that they occupied within the last 30 years. Records of the species in the San Pedro River Valley have historically been few, with the most recent being an unconfirmed report in 2001-2002, and near Aravaipa Creek in the early 1980s. Other recent records of the species in the Project study area include one in northwest Tucson and one near Red Rock (Richardson 2009).

The status review completed in 2011 that determined listing of the species was not warranted also summarized the most recent survey efforts for the species (USFWS 2011a). Cactus Ferruginous Pygmy-owls are known to persist in the Altar and Avra valleys in Pima County. The species was detected in Pinal County during surveys for the Arizona Breeding Bird Atlas (Corman and Wise-Gervais 2005), but no records for Pinal County were presented after that date. However, survey efforts were greatly reduced after the species was delisted, and the current status of the species is not well-known. The habitat of Cactus Ferruginous Pygmy-owls in Arizona and in Sonora, Mexico frequently includes dense vegetation along desert washes (Flesch 2003), adjacent to Sonoran Desertscrub supporting saguaros with nest cavities that may be used by the owls (Flesch and Steidl 2002). Mature riparian woodlands were historically important to the owls (Johnson et al. 2003), but reported observations in riparian woodlands have decreased (Johnson et al. 2000). Suitable habitat for the species is present within the study corridor from the vicinity of the flanks of the Picacho Mountains east to the limits of saguaro habitat along the west and north flanks of the Tortolita Mountains, and southeast to Marana and the northern fringe of Tucson along the mountain base. Additional habitat is present in the study corridor throughout the San Pedro River Valley.

Due to the lack of recent records of the species in the Project study area, and the small number of individuals that have historically occurred here, the potential for the Cactus Ferruginous Pygmy-owl occurring within the study corridor is moderate.

Southwestern Willow Flycatcher (Empidonax traillii extimus)

Southwestern Willow Flycatchers are nearly always found in dense riparian corridors, particularly during the nesting season (Sogge et al. 1997). Vegetation structure appears to be more important than species composition; sites with a corridor width greater than 30 feet, a tall overstory, and thick, brushy understory are strongly preferred, from riparian areas in low deserts up to elevations of approximately 8,000 feet (Sogge and Marshall 2000). Native broadleaf riparian woodlands were the most widespread natural habitat for the flycatcher prior to the twentieth century, but invasive saltcedar and Russian olive dominate many sites currently or formerly used by the species. Southwestern Willow Flycatchers normally build nests in thickets of shrubs and young or small trees between 5 and 25 feet in height, with dense foliage between ground level and 12 feet (Sogge et al. 1997). Females lay a clutch of three to four eggs (USFWS

2002a), and nestlings fledge 12 to 15 days after hatching (Sogge 2000). Like most other flycatchers, the Willow Flycatcher forages primarily by "hawking," or flying from a perch to capture flying insects, and may also pick arthropods directly from vegetation while remaining in flight (Durst 2004). Seeds and berries are occasionally consumed, although rarely as a substantial portion of the diet (Sogge 2000).

Designated critical habitat for the Southwestern Willow Flycatcher extends along the Rio Grande from Isleta Pueblo in Valencia County downstream to approximately 2 miles north of the Sierra County line (USFWS 2013). Locations where the Project may cross the Rio Grande are located within designated critical habitat.

Designated critical habitat for the Southwestern Willow Flycatcher on the San Pedro River is present within the study corridor through all but approximately the southern 3.5 miles of the river near Benson, Arizona (USFWS 2013). There is also a small portion (approximately 3 miles) of occupied habitat for the species in the lower portion of Aravaipa Creek at its confluence with the San Pedro River (*ibid*). Within the study area, the northern portions of the San Pedro River support larger contiguous patches of riparian vegetation that would be attractive to the species. Generally, riparian vegetation becomes less dense farther south along the river within the study corridor and would likely be progressively less suitable as nesting habitat. While all four potential crossings of the San Pedro River are within designated critical habitat, the southern two contain habitat of a lower suitability for nesting Southwestern Willow Flycatchers due to thinning and gaps in the vegetation cover along the river.

The overall potential for the Southwestern Willow Flycatcher occurring within the study corridor is moderate for Arizona (primarily along portions of the San Pedro River) and high for New Mexico (along portions of the Rio Grande).

Sprague's Pipit (Anthus spragueii)

The Sprague's Pipit occurs in Cochise County, Arizona as a winter visitor, where it inhabits shortgrass prairie habitat and pastures or agricultural fields with grasses of medium height (Alsop 2001). It is also present in winter in the grasslands in the Sonoita, San Rafael, and Sulphur Springs valleys (BISON-M 2008; AZGFD 1996). Most of the habitat used by Sprague's Pipit in southern Arizona is located south of the Project study area, but the species winters in and migrates through the study corridor in New Mexico (AZGFD 2001b; Robbins and Dale 1999).

Amphibians

Chiricahua Leopard Frog (Lithobates chiricahuensis)

The Chiricahua Leopard Frog is highly aquatic and is usually found in rocky streams with deep pools surrounded by oak woodlands, mixed pine-oak woodlands, and pine forests, generally at elevations between 3,500 and 8,530 feet (Sredl and Jennings 2005). Historically this species followed streams down into areas of chaparral, grasslands, or deserts, although introduction of non-native predators coupled with habitat reduction and fragmentation has nearly eliminated valley stream use in the United States (USFWS 2007a).

Within the study corridor, the Chiricahua Leopard Frog has been recorded from the Galiuro, Winchester, and Pinaleño mountains in Arizona. The species is recorded at numerous locations in southwestern New Mexico, but within the study corridor only on the Ladder Ranch in Cuchillo Negro Creek. Cuchillo Negro Creek contains permanent water and Chiricahua Leopard Frog habitat near the edge of the study corridor, at a distance of at least 3 miles upstream from the proposed Project centerline. Critical habitat was proposed for the species in March 2011 and finalized in March 2012 (USFWS 2012b), but none of the areas designated occurs within the study corridor. The Ladder Ranch was excluded from the final rule designating critical habitat, in recognition of the substantial conservation and recovery measures implemented by the Turner Endangered Species Fund, Turner Enterprises, and the Ladder Ranch.

Reptiles

Sonoran Desert Tortoise (Gopherus morafkai)

Originally considered a single species, the Sonoran Desert Tortoise is ecologically distinct and separated by the Colorado River from the listed endangered Mojave Desert Tortoise (*G. agassizii*). Genetic and morphological evidence supported the description of the Sonoran Desert Tortoise as a separate species in 2011 (Murphy et al. 2011). Sonoran Desert Tortoises occur primarily in the Arizona Upland and Lower Colorado River Valley subdivisions of Sonoran Desertscrub, as well as Mojave Desertscrub (Arizona Interagency Desert Tortoise Team 2000), and at elevations from 500 to more than 5,000 feet (AZGFD 2001e). Sonoran Desert Tortoises are most often found in a mixed cactus-paloverde scrub association on rocky hillsides (Barrett 1990), where large numbers of boulders provide shelter. Desert Tortoises use a range of burrow and shelter types, including existing rock structures, vegetation, and new or existing burrows (Averill-Murray et al. 2002). Deep burrows are used during the hottest summer temperatures (Barrett 1990).

Desert Tortoises are herbivores, and consume a variety of plant matter, including herbaceous parts of annuals and perennials, grasses, shrubs, flowers, fruit (particularly cactus fruit), and seeds (Van Devender et al. 2002). Both Mojave and Sonoran Desert Tortoises are long-lived, slow-growing, and have very low juvenile survival. Sonoran Desert Tortoises tend to live longer and grow more slowly, but to a larger size than Mojave Desert Tortoises (Curtin et al. 2009).

Sonoran Desert Tortoises are present within a large portion of the study corridor from the San Pedro River Valley west to the Picacho Mountains, although absent from low desert valleys. The BLM in Arizona mapped three categories for Desert Tortoise habitat, with Category 1 habitat being the highest quality and of the greatest conservation value (BLM 1988b). BLM Category 1 Desert Tortoise habitat near the study corridor includes only the southern Picacho Mountains. BLM Category 2 habitat includes the northern Picacho Mountains, and three areas on the east side of the San Pedro River. Only the section of Category 2 habitat near San Manuel, Arizona is crossed by one of the proposed Project alternatives. Approximately half of the length of Project alternatives west of Benson, Arizona is within BLM Category 3 Desert Tortoise habitat.

Arizona Striped Whiptail (Aspidoscelis arizonae)

Arizona Striped Whiptails are currently known from three locations in southeastern Arizona (Sullivan 2009; Sullivan et al. 2005). The species was discovered in 1896, but not observed again until 1962 at a location approximately 40 miles distant from the cited but possibly erroneous type locality (Wright and Lowe 1965). Arizona Striped Whiptails are restricted to semiarid grasslands, often in valley bottoms dominated by alkali sacaton (*Sporobolus airoides*) and saltgrass (*Distichlis spicata*) (Rosen et al. 1998). The Willcox Playa area, including dunes and areas near Cochise Lakes south of the town of Willcox, is the southernmost extant population center for the species. A population is located near Bonita in the northern Sulphur Springs Valley, and another may persist in the Whitlock Valley between the Whitlock Mountains and the western slope of the Peloncillo Mountains. The study corridor is within the known range of the Arizona Striped Whiptail, and suitable habitat is present.

Tucson Shovel-nosed Snake (Chionactis occipitalis klauberi)

The Tucson subspecies of the Western Shovel-nosed Snake is surface-active from late spring through midsummer, with collection records showing a strong decline in activity in late June to early July (Rosen 2003). Reasons for this pattern are not known, although it likely represents cessation of reproduction-related movements or a response to changing soil character following the onset of summer rains. Across the range of the Western Shovel-nosed Snake, preferred soil types are generally sandy and often include active aeolian dune systems (Klauber 1951). The species' morphology is highly adapted to locomotion, respiration (Norris and Kavanaugh 1966), and feeding in sandy soils (Glass 1972). Vegetation associations are predominately creosote-bursage, with some use of creosote-mesquite floodplains, in the Lower Colorado River Valley subdivision of Sonoran Desertscrub.

Suitable habitat exists for the species in the vicinity of the Pinal Central and Tortolita substations (USFWS 2008b). There are contemporary records for the species in the area, and south in the Santa Cruz Flats near Picacho Peak. Patches of suitable habitat exist in the vicinity of Marana and Red Rock, although recent surveys have failed to detect the species in that area within the study corridor. However, the potential for the Tucson Shovel-nosed Snake occurring within the study corridor is high near the Pinal Central Substation.

Northern Mexican Garter Snake (Thamnophis eques megalops)

Mexican Garter Snakes are strongly associated with permanent or near-permanent water sources as adults and juveniles. In the United States portion of their range, streams and rivers were the primary suitable habitat, although natural or artificial ponds and lakes are used when present. Most potential prey species of the Mexican Garter Snakes are aquatic or wetland-associated. Young largely prey on soft-bodied invertebrates such as earthworms and leeches; whereas adults take fish, frogs, and occasionally upland prey such as small mammals, in addition to invertebrate prey (Macias-Garcia and Drummond 1988).

The Northern Mexican Garter Snake is present within the study corridor at Cienega Creek Natural Preserve east of Tucson, Arizona. Small populations of the species may persist in the Upper San Pedro River Valley, but there is low potential for the species to occur within the Lower San Pedro River Valley portion of the study corridor.

Fish

Apache Trout (Oncorhynchus apache)

Historically, the Apache Trout inhabited the headwaters of the Salt and Little Colorado rivers in Arizona. The species currently remains in the White Mountains of east-central Arizona and in several introduced populations in the Pinaleño Mountains. Most extant populations of the species occur above approximately 5,780 feet in elevation (AZGFD 2001d; Minckley and Marsh 2009).

The Apache Trout was introduced to several high-elevation perennial streams in the Pinaleño Mountains southwest of Safford, Arizona in the 1960s. Viable populations of the species remain in the Grant, Ash, Marijilda, and Big Creek drainages (Porath et al. 2010). Although the Project crosses Grant Creek, it does so approximately 6 miles downstream from permanent water with trout. The potential for the Apache Trout occurring within the study corridor is very low in Arizona.

Gila Chub (Gila intermedia)

Gila Chubs are found in smaller creeks, cienegas, and springs of the Gila River Basin (AZGFD 2002; Minckley 1973). Habitat types used by this secretive species vary seasonally and with the fish's age; adults typically inhabit deeper waters or areas with cover. The Gila Chub is omnivorous, but feeds primarily on insects and algae (AZGFD 2002; Minckley 1973).

Critical habitat is designated for the Gila Chub in Hot Springs and Redfield canyons in the Galiuro Mountains, within the study corridor. No permanent water supporting the Gila Chub is present within the study corridor in the San Pedro River Valley. The Gila Chub and designated critical habitat are present in the Cienega Creek Natural Preserve, within the study corridor. The species does not occur within the study corridor in the New Mexico portion of the Project.

Roundtail Chub (Gila robusta)

Extant populations of the Lower Colorado River Basin distinct population segment (DPS) of the Roundtail Chub currently remain in central and eastern Arizona and in the Gila River Watershed of southwest New Mexico. The Roundtail Chub inhabits deep pools in the middle of medium- to large-sized streams and rivers. Roundtail Chubs are omnivorous and include fish, small invertebrates, detritus, and plant materials in their diet (Minckley and Marsh 2009). The only extant population of the Roundtail Chub occurring near the study corridor is in the Aravaipa Canyon watershed, outside of but downstream from the corridor.

Rio Grande Silvery Minnow (Hybognathus amarus)

The Rio Grande Silvery Minnow lives in medium to large rivers, and normally uses habitats where flows are of low to moderate velocity over mud, silt, sand, or gravel substrates, at depths less than 20 inches. The sole remaining natural population of the Rio Grande Silvery Minnow occurs in the Rio Grande in New Mexico, between the Cochiti Dam to the headwaters of Elephant Butte Reservoir north of Truth or Consequences, New Mexico (Sublette et al. 1990).

The Rio Grande Silvery Minnow is present within the study corridor where the Project would cross the Rio Grande. Crossing locations are also within designated critical habitat for the species.

Spikedace (Meda fulgida)

The Spikedace is a small fish that prefers shallow pools and riffles in mid-elevation (approximately 3,000 to 5,000 feet) streams. The Spikedace is native to the Upper Gila River Basin in Arizona and New Mexico, and was reported from the upper San Pedro River in Sonora, Mexico. The species is currently restricted to several isolated populations within the Gila River watershed. Spikedace occur within Arizona in the Verde River, Aravaipa Creek, and Eagle Creek, but appear to be largely extirpated from the middle and lower Gila River. In New Mexico, the Spikedace is restricted primarily to the upper Gila River (Minckley and Marsh 2009). Habitat use varies among populations, and may be controlled by the presence of non-native fish (Rinne 1991).

Critical habitat is designated in three streams within the study corridor (USFWS 2012c). The Spikedace is present in Aravaipa and Turkey creeks downstream from the study corridor. Link C170, which passes through the north end of the Galiuro Mountains, crosses Aravaipa Creek upstream from the designated Aravaipa Creek Critical Habitat Unit (CHU).

The Spikedace was translocated to Hot Springs and Redfield canyons in 2007, and both streams contain designated critical habitat. Link C331 crosses downstream from the Hot Springs Canyon CHU, and Link C470 crosses downstream from the Redfield Canyon CHU. Spikedace are present within the study corridor in both streams.

Loach Minnow (Tiaroga cobitis)

The Loach Minnow is endemic to the Gila River Basin of New Mexico and Arizona, and was reported from the upper San Pedro River in Sonora, Mexico. Populations in the Verde and San Pedro rivers appear to be extirpated. Loach Minnows currently persist in the upper Salt River and smaller tributaries of the Gila River in Arizona, and the Upper Gila River in New Mexico (Minckley and Marsh 2009).

Critical habitat is designated in three streams within the study corridor (USFWS 2012c). The Loach Minnow is present in Aravaipa and Turkey creeks downstream from the study corridor. Link C170, which passes through the north end of the Galiuro Mountains, crosses Aravaipa Creek upstream from the designated Aravaipa Creek CHU.

The Loach Minnow was translocated to Hot Springs and Redfield canyons in 2007, and both streams contain designated critical habitat. Link C331 crosses downstream from the Hot Springs Canyon CHU, and Link C470 crosses downstream from the Redfield Canyon CHU. Loach Minnows are present within the study corridor in both streams.

Desert Pupfish (Cyprinodon macularius)

The Desert Pupfish is found in shallow water in springs, small streams, and marshes, often in areas with soft substrates and clear water. They are able to survive under rapid and extreme

fluctuations in water temperature, salinity, and oxygen content that may preclude competitive or predaceous fish (Carveth et al. 2005). Their diet includes small invertebrates, insect larvae, detritus, algae, and aquatic vegetation.

The species is present within the study corridor as small populations of various genetic stocks that have been introduced into a few areas of suitable habitat. Some of these locations include Turkey Creek and other tributaries to Aravaipa Creek, and a population that was introduced on the Muleshoe Ranch CMA north of Willcox, Arizona, under a Safe Harbor Agreement (TNC 2010; USFWS 2005c). Link C170 crosses Aravaipa Creek in the northern Sulphur Springs Valley, approximately 9 river miles upstream of the perennial portion of Aravaipa Creek. Link C170 also crosses Turkey Creek at the uppermost portion of its watershed, outside the limits of perennial flow.

Gila Topminnow (Poeciliopsis occidentalis)

The historical distribution of the Gila Topminnow included much of the lower elevations of the Gila River drainage in Arizona and New Mexico as well as portions of northwestern Sonora, Mexico; although it has been extirpated from the majority of its former range (Minckley and Marsh 2009). Gila Topminnows are short-lived, usually less than 1 year, and reproduce rapidly and repeatedly as temperatures are adequate. Reproduction may occur year-round in warm springs. Topminnows are livebearers, and brood size ranges from 1 to more than 30. Successive broods may occur within 3 to 4 weeks (Schoenherr 1977).

Gila Topminnows are present within the study corridor in Cienega Creek. The species has also been translocated to several streams within the Aravaipa Creek watershed (USFWS 2005a). Link C170 crosses Aravaipa Creek in the northern Sulphur Springs Valley, approximately 9 river miles upstream of the perennial portion of Aravaipa Creek. Link C170 also crosses Turkey Creek at the uppermost portion of its watershed, outside the limits of perennial flow.

Invertebrates

Chupadera Springsnail (Pyrgulopsis chupaderae)

The Chupadera Springsnail occurred in two privately-owned spring complexes near the western boundary of the Bosque del Apache NWR, approximately 3 miles east of Link A161. The species has been extirpated from one spring complex, but is believed to be present in Willow Spring. Both springs were designated as critical habitat in 2012 (USFWS 2012d).

Socorro Springsnail (Pyrgulopsis neomexicana)

The Socorro Springsnail is extinct (as of 1987) at its type locality at Willow Spring, a thermal spring approximately 18 miles south-southwest of Socorro, New Mexico. It also no longer occurs at the springs approximately 3 miles southwest of Socorro where the species was also recorded (Taylor 1987). The species survives only at Torreon Spring, approximately 15 miles southwest of Socorro in the southeastern foothills of the Magdalena Mountains (USFWS 2008c). While the springsnails at Torreon Spring appear to be *P. neomexicana*, their identity remains uncertain due to a lack of comparative specimens (*ibid*). Link A161b passes within 500 feet of

Torreon Spring. Since the species was originally known from other springs in the Socorro area, there is a small possibility that the species may exist undetected at other springs in the area.

Plants

Pima Pineapple Cactus (Coryphantha scheeri var. robustispina)

The Pima pineapple cactus is found along ridges and level uplands in semidesert grassland and alluvial fans in the Arizona Upland subdivision of Sonoran Desertscrub, but rarely occurs in floodplains and washes or on steep slopes (Pima County 2004). The range of the Pima pineapple cactus is generally south of I-10 and west of SR 83 in Pima County, Arizona. The Pima pineapple cactus is present near Tucson within the study corridor.

Kuenzler's Hedgehog Cactus (Echinocereus fendleri var. kuenzleri)

The Kuenzler's hedgehog cactus is endemic to New Mexico, and occurs in isolated populations from the Guadalupe Mountains northward to the vicinity of Carrizozo. The species prefers rocky slopes and hilltops, typically facing south or east (May et al. 2008). Kuenzler's hedgehog cacti have not been recorded within the study corridor, but known populations are located approximately 15 miles southwest of the proposed SunZia East Substation. Suitable habitat may be present in the foothills of the Gallinas Mountains.

Acuña Cactus (Echinomastus erectocentrus var. acunensis)

The Acuña cactus occurs on low hills and gravel ridges on granitic or andesite-derived soils in the Arizona Upland subdivision of Sonoran Desertscrub habitat (Arizona Rare Plant Committee, no date) in two disjunct regions of Arizona, each with multiple small populations. A southern Arizona population center includes cacti in the Sauceda and Sand Tank mountains and other small ranges, largely within Organ Pipe Cactus National Monument and the Barry M. Goldwater Air Force Range. The cactus also occurs in central Arizona in two populations east of Florence, north and south of the Gila River. The southernmost of the central Arizona populations occurs in the Ninetysix Hills and around the adjacent Box O Wash area, where critical habitat was proposed outside the study corridor in 2012 (USFWS 2012e). Suitable habitat may be present within the study corridor, although the species has not been recorded there.

Todsen's Pennyroyal (Hedeoma todsenii)

Todsen's pennyroyal is found in two mountain ranges in southern New Mexico; 17 known populations exist on the west slope of the San Andres Mountains within the WSMR, and 15 scattered populations are currently known in the Sacramento Mountains east of Tularosa, New Mexico, in the Lincoln National Forest and on BLM-administered lands (Howard 2011). Although no known populations are in proximity to the study corridor, the recovery plan for the species suggests that populations could exist where appropriate soils and slopes are present on the Chupadera Mesa (USFWS 2001a), which is crossed by any of the Route Group 1 subroutes.

Pecos Sunflower (Helianthus paradoxus)

The threatened Pecos sunflower occurs in several isolated populations in New Mexico and Texas. Critical habitat has been designated for the species, outside the Project study area (USFWS 2008d). Pecos sunflowers are restricted to the margins of permanent or near-permanent wetlands, often with saline soils. A large, natural population is present at Sevilleta NWR, and a population was recently established south of Socorro, New Mexico through translocation of seeds as a conservation effort (Zenone 2012).

Huachuca Water-umbel (Lilaeopsis schaffneriana var. recurva)

At the time of its listing and critical habitat designation, the Huachuca water-umbel was only known from sites in the upper drainages of the San Pedro and Santa Cruz rivers and several sites in the Huachuca Mountains. In 2001, a disjunct population of the plant was discovered in Bingham Cienega (Titus and Titus 2008), a natural wetland managed by TNC and the Pima County Flood Control District. The Bingham Cienega Natural Preserve is located in the San Pedro River Valley north of the town of Redington, Arizona. The Bingham Cienega population was not known at the time critical habitat was designated for the species, and the designation was not revised to include the population. Link C470 is approximately 3.8 miles east of Bingham Cienega, and Link C441 is approximately 2.8 miles to the west of the cienega. Two potential Project crossings of the San Pedro River are equally spaced upstream and downstream (approximately 15 river miles) of the cienega. The species is also present within the study corridor in the Cienega Creek Natural Preserve.

Chihuahua Scurf-pea (Pediomelum pentaphyllum)

The Chihuahua Scurf-pea is recorded from Graham, Santa Cruz, and Cochise counties in Arizona; Hidalgo County, New Mexico; and in northern Mexico (AZGFD 2001c; Rare Plant Technical Council 1999; USDA 2011). Recent surveys for the species in Arizona and New Mexico have increased the known numbers of plants, rediscovered a population thought extirpated, and somewhat expanded the known range of the species (Howard 2011). The Hidalgo County, New Mexico population in the Hachita Valley is the most robust known population, with more than 1,000 plants within a 15-square mile area; a population southeast of Safford, Arizona contains approximately 160 plants within 10 square miles, and is within the study area; and a population near Sunizona, Arizona contains more than 200 plants within a 20-square mile area. The species is known near or in the study corridor on private land in the San Simon Valley in Graham County, Arizona (Welsh and Licher 2010; WildEarth Guardians 2008). Suitable habitat is probably present over a wide area within the study corridors in southeastern Arizona and southwestern New Mexico as far east as Gage, New Mexico, although surveys conducted by the BLM have not detected additional populations (Howard 2011).

3.6.6.2 State of New Mexico Threatened and Endangered Species

Forty-four species that are listed by the state of New Mexico as threatened or endangered were identified as potentially occurring within the New Mexico portion of the study corridor. These include 7 mammals, 19 species of birds, 2 amphibian, 3 reptiles, 6 fish, 2 invertebrates, and 5 plant species; 12 of these species are also ESA-listed. A discussion of each of these species, including its distribution within the study corridor as it is currently known, recognized threats to

the species, and its potential for occurring within the study corridor can be found in the biological technical report (Appendix B1).

3.6.6.3 Bureau of Land Management Sensitive Species

New Mexico

Ten species of plants and 19 wildlife species that are considered sensitive by the New Mexico Office of the BLM potentially occur within the New Mexico portion of the Project study corridor. A brief account of each species, including its distribution within the study corridor as it is currently known, recognized threats to the species, and potential for occurrence within the study corridor can be found in the biological technical report (Appendix B1).

Arizona

Seven species of plants and 27 wildlife species that are considered sensitive by the Arizona Office of the BLM potentially occur within the Arizona portion of the Project study corridor. A brief account of each species, including its distribution within the study corridor as it is currently known, recognized threats to the species, and its potential for occurring within the study corridor can be found in the biological technical report (Appendix B1).

3.6.6.4 U.S. Forest Service Sensitive Species

Eleven plant species and 58 wildlife species considered sensitive by Region 3 (Southwest) of the USFS may occur within the Project study corridor. A brief account of each species, including its distribution within the study corridor as it is currently known, recognized threats to the species, and its potential for occurring within the study corridor can be found in the biological technical report (Appendix B1).

3.6.6.5 USFWS Species of Concern

Fifteen species of plants and 38 wildlife species that are USFWS species of concern potentially occur within the study corridor. A brief account of each species, including its distribution within the study corridor as it is currently known, recognized threats, and potential for occurrence within the study corridor can be found in the biological technical report (Appendix B1).

3.6.6.6 USFWS Birds of Conservation Concern

The USFWS maintains lists of Birds of Conservation Concern (BCC), focusing on species that are not listed under the ESA but that are typically declining and have the potential to merit listing in the future if declines are not addressed. BCC lists are maintained at three geographic scales: Bird Conservation Regions (BCR) at the ecoregion scale, USFWS administrative regions, and a national list. A species may be listed at the BCR scale when certain regional populations are declining, but species on the national list may require conservation throughout their range.

Approximately 57 BCC may occur in the study corridor, which crosses the following BCRs: Southern Rockies-Colorado Plateau, Chihuahuan Desert, Sierra Madre Occidental, and Sonoran-

Mojave Deserts. The entire study corridor is within USFWS Region 2. Additional information is included in the biological technical report (Appendix B1).

3.6.6.7 AZGFD Wildlife Species of Concern

Thirty-nine species that are considered wildlife species of concern (WSC) by the AZGFD potentially occur within the Project study corridor. Additional information is included in the biological technical report (Appendix B1).

3.6.6.8 AZGFD Species of Economic and Recreational Importance

Thirteen wildlife species are currently managed by the AZGFD as Species of Economic and Recreational Importance. Wildlife viewing and hunting of these animals represents a significant recreational and economic resource for the state of Arizona. Management of these resources requires an understanding of the key elements necessary for the conservation of habitats supporting these species. Additional information is included in the biological technical report (Appendix B1).

3.6.6.9 Arizona Department of Agriculture Highly Safeguarded Plant Species

Three species of highly safeguarded plants potentially occur within the study corridor; the Pima pineapple cactus and Huachuca water-umbel (both discussed previously), and the crested form of the saguaro cactus. All of these species are discussed in the biological technical report (Appendix B1).

3.6.6.10 Species of Greatest Conservation Need

In an effort to stem a growing tide of ESA listing petitions and related litigation, the federal government provided an avenue for state wildlife management agencies to preserve nongame wildlife in the 1980 Forsythe-Chafee Act. Funding for development of individual state plans is provided for by the USFWS Wildlife Conservation and Restoration Program (USFWS 2001b) and the Association of Fish and Wildlife Agencies State Wildlife Grants Program (Association of Fish and Wildlife Agencies 2002). To receive federal funding under these programs, congress mandated that each state complete a 10-year Comprehensive Wildlife Conservation Strategy by 2005. A key element of these plans is the development of a set of species of greatest conservation need (SGCN), which are monitored by the state agencies to help preclude the need for future ESA listing needs. These species have been included in the review for this Project.

<u>New Mexico</u>

One-hundred-twelve wildlife species that may occur within the New Mexico portion of the Project study corridor are considered SGCN by the NMDGF. All of these species are discussed in the biological technical report (Appendix B1).

Arizona

One-hundred-three wildlife species that may occur within the Arizona portion of the Project study corridor are considered SGCN by the AZGFD. These species are discussed in the biological technical report (Appendix B1).

3.6.6.11 Pima County (Arizona) Priority Vulnerable Species

Thirty-four species that are recognized as Priority Vulnerable Species under the Pima County SDCP are known or have some potential to occur within the Project study corridor. These species are discussed in the biological technical report (Appendix B1).

3.6.7 Biological Resource Conservation Areas

The following discussion on conservation areas, managed in part for biological resources, focuses on those that occur in part or in their entirety within the study corridor and that are owned by federal, state, county, and nongovernmental organizations. A brief discussion of each of these managed areas, including some of their key resource values, is provided. Many of these areas are displayed on Figures M 6-3 (see Map Volume).

3.6.7.1 Sevilleta National Wildlife Refuge

Sevilleta NWR, established in 1973, contains approximately 230,000 acres of land that straddles the Rio Grande approximately 50 miles south of Albuquerque, New Mexico. Four major biomes meet within the refuge—Chihuahuan Desert, Great Plains shortgrass prairie, piñon-juniper woodland, and Colorado Plateau shrub steppe. Sevilleta NWR is managed to allow natural ecological processes to prevail, and portions of the refuge are used for education and long-term scientific research. The refuge supports waterfowl and dove hunting, and other wildlife-related recreation. The endangered Southwestern Willow Flycatcher and Rio Grande Silvery Minnow occur on the refuge, along with other sensitive species that include Desert Bighorn Sheep and American Pronghorn (USFWS 2011b). Link E101b follows the southern boundary of the Refuge, but comes no closer than approximately 0.85 mile. Link E86b approaches within approximately 1.6 miles of the refuge boundary.

3.6.7.2 Bosque del Apache National Wildlife Refuge

Bosque del Apache NWR, established in 1939, contains 57,331 acres of land that straddles the Rio Grande approximately 20 miles south of Socorro, New Mexico. The dominant features of the refuge are the active river floodplains, moist bottomlands, and developed wetlands and riparian forest habitats that support an enormous quantity of migratory birds, including Sandhill Cranes (*Grus canadensis*), Ross's and Snow Geese (*Chen rossii* and *C. caerulescens*), and many other species during winter (USFWS 2011c). The refuge is in the heart of the Rio Grande avian flyway; nearly 400 species of birds have been recorded within its boundaries (USFWS 1995). Habitat restoration is a key element of the ongoing management efforts at the refuge. The refuge supports nesting endangered Southwestern Willow Flycatchers, and the reach of the Rio Grande within the refuge is designated critical habitat for the endangered Rio Grande Silvery Minnow. Links A111 and A160 pass north of the refuge, north of SR 380.

3.6.7.3 Ladd S. Gordon Waterfowl Complex

The Ladd S. Gordon Waterfowl Complex, managed by the NMDGF, consists of four subunits (waterfowl areas) along the Rio Grande in New Mexico, between Belen and Socorro. The Bernardo (1,573 acres) and La Joya (3,550 acres) waterfowl areas are short distances north of Sevilleta NWR, and provide foraging and resting habitat for large numbers of waterfowl and Sandhill Cranes. Habitat is created through flooding farmland and riparian habitat management. Wintering birds may move freely between these sites and Bosque del Apache NWR.

3.6.7.4 Ladder Ranch

The Ladder Ranch, owned by Turner Ranch Properties L.P., comprises 156,439 acres of privately owned land due west of Truth or Consequences, New Mexico. The western boundary of the Ranch abuts the Gila National Forest; the property contains significant streams that have their headwaters on the eastern flank of the Black Range. These streams support some of the last remaining populations of the endangered Chiricahua Leopard Frog (*Lithobates chiricahuensis*) in New Mexico (Kruse and Christman 2007). A prerelease acclimatization facility for Mexican Gray Wolves is located on the Ladder Ranch, although all releases into the wild have taken place in Arizona. Link A330b crosses the Ladder Ranch.

3.6.7.5 Cluff Ranch Wildlife Management Area

The Cluff Ranch Wildlife Management Area (WMA), managed by the AZGFD, comprises 788 acres along Ash Creek on the northeast flank of the Pinaleño Mountains, approximately 6 miles southwest of Thatcher, Arizona. Approximately one third of the acreage in the wildlife area consists of mature cottonwood-willow riparian habitat along Ash Creek. The property supports two aquatic impoundments, totaling 14 acres, and is currently managed for public access for fishing, hunting, and wildlife viewing. No species listed under the ESA are recorded using the property. Special-status species documented using the property include American Peregrine Falcon (*Falco peregrinus*), Cave Myotis (*Myotis velifer*), Greater Western Mastiff Bat (*Eumops perotis californicus*), Arizona alum root (*Heuchera glomerata*), and branching penstemon (*Penstemon ramosus*) (AZGFD 2011a). The closest link to the Cluff Ranch is Link B153b, which passes approximately 0.25 mile south (upslope) of the south property boundary.

3.6.7.6 Bonita Grasslands Restoration Project

The Bonita Grasslands Restoration Project was initiated by the AZGFD in partnership with private land owners on an aggregation of Arizona State Trust Lands and private lands in the northern Sulphur Springs Valley, north of Willcox, Arizona. The project plan is to restore 20,000 acres of grassland habitat over the next 10 to 15 years, which will support an existing Pronghorn population and restore connectivity between the Bonita and Southern Greasewood Pronghorn herds. These populations have been the subject of intensive, active habitat management and monitoring. Populations have varied widely but declined overall since monitoring began in response to ongoing habitat degradation, development in the northern Sulphur Springs Valley, and other factors. Grassland habitat is also important for Scaled Quail (*Callipepla squamata*), Botteri's Sparrow (*Aimophila botterii*), Cassin's Sparrow (*A. cassinii*), and other Chihuahuan grassland bird assemblages and general wildlife (AZGFD 2010).

Funding for the project to date has been provided by the AZGFD, NRCS, and private landowners. Additional support from the NRCS and the Habitat Partnership Committee are being solicited, and ultimately the partners hope to restore 100,000 acres of grassland habitat in the northern Sulphur Springs Valley.

3.6.7.7 Aravaipa Wilderness and Ecosystem Management Area

The Aravaipa Wilderness contains 19,410 acres of BLM-administered land located approximately 12 miles northeast of Mammoth, Arizona. The Aravaipa Wilderness and Ecosystem Management Area are centrally located within one of the largest habitat blocks remaining in the Southwest that is unfragmented by highways, canals, residential development, and other major barriers to wildlife movement. The Galiuro, Winchester, Santa Teresa, and the northern Pinaleño mountains are not crossed by any paved roads or major infrastructure.

Aravaipa Creek supports seven native fishes and is considered the best remaining native fish habitat in Arizona (BLM 2009b). Aravaipa Creek downstream of Stowe Gulch is designated critical habitat for the Loach Minnow (*Tiaroga cobitis*) and Spikedace (*Meda fulgida*); this critical habitat ends at the Aravaipa-San Pedro River confluence (USFWS 2012c). The Aravaipa Wilderness and Ecosystem Management Area in the Galiuro and Santa Teresa mountains support a regionally important population of Desert Bighorn Sheep. White-nosed Coati (*Nasua narica*) and many other wildlife species are present, including 150 bird species documented within the wilderness boundary. The ESA-listed Southwestern Willow Flycatcher also occurs in the wilderness. Special-status species include the Cactus Ferruginous Pygmy-owl, Common Black-hawk (*Buteogallus anthracinus*), and the Northern Peregrine Falcon. Public uses of the wilderness include hiking, photography, and wildlife watching. Limited hunting is also permitted, with certain restrictions (BLM 2009b). Link C170 crosses a nonperennial portion of Aravaipa Creek approximately 4.5 stream miles upstream from the boundary of Loach Minnow-Spikedace critical habitat. Link C592 crosses the San Pedro River approximately 8 river miles upstream from the San Pedro-Aravaipa Creek confluence.

3.6.7.8 Muleshoe Ranch CMA

The Muleshoe Ranch CMA consists of 55,000 acres of private and publicly owned lands in the Galiuro Mountains, Winchester Mountains, and northern Sulphur Springs Valley; approximately 15 miles northwest of Willcox, Arizona. It is jointly managed by TNC, the BLM, and USFS. The seven perennial streams within the Muleshoe Ranch CMA support five native fish species, including the endangered Gila Chub (TNC 2011). The Muleshoe Ranch CMA also supports Desert Bighorn Sheep that are part of a metapopulation associated with herds in the Aravaipa Wilderness. All regulations and guidelines pertaining to public land apply to those lands within this CMA.

3.6.7.9 Lower San Pedro River Collaborative Conservation Initiative

The USFWS has conducted a scoping period from June to August, 2012 for this collaborative conservation initiative, which would include a network of lands owned by private individuals, nongovernmental organizations, and governmental agencies. This initiative would provide an opportunity for cooperative management of new or existing conservation efforts, mitigation

lands, and conservation easements. Some of these lands may be managed or acquired by the USFWS as a proposed NWR. Scoping was conducted for an area 2 miles on either side of the San Pedro River, from "The Narrows" USGS gauging station north of Benson to the confluence with the Gila River.

3.6.7.10 H & E Farm

The H & E Farm is a 570-acre parcel on the San Pedro River that is owned by TNC, located approximately 3 miles downstream of Mammoth, Arizona. The reach of the San Pedro River on the property does not currently support perennial flow (Haney 2005). The parcel is part of the San Pedro River corridor that supports wildlife and wildlife movement between northern Sonora, Mexico, and the interior highlands of Arizona.

3.6.7.11 7B Ranch

The 3,100-acre 7B Ranch on the San Pedro River is owned by Resolution Copper Company and is managed by TNC. The 7B Ranch contains significant mesquite bosque habitat.

3.6.7.12 Three Links Farm

The Three Links Farm, located approximately 15 miles north of Benson, Arizona, was recently purchased by TNC to place 2,209 acres (approximately 6 river miles) of San Pedro River deciduous riparian habitat under the protection of a conservation lease agreement. The lands have since been subdivided into five parcels that are privately owned and carry conservation easements. The San Pedro River riparian corridor supports important fish habitat and is an important avian migratory corridor. The ESA listing candidate Yellow-billed Cuckoo, Gray Hawk (*Buteo plagiatus*), and many other avian species use this reach of the San Pedro River. The American Beaver (*Castor canadensis*) was reintroduced to the San Pedro River upstream of the property, and has moved onto the property subsequent to the purchase of these lands by TNC (Headquarters West LTD 2011).

3.6.7.13 A7 Ranch

The A7 Ranch consists of approximately 46,898 acres of private, State Trust, Pima County, and other conservation easement lands. The property is a working ranch under a grazing lease from the ASLD that supports a variety of native wildlife, including four Pima County Priority Vulnerable Species identified in the Pima County SDCP: the Lowland Leopard Frog (*Lithobates yavapaiensis*), Giant Spotted Whiptail (*Aspidoscelis burti stictogrammus*), Bell's Vireo (*Vireo bellii*), and Mexican Long-tongued Bat (*Choeronycteris mexicana*). The A7 Ranch contains important riparian and grassland habitats that provide connectivity between the Buehman Canyon area and the San Pedro River corridor (Pima County 2011a).

3.6.7.14 Six Bar Ranch

The Six Bar Ranch, located 3 miles northwest of the A7 Ranch, consists of approximately 12,300 acres of State Trust and Pima County lands. Resources and management of the Six Bar Ranch

are similar to the A7 Ranch (Pima County 2011a). Link C450 crosses a small portion of the Six Bar Ranch, adjacent to an existing natural gas pipeline.

3.6.7.15 Bingham Ranch and Cienega

The Bingham Ranch, located in the San Pedro River Valley approximately 2 miles north of Redington, Arizona, was purchased in 1989 by the Pima County Regional Flood Control District to preserve Bingham Cienega, a spring-fed marsh on the property. Other valuable resources on this 285-acre parcel include significant wetlands, sacaton grassland, mesquite bosque, and riparian forest habitats (University of Arizona [UA] 2008). TNC manages the property under an agreement with the Pima County Regional Flood Control District.

3.6.7.16 Bar V Ranch

The Bar V Ranch, a combination of lands owned or leased by Pima County, surrounds a portion of the Cienega Creek Natural Preserve. The Bar V Ranch protects a perennial reach of Davidson Canyon with native fish present, as well as Sonoran desertscrub and semidesert grassland. A number of Pima County Priority Vulnerable Species are present.

3.6.7.17 Cienega Creek Natural Preserve

The Cienega Creek Natural Preserve is a 3,979-acre preserve owned by Pima County that provides protection for 12 miles of the Cienega Creek riparian area near Vail, Arizona (Pima County 2011b). Perennial waters in portions of the preserve provide habitat that supports a variety of important wildlife species, including three special-status fish species; the Longfin Dace (*Agosia chrysogaster*), and the endangered Gila Topminnow and Gila Chub. Other wildlife recorded within the preserve includes 174 species of birds (Pima County 2004).

3.6.7.18 Saguaro National Park

Saguaro National Monument was originally established in 1933, and was expanded concurrent with its designation as a National Park in 1994. Saguaro National Park consists of two units totaling 91,440 acres. The Tucson Mountain District is situated on the western flank of the Tucson Mountains west of Tucson, Arizona, and the larger Rincon Mountain District is in the Rincon Mountains at the east edge of the Tucson Valley. Park elevations range from a low point of 2,180 feet in the Tucson Mountain District, to 8,666 feet on Mica Mountain in the Rincon Mountain District. Saguaro National Park was established primarily to protect the forests of the saguaro cactus (*Carnegiea gigantea*) (NPS 2007). Because of the wide elevation range within the Park, many biomes are represented, and the lands support a large suite of plant and wildlife species. ESA-listed species occurring here include the endangered Lesser Long-nosed Bat, the threatened Mexican Spotted Owl, and the candidate Sonoran Desert Tortoise.

3.6.7.19 Ironwood Forest National Monument

Ironwood Forest National Monument, managed by the BLM, consists of 129,000 acres of Sonoran Desert west of Marana bordering the Tohono O'odham Nation, and was set aside in 2000 to preserve an example of forests of the desert ironwood tree (*Olnea tesota*). ESA-listed

species that occur here include the Lesser Long-nosed Bat, Nichol's Turk's head cactus (*Echinocactus horizonthalonius* var. *nicholii*), and the candidate Sonoran Desert Tortoise. Other notable special-status species include the Desert Bighorn Sheep and the Cactus Ferruginous Pygmy-owl (BLM 2009c).

3.6.8 Agency-identified and Other Biological Resource Areas

Several sensitive biological resources were identified within the study corridor through the resource inventory process and discussions with biologists from the NMDGF and AZGFD. These biological resource issues are presented below.

3.6.8.1 Wildlife Linkages

The concept of wildlife linkages identifies the importance of corridors connecting large areas of relatively undisturbed, protected natural habitat (wildland blocks) that are threatened by fragmentation resulting from a variety of human-induced impacts. Habitat fragmentation and loss are currently recognized as the principal threats to biodiversity.

Conservation of large wildland blocks that still support functional ecological communities, often retaining their full suite of native species, are in many cases dependent on movement corridors that provide connectivity between subcomponents of species' metapopulations. Without corridors between wildland blocks, ecological balance regulated by large predators cannot function. Interspecific competition, mutualism, energy flow, nutrient cycling, pollination, species dispersal, and long-term gene flow within metapopulations may be inhibited or lost. In addition, the presence of corridors allows ecosystems to recover from stochastic events such as fire, flooding, exotic species invasion, and climate change by allowing an escape to adjacent blocks; or, for species with more limited home ranges, within corridors themselves (Beier et al. 2006).

The Arizona Wildlife Linkages Workgroup, a collaborative effort of nine public agencies and nonprofit organizations initiated in 2004, resulted in the publication of Arizona's Wildlife Linkages Assessment; an analysis identifying important wildlife habitat areas needing connectivity (blocks), and the associated threats to that connectivity (ADOT 2010; Corridor Design 2010). The Wildlife Linkages Assessment identified potential linkage zones (corridors) that are important to Arizona's wildlife and natural ecosystems (ADOT 2010). Subsequently, the Arizona Missing Linkages Project operated through Northern Arizona University has created detailed linkage designs for 16 identified priority areas identified in the assessment. The detailed analysis includes habitat modeling for a suite of representative wildlife expected to use each linkage. Discrete linkage strands may be needed to provide suitable corridors for species with different habitat requirements (Beier et al. 2008).

The following four linkages would potentially be traversed by the Project: Galiuro–Pinaleño–Dos Cabezas, Rincon–Santa Rita–Whetstone, Tucson–Tortolita–Santa Catalina Mountains, and Ironwood–Picacho. Additional proposed linkages within the study corridor have not been analyzed or modeled in detail by the Arizona Wildlife Linkages Workgroup, and so are not discussed here.

Galiuro–Pinaleño–Dos Cabezas Linkage

The Galiuro–Pinaleño Linkage contains two principal strands, and the Pinaleño–Dos Cabezas Linkage contains three; any of which could be traversed by the proposed Project alignments. The linkage strand between the Galiuro and Pinaleño mountains crosses the grasslands of the northern Sulphur Springs Valley. In addition to the Pronghorn, other species that were used in developing the linkage model (both strands) and that may potentially be affected by the Project include Black Bear (*Ursus americanus*), Bobcat (*Felis rufus*), Mountain Lion (*Puma concolor*), and Mule Deer (*Odocoileus hemionus*). Two species that were modeled but are not known to currently be present in the area are the Jaguar and the Mexican Gray Wolf. Links C110, C130a, C130b, and Local Alternative Link C90 cross strands of the Galiuro–Pinaleño–Dos Cabezas Linkage.

Rincon–Santa Rita–Whetstone Linkage

Four of the six strands that make up this linkage are potentially crossed by Project alternatives (links F40a, F40b, F51, and F600). Some of the species that were used to model this linkage include Black Bear, Coues White-tailed Deer (*Odocoileus virginianus couesi*), Mountain Lion, Mule Deer, Pronghorn, Lowland Leopard Frog, Desert Box Turtle (*Terrapene ornata luteola*), Giant Spotted Whiptail (*Aspidoscelis burti stictogrammus*), Northern Mexican Garter Snake, Gila Topminnow, and Longfin Dace (*Agosia chrysogaster*). Species that were included in the linkage model but that do not currently occur in the study corridor include the Chiricahua Leopard Frog and the Jaguar. Suitable habitat for these two species is present.

Tucson–Tortolita–Santa Catalina Mountains Linkage

The Tucson–Tortolita–Santa Catalina Mountains Linkage contains two linkages; the Tucson–Tortolita linkage and the Tortolita–Santa Catalina Linkage. Only the Tucson–Tortolita linkage is potentially traversed by any Project alternatives. One subroute crosses the Tucson–Tortolita Linkage (links F510 and F540). Some of the species that were used to model this linkage include Black Bear, Bobcat, Mountain Lion, Mule Deer, Desert Tortoise, and the Gila Monster (*Heloderma suspectum*). Function of this linkage is compromised by the presence of existing linear developments, including the UPRR right-of-way and I-10. These features have a significant fragmentation effect on wildlife movements through the area.

Ironwood–Picacho Linkage

The Ironwood–Picacho Linkage contains two principal strands, one that connects the Picacho Mountains with the Ironwood Forest National Monument and the Silverbell Mountains, and the other that is between the Ironwood Forest National Monument and the Durham–Coronado Plains. Both of these strands are traversed by Project alternatives. Links C810, C810a, C812, C813, C814, C815, C816, and C817 pass through the eastern strand of the linkage, which connects Ironwood Forest National Monument with the BLM-designated Durham-Coronado Plains wildland block to the northeast. Some of the species used in modeling this linkage include Desert Bighorn Sheep, Mule Deer, Sonoran Desert Tortoise, and Tucson Shovel-nosed Snake. All links that occur within the wildlife linkage pass through suitable Tucson Shovel-nosed Snake

habitat. Links C813, C814, C815, and C816 all pass through BLM Category III Desert Tortoise Habitat. Function of this linkage is adversely affected by the presence of existing linear features that include the CAP canal, UPRR right-of-way, and I-10.

3.6.8.2 Picacho Reservoir Area

Picacho Reservoir, located south of Florence and east of Casa Grande, was originally constructed in 1889-1890 as part of the Florence Canal. The San Carlos Irrigation Project was initiated in 1924, incorporating the Florence Canal and the Reservoir. Picacho Reservoir is an approximately 50-acre site that serves as a water holding area and recharge site for diverted Gila River waters used by the Gila River Reservation and adjacent privately owned agricultural developments in the region. The Reservoir functions in regulating flows within the Florence–Casa Grande and Casa Grande Canals and provides a water storage reserve for the system (GRIC 2003). It is seasonally or completely dry in most years, but is filled when the Gila River system and San Carlos Reservoir contain a surplus of water. When water is present, the site becomes highly attractive to waterfowl and shorebirds. The endangered Yuma Clapper Rail is occasionally recorded at Picacho Reservoir (AZGFD 2006; Todd 1986), and the site is identified as potential Southwestern Willow Flycatcher habitat in need of surveys. The Yuma Clapper Rail and Southwestern Willow Flycatcher may only be present during very wet years. Hunting is permitted on the property. Link C880 passes within 0.25 mile of the northwestern edge of the Reservoir.

In addition, irrigation systems that serve the surrounding farmland provide temporary and permanent sources of water. The CAP canal and other canals are regularly used by waterfowl in winter, and temporary pools may form in adjacent washes against the upstream side of the canal banks where natural flow patterns have been blocked. These areas can support dense xeroriparian vegetation and relatively high densities of wildlife year-round.

3.6.8.3 Bird Habitat Conservation Areas

The Intermountain West Joint Venture, established in 1994, is a consortium of 11 partner states, public agencies, and bird conservation organizations. Participating organizations in New Mexico include New Mexico Partners in Flight, USFWS, NMDGF, Holloman AFB, USFS, BLM, and Hawks Aloft. The Intermountain West Joint Venture encompasses all or part of the 11 member states, including the western two thirds of New Mexico, where the group identified 20 Bird Habitat Conservation Areas (BHCA). Three of these BHCAs occur in part within the study corridor: Chupadera Mesa, Luna County Grasslands, and the Middle Rio Grande (Intermountain West Joint Venture 2005). The Sonoran Joint Venture is a similar collaborative effort that covers the Arizona portion of the study corridor; however, it has not mapped any BHCAs.

<u>Chupadera Mesa</u>

The Chupadera Mesa BHCA is located between Mountainair, New Mexico, and the WSMR in middle-elevation woodland and scrubland habitats. It contains a large area of high-quality, relatively pristine grassland-piñon juniper ecotone in a largely undisturbed area, although linear utilities such as natural gas pipelines cross the northern portion of the mesa. In addition, the northern part of the mesa may be affected in the future by tree harvest to support a proposed

biomass energy generation facility. Juniper removal for rangeland improvement is also ongoing in some areas. The Chupadera Mesa BHCA is considered a state Important Bird Area (IBA) (*ibid*).

Luna County Grasslands

The Luna County Grasslands BHCA covers large portions of Luna County, primarily east and south of Deming, New Mexico. The land cover is predominantly Chihuahuan Desert grasslands and adjacent shrubby upland areas, and includes the Florida Mountains southeast of Deming. Important grassland habitats in the Uvas Valley and elsewhere are important for wintering grassland birds; and agricultural areas in the Uvas Valley are important for Sandhill Cranes and geese. The Luna County Grasslands BHCA is considered a state IBA (*ibid*).

Middle Rio Grande

The Middle Rio Grande BHCA is located on the Rio Grande from near Los Alamos, New Mexico, south to the headwaters of Elephant Butte Reservoir. It contains extensive areas of middle-elevation riparian and wetland habitats, and is an important avian migratory corridor. Nearly 300 bird species have been regularly recorded in the region, the majority associated with the riparian corridor; approximately 100 other species have been recorded as accidentals. The area is important for wintering waterfowl, as well as migrant and resident waterbirds and shorebirds. It provides habitat for the Southwestern Willow Flycatcher, Western Yellow-billed Cuckoo, and many other special-status species. The Middle Rio Grande BHCA is considered a state IBA (*ibid*).

3.6.8.4 Important Bird Areas (Arizona)

Audubon Arizona lists 40 IBAs in Arizona. All or portions of three of these areas occur within the study corridor, including Sabino and Lower Bear Creek, Lower San Pedro River, and the Willcox Playa/Cochise Lakes IBAs (National Audubon Society 2011).

Sabino and Lower Bear Creek

The Sabino and Lower Bear Creek IBA is located low on the front range of the Santa Catalina Mountains, in the northeast portion of the Tucson Valley. The area is a popular local attraction and tourist destination. The stream in Sabino Canyon is perennial and supports a broadleaf deciduous riparian plant community in the canyon bottom that contrasts sharply with the Arizona Upland Subdivision Sonoran Desertscrub vegetation community on the adjacent hillsides. The Sabino Canyon/Bear Canyon area supports a large number of resident bird species, and the attraction of perennial water available in the riparian habitat draws many additional migratory species seasonally. The Sabino and Lower Bear Creek IBA is considered a state IBA (*ibid*).

Lower San Pedro River

The Lower San Pedro River IBA consists of 6,938 acres of riparian habitat along nearly 59 miles of the river from the “Narrows” (north of Cascabel, Arizona) downstream (north) to the junction

with the Gila River at Hayden, Arizona. This reach of the river contains significant segments of cottonwood-willow gallery forest interspersed among mesquite bosques. Important special-status species that use the river area include the Southwestern Willow Flycatcher and the Western Yellow-billed Cuckoo, and the largest populations of nesting Gray Hawks (*Buteo nitidus*) and Mississippi Kites (*Ictinia mississippiensis*) in Arizona. The entire San Pedro River corridor in Arizona is an important movement corridor for avian and other wildlife species. The Lower San Pedro River is designated as a globally significant IBA (*ibid*).

Willcox Playa/Cochise Lakes

The Willcox Playa/Cochise Lakes area encompasses somewhat more than 600,000 acres, consisting primarily of the Willcox Playa and surrounding vegetated avian habitat. Many species of shorebirds use the area in winter and as a stopover point during spring and fall migration. Small numbers of shorebirds occasionally breed in the IBA. The Willcox Playa/Cochise Lakes IBA is considered a state IBA (*ibid*).

3.6.8.5 Colossal Cave Area Karst Resources

The most significant known cave and limestone karst area in Pima County, Arizona, including the caves in Colossal Cave Mountain Park, occurs in the vicinity of Vail, Arizona. Caves and crevices developed in Paleozoic limestone strata in this area support a significant suite of endemic cave-inhabiting invertebrate species, including the Arkenstone Cave pseudoscorpion (*Albiorix anophthalmus*), a Pima County SDCP Priority Vulnerable Species (Pima County 2004, 2010). Portions of links F40b and F51 pass through at least 1 mile of this resource to the south of Colossal Cave Mountain Park and along the Agua Verde Creek drainage.

3.6.9 Summary of Inventory Results

This section describes existing vegetation, conservation areas, special-status species, and other biological resources that may occur within the study corridor for each subroute. Table 3-31 presents vegetation communities that are crossed by each subroute.

The subroute discussions that follow include a list of species listed under the ESA, or species proposed or candidates for listing, that may occur within the study corridor. Two species under review for ESA listing, the Arizona Striped Whiptail and the Chihuahua scurfpea, are also included. The Cactus Ferruginous Pygmy-owl is a BLM sensitive species with widespread suitable habitat within the study corridor, and is included as well (USFWS 2011a).

Following each species name is a potential habitat distribution within the study corridor by link. The potential distribution for each species is based on known records, as well as the presence of suitable habitat near known records or within dispersal distance. The potential distribution of birds is based on the presence of habitat elements typically used by each species, as migratory species may travel widely and are often recorded in unpredictable settings lacking such habitat elements. It should be noted that any species may not be distributed along an entire link, or may be absent despite the presence of suitable habitat. Additional information on the estimated mileage on each link where these species may occur is provided in Appendix B3.

3.6.9.1 Route Group 1: SunZia East Substation to Midpoint Substation

Subroute 1A1 – North River Crossing

Vegetation Communities

The proposed SunZia East Substation and portions of Subroute 1A1 are located in northern Lincoln County, New Mexico, in a patchwork of plains-mesa grassland and juniper savanna. North of the Gran Quivira, Subroute 1A1 crosses juniper savanna and areas where junipers have been mechanically removed for rangeland improvement. The subroute continues west across Chupadera Mesa and intact juniper woodland, entering an area of low hills and mesas between the Sierra Larga and Los Piños Mountains. The upper slopes of the Rio Grande Valley are dominated by semidesert grassland, becoming Chihuahuan Desertscrub near the valley bottom. The subroute crosses the Rio Grande north of Socorro, New Mexico, in a location with a narrow band of riparian woodland along a narrow, channelized reach of the river. A small area of the floodplain at this crossing is active agriculture. Subroute 1A1 returns to Chihuahuan Desertscrub, roughly following Nogal Canyon between Polvadera Mountain and Socorro Peak. It then turns south through semidesert grassland between the Magdalena and Chupadera mountains until it nears I-25, where it crosses the southern foothills of the San Mateo Mountains. Subroute 1A1 passes through extensive Chihuahuan Desertscrub to the west of I-25, until near the Goodsight Mountains in southern Sierra County where semidesert grassland becomes dominant for the remainder of the subroute to the Midpoint Substation.

Conservation Areas and Other Biological Resources

Approximately 17 miles of Subroute 1A1 are located within the Chupadera Mesa BHCA. The subroute follows near the northern border of the BHCA with links E82, E84, and E85, through an area that has been affected by ranching activities and juniper removal. Dense, intact juniper woodland is present primarily near the juncture of links E85 and E80d. Between Chupadera Mesa and the Rio Grande, the subroute approaches within 1 mile of the boundary of Sevilleta NWR. This upland area of the refuge is reserved for research and generally closed to the public. The subroute crosses a relatively narrow point in the Rio Grande floodplain within an important bird flight corridor. Wintering waterfowl travel daily from Bosque del Apache NWR and the Ladd S. Gordon Waterfowl Complex to forage in farmland along the river. The river valley also sees heavy use as a migratory corridor and stopover for passerines and other birds. West of the Rio Grande between Polvadera Mountain and Socorro Peak, the subroute crosses a movement corridor for a reintroduced population of Desert Bighorn Sheep. West of Caballo Reservoir, the subroute crosses a portion of the Ladder Ranch, a conservation area managed by Turner Properties, L.P. Chiricahua Leopard Frogs are present in several streams flowing from the Ladder Ranch into the Rio Grande, upstream from Subroute 1A1.

- Northern Aplomado Falcon (A161, A161a, A260, A330a, A330b, A400, A440, A520, and A530)
- Southwestern Willow Flycatcher and designated Critical Habitat (E180)
- Sprague's Pipit (A361, A400, A440, A520, and A530)
- Rio Grande Silvery Minnow and designated Critical Habitat (E180)

Subroute 1A2 – BLM Preferred Alternative

Vegetation Communities

Subroute 1A2 is located within vegetation types identical to those on Subroute 1A1. Links E86a and E86b cross juniper savanna, with some dense patches of juniper woodland. Juniper removal for rangeland improvement has affected much of Link E86a. Similar to Subroute 1A1, a portion of Subroute 1A2 is located within approximately 1.6 miles of the southwestern boundary of Sevilleta NWR.

Conservation Areas and Other Biological Resources

Approximately 24 miles of Subroute 1A2 are located within the Chupadera Mesa BHCA. The subroute follows near the northern border of the BHCA with links E86a and E86b through a largely undisturbed area with little existing access.

- Northern Aplomado Falcon (A161, A161a, A260, A330a, A330b, A400, A440, A520, and A530)
- Southwestern Willow Flycatcher and designated Critical Habitat (E180)
- Sprague's Pipit (A361, A400, A440, A520, and A530)
- Rio Grande Silvery Minnow and designated Critical Habitat (E180)

Subroute 1A – North River Crossing

Vegetation Communities

Subroute 1A is largely identical to Subroute 1A1, but differs in two locations. On Chupadera Mesa, Subroute 1A crosses several large areas of relatively dense, mature juniper woodland. North and west of Elephant Butte Reservoir, Link A270 crosses steeper terrain but similar vegetation types compared to Link A260, used on Subroute 1A1. The remainder of Subroute 1A is identical to Subroute 1A1.

Conservation Areas and Other Biological Resources

Approximately 25 miles of Subroute 1A are located within the Chupadera Mesa BHCA, an informally designated area of conservation value.

- Northern Aplomado Falcon (A161, A161a, A161b, A260, A270, A330a, A330b, A361, A400, A430, A440, A481, A520, and A530)
- Southwestern Willow Flycatcher and designated Critical Habitat (E180)
- Sprague's Pipit (A361, A400, A430, A440, A481, A520, and A530)
- Chiricahua Leopard Frog (A330a)
- Rio Grande Silvery Minnow and designated Critical Habitat (E180)
- Socorro Springsnail (A161b)

Subroute 1B1 – San Antonio Crossing

Vegetation Communities

Subroute 1B1 is initially identical to Subroute 1A, but turns to the south through plains-mesa grassland after it crosses Chupadera Mesa. Near SR 380, the subroute turns to the west, entering Chihuahuan Desertscrub and the Rio Grande Valley, and crosses the Rio Grande north of San Antonio, New Mexico. The eastern floodplain of the river contains a large area of abandoned farmland, with a band of riparian woodland and mesquite bosque approximately 500 feet wide adjacent to the river. The west bank of the river contains a narrower band of riparian woodland adjacent to a canal and active farmland. The subroute continues west through Chihuahuan Desertscrub, crossing the Chupadera Mountains roughly following Walnut Creek (Nogal Canyon), after which it turns to the south and becomes identical to Subroute 1A.

Conservation Areas and Other Biological Resources

Biological features of the landscape crossed by Subroute 1B1 are identical to Subroute 1A. However, the crossing of the Rio Grande is located 1.5 miles north of San Antonio, New Mexico, and 4.8 miles north of the northern boundary of Bosque del Apache NWR. The subroute also approaches within approximately 2 miles of the northwestern boundary of Bosque del Apache NWR in the Chupadera Mountains west of the Rio Grande.

- Northern Aplomado Falcon (A111, A112, A140, A160, A161, A161a, A161b, A260, A270, A330a, A330b, A361, A400, A430, A440, A481, A520, and A530)
- Sprague's Pipit (A361, A400, A430, A440, A481, A520, and A530)
- Socorro Springsnail (A161b)
- Southwestern Willow Flycatcher and designated Critical Habitat (A140)
- Chiricahua Leopard Frog (A330a)
- Rio Grande Silvery Minnow and designated Critical Habitat (A140)

Subroute 1B2 – San Antonio Crossing

Vegetation Communities

Subroute 1B2 bears southwest through juniper savanna and plains-mesa grassland before it turns west to cross a relatively narrow portion of the Chupadera Mesa, after which it continues west to intersect with Subroute 1B1. The remainder of the subroute is identical to Subroute 1B1. Subroute 1B2a is identical to Subroute 1B2, but differs by using Link A260 northwest of Elephant Butte Reservoir.

Table 3-31. Vegetation Communities Crossed by Each Subroute

Subroute	Miles (percentages shown in parentheses)	Arizona Upland Sonoran Desertscrub	Chihuahuan Desertscrub	Closed Basin Scrub	Great Basin Conifer Woodland	Interior Chaparral	Juniper Savanna (ecotone)	Lower Colorado River Valley Sonoran Desertscrub	Pine-Oak Woodland	Plains-Mesa Grassland	Plains-Mesa Sand Scrub	Semidesert Grassland	Urban/ Agriculture	Floodplain
1A1	228.8	—	93.1 (40.7)	—	—	—	55.7 (24.3)	—	6.2 (2.7)	6.9 (3.0)	—	63.1 (27.6)	2.6 (1.1)	1.2 (0.5)
1A2	230.3	—	93.1 (40.4)	—	—	—	57.2 (24.8)	—	6.2 (2.7)	6.9 (3.0)	—	63.1 (27.4)	2.6 (1.1)	1.2 (0.5)
1A	219.5	—	89.5 (40.8)	—	—	—	43.2 (19.7)	—	6.2 (2.8)	13.7 (6.2)	—	63.1 (28.8)	2.6 (1.2)	1.2 (0.6)
1B1	223.6	—	94.6 (42.3)	—	—	—	31.2 (14.0)	—	6.2 (2.8)	13.7 (6.1)	28.9 (12.9)	45.0 (20.1)	1.9 (0.9)	2.1 (0.9)
1B2	209.2	—	94.6 (45.2)	—	—	—	30.4 (14.5)	—	—	12.4 (5.9)	22.8 (10.9)	45.0 (21.5)	1.9 (0.9)	2.1 (1.0)
1B3	206.3	—	94.6 (45.9)	2.3 (1.1)	—	—	33.3 (16.1)	—	—	12.4 (6.0)	17.8 (8.6)	41.9 (20.3)	1.9 (0.9)	2.1 (1.0)
3A2	123.9	—	20.2 (16.3)	2.2 (1.8)	—	—	—	—	—	—	—	101.5 (81.9)	—	—
3A	123.4	—	19.8 (16.1)	2.2 (1.8)	—	—	—	—	—	—	—	101.4 (82.2)	—	—
3B	128.6	—	39.4 (30.6)	12.0 (9.3)	—	—	—	—	—	—	—	77.2 (60.0)	—	—
4A	132.9	41.6 (31.3)	—	—	1.0 (0.8)	7.2 (5.4)	—	6.0 (4.5)	2.1 (1.6)	—	—	67.4 (50.7)	5.6 (4.2)	2.0 (1.5)
4B	133.0	41.6 (31.3)	—	—	1.0 (0.8)	9.2 (6.9)	—	6.0 (4.5)	2.1 (1.6)	—	—	65.5 (49.3)	5.6 (4.2)	2.0 (1.5)
4C1	139.0	55.6 (40.0)	2.5 (1.8)	—	—	—	—	6.0 (4.3)	8.5 (6.1)	—	—	59.9 (43.1)	5.6 (4.0)	0.9 (0.7)
4C2	151.8	51.2 (33.7)	5.5 (3.6)	—	—	—	—	6.0 (4.0)	8.5 (5.6)	—	—	74.6 (49.1)	5.6 (3.7)	0.4 (0.3)
4C3	172.9	60.6 (35.1)	12.5 (7.2)	—	—	—	—	11.9 (6.9)	6.5 (3.8)	—	—	59.6 (34.5)	21.3 (12.3)	0.5 (0.3)
4C2c	161.2	51.2 (31.8)	7.5 (4.7)	—	—	—	—	6.0 (3.7)	6.5 (4.0)	—	—	84.2 (52.2)	5.6 (3.5)	0.2 (0.1)

Conservation Areas and Other Biological Resources

- Northern Aplomado Falcon (A111, A112, A140, A160, A161, A161a, A161b, A260, A270, A330a, A330b, A361, A400, A430, A440, A481, A520, and A530
- Southwestern Willow Flycatcher and designated Critical Habitat (A140)
- Sprague's Pipit (A361, A400, A430, A440, A481, A520, and A530)
- Chiricahua Leopard Frog (A330a)
- Rio Grande Silvery Minnow and designated Critical Habitat (A140)
- Socorro Springsnail (A161b)

Subroute 1B3 – San Antonio Crossing

Vegetation Communities

Subroute 1B3 is initially identical to Subroute 1B2, but continues to the southwest and west across a slightly wider portion of the Chupadera Mesa, until it nears SR 380. The subroute then turns west roughly parallel to SR 380 until it intersects subroutes 1A, 1B1, and 1B2. Vegetation types and other features are similar to Subroute 1B2.

Conservation Areas and Other Biological Resources

- Northern Aplomado Falcon (A111, A112, A140, A143, A160, A161, A161a, A161b, A260, A270, A330a, A330b, A361, A400, A430, A440, A481, A520, and A530)
- Southwestern Willow Flycatcher and designated Critical Habitat (A140)
- Sprague's Pipit (A361, A400, A430, A440, A481, A520, and A530)
- Chiricahua Leopard Frog (A330a)
- Rio Grande Silvery Minnow and designated Critical Habitat (A140)
- Socorro Springsnail (A161b)

Local Alternative and Crossover Links for Route Group 1

Vegetation Communities

Local Alternative Link A161b is located primarily in semidesert grassland and Chihuahuan Desertscrub, similar to subroutes 1A and 1B, Link A161. Vegetation on Local Alternative Link A260 is also very similar to the adjacent subroutes 1A and 1B, Link A270. Links A361-A430-A481 pass through the Uvas Valley and cross the low Goodsight Mountains. The Uvas Valley contains a small agricultural center, and the Goodsight Mountains are dominated by Chihuahuan Desertscrub similar to that on adjacent portions of Subroute 1A. However, topographic relief is greater and plant community composition may differ from surrounding lowlands. Crossover Link A70 is located in a mixture of plains-mesa sand scrub and juniper savanna, identical to surrounding links.

Conservation Areas and Other Biological Resources

Link A161b passes very near to Torreon Spring and its outflow ponds, which make up the sole known location for the ESA-listed Socorro springsnail. Sandhill Cranes often forage in the farmlands in the Uvas Valley during winter.

Much of the juniper savanna in the area along links E81, E82, E83, E84, and E85 was included within the Chupadera Mesa BHCA, and is crossed to some degree by each of these local alternative links. Link E81 crosses the greatest amount of high-density juniper woodland, followed by the combination of links E82-E83-E85. Links E82-E84-E85 take the most northern route, crossing some areas cleared of junipers, affecting the lowest amount of juniper woodland. No species with status under the ESA are known to occur on any of these links.

3.6.9.2 Route Group 3: Midpoint Substation to Willow-500 kV Substation

Subroute 3A2 – BLM Preferred Alternative

Vegetation Communities

Subroute 3A2 begins at the Midpoint Substation in the Mimbres River Valley, part of the enclosed Guzmán Basin. The subroute passes through uniform semidesert grassland in Luna, Grant, and eastern Hidalgo counties, and then crosses small areas of closed basin scrub north of the Lordsburg Playa in north-central Hidalgo County. Crossing into Arizona, the subroute passes through mixed semidesert grassland and Chihuahuan Desertscrub. Subroute 3A2 crosses a low pass in the Peloncillo Mountains near the Whitlock Valley, and then crosses the San Simon Valley through Chihuahuan Desertscrub. West of the San Simon River, the vegetation returns to semidesert grassland until it reaches the Willow-500 kV Substation near the southern end of the Pinaleño Mountains.

Conservation Areas and Other Biological Resources

No conservation areas are crossed by Subroute 3A2, although the subroute passes within approximately 1 mile of the Gila National Forest in the southern Big Burro Mountains.

- Lesser Long-nosed Bat (B160a, B160d, and B170)
- Mexican Long-nosed Bat (B150a)
- Jaguar (B160a)
- Northern Aplomado Falcon (B60, B90, B120a, B120b, B121, and B160a)
- Sprague's Pipit (B60, B90, B120a, B120b, B121, B160a, B160d, B160c, and B170)
- Arizona Striped Whiptail (B160d)
- Chihuahua Scurf-pea (B160d and B160c)

Subroute 3A – North

Vegetation Communities

Vegetation communities present on Subroute 3A are identical to those on Subroute 3A2.

Conservation Areas and Other Biological Resources

No conservation areas are crossed by Subroute 3A.

- Lesser Long-nosed Bat (B160a and B170)
- Jaguar (B160a)
- Northern Aplomado Falcon (B60, B90, B111, B120a, B120b, B121, and B160a)
- Sprague's Pipit (B60, B90, B111, B120a, B120b, B121, B140, B160a, B160b, B160c, and B170)
- Chihuahua Scurf-pea (B160b and B160c)
- Arizona Striped Whiptail (B160b)

Subroute 3B – South

Vegetation Communities

Subroute 3B begins at the Midpoint Substation in the Mimbres River Valley, part of the enclosed Guzmán Basin. It passes through uniform semidesert grassland in Luna and Grant counties before it enters intermixed Chihuahuan Desert and closed basin scrub in the vicinity of Lordsburg Playa in Hidalgo County. After crossing Lordsburg Playa, the subroute passes through mixed semidesert grassland and Chihuahuan Desertscrub in the Peloncillo Mountains. Much of the remainder of the subroute in Arizona is located within areas affected by past farming and severe erosion in the San Simon Valley, but intact mixed semidesert grassland and Chihuahuan Desertscrub is present north of Bowie and near the Willow-500 kV Substation.

Conservation Areas and Other Biological Resources

No conservation areas are crossed by Subroute 3B. However, Lordsburg Playa serves as a winter stopover site for migratory shorebirds, and provides habitat for sensitive plants and invertebrates.

- Lesser Long-nosed Bat (B150a, B151, and B170)
- Mexican Long-nosed Bat (B150a)
- Jaguar (B150a)
- Northern Aplomado Falcon (B60, B80, B110a, B110b, B111, and B112)
- Sprague's Pipit (B60, B80, B110a, B110b, B111, B112, B140, B150a, B150b, B151, and B170)
- Chihuahua Scurf-pea (B150b and B151)

Local Alternative and Crossover Links for Route Group 3

Vegetation Communities

Crossover Link B111 is located entirely within semidesert grassland, identical to surrounding links on subroutes 3A and 3B. Crossover Link B140 is located within a mixture of Chihuahuan Desertscrub and closed basin scrub, similar to Subroute 3B.

3.6.9.3 Route Group 4: Willow-500 kV Substation to Pinal Central Substation

Subroute 4A – North of Mt. Graham

Vegetation Communities

From the Willow-500 kV Substation, Subroute 4A follows US Route 191 north through semidesert grassland in the San Simon Valley. The subroute turns northwest and west as it enters the Gila River Valley north of the Pinaleño Mountains, continues west into the Aravaipa Valley, and passes through a small area of interior chaparral in the divide between the Pinaleño and Santa Teresa mountains. Subroute 4A crosses Aravaipa Creek in an ephemeral reach south of Klondyke, Arizona, and then crosses the northern Galiuro Mountains near the Fourmile Creek and Copper Creek drainages. Vegetation in the Galiuro Mountains is a patchwork of interior chaparral, Great Basin conifer woodland, and pine oak woodland. The subroute descends into the San Pedro River Valley through semidesert grassland into the Arizona upland subdivision of Sonoran Desertscrub, crossing the San Pedro River north of Mammoth, Arizona. Vegetation near the ephemeral river crossing is patchy mesquite bosque, with few riparian-associated trees and no developed riparian woodland.

Arizona Upland Sonoran Desertscrub continues on the west side of the San Pedro River, becoming semidesert grassland as elevation increases to the north of the Santa Catalina Mountains. The subroute crosses a small area of interior chaparral near Black Mountain, 15 miles northwest of Oracle, Arizona. Subroute 4A then travels west and northwest to the northern end of the Picacho Mountains. West of the Picacho Mountains, vegetation becomes the Lower Colorado River subdivision of Sonoran Desertscrub as the subroute approaches the Santa Cruz River Valley. The subroute crosses the CAP and Florence-Casa Grande Canal east of the Pinal Central Substation, where agriculture replaces all native vegetation cover.

Conservation Areas and Other Biological Resources

After leaving US Route 191, Subroute 4A follows parallel to or near the boundary of the CNF in the Pinaleño Mountains. The subroute passes between the CNF and AZGFD's Cluff Ranch WMA, within 0.35 mile of the WMA. The subroute remains near the CNF boundary until it enters the Aravaipa Creek watershed. In the northern Galiuro Mountains, the subroute is located approximately 1 mile to the south and outside of the Aravaipa Ecosystem Planning Area. The Turkey Creek ACEC and Table Mountain Research Natural Area (RNA) ACEC are approximately 2.5 miles north of the subroute, and the Aravaipa Wilderness boundary is approximately 4 miles north. The BLM mapped the eastern slope of the San Pedro River Valley as Category 3 Sonoran Desert Tortoise habitat. The San Pedro River crossing is located approximately 1,200 feet south and upstream from the boundary of TNC's H & E Farm. Category 2 Sonoran Desert Tortoise habitat continues west of the San Pedro River to approximately the point where the subroute crosses Arizona SR 79. Near this point, beginning at Link C830, all subroutes become identical. All subroutes pass within 500 feet of Picacho Reservoir, a seasonal wetland not directly managed for wildlife resources but used by wintering waterfowl.

- Lesser Long-nosed Bat (C170, C173, C174, C178, C500, C501, C502, C592, C595, C620, C671, C760, C780, C830, C840, and C850)

- Jaguar (B153a, C170, and C178)
- Ocelot (B153a, B153b, and C170)
- Yuma Clapper Rail (C880 and C880a)
- Yellow-billed Cuckoo (C592)
- Cactus Ferruginous Pygmy-owl (C173, C174, C500, C501, C502, C592, C595, C620, C671, C760, C780, C830, C840, and C850)
- Southwestern Willow Flycatcher and designated Critical Habitat (C592)
- Sprague's Pipit (B153a and B153b)
- Sonoran Desert Tortoise (C173, C174, C178, C500, C501, C502, C592, C595, C620, C671, C760, C780, C790, C830, C840, and C850)
- Tucson Shovel-nosed Snake (C850)
- Spikedace and designated Critical Habitat (C170)
- Loach Minnow and designated Critical Habitat (C170)
- Roundtail Chub (C170)
- Acuña Cactus (C620)

Subroute 4B – Sulphur Springs Valley

Vegetation Communities

From the Willow-500 kV Substation, Subroute 4B travels southwest and west between the Fisher Hills and the southern foothills of the Pinaleño Mountains in semidesert grassland. It enters the Sulphur Springs Valley, travelling generally northwest through semidesert grassland along the western flanks of the Pinaleño Mountains. Subroute 4B intersects with Subroute 4A in interior chaparral in the southern foothills of the Santa Teresa Mountains. The remainder of this subroute is identical to Subroute 4A.

Conservation Areas and Other Biological Resources

After leaving the Willow-500 kV Substation and entering the Sulphur Springs Valley, Subroute 4B turns northwest through extensive, relatively intact semidesert grassland that has been identified as an important Pronghorn fawning area. The subroute intersects with Subroute 4A after entering the Aravaipa Creek watershed.

- Lesser Long-nosed Bat (C71, C72, C90, C130a, C130b, C170, C173, C174, C178, C500, C501, C502, C592, C595, C620, C671, C760, C780, C830, C840, and C850)
- Jaguar (C130a, C130b, C170, and C178)
- Ocelot (C71, C72, C130a, C130b, and C170)
- Yuma Clapper Rail (C880 and C880a)
- Yellow-billed Cuckoo (C592)
- Cactus Ferruginous Pygmy-owl (C173, C174, C500, C501, C502, C592, C595, C620, C671, C760, C780, C830, C840, and C850)
- Southwestern Willow Flycatcher and designated Critical Habitat (C592)
- Sprague's Pipit (C130a and C130b)
- Sonoran Desert Tortoise (C173, C174, C178, C500, C501, C502, C592, C595, C620, C671, C830, C840, and C850)
- Arizona Striped Whiptail (C130a)

- Tucson Shovel-nosed Snake (C850)
- Spikedace and designated Critical Habitat (C170)
- Loach Minnow and designated Critical Habitat (C170)
- Roundtail Chub (C170)
- Acuña Cactus (C620)

Subroute 4C2c – BLM Preferred Alternative

Vegetation Communities

From the Willow-500 kV Substation, Subroute 4C2c heads southwest through semidesert grassland, partially converted to Chihuahuan Desertscrub by shrub invasion, between the Fisher Hills and the Pinaleño Mountains into the Sulphur Springs Valley. The valley bottom is currently a mixture of active and fallow agriculture. The subroute then crosses semidesert grassland with pine-oak woodland near the southern foothills of the Winchester Mountains. Vegetation shifts from semidesert grassland to Chihuahuan Desertscrub as the subroute descends into the San Pedro River Valley. Subroute 4C2c crosses the San Pedro River in an ephemeral reach approximately 0.5 mile downstream (north) from "The Narrows," a location where the floodplain is constrained between hills on both sides of the river. The floodplain is relatively narrow in this area, approximately 800 feet wide at the proposed Project crossing, and dominated by mesquite bosque. The subroute then proceeds northwest along the west side of the valley, in an ecotone between Sonoran Desertscrub and semidesert grassland. North of San Manuel, the subroute turns to the west and passes to the north of the Santa Catalina and Tortolita mountains, descending into Sonoran Desertscrub. Near the Tortolita Substation northeast of Red Rock, Subroute 4C2c turns to the north through an ecotone between Lower Colorado River Valley and Arizona Upland Sonoran Desertscrub. The subroute then turns to the west, passes north of the Picacho Mountains, and crosses an area entirely converted to farmland to the Pinal Central Substation.

Conservation Areas and Other Biological Resources

Subroute 4C2c crosses the Sulphur Springs Valley through active and fallow farmland used by large numbers of foraging Sandhill Cranes as well as other birds, particularly during winter. West of Willcox, Link C260 crosses Allen Flat, where a population of Pronghorn occurs with management concerns similar to the larger population present on Subroute 4B in the Sulphur Springs Valley. Link C201 crosses a narrow, ephemeral reach of the San Pedro River within designated critical habitat for the Southwestern Willow Flycatcher. Although none of the west slope of the San Pedro River Valley was mapped as Sonoran Desert Tortoise habitat by the BLM, the habitat is similar to the Category 2 habitat mapped on the east side of the river. After crossing Arizona SR 77, Subroute 4C2 remains in mapped Category 2 Desert Tortoise habitat to the vicinity of Desert Peak northeast of the Tortolita Substation. Subroute 4C2c passes within 500 feet of Picacho Reservoir, an area of local, seasonal importance to waterfowl. Yuma Clapper Rails have been recorded at Picacho Reservoir, although no nesting attempts have been recorded.

- Lesser Long-nosed Bat (C71, C71a, C110, C201, C212, C260, C261, C441, C450, C661, C670, and C680)
- Jaguar (C110, C201, C212, C260, C261, C441, and C450)
- Ocelot (C71, C71a, C110, C201, C212, C260, C261, C441, and C450)

- Yuma Clapper Rail (C880 and C880a)
- Cactus Ferruginous Pygmy-owl (C201, C441, C450, C661, C670, C680, C818, C820, C830, C840, and C850)
- Southwestern Willow Flycatcher designated Critical Habitat (C201)
- Sprague's Pipit (C110)
- Sonoran Desert Tortoise (C201, C261, C441, C450, C661, C670, C680, C818, C830, C840, and C850)
- Tucson Shovel-nosed Snake (C850)

Subroute 4C1 – East of San Pedro River

Vegetation Communities

Subroute 4C1 is initially identical to Subroute 4C2c, between the Willow-500 kV Substation and the foothills of the Winchester Mountains. Link C270 crosses semidesert grassland on Allen Flat. Vegetation shifts from semidesert grassland to the Arizona upland subdivision of Sonoran Desertscrub, as the subroute descends into the San Pedro River Valley and turns to the north. The subroute is located in the ecotone between Sonoran Desertscrub and semidesert grassland as it passes north through the San Pedro River Valley to the crossing point near San Manuel. The crossing is located at the lower end of a perennial reach of the river, surrounded by a wide mesquite bosque and former farmland. Little riparian woodland is present at or near the river crossing, although some young willows and cottonwoods are present.

Leaving the San Pedro River Valley, the subroute travels west and reenters semidesert grassland as elevation increases to the north of the Santa Catalina Mountains. North of Oracle, the subroute turns to the northwest, descending into the Arizona upland subdivision of Sonoran Desertscrub near Black Mountain. West of Black Mountain, Subroute 4C1 intersects Subroute 4A, after which the subroutes are identical.

Conservation Areas and Other Biological Resources

Hot Springs and Redfield canyons in the southern Galiuro Mountains contain designated critical habitat for the Gila Chub, Spikedace, and Loach Minnow. The subroute is located approximately 0.3 mile downstream from the lower limit of Gila Chub critical habitat in Hot Springs Canyon, and approximately 0.8 mile downstream from the lower limit of Gila Chub critical habitat in Redfield Canyon. The designated critical habitat for Spikedace and Loach Minnow in Hot Springs and Redfield canyons also ends upstream from the proposed crossing locations of links C331 and C470, and is not crossed by the subroute.

Much of the eastern slope of the San Pedro River Valley is mapped by the BLM as Category 3 Sonoran Desert Tortoise habitat, with a small area of Category 3 habitat where the subroute turns west to cross the river. Much of the perennial reach of the river immediately upstream from this river crossing is located on property owned by BHP Billiton, with management for biological resources by the Tucson Audubon Society. The 7B Ranch, a proposed addition to the San Pedro Riparian National Conservation Area through a land exchange, is located approximately 1.8 miles downstream from the river crossing. West of the San Pedro River, Category 3 Desert Tortoise habitat exists from approximately Arizona SR 77 to Arizona SR 79 on this subroute.

- Lesser Long-nosed Bat (C71, C71a, C72, C110, C111, C121, C174, C211, C212, C270, C301, C331, C361, C470, C500, C501, C502, C510, C660, C661, C670, C671, C690, C691, C692, C693, C760, C780, C790, C830, C840, and C850)
- Jaguar (C110, C121, C211, C212, C270, C301, C331, C361, and C470)
- Ocelot (C71, C71a, C72, C90, C110, C212, C270, C301, C331, C361, and C470)
- Yuma Clapper Rail (C880 and C880a)
- Yellow-billed Cuckoo (C660)
- Cactus Ferruginous Pygmy-owl (C174, C331, C361, C470, C501, C502, C510, C660, C661, C670, C671, C690, C691, C692, C693, C760, C780, C790, C830, C840, and C850)
- Southwestern Willow Flycatcher and designated Critical Habitat (C660)
- Sprague's Pipit (C110 and C121)
- Sonoran Desert Tortoise (C174, C331, C361, C470, C500, C501, C502, C510, C660, C661, C670, C671, C690, C691, C692, C693, C830, C840, and C850)
- Arizona Striped Whiptail (C121)
- Tucson Shovel-nosed Snake (C850)
- Gila Chub designated Critical Habitat (C331 and C470)
- Spikedace designated Critical Habitat (C331 and C470)
- Loach Minnow designated Critical Habitat (C331 and C470)

<u>Subroute 4C2 – West of San Pedro River</u>

Vegetation Communities

Subroute 4C2 is initially identical to Subroute 4C2c, but differs in the links used from the Winchester Mountains until after crossing the San Pedro River. Similar to Subroute 4C2c, Subroute 4C2 crosses semidesert grassland and Chihuahuan Desertscrub as it descends into the San Pedro River Valley. The river crossing is within an ephemeral reach. Mature mesquite bosque is present on both sides of the river, and the riparian woodland consists of an early-successional mix of tamarisk and native tree species. Approximately 3.4 miles west of the Rio Grande at the end of Link C276, Subroute 4C2 becomes identical to Subroute 4C2c. Subroute 4C2a differs from Subroute 4C2 between Oracle and the Pinal Central Substation, and is identical to Subroute 4C1 beginning with Link C690. Subroute 4C2b is similar to Subroute 4C2a, but also uses the southern crossing of the San Pedro River similar to Subroute 4C2c.

Conservation Areas and Other Biological Resources

Subroute 4C2 crosses the San Pedro River near Cascabel, Arizona, within designated critical habitat for the Southwestern Willow Flycatcher. This reach of the river is ephemeral, and is not suitable nesting habitat at present. After crossing the San Pedro River, the subroute rejoins Subroute 4C2c near the boundary of the A7 Ranch.

- Lesser Long-nosed Bat (C71, C71a, C72, C110, C111, C121, C174, C211, C212, C266, C270, C271, C276, C441, C450, C500, C501, C502, C661, C670, C671, C680, C818, C820, C830, C840, and C850)
- Jaguar (C110, C211, C212, C266, C270, C271, C276, C441, and C450)
- Ocelot (C71, C71a, C72, C90, C110, C212, C270, C271, C441, and C450)

- Yuma Clapper Rail (C880 and C880a)
- Yellow-billed Cuckoo (C276)
- Cactus Ferruginous Pygmy-owl (C174, C266, C276, C441, C450, C500, C501, C502, C661, C670, C671, C680, C818, C820, C830, C840, and C850)
- Southwestern Willow Flycatcher and designated Critical Habitat (C276)
- Sprague's Pipit (C110 and C121)
- Sonoran Desert Tortoise (C174, C441, C450, C500, C501, C502, C661, C670, C671, C680, C818, C830, C840, and C850)
- Arizona Striped Whiptail (C121)
- Tucson Shovel-nosed Snake (C850)

Subroute 4C3 – Tucson

Vegetation Communities

Subroute 4C3 is identical to Subroute 4C2c from the Winchester Substation until the San Pedro River. After crossing the river, Subroute 4C3 continues to the southwest roughly parallel to the San Pedro River and Ash Creek through intermixed Chihuahuan Desertscrub and semidesert grassland. The subroute passes to the south of the Rincon Mountains, crossing Cienega Creek and I-10 near the creek's confluence with Mescal Arroyo. The subroute continues west through semidesert grassland, turning north and northwest while crossing I-10 in two locations. The subroute then roughly parallels I-10 through the Tucson metropolitan area, using the bed of the Santa Cruz River after it crosses I-19. The Arizona Upland subdivision of Sonoran Desertscrub occurs where native vegetation remains in the Tucson region. Near the town of Marana, the subroute leaves the Santa Cruz River and continues parallel to I-10 near the CAP in the ecotone between the Arizona upland and Lower Colorado River subdivisions of Sonoran Desertscrub. After reaching the Tortolita Substation, the remainder of Subroute 4C3 is identical to Subroute 4C2c.

Conservation Areas and Other Biological Resources

Subroute 4C3 crosses the San Pedro River approximately 1,500 feet upstream from the southern boundary of TNC's Three Links Farm, using the same crossing location as Subroute 4C2c. The subroute passes between two disjunct parcels of the Pima County Cienega Creek Natural Preserve near I-10. Following parallel to the Santa Cruz River through Tucson, the subroute passes within approximately 0.25 mile of Sweetwater Wetlands, an artificial wetland supported by reclaimed water from the Roger Road Wastewater Treatment Plant and managed in part for wildlife use. After passing the Tortolita Substation, this subroute crosses a small area of Category 2 Sonoran Desert Tortoise habitat near Desert Peak.

- Lesser Long-nosed Bat (C71, C71a, C110, C212, C260, C261, C810, C810a, C812, C813, C816, C817, C820, C830, C840, C850, F40a, F40b, F51, F60a, F60b, F80, F111, F112, F510, F540, and F600)
- Jaguar (C110, C212, C260, and C261)
- Ocelot (C71, C71a, C110, C212, C260, C261, and F40a)
- Yuma Clapper Rail (C880 and C880a)
- Yellow-billed Cuckoo (F600)

- Cactus Ferruginous Pygmy-owl (C810, C810a, C813, C816, C817, C820, C830, C840, C850, F60a, F60b, F80, F82, F111, F510, F540, and F600)
- Southwestern Willow Flycatcher designated Critical Habitat (F40a)
- Southwestern Willow Flycatcher (F51 and F600)
- Sprague's Pipit (C110)
- Sonoran Desert Tortoise (C816, C817, C830, C840, C850, F51, F60a, and F60b)
- Tucson Shovel-nosed Snake (C810, C810a, C812, C850, and F540)
- Northern Mexican Garter Snake (F600)
- Gila Chub and designated Critical Habitat (F51 and F600)
- Gila Topminnow (F600)
- Pima Pineapple Cactus (F80, F82, and F111)
- Huachuca Water-umbel (F600)

Local Alternative and Crossover Links for Route Group 4

Local Alternative Links for Pinal Central Substation

These local alternative links may be used by any subroute within Route Group 4.

Vegetation Communities

The existing vegetation for these local alternative links is identical to the vegetation present on adjacent links used by all subroutes within Route Group 4.

Conservation Areas and Other Biological Resources

These local alternative links are located near Picacho Reservoir, a locally important waterfowl site and potential habitat for the Yuma Clapper Rail during wet years. Suitable habitat may be present for the Southwestern Willow Flycatcher, but no surveys for the species have been conducted. Link C880, used by all subroutes within Route Group 4, is located much closer and passes within approximately 400 feet of the reservoir, and would have a greater impact on waterfowl than any links within this local alternative.

- Lesser Long-nosed Bat (C860)
- Yuma Clapper Rail (C890)
- Cactus Ferruginous Pygmy-owl (C860)
- Sonoran Desert Tortoise (C860)
- Tucson Shovel-nosed Snake (C860)

Local Alternative Links in the Sulphur Springs Valley

The local alternative that includes links C72, C90, C121, and C211 takes a slightly more northern route through the Sulphur Springs Valley than the 4C family of subroutes.

Vegetation Communities

Native vegetation and agricultural use of the local alternative links is similar to the links used by the 4C family of subroutes, although the total mileage is greater with the local alternative links.

Conservation Areas and Other Biological Resources

No conservation areas are crossed by these local alternative links, although Link C121 passes near two known locations for the special-status Arizona Striped Whiptail. Similar to Link C110 used by the 4C family of subroutes, Link C121 crosses farmland used by large numbers of foraging Sandhill Cranes and other birds that winter in the Sulphur Springs Valley.

- Lesser Long-nosed Bat (C72, C90, C121, and C211)
- Arizona Striped Whiptail (C121)

Local Alternative Links for Winchester Substation

These local alternative links may be used by Subroute 4C2, allowing a connection to the Winchester Substation and crossing the San Pedro River in a location without permanent water.

Vegetation Communities

Upon entering the San Pedro River Valley, links C260 and C261 proceed through semidesert grassland and Chihuahuan Desertscrub southwest to the Winchester Substation, then continue to the southwest and cross the San Pedro River east of the Johnny Lyon Hills. This river crossing is ephemeral and lacks riparian woodland, although mesquite bosque is present. Link C201 then turns to the northwest and intersects with Subroute 4C2 west of Cascabel, Arizona.

Conservation Areas and Other Biological Resources

Link C201 crosses the San Pedro River approximately 1,500 feet upstream from the southern boundary of TNC's Three Links Farm. After crossing the river, the local alternative turns northwest and intersects Subroute 4C2 near the southern boundary of the A7 Ranch.

- Lesser Long-nosed Bat (C201, C260 and C261)
- Jaguar (C201, C260 and C261)
- Ocelot (C201, C260 and C261)

Local Alternative Links for Tortolita Substation

These local alternative links provide options for multiple configurations to allow a connection to the Tortolita Substation in Pinal County.

Vegetation Communities

These local alternative links near Red Rock are located in an ecotone between the Arizona Upland and Lower Colorado River subdivisions of Sonoran Desertscrub.

Conservation Areas and Other Biological Resources

The vicinity of Desert Peak is mapped as Category 2 Sonoran Desert Tortoise habitat. No conservation areas are crossed by these local alternative links:

- Lesser Long-nosed Bat (C680b, C810, C810a, C812, C813, C814, C815 and C816)
- Cactus Ferruginous Pygmy-Owl (C680b, C810, C810a, C812, C813, C814, C815 and C816)
- Sonoran Desert Tortoise (C680b, C814, C815 and C816)
- Tucson Shovel-nosed Snake (C810, C810a and C812)

Local Alternative Links for Cienega Creek

These local alternative links may be used by Subroute 4C3, providing an alternative crossing location for Cienega Creek.

Vegetation Communities

Near the southern end of the Rincon Mountains, Link F40b roughly follows Agua Verde Wash, and Link F51 crosses Cienega Creek at its confluence with Agua Verde Wash. Vegetation transitions from Chihuahuan Desertscrub into the Arizona Upland subdivision of Sonoran Desertscrub moving from east to west. The crossing of Cienega Creek would affect some riparian-associated vegetation, primarily mesquite bosque at the mouth of Agua Verde Creek. Both streams are ephemeral at this location, and only support scattered individual cottonwoods and willows.

Conservation Areas and Other Biological Resources

These local alternative links cross a karst region and potential bat roost habitat in the Agua Verde Wash area, and then cross the Cienega Creek Natural Preserve at the confluence of Agua Verde Wash and Cienega Creek. No other conservation areas are crossed by these local alternative links.

- Lesser Long-nosed Bat (F40b, F51, and F60a)
- Yellow-billed Cuckoo (F51)
- Cactus Ferruginous Pygmy-owl (F51and F60a)
- Southwestern Willow Flycatcher (F51)
- Sonoran Desert Tortoise (F51and F60a)
- Northern Mexican Garter Snake (F51)
- Gila Chub and designated Critical Habitat (F51)
- Gila Topminnow (F51)
- Pima Pineapple Cactus (F40b, F51, and F60a)
- Huachuca Water-umbel (F51)

Local Alternative Links for Pantano to Rillito

These local alternative links would be used by Subroute 4C3 as an alternative route through the City of Tucson.

Vegetation Communities

These local alternative links are located within the Arizona Upland subdivision of Sonoran Desertscrub and urban areas. Link F81a begins northwest of Vail, travelling generally north parallel to and east of Houghton Road. A portion of Link F81 and all of Link F81b travels through urban Tucson in the streambeds of Pantano Wash and the Rillito River. The Rillito River crosses I-10 and flows into the Santa Cruz River, at which point Link F81b rejoins Subroute 4C3.

Conservation Areas and Other Biological Resources

No conservation areas are crossed by this local alternative.

- Lesser Long-nosed Bat (F81a and F81b)
- Cactus Ferruginous Pygmy-owl (F81a)
- Sonoran Desert Tortoise (F81a)
- Pima Pineapple Cactus (F81a)

3.7 WILDLAND FIRE ECOLOGY AND MANAGEMENT

3.7.1 Introduction, Methods, and Regulatory Framework

3.7.1.1 Introduction

This section discusses past and current conditions relating to fire ecology, recent fire history, and current management directives within the Project area. Fire is a landscape-scale process, potentially affecting large areas across multiple jurisdictions. The discussion focuses on issues within a 20-mile buffer for this resource around all proposed alternatives, hereafter referred to as the study area, which was chosen in acknowledgment of the potential scale of the effects of large fires.

"Wildland fire" is a general term that describes any nonstructural fire that occurs in the wildland. Wildland fires are categorized into two distinct types:

- Wildfires: Unplanned ignitions or prescribed fires that escape and are declared wildfires.
- Prescribed Fires: Planned ignitions.

3.7.1.2 Methods

Although fire may cross administrative boundaries, federal and state management plans do not typically have jurisdiction outside their respective planning areas. In some cases, fire protection and planning may be conducted under cooperative agreements between federal and state or local agencies. All land management plans relating to fire management for land crossed by proposed

subroutes were reviewed. Federal interagency coordination on fire planning, such as between the BLM and USFS, is required under national directives. However, fire management planning on national forests, tribal lands, or any other land that would not be crossed by the proposed Project is beyond the scope of this analysis.

Peer-reviewed literature, agency publications, and remote sensing data on fire ecology and current vegetation conditions were reviewed. Remote sensing data was accessed primarily from LANDFIRE (also known as Landscape Fire and Resource Management Planning Tools), which is an interagency source of information on vegetation, fire behavior, fuels, and landscape-scale vegetation change. A number of geospatial datasets relating to those aspects of fire ecology were developed. One of the goals of LANDFIRE is to provide those datasets uniformly for the entire United States, at a resolution of 30 meters per pixel. A number of LANDFIRE datasets were reviewed, including fire regime group, Fire Regime Condition Class (FRCC), Vegetation Condition Class (VCC), fire return interval, canopy height, canopy cover, and vegetation departure[1].

Fire regimes represent the average frequency and intensity of fires in a given area, and are directly related to the vegetation community. A "fire cycle" is the process of burning and recovery, to the occurrence of the next fire; the average length of that period is referred to as the "fire return interval." Fire regimes are assigned to five groups, based on the fire return interval and typical severity:

- Group I: < 35-year fire return interval, low and mixed severity
- Group II: < 35-year fire return interval, replacement severity
- Group III: 35 to 200-year fire return interval, low and mixed severity
- Group IV: 35 to 200-year fire return interval, replacement severity
- Group V: > 200-year fire return interval, any severity

FRCC is a measure that uses three classes to describe the similarity between the current fire regime and the natural fire regime. Class I represents a substantial similarity to the natural fire regime, Class II represents a moderate departure from the natural regime (deviating by more than one fire cycle), and Class III represents a major departure (deviating by two or more fire cycles). However, FRCC does not quantify the exact degree or describe the direction of the departure. In the Southwest, many montane forests are mapped as Class III because fire frequency has decreased, although the fires are often more severe when they occur. In contrast, grass-invaded Sonoran desertscrub, where fire was naturally rare or absent, can also be mapped as Class III because fire frequency or potential has significantly increased.

VCC is similar to FRCC, assigning areas to three categories of low, moderate, and high levels of change from the natural vegetation community. Vegetation departure represents, on a scale of 1 to 100, the estimated change in composition of a given vegetation community from the natural composition.

[1] All layers except FRCC were from LANDFIRE version 1.1.1.0 (Refresh 2008). FRCC was developed during the 2006 Rapid Assessment, LANDFIRE version 0.5.0.

Any characterization or classification scheme may vary between mapping efforts. Each unique local, site-specific mapping effort of VCC, FRCC, or other subjective classes may be based on different assumptions of natural conditions, data sources, modeling parameters, or fine-scale measurements, and may result in unique outputs. LANDFIRE was selected as it is a uniform, multi-state dataset intended for use at a regional scale, and in this context is used to give a regional picture of current conditions. LANDFIRE does not provide the detail needed for site-specific analysis of conditions, and is not used to compare individual subroutes in this discussion.

3.7.1.3 Regulatory Framework

The Wildland Fire Leadership Council (WFLC) was established in 2002, as a federal interagency committee that develops and oversees national fire management planning. The Guidance for Implementation of Federal Wildland Fire Management Policy (WFLC 2009) was created by the WFLC as an update of earlier guidance developed in 2003. The Guidance sets standards for fire planning, interagency coordination, and other fire-related concerns, and requires that a Fire Management Plan (FMP) be developed by the managing agency for all areas of burnable vegetation. FMPs are implemented as a part of the existing land management plan for that area, and describe fire objectives, affected resources, and safety concerns.

The BLM's RMP Amendment for Fire and Fuels on Public Land in New Mexico and Texas (BLM 2004a) and Arizona Statewide Land Use Plan Amendment for Fire, Fuels, and Air Quality Management (BLM 2004b) allow statewide planning for fire management. Both plans categorized BLM-administered land into four categories, with the Arizona plan also categorizing some surrounding state, private, and federal lands. Large, adjacent, or contiguous areas with similar fire management objectives were typically mapped as Fire Management Units (FMU) for planning purposes. The management objectives for the four categories are as follows:

- A: "Areas where fire is not desired at all." These may be areas with high resource sensitivity, or vegetation communities that are not fire-adapted.
- B: "Areas where unplanned wildland fire is not desired because of current conditions." These may be areas with sensitive resources, or areas that perhaps burned naturally but now have excessive fuel loads such that an unplanned fire would risk lives or severely damage resources.
- C: "Areas where wildland fire is desired, but there are significant constraints that must be considered for its use." Fire may benefit these areas as a management tool, but under controlled conditions. Fuels reduction may be required prior to reintroduction of fire.
- D: "Areas where wildland fire is desired, and there are few or no constraints for its use." Relatively unaltered vegetation communities without lives, property, or sensitive resources at risk that may benefit from an unmanaged, natural fire regime or from prescribed fire.

In coordination with the statewide planning efforts for Arizona and New Mexico, individual BLM field offices or district offices developed FMPs with additional detail specific to each planning area, sometimes including refined mapping of FMUs. The following BLM plans were reviewed:

- Resource Management Plan Amendment for Fire and Fuels on Public Land in New Mexico and Texas (BLM 2004a)
- Arizona Statewide Land Use Plan Amendment for Fire, Fuels, and Air Quality Management (BLM 2004b)
- Las Cruces District Office: Mimbres Resource Management Plan (BLM 1993)
- Las Cruces District Office: Fire Management Plan (BLM 2010e)
- Rio Puerco Field Office: Fire Management Plan (BLM 2010f)
- Roswell Field Office: Fire Management Plan (BLM 2010g)
- Socorro Field Office: Socorro Resource Management Plan and Final Environmental Impact Statement (BLM 2008c)
- Socorro Field Office: Fire Management Plan (BLM 2010h)
- Safford District Office: Safford District Resource Management Plan and Environmental Impact Statement (BLM 1991)
- Safford District Office and Tucson Field Office: Safford-Tucson Fire Management Zone: Fire Management Plan (BLM 2004c)
- Gila District: Fire Management Plan (BLM 2010h)
- Tucson Field Office: Muleshoe Ecosystem Management Plan and Environmental Assessment (BLM 1998b)

The Southwest Coordination Center coordinates firefighting efforts among federal land management agencies in the Southwest. The Southwest Coordination Center is a regional office of the National Interagency Fire Center in Boise, Idaho, which coordinates national firefighting efforts for major incidents. Both centers may have operational jurisdiction over large wildfires within the study area, but are not otherwise directly involved in land management planning related to fire.

The New Mexico State Forestry Division and Arizona State Forestry Division are responsible for fire management on state trust land in their respective states. Fire management on some other lands, including adjacent federal lands or unincorporated private lands, may be conducted under cooperative agreements. State trust land is managed under constitutional mandate to provide revenue for specified beneficiaries. As such, fire planning is subject to its effects on that revenue. Prescribed fire may be employed when resources such as livestock forage are at risk from the absence of fire, potentially affecting revenue generation. Unplanned fires may be allowed to burn for the benefit of resources when this is the lowest-cost and safest option (Arizona State Forestry Division 2008).

Some counties or communities in the Project area have developed community wildfire protection plans, and other plans may be in development. Community wildfire protection plans identify communities with high fire risk, provide detailed vegetation or fuels maps, and provide for cooperative fire management with federal and state agencies. The following community wildfire protection plans cover portions of the Project area:

- Sierra County, New Mexico (Sierra County Community Wildfire Protection Plan Team 2012)
- Lincoln County, New Mexico (Walsh Environmental Scientists and Engineers 2008)
- Socorro County, New Mexico (Socorro County 2006)
- Middle Rio Grande Bosque, New Mexico (SWCA Environmental Consultants 2007)
- Luna County, New Mexico (Luna County 2010)
- Grant County, New Mexico (Grant County 2006)
- Hidalgo County, New Mexico (Hidalgo County 2009)
- Claunch-Pinto Soil and Water Conservation District (SWCA Environmental Consultants and Arid Land Innovation 2008)
- Torrance County, New Mexico (SWCA Environmental Consultants and Arid Land Innovation 2008)
- Pinal County, Arizona (Logan Simpson Design 2009)
- Cascabel, Arizona (Logan Simpson Design 2006)
- Pima County, Arizona – in progress
- Cochise County, Arizona – in progress
- Graham County, Arizona (Graham County 2005)
- Greenlee County, Arizona (Logan Simpson Design 2005)

3.7.2 Regional Overview

3.7.2.1 Natural Fire Conditions and Recent Changes

Fire regimes in the study area are diverse, reflecting the diversity of natural and altered vegetation communities present. Widespread, landscape-scale change from human activities has altered many vegetation communities throughout the Southwest. Deliberate fire suppression, grazing, and the introduction of non-native plants have all resulted in substantial changes to fire regimes. Altered fire regimes may also create a positive feedback loop under certain conditions, when increased fire frequency creates conditions that favor fire-adapted plants, including some invasive grasses, increasing fire frequency even further (Brooks 2008).

Fires in the pre-industrial Southwest were typically ignited by lightning, although Native Americans would also light fires for use in hunting, warfare, and numerous other purposes (Denevan 1992). Fires were only limited by fuel availability or weather conditions rather than by suppression. Fire was rare or absent from Sonoran or Chihuahuan desertscrub where fuel was typically too sparse to carry a fire across the landscape, and from communities such as riparian woodlands and high-elevation montane forests where fuel moisture generally remained high year-round. However, fire was an important feature in controlling the structure and function of grasslands and mid-elevation conifer or mixed woodlands.

Following the advent of modern fire suppression techniques, fires were often extinguished when possible. Fires in montane woodlands were perceived as threatening timber, and fires in grasslands often threatened residents, structures, fencing, and livestock. As a result of suppression, the total acreage in western North America that burned each year dropped dramatically through the middle of the twentieth century (Littell et al. 2009).

Fire suppression in montane woodlands allowed high recruitment of saplings, as well as the accumulation of litter such as pine needles and downed branches. The typical behavior of a fire prior to widespread suppression would burn most litter on the ground, but rarely damage mature trees. The unnaturally high fuel loads resulting from fire suppression often allowed fires, when they did occur, to become stand-replacing "crown fires" that could burn entire mature trees over very large areas (Arno 2000).

Grasslands are often dependent on fires for maintenance. Decreased fire frequency in the Southwest allowed widespread invasion of native shrubs and subshrubs previously excluded by fire. Selective grazing also favored shrubs that were less palatable to cattle. These and other factors led to a conversion of shrub-dominated landscape and resulted in large areas becoming less suitable for grassland wildlife and livestock (Wilson et al. 2001).

In the nineteenth and twentieth centuries, many species of plants from Europe, Africa, and Asia were introduced to North America. Plants such as buffelgrass (*Cenchrus ciliaris*), several species of *Bromus*, and other grasses were deliberately introduced, generally as potential forage sources or for erosion control and reclamation. These grasses were often perceived as beneficial for being more drought-tolerant or more productive than native forage plants. Other plants were accidentally introduced in livestock feed, stored grains, or other materials. Many of the species that were successfully established supported different fire regimes than were naturally present, and in some cases introduced fire to vegetation communities that were not adapted to it (Brooks and Esque 2000). Fire resulting from invasion of buffelgrass and other species into Sonoran Desertscrub can cause very high mortality of cacti and many other native species that define the community, converting the landscape to an arid savanna (McLaughlin and Bowers 1982).

Land managers became aware of these widespread, significant negative effects as fires shifted towards being larger, more destructive, and difficult to control. From the mid-century period when fire suppression was most successful, the acres burned each year began to trend upwards and now can be much higher than natural (Littell et al. 2009). Recent management and research is often dedicated towards returning to a natural fire regime where possible. However, ongoing population growth, urbanization, utility construction, and rural development have created an extensive and expanding wildland-urban interface (WUI); potentially in conflict with desired fire management and a safety hazard to residents in the WUI.

3.7.3 Inventory

The following sections discuss the current fire ecology and fire management planning in the vicinity of the proposed Project.

3.7.3.1 Vegetation and Fire Regime Conditions

The majority of each alternative subroute is within vegetation types that either rarely burn under natural conditions, or consist of fine, low-level fuels such as grasses and shrubs that can burn frequently. Dense, woody fuels that can support the most intense fires are sparsely distributed or absent.

Juniper-dominated woodlands and savanna on Chupadera Mesa are the most extensive woodlands crossed by any subroute, but canopy height is nearly always less than 30 feet. Juniper

woodlands can be a climax community that develops when juniper savannas remain unburned for long time periods (Paysen et al. 2000). Juniper-dominated areas were typically assigned by LANDFIRE to fire regime group III, and savannas with scattered junipers were typically assigned to group I. Portions of the Galiuro Mountains on subroutes 1A and 1B are within an open-canopy mixed juniper-pine-oak woodland and chaparral, a mixture of groups I, III, and IV. No other large, contiguous areas were mapped as forested by LANDFIRE.

Grasslands, particularly when shrubs are also common, can support intense fires. However, the light fuels that are present typically burn rapidly when compared with heavier fuels such as mature trees. The lower fuel masses and quick burning in grasslands also cause relatively lower soil heating, resulting in lower levels of erosion and water repellency that can occur after intense fires (DeBano et al. 2005). Grasslands naturally burn frequently, and were generally assigned to fire regime group I.

Riparian woodlands or mesquite bosques occur at each major river crossing. Riparian woodlands may have occasionally burned in the past, but fire severity was generally limited by high fuel moisture except during drought years. Mature mesquite bosques often have large areas with closed canopies, where fuel moisture is relatively high and fine understory fuels are often insufficient to carry a fire of sufficient intensity to damage healthy trees. If burned, mesquite trees can resprout from the root crown, although bosque recovery may take decades (Stromberg 1993). Riparian trees such as cottonwoods can be highly susceptible to fire damage, particularly when heavy or dense ground fuels such as downed logs and introduced Bermuda grass are present. Riparian woodlands may have burned occasionally in the past, but the loss of the majority of such woodlands has increased the importance of those remaining. Fire is now rarely a desired management tool, although some controlled burns may be effective (Quintana 2004).

Sonoran and Chihuahuan Desertscrub rarely burn under a natural fire regime, as native fine fuels between shrubs could not carry a fire under most conditions. Fires could occur after unusually wet years, when sufficient annuals and grasses were present (Paysen et al. 2000). Sonoran desertscrub is primarily within fire regime group V, and Chihuahuan desertscrub is primarily within group IV, except where it interfaces with semidesert grassland and experiences a higher fire frequency. However, increased presence of drought-tolerant invasive grasses in both ecosystems now allows fire to occur more frequently and over greater areas than under a natural fire regime.

Nearly all vegetation within the study area has diverged from the natural fire regime, as estimated by LANDFIRE's FRCC model (Table 3-32). Large blocks mapped as Class I only occur in the vicinity of Chupadera Mesa and west of Socorro, New Mexico. Nearly all montane woodlands and large areas of Sonoran desertscrub are mapped as Class III. The majority of semidesert grassland and shrub-invaded former grassland is mapped as Class II.

Table 3-32. Percent of Land Assigned to FRCC Classes within the Study Area[1]

	New Mexico	Arizona	Entire study area
Percent Class I	11	3	**7**
Percent Class II	66	49	**58**
Percent Class III	20	39	**29**

[1] Totals do not equal 100%. Barren and urban areas, agriculture, snow, and open water were not assigned an FRCC Class.

3.7.3.2 Recent fire history

The recent fire history of the Southwest has been shaped by human-caused changes in vegetation, in concert with an ongoing, multi-year drought and higher than average temperatures. Consecutive dry winters and unusually warm summers in 2011 and 2012 contributed to active fire seasons both years. In 2011, New Mexico experienced the largest fire (Las Conchas) in its recorded history to that date, and Arizona simultaneously experienced its largest fire (Wallow). However, in 2012, the Whitewater-Baldy Complex fire became the largest fire in New Mexico's recorded history at nearly twice the size of the Las Conchas Fire.

Fire history is derived from publically available information provided through the Geospatial Multi-Agency Coordination Group (GeoMAC). GeoMAC uses remote sensing infrared data as well as field reports to generate spatial data for wildfire perimeters and behavior. Historical wildfire perimeters dating to the initiation of the mapping project in 2000 through the end of 2012 form the basis for the following discussion (GeoMAC 2011, 2012). However, the data are largely limited to wildfires and do not include information on some prescribed burns that have occurred within the study area.

Fires between 2000 and 2012 burned 273,034 acres, or approximately 1.6 percent, of the entire study area, but several of the montane fires that occurred were catastrophic and stand-replacing events, much more severe than typical fires. Fires burned approximately 0.2 percent of the study area in New Mexico, within vegetation communities similar to those that would be crossed by the Project. Within Arizona, fires burned 3.3 percent of the study area, nearly all at higher elevations than the Project area in montane vegetation communities.

The following fires occurring in the study area since 2000 were unusually large or severe, and provide examples of the results of the existing unnatural fire regime. All except the Mitchell Fire occurred in Arizona. The majority of fires in New Mexico were relatively small and occurred in vegetation communities that can benefit from fire.

- Bullock (30,589 acres, 2002): This fire burned in the Santa Catalina Mountains near Subroute 4C2, primarily in the CNF. The fire was human-caused.
- Aspen (85,736 acres, 2003): This extremely costly, human-caused fire burned much of the Santa Catalina Mountains that did not burn in the Bullock fire the previous year. The town of Summerhaven suffered severe damage, including the loss of approximately 340 homes.
- Gibson–Nuttall Complex (29,474 acres, 2004): This pair of fires, both ignited by lightning, burned parts of the Pinaleño Mountains, threatening observatories on Mount Graham and severely damaging habitat for the endangered Mount Graham Red Squirrel. The eastern flank of the fire burned within 1 mile of the proposed route for Subroute 4A.
- Florida (23,201 acres, 2005): This lightning-caused fire burned a large part of the Santa Rita Mountains. Unlike many other recent fires, the majority of the fire was at a low, relatively healthy intensity.

- Mitchell (1,021 acres, 2005): This human-caused fire was relatively small, but burned from an area of invasive tamarisk into native riparian woodlands along the Rio Grande at the proposed San Antonio Crossing. Restoration is ongoing within the burned area.
- Distillery (7,567 acres, 2008): This lightning-caused fire burned at a relatively low intensity in the Rincon Mountains near Subroute 4C3, primarily in the CNF.
- Stanley (8,832 acres, 2011): This lightning-caused fire burned from the San Carlos Apache Indian Reservation into a small part of the CNF, in the Santa Teresa Mountains north of Aravaipa Canyon.
- Horseshoe II (223,213 acres, 2011): This human-caused fire was the fifth-largest in Arizona history, and burned much of the Chiricahua Mountains.
- Fox (7,474 acres, 2012): This lightning-caused fire burned semidesert grassland and pine-oak woodland in the Rincon Mountains, including a portion of the Rincon Mountain Wilderness, near the BLM preferred alternative.
- Grapevine (18,361 acres, 2012): This lightning-caused fire burned semidesert grassland and pine-oak woodland in the southern Pinaleño Mountains near Subroute 4B.

3.7.3.3 Fire Management Plans in New Mexico

In the RMP Amendment for Fire and Fuels on Public Land in New Mexico and Texas (BLM 2004a), all BLM land in New Mexico was assigned to the four fire management categories defined in Section 3.7.1.3.

Category A in New Mexico was generally mapped to include riparian habitats and areas with very sensitive resources. No Category A land would be crossed by any alternative; the nearest being the Socorro Nature Area approximately 2.5 miles north of the proposed North Crossing. The majority of Category B land within the study area is concentrated in scattered parcels from the Nutt Valley west to near Lordsburg. Although the vegetation would benefit from burning, this area was designated Category B because the small parcel size of most BLM-administered land makes prescribed fire planning difficult. Category C land is the majority for every subroute, and includes much of the Rio Grande Valley and the Peloncillo Mountains. Lands in Category D are only crossed east of the Rio Grande, including parts of Chupadera Mesa and nearby plains-mesa grasslands. The Veranito WSA north of Socorro is Category D, and would be approached by Subroute 1A, 1A1, or 1A2. Table 3-33 presents the miles of BLM-administered land that would be crossed by each subroute within the four fire management categories.

Table 3-33. Comparison of Miles of BLM Fire Management Categories Crossed by Each Subroute in New Mexico

	A	B	C	D	Not categorized[1]
Subroute 1A1	0	6.9	103.2	0	118.7
Subroute 1A2 (BLM preferred alternative)	0	6.6	101.3	0	122.2
Subroute 1A	0	6.9	98	0	114.6
Subroute 1B1	0	6.9	107.1	0	109.6
Subroute 1B2	0	6.9	102.6	10.7	89

Table 3-33. Comparison of Miles of BLM Fire Management Categories Crossed by Each Subroute in New Mexico					
	A	**B**	**C**	**D**	**Not categorized[1]**
Subroute 1B2a	0	6.9	106.7	10.7	88.5
Subroute 1B3	0	6.9	98.1	17.4	83.9
Subroute 3A2 (BLM preferred alternative)	0	6.7	20	0	69.3
Subroute 3A	0	6.7	20	0	60.2
Subroute 3B	0	3.9	12.9	0	67.5
[1] BLM New Mexico only categorized BLM-administered land.					

3.7.3.4 Fire Management Plans in Arizona

The Arizona Statewide Land Use Plan Amendment for Fire, Fuels, and Air Quality Management (BLM 2004b) mapped FMUs on BLM land and some surrounding lands; in some cases combining multiple categories within a single FMU. Further detail on boundaries between categories within each FMU was not available. Table 3-34 presents the miles of BLM-administered land that would be crossed by each subroute within the four fire management categories or their combinations.

Table 3-34. Comparison of Miles of BLM Fire Management Categories Crossed by Each Subroute in Arizona						
	A	**ABD**	**B**	**BC**	**CD**	**Not categorized[1]**
Subroute 3A2 (BLM preferred alternative)	0	34.9	0	0	0	2.6
Subroute 3A	0	34.4	0	0	0	2.1
Subroute 3B	0	41.7	0	0	0	2.6
Subroute 4A	45	6	0	40.2	0	41.7
Subroute 4B	45	0	0	0	0	47.9
Subroute 4C1	39.6	0	0	0	0	40.9
Subroute 4C2	64.6	0	0	29.3	17	40.9
Subroute 4C2a	53.1	0	0	26.8	17	40.9
Subroute 4C2b	53.1	0	0	21.8	37.3	35
Subroute 4C2c (BLM preferred alternative)	64.6	0	0	24.3	37.3	35
Subroute 4C3	61.6	0	7.4	46.5	22.4	35
[1] BLM Arizona categorized BLM-administered lands and some additional federal, state, and private land, although not the entire study area. Some categories were combined by the BLM.						

3.8 CULTURAL RESOURCES AND TRIBAL CONCERNS

3.8.1 Introduction, Methods, and Regulatory Framework

3.8.1.1 Introduction

Cultural resources include archaeological sites, districts, and objects; standing historic structures; locations of important historic events; and places and living or nonliving things that are important to the practice and continuity of traditional cultures. Cultural resources may involve historic properties, traditional use areas, and places of traditional religious or cultural importance.

Based on results of preliminary research, the public scoping process, and consultation with the BLM, the following cultural resource issues and other areas of concern were identified:

- Salinas Pueblo Missions National Monument
- Historic rail line and several historic trails (Butterfield Overland Mail, Coronado, Anza, Zuñiga, El Camino Real de Tierra Adentro NHT)
- Mount Graham and surrounding culturally sensitive areas
- Known high-sensitivity sites, including numerous habitation sites
- Archaeological districts
- NRHP-listed historic districts and historic landmarks
- High density of cultural resources along rivers and other watercourses

3.8.1.2 Methods

The methods for the cultural resource study conducted for the EIS are described below. This includes a Class I records review, Class II sample inventory at locations where the Project crosses historically significant rivers and trails, and a cultural-visual assessment for the Gran Quivira. A sensitivity analysis is applied to the known cultural resource sites to assess the relative impact each alternative could potentially have on cultural resources.

Class I Records Review

A detailed Class I records review in support of the proposed Project was conducted to identify prior inventories, research, and previously recorded sites within the study corridor, which was 1 mile from the edge of the 1,000-foot corridor for each alternative. This review resulted in an enormous amount of data, so results for an area within 0.25 mile of the Project centerline were analyzed and are presented in the resulting report (Swanson and Rayle 2012). The records review was conducted from December 2009 through December 2010 and in May 2011, to include additional alternative corridors considered in the EIS studies.

The review involved a physical examination of records maintained by the following institutions:

- Arizona State Historic Preservation Office (AZ SHPO)/New Mexico State Historic Preservation Office (NM SHPO)
- NRHP

- Arizona State Register of Historic Places
- BLM – Lower Sonoran, Tucson, Safford, Socorro, Las Cruces, Roswell, and Rio Puerco field offices

The records review relied primarily on two GIS databases: AZSITE[1] and New Mexico Cultural Resources Information System (NMCRIS). The AZSITE Cultural Resources Inventory includes records of AZSITE Consortium members (ASM, Arizona State University, Museum of Northern Arizona, and the AZ SHPO) and other participating agencies, such as the BLM (AZSITE Consortium 2009). The AZSITE database includes information on properties listed in the Arizona Register and NRHP, as well as tens of thousands of other cultural resources recorded by many researchers for a variety of purposes over many decades. The NMCRIS database allows researchers to access the cultural site and project records of the Archaeological Records Management Section of the New Mexico State Historic Preservation Division. In addition, reports of selected prior studies were reviewed to supplement the information obtained from these two databases. Site records and General Land Office (GLO) plats on file at the BLM, and other historical maps were reviewed for indications of potential unrecorded historic resources.

Information was also provided by other interested groups (see below), as well as by Archaeology Southwest (formerly known as the Center for Desert Archaeology). Archaeology Southwest provided information on Priority Conservation Areas (see Figure M 8-1, Map Volume), which represent areas of cultural resources identified by Archaeology Southwest, in partnership with the National Trust for Historic Preservation, as cultural resource conservation priorities in the San Pedro River basin and adjacent areas. These consist of prehistoric sites and site complexes that meet one or more criteria for NRHP significance, maintain sufficient integrity to convey their significance, are unique or of limited occurrence, and are representative of a particular cultural manifestation for a time period and context.

Discussions with other members of the public and agency personnel provided additional information on the location and/or nature of specific historic or prehistoric resources:

- NPS (Salinas Pueblo Missions National Monument)
- New Mexico Archaeological Council (historic trails in Project area)
- Arizona Archaeological Council (historic trails in Project area)
- Deni Seymour (Protohistoric sites)
- John Madsen of ASM (Zuñiga trail)
- Steve Lekson and Katy Putsavage, University of Colorado, Boulder (Black Mountain site)
- Mogollon Prehistoric Landscapes Project, Arizona State University (Sierra County, New Mexico sites)
- BLM Field Office archaeologists (Camino Real de Tierra Adentro Trail, historic homesteads)
- Camino Real de Tierra Adentro Trail Association

[1] http://azsite.arizona.edu

The Class I review also provides information on previous projects that have been completed in the study corridor. From this, the percentage of the Project study area that has been previously investigated for cultural resources was calculated; it varies between 3 and 28 percent, depending on the subroute. Together, the amount of area that has been previously investigated for cultural resources and the length of each of the subroutes create a bias that certain subroutes could impact more sites than others. For example, Subroute 4B has 52 known sites, whereas Subroute 4C3 has 416 known sites. At quick glance, it would appear that 4C3 would impact a greater number of sites; however, Subroute 4B is 133 miles in length, and Subroute 4C3 is 173 miles long. In addition, only 5 percent of Subroute 4B has been previously inventoried for cultural resources, as compared to 28 percent of Subroute 4C3.

In order to normalize this bias, the estimated site density within each of the alternative subroute corridors was calculated by taking the number of sites identified in the inventoried area and dividing them by the amount of acres inventoried within the subroute corridor. This approach to site density assumes all routes have an equal potential for sites along all portions of the routes. Since areas were previously inventoried for other projects, the site densities obtained in the Class I data represent an average site density. It is probable that some previously inventoried areas contain high site density areas while others contain low site density areas.

Some of these inventories were conducted prior to the establishment of current ASM and NMCRIS criteria for intensive (Class II level) inventory (survey interval, transect width) and site definition criteria. These factors could also present additional biases in estimating site density projection. Specifically, cultural resources that were not considered sites in older surveys may now meet current site definition criteria, and sites that were not considered historic (older than 50 years) when recorded may have since crossed the 50-year threshold.

The lack of inventory coverage revealed by the Class I data led to the decision to conduct Class II studies. Information on the methodology and rationale behind the Class II sample inventories are presented below.

Class II Inventory

The Class I records review indicated that generally less than 10 percent of the alternative subroutes were inventoried for cultural resources. Although a Class III intensive pedestrian inventory will be conducted for the preferred route, a Class II judgmental sample inventory was completed to allow for a comparison between different alternative routes at areas that are known or predicted to be culturally sensitive. The Class III survey will take place once an alternative is selected and a right-of-way grant issued.

The methodology for selection of the Class II sample inventory parcels focused on areas where there is limited existing data, but for which there is a high expectation of cultural resources to be present. These include riverine settings known to have supported significant prehistoric and historic populations, and historically significant trails where proposed Project alternatives cross at multiple locations. The riverine settings included in the Class II inventory parcels are the San Pedro, Sulphur Springs Valley, San Simon, Mimbres, and Rio Grande. The inventory parcels included a 1,000-foot-wide corridor extending 0.5 mile on either side of the river or creek crossings to determine the density and types of cultural resources within the corridor. In addition,

the Class II inventory included areas where the proposed Project alternatives extend across the Butterfield Trail and the El Camino Real de Tierra Adentro NHT.

Visual Impacts to Historic Properties

The following is a description of the methodology used to inventory visually sensitive historic properties, characterize anticipated Project contrast, assess potential visual impacts, and identify potential mitigation measures.

Methodology is based on: (1) the BLM's VRM Manual (VRM 8400 Series 1986); (2) criteria for assessing both historic significance of, and adverse effects to historic properties under the rules of the Advisory Council on Historic Preservation (ACHP), implementing Section 106 of the NHPA (16 U.S.C. § 470 [f]); and (3) guidance on integrity and eligibility from the NRHP (Shrimpton 2002).

The methodology involves a screening process to identify potential adverse visual effects to historic properties and comprises the following components: (1) inventory and identification of historic properties associated with visual sensitivity; (2) visual contrast assessment; (3) determination of visual effects; and (4) mitigation or resolution of adverse visual affect.

Inventory and Identification of Historic Resources Associated with Visual Sensitivity

The inventory and identification of historic resources are based on Class I data (i.e., site records) collected for the Project. Class I data were gathered for 1 mile on either side of the centerline for all alternatives, but due to the enormity of the dataset, only data contained within a 0.25 mile of the centerline were analyzed. Historic resources that are eligible or potentially eligible under Criterion A, B, or C of the NHPA will be evaluated for visual sensitivity based on NRHP evaluation of integrity. For purposes of this methodology, to qualify as an adverse effect to a historic property a visual impact must alter, directly or indirectly, a characteristic of that property that qualifies it for inclusion to the NRHP, and does so in a manner that would diminish that property's integrity of setting, feeling, and/or association. Each historic property will be evaluated to determine the qualities of integrity and the historical significance of each property to accurately identify elements associated with visual sensitivity.

Integrity is defined as the ability of a historic property to convey its own significance. According to the guidelines of the NRHP, the evaluation of integrity must always be grounded in an understanding of a property's physical features and how the features relate to its significance. Of the seven aspects of integrity (36 CFR 60), setting, feeling, and association are closely linked with visual sensitivity because those aspects pertain to the physical environment, features, or aesthetic sense that conveys the property's historic character. Historic properties associated with visual sensitivity must retain the aspects of integrity necessary to convey significance (i.e., setting, feeling, and/or association), and those features must directly contribute to its NRHP eligibility. Under the Guidelines of the NRHP, a historic property's setting is the physical environment of that property, and setting refers to the character of the place in which the property played its historic role. A historic property's feeling and/or association is the property's own expression of the historic sense of a particular period of time, and results from the presence

of physical features of the property that, taken together, convey the property's historic character and association.

Sensitivity Analysis

Identification of known sites within each alternative is limiting, because it focuses only on the kind and number of cultural resources. It is important to assign a value to the sites in order to evaluate each of the alternatives, since not all sites have similar values. The relative value is considered its sensitivity.

The sensitivity of cultural resources within the study corridors was defined based on eligibility for listing on the NRHP, site type, and the presence of specific features (i.e., habitation structures and known locations of human burials). Previously recorded cultural resources have been ranked and assigned to one of five sensitivity categories:

- Low Sensitivity Level (1) – includes destroyed sites, sites that were determined not eligible, and twentieth-century trash scatters lacking features.
- Moderate-Low Sensitivity Level (2) – includes prehistoric artifact scatters with nondiagnostic artifacts, and historic trash scatters with associated features that may predate the twentieth century.
- Moderate Sensitivity Level (3) – includes prehistoric artifact scatters with diagnostic artifacts, caches, historic trails lacking physical traces, historic homesteads or structures, and historic transportation or utility related sites.
- High-Moderate Sensitivity Level (4) – includes archaeological districts, historic landscapes, historic trails, habitation sites with domestic structures, rock shelters, petroglyph sites, and Paleoindian sites.
- High Sensitivity Level (5) – includes NHTs, monuments (i.e., Salinas Pueblo Missions National Historic Monument), landmarks, cemeteries, habitation sites with known human remains, and known properties of traditional religious and cultural importance.

Sensitivity rankings were assigned to the cultural resource sites located within the study corridor for each of the proposed Project alternatives.

3.8.1.3 Regulatory Framework

Cultural resources are nonrenewable scientific, educational, and traditional use area resources that are protected by federal and state statutes (summarized in Table 3-35).

Table 3-35. Federal and State Laws and Regulations for Cultural Resources

Law/Regulation	Description/Summary
Federal	
Antiquities Act of 1906, 16 USC 431–433	Established the early framework for federal protection of cultural resources. It authorized permits for legitimate archaeological investigations and penalties for persons taking or destroying antiquities without permission.
National Historic	Established the ACHP, SHPOs, NRHP, and Section 106 review process.

Table 3-35. Federal and State Laws and Regulations for Cultural Resources	
Law/Regulation	**Description/Summary**
Preservation Act of 1966, 16 USC 470x–6	The ACHP is a federal agency created to address historic preservation issues and is staffed by presidentially appointed experts. The ACHP may elect to participate in projects that have high public interest. The State Historic Preservation Officer is a state level officer who evaluates and manages the historic properties that are listed or have potential to be listed on the NRHP. In addition, their office maintains a staff of archaeologists who are responsible for reviewing reports conducted as part of the Section 106 review process. The NRHP is the nation's official list of districts, sites, buildings, structures, and objects worthy of preservation. As a requirement of Section 106, cultural resources identified during inventory must be evaluated as to their eligibility for listing on the NRHP. Section 106 of the NHPA requires that federal agencies must take into consideration whether a proposed project would affect historic properties and provide the ACHP an opportunity to comment, should they choose to participate.
National Trails System Act of 1968, 16 USC 1241-1251	To create and preserve extended trails so located as to provide for maximum outdoor recreation potential, and for the conservation and enjoyment of the nationally significant scenic, historic, natural, or cultural qualities of the areas through which such trails may pass.
National Environmental Policy Act of 1969, 42 USC 4321	Requires the assessment of potential impacts of a federal undertaking to the human environment, which includes cultural resources.
EO 11593, May 13,1971, *Federal Register* 36:8921	Requires federal agencies to administer cultural properties under their control and direct their policies, plans, and programs so that federally owned sites, structures, and objects of historical, architectural, or archaeological significance are preserved, restored, and maintained. Federal agencies were required to locate, inventory, and nominate to the NRHP all properties under their jurisdiction or control that appear to qualify for listing in the NRHP (ACHP 2009).
American Indian Religious Freedom Act of 1978, Public Law 95-341; 42 USC 1996	Establishes a national policy to protect the right of tribes and other indigenous groups to exercise their traditional religions.
Archaeological Resources Protection Act of 1979, 16 USC 470aa–470mm	Provides additional protection of archaeological resources from vandalism and unauthorized collecting on federal and tribal lands. Section 4 of the statute and Sections 16.5–12 of the uniform regulations describe the requirements that must be met before federal authorities can issue a permit to excavate or remove any archaeological resource on federal or tribal lands.
Native American Graves Protection and Repatriation Act of 1996, 25 USC 3001–3013	Provides for ownership of tribal graves and objects of cultural patrimony on federal lands. Assigns ownership and disposition of tribal graves, associated artifacts, and items of special cultural significance to appropriate tribes. Applies directly to all federal lands or federal undertakings.
EO 13007, May 24, 1996, *Federal Register* 61:26771 Indian Sacred Sites	Designed to protect, when practical, access to tribal sacred sites on federal land.

Table 3-35. Federal and State Laws and Regulations for Cultural Resources	
Law/Regulation	**Description/Summary**
New Mexico	
The Prehistoric and Historic Sites Preservation Act of 1989 Sections 18-8-1 through 18-8-8, NMSA 1978	Prohibits the use of state funds for projects or programs that would adversely affect sites on the State or National Registers, unless the state agency or local government demonstrates that there is no feasible and prudent alternative and that all possible planning has been done to minimize the harm to the site. The Historic Preservation Division works closely with local governments in particular, to find ways of accommodating development while still preserving the historic character of our downtown and historic districts.
Cultural Properties Protection Act of 1993 Sections 18-6A-1 through 18-6A-6, NMSA 1978	Encourages subdivisions of the state government to work with the Historic Preservation Division to develop programs for identifying cultural properties under their jurisdiction, and requires them to ensure that such properties are not inadvertently damaged or destroyed.
New Mexico Cultural Properties Protection Act of 1995 N.M. Stat. 18-6A-1 through 6; 18-6-11.2	This statute encourages state agencies to work with the Historic Preservation Division to develop programs for identifying cultural properties under its jurisdiction, and to ensure that cultural properties are not inadvertently damaged or destroyed. It also establishes a Cultural Properties Restoration Fund for the purpose of providing grants for interpretation, restoration, preservation, stabilization, and protection of cultural property belonging to the state. The statute also provides protection for unmarked burials and associated grave goods.
Arizona	
Arizona Antiquities Act of 1960 *ARS* §41–841 through 844	Preserves and protects historic and prehistoric resources in Arizona, and requires professional institutions to obtain permits to excavate. The Director of the ASM set the regulations for permitting; requires that discovery of human remains and associated funerary objects on state lands to be reported to the Director of the ASM.
State Historic Preservation Act of 1982 ARS 41-861 through 41-864	Requires state agencies to consider impacts of their programs on historic properties listed in, or eligible for, the Arizona Register of Historic Places, and to provide the SHPO an opportunity to review and comment on the Commission's actions that affect such properties.
State Historic Preservation Act of 1982 ARS 41-865	Requires discovery of human remains and associated funeral objects on private lands to be reported to the Director of the ASM. Requires tribal consultation for discovery of human remains and associated funerary objects.

In the context of the NHPA, as amended, a *historic property* is any prehistoric or historic district, site, building, structure, or object included in or eligible for inclusion in the NRHP. The definition also includes artifacts, records, and remains that are related to such a district, site, building, structure, or object. A *traditional use area* refers to an area identified by a cultural group to be necessary for the continuation of the traditional culture (see National Register Bulletin – Guidelines for Evaluating and Documenting Traditional Cultural Properties). The concept can include areas for the collection of food and nonfood resources, occupation sites, and ceremonial and/or sacred areas. *Sacred sites* apply to traditional sites and places that tribes or groups perceive as having religious significance. *Traditional cultural* and *sacred geographies* consist of conceptually related landforms important to a particular culture. A *Traditional Cultural Property* is a property associated with the historically rooted beliefs and practices of a living community that have been handed down through generations (Parker 2008).

Section 106 of the NHPA

Section 106 of the NHPA defines the legal process followed by federal agencies to identify and address the effects of a proposed project on cultural resources. Under the NEPA, agencies must also consider such effects; however, Section 106 provides statutory obligations independent of the requirements of the NEPA. Both processes share similar steps that are addressed concurrently: the identification and evaluation of affected resources with public and tribal participation, the assessment of the effects of the proposal, and the resolution and mitigation of any adverse effects.

- **Establishment of the Undertaking** – The BLM is the lead federal agency responsible for completion of the Section 106 process. Other federal agencies (ACHP, USACE, NPS), state agencies (SHPOs, ASLD, NMSLO), tribes, and the public have been notified and invited to participate in Section 106 consultations for the SunZia Project. In general, the Section 106 process is initiated when a federal agency identifies an undertaking or project that is located on federal land, requires a federal permit, or uses federal funding (36 CFR 800.16[y]), and is the type of activity that has the potential to cause effects on historic properties. The areas of potential effect (APE) are determined through Section 106 consultation and are presented in the Project-specific PA.
- **Identification and Evaluation of Historic Properties** – A Class I records review was conducted for a 2-mile-wide corridor on either side of the centerline for each of the alternatives; due to the size of the resulting dataset, however, only those data contained within a 0.25 mile were analyzed. This review identified known cultural resource sites located within the 0.25-mile-wide study area, as well as significant cultural resources outside of the Class I study area that could be affected by the Project (such as historic trails, NRHP-listed sites and districts, and places of traditional cultural importance). A Class II judgmental sample inventory was completed for all alternatives at selected locations known to be sensitive for cultural resources (i.e., river and historic trail crossings). A phased identification and evaluation approach is appropriate for projects "where alternatives under consideration consist of corridors or large land areas…" And, "the agency official may also defer final identification and evaluation of historic properties if it is specifically provided for in a…programmatic agreement executed pursuant to §800.14(b)" (§800.4[b][2]). An intensive Class III pedestrian inventory of any route that may be ultimately approved identifying all the cultural resources will be completed. These resources will then be evaluated for their eligibility to the NRHP (36 CFR §60.4). Eligibility determinations are made pursuant to the requirements of Section 106.
- **Assessment of Adverse Effects** – Sites determined "eligible" for the NRHP are defined as historic properties (36 CFR 800.16[l]) and are assessed for adverse effects. The assessment would take into consideration the anticipated disturbance resulting from the construction, operation, and maintenance of the BLM preferred alternative. A finding of "adverse effect" for a project is made if an undertaking alters, either directly or indirectly, any of the characteristics of a historic property that qualify it for the NRHP. For large complex projects such as SunZia, the federal agency often assumes an "adverse effect" early in the process, before the completion of studies.

- **Resolution of Adverse Effects** – Once a determination of "adverse effect" is made, steps are taken to resolve these effects. The agency continues to consult with the consulting parties, including tribes, to develop and evaluate alternatives or modifications to the undertaking that could avoid, minimize, or mitigate adverse effects on historic properties. The ACHP is notified of the effect determination, provided with the information specified in §800.11(e), and invited to participate in the consultations to resolve the adverse effects.

  Normally, a memorandum of agreement is developed to document how the adverse effects of the undertaking will be resolved, unless a PA is used. For this Project, a PA will be developed because the "effects on historic properties cannot be fully determined prior to the approval of" this undertaking (§800.14[b]). Adverse effects can be resolved through avoidance of a historic property, minimized by project redesign (selective pole placement to avoid direct site impacts) or through mitigation, or treatment of the affected historic properties. A project-specific HPTP is developed to guide the mitigation effort. For this Project, the HPTP will include a NAGPRA Plan of Action, and a Monitoring and Discovery Plan.

  A PA is a legally binding document that completes the Section 106 process. It is mutually accepted by various agencies with Section 106 compliance responsibility and project authorizations, and outlines a phased approach to the identification, assessment, and treatment of cultural resources. Nondestructive project planning activities, such as inventory and assessment of cultural resources, can be carried out prior to the completion of the Section 106 process.

NEPA

The NEPA process for the cultural resources is addressed in this EIS; it consists of establishing the baseline data (i.e., the affected environment), followed by assessing the impacts of the Project on cultural resources and evaluating the potential cumulative effects. The PA must be signed either prior to or at the same time as the ROD. Consultation is also a required part of the NEPA process. For this Project, under NEPA regulations, consultation with federal agencies, state agencies, tribes, and the public has been initiated and is ongoing.

3.8.2 Cultural History

In order to evaluate these resources, it is important to understand their prehistoric and historic (10,000 BC to AD 1960) context. Specifically, the Project study corridors extend across an area that has been an important place of human activity for approximately 12,000 years. These activities include exploration, trade, colonization, and communication, as well as military related activities and events, such as the first Spanish incursion into the Southwest. Consequently, archaeological investigations within the corridor should reveal a diverse array of prehistoric and historic site types associated with numerous cultural or ethnic groups. Potential site types include, but are not limited to: temporary campsites and habitation sites; ranches and homesteads; agricultural infrastructure; prospects and mines; trails, roads, and railroads; and telegraph, telephone, and power lines. Following is a discussion of the cultural history of the Project area.

3.8.2.1 Prehistoric New Mexico

Paleoindian Period (ca. 10,000 to 8000 BC)

The earliest occupation of New Mexico is known as the Paleoindian Period, a time marked by warming and cooling trends associated with the advance and retreat of continental and mountain glaciers. Much of the paleoenvironment in the Southwest consisted of lush grasslands and playas that sustained numerous, now extinct, megafauna herbivore populations such as mammoth, tapir, camel, horse, and bison (Haynes 1970; Mehringer and Haynes 1965). The prehistoric inhabitants of this period operated as highly mobile, nomadic groups, hunting large game animals and collecting native plant foods. Archaeologists defined the material remains of the earliest Paleoindian groups as the Clovis cultural tradition, which is distinguished by "fluted" lanceolate projectile points and a number of stone and bone butchering and processing tools that have been found in association with extinct Pleistocene megafauna dating 11,500 to 11,000 years ago (Boldurian and Cotter 1999; Bonnichsen and Turmire 1991). Physical remains of several Paleoindian cultural traditions, including the Clovis, Folsom, and Cody complexes dating from 10,000 BC to 8,500 BC, have been located throughout New Mexico (Cordell 1997); however, Folsom artifact assemblages are absent in southwestern New Mexico. It has been suggested that this dichotomy resulted from resident Paleoindian populations foregoing bison hunting in favor of subsistence strategies suited to the changing climate (Waters 1986).

Archaic Period (ca. 8000 BC to AD 300)

The extinction of Pleistocene megafauna marks the transition from the Paleoindian to the Archaic Period. With this episode of extinction is an abrupt change from lanceolate and stemmed projectile points to the less specialized side-notched points (Frison 1991). The presence of plant processing tools in association with this change suggests that the early inhabitants of the region increasingly relied on wild plants in their subsistence strategies (Cordell 1997; Hayden 1982; Rogers 1966).

Archaeologists defined several subregional cultural traditions for the Southwest, including the Cochise of southwestern New Mexico and the Oshara of north-central New Mexico (Beckett and MacNeish 1994; Irwin-Williams 1973; Rogers 1939, 1966; Sayles and Antevs 1941; Sayles et al. 1983). However, critics suggest that these subregional traditions, presumed to reflect prehistoric cultures, in truth represent archaeological constructs that appear more burdensome than useful (Berry and Berry 1986; Huckell 1984, 1988). This resulted in the first major revision of the Archaic Period chronology, which consisted of just three broad temporal divisions—Early, Middle, and Late (Huckell 1984). Most researchers of the Southwest have adopted this three-part scheme.

During the Early Archaic Period (8000 BC to 4800 BC) cultural groups adopted more varied hunting and gathering subsistence strategies, with an emphasis on plant processing and small game. This reliance on wild plant foods increased significantly during the Middle Archaic Period (4800 BC to 1500 BC), as evidenced by the frequency of groundstone artifacts and the presence of rock-filled hearths or roasting pits at sites dating to this period. The Late Archaic Period (1500 BC to AD 300)—most recently termed the Early Agricultural Period—represents the

beginnings of settled village life, farming, and the manufacture of pottery in the Southwest. However, there is not a strict dichotomy between the Middle Archaic and Late Archaic periods, as the timing of these developments varied among cultural groups and geographic area (Lockhart 1997; Seymour 2009a; Stuart and Gauthier 1981).

Pithouse/Pueblo Era (ca. AD 200 to AD 1600)

The production of pottery for containers and storage vessels, and the settlement of pithouse villages, highlights the transition from the Late Archaic Period to the agrarian way of life that typified the Pithouse/Pueblo era in the Southwest. During this era, farming populations increased and expanded into territories previously occupied by hunter-gatherers. Elaborate technological innovations for increasing crop yields were developed, and new ideas regarding property ownership, communal religious architecture, and symbols of different social status appeared (Cordell 1997; Plog 1997). In addition, numerous subregional cultural traditions emerged throughout the Southwest during this era, including the Anasazi and Mogollon, which are of particular relevance to the New Mexico portion of the Project.

Emerging from the Basketmaker cultural tradition, the Anasazi occupied settlements throughout the northern Southwest. Archaeologists recognize several Anasazi branches, including Chaco Canyon, Mesa Verde, Kayenta, and Rio Grande (Cordell 1997; Plog 1997; Reid and Whittlesey 1997). Distinct from the Anasazi cultural tradition, the Mogollon occupied the mountains and deserts of eastern Arizona, western New Mexico, and northern Mexico. Based on excavations along the San Francisco and Mimbres rivers, Haury (1936) defined the Mogollon as *in situ* cultural development from the preceding Cochise cultural tradition. The San Simon Mogollon branch of southeastern Arizona and the Mimbres Mogollon branch of southwestern New Mexico are of relevance for the Project area (Breternitz 1959; Haury and Sayles 1947; Martin and Rinaldo 1947, 1960; Sayles 1945; Wheat 1954). Although peripherally associated with one another, the San Simon and Mimbres branches represent distinctive subgroups with separate cultural histories after AD 1100.

Early Pithouse Era (AD 200 to AD 775)

The adoption of the bow and arrow, pottery production, and increased agricultural dependence characterize this time period in the Anasazi region (Cordell 1997). Changes in pithouse construction during this period consisted of the incorporation of more complex architectural elements such as cribbed log superstructures, vent shafts, wind walls, interior hearths, and storage pits and cists. Also during this period, the Anasazi of larger pithouse settlements constructed what may be considered the first public buildings used for group ceremonies and other non-domestic activities, as evidenced by the excavation of a great kiva at Juniper Cove (Cummings 1953). By AD 500, production of gray and whiteware pottery was widespread (Cordell 1997).

The Mogollon of the Early Pithouse era (AD 200 to AD 600) practiced a combination of hunter-gathering and farming strategies (Wills 1988, 1995), and were mobile some part of the year (Gilman 1983, 1987, 1997). Starting around AD 200, early pithouse settlements consisting of one to several dozen roughly oval or circular pithouses (not all occupied in the same period of time) were constructed along large and small drainages, and in upland areas far from streams

(Anyon et al. 2005; Lekson 2006). Mogollon potters of this time produced a plain brownware pottery; however, flaked and groundstone tools remained essentially unchanged from those of the earlier Cochise cultural tradition (Sayles 1945:65). Local redwares (plain brownwares with a red slip) appeared in southwest New Mexico between AD 450 and 550 (Diehl and LeBlanc 2001; Gilman 1997).

Late Pithouse Era (AD 600 to 1000)

In terms of regional patterns, this period marks an interval of major population growth and dispersion throughout most of the Southwest. Associated with a greater reliance on maize-based horticulture, these demographic trends lead to territorial reductions and constrained group mobility, resulting in more integrated sociopolitical structures and exchange networks (Smiley 2002). The region along the Upper Rio Grande Valley between Santa Fe and Elephant Butte, occupied during the Rio Grande Developmental Period (AD 600 to AD 1200), remained relatively free of human occupation in comparison to other Anasazi areas during this era. Sites dating to the early part of this period contain small groups of circular pithouses, sometimes with above-ground jacal rooms. The earliest pottery produced in the area consists of brownware and grayware cooking vessels, reflecting the mix of Mogollon and Anasazi traits prevalent in the region (Cordell 1997; Cordell and Gumerman 1989).

In the western Anasazi region, neck-banded grayware ceramics, unslipped mineral-painted whiteware ceramics, and cranial deformation resulting from the use of cradle boards in childrearing represent the typical archaeological traits of the Pueblo I Period (AD 700 to AD 900). In the Cibola area of western New Mexico, a mix of Mogollon and Anasazi cultural traits is gradually replaced by Anasazi-only characteristics such as grayware ceramics, pithouses with air shafts, jacal and slab storage units, and a lack of kivas (especially rectangular great kivas) by the AD 800s. After AD 900, aboveground habitations are common; perhaps influenced by architectural trends in Chaco Canyon (Cordell and Gumerman 1989).

In the Mogollon region, the Late Pithouse era (AD 600 to AD 1000) represents a time of increased contact between the Mogollon and their regional neighbors. While archaeologists characterize Early Pithouse era dwellers as seasonally mobile and only moderately dependent on agriculture (Gilman 1987; Wills 1991), it is believed that this changed over the course of the period, with people becoming more sedentary and more reliant on agriculture (Diehl and Gilman 1996; Gilman 1997; Mauldin 1993; Minnis 1985; Wills 1988, 1995).

Pueblo Era (AD 900 to 1600)

During the Pueblo II Period in the Anasazi region (AD 900 to AD 1100), demographic growth and expansion facilitated by ongoing developments in water management techniques allowed the Anasazi to inhabit areas previously deemed unviable. These demographic trends correlate with significant sociopolitical developments involving the emergence of political structures larger and more complex than previously developed. The “Chaco Phenomenon” that occurred at Chaco Canyon in the southern San Juan Basin exemplifies this trend where a new form of settlement, the “great house,” appears contemporarily with villages or “small houses” around AD 900 (Lekson 1991). Numerous Anasazi communities in the northern Southwest, influenced by the architectural tradition developed at Chaco Canyon, constructed similar great houses in the late

eleventh century. One element of this new settlement pattern involves the proliferation of exotic prestige goods, which suggests widespread exchange and interaction networks, and some level of specialized production. An extensive network of well-marked roadways constructed during the Pueblo II Period may have facilitated the movement of such goods (*ibid).*

The Pueblo III Period (AD 1100 to AD 1300) represents the peak of demographic and settlement trends initiated in the preceding Pueblo II Period, and ends with the precipitous collapse of regional societies and abandonment of large portions of the Four Corners region by the Anasazi. By AD 1150, Chaco was no longer the preeminent cultural center in the northern Southwest; by AD 1150 to AD 1180, deteriorating environmental conditions ultimately forced the collapse of the Chacoan system (Cordell 1997; Judge 1989). Despite this collapse, village size in other parts of the region increased from AD 1200 to 1275. Eventually, environmental and demographic conditions in the Eastern San Juan region reached a breaking point and the entire area was abandoned between AD 1300 and AD 1350. Many of the migrants settled among other populations in the northern and middle Rio Grande region.

In the beginning of the Pueblo IV Period (AD 1300 to AD 1600), substantial populations congregated in areas with arable land and water, such as the Zuni Pueblo, Hopi Mesas, Little Colorado River, and Rio Grande Valley. Sites dating to this period consisted of several hundred rooms configured as large room blocks situated around a central plaza or as parallel rows of rooms separated by open spaces that may have served as communal plazas. Important social changes are indicated by the decrease in kiva size and number and the appearance of the kachina cult. Corrugated graywares were replaced by plain gray ceramics, and black-on-white wares by red, orange, and yellow wares. Beginning around AD 1325, the region experienced a time of relatively abundant rainfall that was ended by a drought around AD 1425. By the time of the Spanish *entrada* (when the Spaniards first came to the country), the large communities in the greater region, except those on the Hopi Mesas, had been abandoned (Roberts 1996).

The Cibola Branch (or Ancestral Zuni) of the Anasazi lived in west-central New Mexico and eastern Arizona, and were clearly influenced by neighbors to the north (Chaco) and south (Mogollon). Before AD 900, the presence of brownware ceramics indicated contact with the Mogollon to the south; a shift to Chacoan-style architecture and ceramics occurs after AD 900. By AD 1000, inhabitants of the Cibola Branch area were indistinguishable from those in other parts of the region (Leonard 1998). Following the collapse of Chaco around AD 1150, it appears that contact with Mogollon neighbors resumed. By AD 1250 to AD 1300, the relatively small communities grew into larger villages, and ultimately very large, nucleated pueblos (Kintigh 1996); and by AD 1400, the large communities in the Cibola area had been abandoned.

The Mogollon Pueblo Period (AD 1000 to AD 1400) was a time of major cultural adjustments and transformations in subsistence, technology, architecture, settlement patterns, population size, and social interaction with outside groups. Specifically, Mogollon subsistence strategies shifted from the use of a broad spectrum of plant and animal resources to a primary dependence upon cultivated plants, especially corn and beans. While hunting and gathering did not disappear completely during this period, increases in local population size and density appear to have reduced the availability of wild resources in the immediate vicinity (Reid 1989; Tuggle et al. 1984; Welch 1991). The most apparent change during this period is the appearance of surface architecture and larger settlements exemplified by small room blocks with separate semi-

subterranean kivas. After AD 1200, these small communities were abandoned and populations aggregated into larger, more complex pueblos (Haury 1985; Reid and Whittlesey 1997, 1999; Rice 1980). These large pueblos, often consisting of hundreds of rooms, were built around several kivas or a single, centrally located great kiva (Rice 1980).

Changes in the Jornada Mogollon region during the Late Pithouse era—including parts of the western Trans-Pecos, south-central New Mexico, and northeastern Chihuahua—were similar to those taking place elsewhere in the Mogollon area, and among the Anasazi to the north. Pithouse villages grew larger and more complex, developing into the first pueblos around AD 1200. During the Pueblo Period, or El Paso phase (AD 1200 to AD 1450), numerous pueblos were constructed and agriculture was the main source of food. A variety of farming techniques were employed, including dry land, runoff diversion, floodplain, and irrigation agriculture. Non-local ceramics observed at Jornada sites suggest the development of extensive trade networks. As for neighboring areas, by the mid-1400s large communities had been abandoned and the population dispersed and reorganized into smaller habitations (O'Laughlin 2001).

"Mimbres" describes a branch of the Mogollon culture that was centered on the Mimbres River Valley, but extended northwest to the upper Gila River, southwest into southwestern New Mexico, and east to the Rio Grande. During the Classic Mimbres Period (AD 1000 to AD 1150), a shift occurred in domestic house construction, from pithouses to above-ground structures. Dependence on corn increased at this time, accompanied by reliance on small irrigation systems. Mimbres black-on-white pottery was produced and traded throughout the Mogollon region (Hegmon and Nelson 2003; Stuart and Gauthier 1981). By the twelfth century, a period of reorganization occurred, and the Mimbres Mogollon left the large pueblos and dispersed into smaller, less structured hamlets in the area (Hegmon and Nelson 2003; Nelson 1999). Between AD 1300 and AD 1400, households again began to aggregate into larger villages; but populations were still more mobile than they had been during the Classic Mimbres Period (Nelson 1999). During the post-Classic Mimbres era, U-shaped pueblos of puddle adobe replaced the cobble masonry of the Classic Mimbres Period, and kivas were no longer constructed (Stuart and Gauthier 1981). By 1450, southwest New Mexico was largely abandoned by the Mogollon peoples and the region was relatively uninhabited, until the arrival of the Apache and Spanish explorers (Fowler 1990).

In the Rio Abajo area, along the Rio Grande in southern New Mexico, the production of glazeware pottery signified the beginning of the Ancestral Piro, or Pueblo IV, Period (AD 1300 to AD 1600). Both the Pecos classification and Marshall and Walt's (1984) Rio Abajo phases are used to describe sites in the area, because both Anasazi and Mogollon traits have been observed. The Piro pueblos were large adobe villages with enclosed plazas (Earls 1987; Marshall and Walt 1984). The presence of grayware, similar to Anasazi ceramics and brownware that shares characteristics of Mogollon pottery, may indicate trade with, or immigration from, these neighboring groups. In contrast with the Mimbres area to the southwest, there was no dramatic shift from the preceding Pueblo III Period, though site number and density did increase.

3.8.2.2 Prehistoric Arizona

Paleoindian Period (ca. 10,000 to 8000 BC)

As is the case for New Mexico, the earliest occupation of Arizona is the Paleoindian Period. Physical remains of Paleoindian cultural traditions, dating from 10,000 to 8500 BC, have been located in southeastern Arizona. The cultural history of Paleoindians in Arizona parallels that of their counterparts in New Mexico, discussed previously.

Archaic Period (ca. 8000 BC to AD 300)

The cultural history of Archaic Period populations in Arizona parallels those identified and briefly discussed for New Mexico, particularly for the Early and Middle Archaic periods. By the second millennium BC, archaeologists have identified potential differences in the Archaic Period way of life for different subregions. Although Archaic groups in central and southern Arizona experimented with agriculture as one aspect of their subsistence strategy (Huckell 1995), radiocarbon dates taken from maize samples suggest significant agricultural subsistence in the Tucson Basin as early as 2100 BC (Gregory et al. 2001; Huckell et al. 1999; Mabry 2008; Thiel and Mabry 2006). Recent excavations in the western Tucson Basin revealed an Early Agricultural component with numerous canals, dating from 1250 to 500 BC. These early canals suggest an increasing reliance on irrigation-based agriculture along the Santa Cruz River (Mabry 2008).

Pithouse/Pueblo Era (ca. AD 200 to 1600)

As in New Mexico, pottery production, village establishment, and increased emphasis on agriculture mark the end of the Late Archaic Period. Elaborate technological innovations for increasing crop yields were developed during Pithouse/Pueblo eras, and new ideas regarding property ownership, communal religious architecture, and symbols of different social status appeared (Cordell 1997; Plog 1997). Numerous subregional cultural traditions emerged throughout the Southwest during this era. Of particular relevance for the Arizona portion of the Project are the cultural traditions identified as Hohokam, the San Simon branch of the Mogollon, and the archaeological tradition called Salado.

Increasing dependence on agricultural subsistence in southern Arizona led to significant socioeconomic changes by AD 300. At this point in time, semipermanent pithouse villages emerged throughout the river valleys of the Tucson and Phoenix basins, and pottery production increased considerably. This cultural tradition, referred to as Hohokam, employed a variety of farming practices, eventually constructing an elaborate network of irrigation canals for agricultural production (Fish and Fish 2006). Debate remains whether the Hohokam cultural tradition represents an *in situ* cultural development, or was the result of immigration to the region. Haury (1950) initially postulated an indigenous model for Hohokam origins, but after excavating Snaketown a second time, changed to the immigrant model, based on the presence of a fully developed irrigation system (Haury 1976). As such, a number of researchers believe that the Hohokam entered the Southwest from Mexico sometime between AD 750 and AD 900 (Crown and Judge 1991).

During the Early and Late Pithouse periods, the cultural history of the San Simon branch of the Mogollon generally parallels that of the Mimbres branch. One difference between these culturally related groups is that the San Simon culture appears to have had stronger connections with and influence from the Hohokam to their west. Cultural history in the San Simon regions diverges from the Mimbres around AD 1100, and is discussed in more detail below.

Originally conceived as a cultural group that colonized the Gila-Salt Basin in the late thirteenth century (Gladwin and Gladwin 1935), Salado now appears to more accurately reflect a ceramic tradition that spread as populations migrated south from the Colorado Plateau to the Gila-Salt Basin, and then east into southwestern New Mexico and southeastern Arizona (Cordell 1997). No consistent set of cultural traits (architectural, burial, etc.) appears to accompany the use of this pottery produced from the AD 1200s to the AD 1400s. The change in designs and motifs of the various pottery types may reflect influences of the various regions from which they were found. However, it is possible that they were manufactured in limited centers and widely traded. Crown (1994) suggests that this was a widely copied tradition with little variation, produced locally by and for the household.

Early Pithouse Era (AD 200 to AD 775)

Increasing variation and complexity in architecture and the emergence of specialized production characterize the Hohokam region during the Pithouse era. Early architecture consisted of small square constructions; later construction consisted of large jacal structures surrounded by a central plaza (Doyel 1991; Mabry 2000). By the end of the period, houses remained situated around central plazas, with either square, rectangular, or ellipsoidal houses with single-side entries generally centered along a long wall (Crown and Judge 1991). Early pottery production consisted of plain brown vessels and clay figurines. Potters later introduced polished redwares, as well as the earliest decorated wares (Wilcox et al. 1981). Improved firing methods in the latter part of the period enabled the production of distinctive red-on-buff ceramics manufactured through the paddle and anvil technique. In addition, new material traits emerged during the final phase of the Pithouse era, such as trash mounds capped with adobe and large-scale irrigation systems (Reid and Whittlesey 1997).

Late Pithouse Era (AD 600 to AD 1200)

Hohokam inhabitants during the Colonial Period (AD 775 to AD 975) arranged domestic architectural units into clusters or courtyard groups in the Gila-Salt and Tucson basins (Howard 1985; Wilcox et al. 1981). These courtyard groups typically consisted of two to four structures, with entries focused on a common area that often served as the center of cremation activities, trash disposal, and communal cooking activities (*hornos*) (Gregory 1984; Sires 1984). The presence of monumental architecture (e.g., ballcourts) at many Colonial Period sites suggests that permanent villages emerged during this period. The origin of the ballcourt phenomenon remains unclear; however, some archaeologists suggest that the idea may have been adopted from Mesoamerican peoples to the south (Gladwin et al. 1937; Wilcox 1991).

Colonial Period artifact assemblages suggest a more elaborate material culture, with craft specialization existing at the household and village level (Reid and Whittlesey 1997). Elaborate stone and shell bowls carved in the shape of frogs, toads, and snakes, often covered with

turquoise, are representative of this time. Stone palettes also became more elaborate during this period (Haury 1976; White 2004). Potters produced vessels consisting of incised exteriors on buff backgrounds with curvilinear scrolls, small design elements, and life forms in red paint. During the latter portion of the period, potters incorporated small repeated elements, forming spiral or circular bands of decoration as well as animal and human figures. Exotic forms introduced by Hohokam potters at this time included human and animal effigy vessels, thick-walled censors, rectangular bowls, and tripod plates (Reid and Whittlesey 1997).

Further expansion of settlements, the development of canal irrigation systems, and improvements in various alternate agricultural strategies characterize the Sedentary Period (AD 975 to AD 1150) of the Hohokam. Although the construction of ballcourts persisted at this time, Hohokam villagers began constructing another form of monumental architecture, the platform mound. Houses constructed during this period tended to be ellipsoidal. Also during this period, Hohokam artisans began using new technologies for working shell jewelry and designing more sophisticated mosaic mirrors (*ibid*). Copper bells traded from Mexico and new types of redware pottery also appear. Moreover, the ceramic technology of this period provided for a significant increase in pottery production.

Pueblo Era (AD 900 to AD 1600)

Contrasting sharply with the pre-Classic periods, the Hohokam Classic Period (AD 1150 to AD 1400) exhibited radical shifts in material culture, architecture, and settlement patterning. Previous settlements in outlying areas such as Gila Bend, the Lower Verde River, Flagstaff, and San Pedro River were abandoned at the end of the Sedentary Period (Wilcox and Sternberg 1983). Population increased in the Gila-Salt Basin at this time, probably with people from outlying areas migrating into the basin. Agricultural intensification occurred in the Gila-Salt and Tucson basins; it has been argued that the Tucson Basin increased in importance as a regional center during this time (Doelle and Wallace 1991). Doelle and Wallace view Cerro de Trincheras sites as evidence for warfare or at least hostilities between the Gila-Salt and Tucson basins; while a subsequent assessment by Downum and others (1994) concludes that evidence for the use of Cerro de Trincheras sites as defensive or fortified locations is not convincing.

At this time, Hohokam villagers began constructing several new forms of domestic architecture, consisting of houses with post-reinforced caliche walls, built-in pits, and freestanding walls of cobbles with adobe. Contiguous-walled pueblos of coursed adobe also were constructed, mostly associated with settlements containing ceremonial architecture within compound walls (Crown and Judge 1991). Platform mounds are found at a number of Tucson Basin villages dating from AD 1275 to AD 1300 (Gabel 1931), and are similar to mounds that occur throughout southern and central Arizona. Maize agriculture remained the primary subsistence focus; however, extremely large, rock-pile field systems associated with the cultivation of agave have been found in both the northern and southern portions of the Tucson Basin dating to this time (Doelle and Wallace 1991; Fish et al. 1992). Artifact assemblages dating to this period appear much less diverse (McGuire 2001; Mitchell 2003). Hohokam artisans no longer produced figurines, palettes, and elaborate projectile points, and there was a decline in the manufacture of red-on-buff ceramics. Polychrome vessels represent the dominant ceramic type at Classic Period sites; yet there was also an increase in the presence of redware ceramics and obsidian artifacts.

Village abandonment occurred between AD 1450 and AD 1500, and the Hohokam tradition as presently known disappeared from the archaeological record. Excavated sites dating to the subsequent Protohistoric Period remain either unrecognized or do not exist; however, a Late Classic or post-Classic occupation has been identified at a small number of sites in the Gila-Salt Basin, as well as along the middle Gila River Valley (Craig 2001; Crown and Sires 1984; Doyel and Fish 2000; Sires 1983). Researchers are still debating how to interpret this period, which is characterized by a return to pithouse architecture, an absence of enclosing compounds, low frequencies of buffware ceramics, high frequencies of Salado polychrome and redware, and an increase in obsidian procurement (Abbott et al. 1994; Chenault 2000; Henderson and Hackbarth 2000).

In the San Simon region, increases in growth, immigration, and agricultural productivity characterize the period spanning AD 1200to AD 1450 (Neely 2004). Large settlements emerged as groups migrated from the north and east, and previously occupied areas were abandoned. In the western portion of the Safford area, there is evidence of ties to the Hohokam civilization to the west, while the eastern portion displays evidence of a variety of Greater Southwest traditions. Of the decorated types present in sites dating to the period, locally made polychromes appear the most common. This period is thought to represent a merging of immigrant groups from the Point of Pines, White Mountains, and Little Colorado River areas, with the local population (Neuzil 2005). Towards the Late Classic Period there is a notable change, with the emergence of Puebloan-style structures such as room blocks and kivas. There was also Salado influence from the west and northern Chihuahua to the south, as evidenced by the presence of decorated ceramics of these regions at San Simon sites. The large pueblos appear to have been mostly abandoned around AD 1450.

3.8.2.3 Terminal Prehistoric, Protohistoric, and Historic Era (AD 1300 to 1960) in Arizona and New Mexico

The Protohistoric Period in the American Southwest represents a time of transition between the Prehistoric and Historic periods. Traditionally, this period has been roughly and conveniently estimated as ranging from AD 1450 to 1700; however, dates for the Protohistoric Period have varied widely (Di Peso et al. 1953; Gilpin and Phillips 1998; Ravesloot and Whittlesey 1987; Riley 1987; Wilcox and Masse 1981) because they have been based on guesses, lack of data, and differing criteria. This circumstance has derived from past uncertainty in dating sites that postdate AD 1450, which left a significant period of time unaccounted for between the end of the Prehistoric Period and the Spanish *entrada* (Whittlesey et al. 1994a:225).

In North America, the most common definition of the Protohistoric is the period that begins with the arrival of Europeans to the New World to the time of continuous occupation or contact with Europeans (Ravesloot and Whittlesey 1987). In the Southwest, this period begins with the landing of Spanish forces under the command of Hernán Cortés de Monroy y Pizarro in present-day Veracruz, Mexico, and his subsequent conquest of the Méxica capital at Tenóchtitlán (1519 to 1521). The problem with this definition and the use of the term *protohistoric* is that we have learned that many of the adaptations, lifeways, and groups characteristic of this period in the southern Southwest begin at least a hundred years earlier, and fall within the terminal prehistoric period. There is an overlap with prehistoric cultural entities, either as an extension of earlier ways, or a replacement for, or a supplement to, earlier manifestations. Moreover, there is

mounting archaeological evidence and long-standing oral traditions that indicate interactions of a variety of types occurred between many newcomer groups and existing tribes. Changing adaptations of members of extant tribes complicates this transitional period even more as resident tribes, or subgroups of them, adjusted to new ways of life.

Recent work has revealed archaeologically recognizable signatures and chronometric dates that place the beginning of these so-called *protohistoric* adaptations in the terminal prehistoric period, beginning in the AD 1300s. An overlap with prehistoric cultures is evident, which is one reason the definition of these purported *protohistoric* groups has been so difficult (Seymour 2008, 2010, 2011, 2013a). In this sense, the term *protohistoric* actually hinders understanding of this period. Recognition that these groups were present much earlier means that we cannot use AD 1450 as a point of departure, expecting to see distinctive adaptations before and after this temporal divide. There is no divide but rather a considerable overlap between extant prehistoric cultural entities (Hohokam, Mogollon, Trincheras, Anasazi/Ancestral Pueblo) and those present in the Historic Period. Many of these historical groups changed drastically through time as well, which means that their archaeological signatures must be tracked temporally and spatially, while recognizing the basis for changes in landscape use, feature characteristics, and artifact types (Seymour 2012a).

The end of the Protohistoric, customarily defined as sustained contact with Europeans, is not consistent and cannot be readily applied to all parts of the region. New Mexico archaeologists broadly correlate the end of the Protohistoric with the establishment of the Spanish province of Santa Fé de Nuevo México at the turn of the seventeenth century. Conversely, Arizona archaeologists broadly correlate the end of the Protohistoric with the entrance of Spanish Jesuit missionaries into southern Arizona at the end of the seventeenth century (Gilpin and Phillips 1998).

These vague and varying notions of the Protohistoric Period result largely from a lack of archaeological sites and other forms of evidence on which to base assessments. More recently, however, a significant number of chronometric dates have been obtained from numerous intensively studied archaeological sites. These sites represent the historically referenced groups encountered by the first Europeans who occupied this region prior to Spanish arrival. Owing to new forms of data, our understanding of this period continues to improve and more refined labels have been applied to the temporal framework used for this period.

Misunderstandings have resulted from relying too heavily on the historic documentary record, which has skewed history towards that which focuses on Europeans. Along these same lines, the term *Protohistoric Period* pertains only to indigenous inhabitants, and once the Historic Period begins, scholars tend to focus on Europeans and only consider indigenous occupants in relation to Europeans. For this reason, some scholars extend the Protohistoric Period well into the historic period, terminating at perhaps the mid-1700s or 1800s, so as to remain focused on the natives. Still, the Native American historic period tends to be subsumed into and considered as a subset of European colonial history, with European-relevant phases and research themes focused on topics pertinent to Europeans. In mainstream historical archaeology, indigenous happenings are evaluated only with respect to their impact on and as a consequence of European history. For this reason, the term Protohistoric Period has maintained some relevance if for no reason other than to keep the focus on indigenous aspects of historical archaeology.

Representing an approximately 500-year record of culture history in the Southwest, the Terminal Prehistoric-Protohistoric-Historic Period includes various phases of cultural influence extending from the arrival of new peoples and new adaptations in the 1300s or before, and includes the Spanish *entrada* through to subsequent Spanish Colonial rule, Mexican Independence, and the entry of the United States into the region with the establishment of the New Mexico Territory in 1850 and the Gadsden Purchase of 1854. More recently, efforts have focused on breaking down these general periods even further to reflect fundamental changes that occurred from the terminal Prehistoric into the late Historic Period (Seymour 2011). Moreover, the period encompasses a wide diversity of cultural groups and language families that include Native Americans, Spaniards, Mexicans, and Anglos. Native cultural identities were greatly affected through biological and cultural exchange with Europeans throughout this period (*ibid*).

The time period from AD 1300 to 1500 marked the beginning of a period of mass abandonment, migration, and social reorganization throughout the Southwest. The Protohistoric Native American world at the time of the Spanish *entrada* represented a mix of sedentary and nomadic cultural groups occupying parts of present-day Arizona and New Mexico. Sedentary groups included the O'odham, situated along the Santa Cruz, San Pedro, Salt, and Gila river valleys; the Western Pueblos of the Hopi, Zuni, and Acoma-Laguna along the Little Colorado River Valley; and the Eastern Pueblos of the Rio Grande Valley. Extant nomadic groups included the Navajo, who lived among the Western Pueblos of the Colorado Plateau; various bands of the Apache, ranging across northern Mexico and the central and southern mountains of eastern Arizona and southern New Mexico; the Manso, Suma, Jano, and Jocome (and many other small groups) who ranged across a wide portion of northern Chihuahua, Sonora, southeastern Arizona, New Mexico, and Texas; and the nomadic Tohono O'odham, Hai-Ced O'odham, Kohatk, and others located in the western Arizona and Sonora deserts (Bolton 1949; Dozier 1983; Forbes 1959; Lockhart 1997; Seymour 2009a, 2011; Wells 2006). Although not present during the early *entradas*, the introduction and subsequent proliferation of the horse resulted in later Ute and Comanche groups entering the region (Kessell 2002). The following discussion of present-day Native American groups is limited to historic cultural groups known to have occupied areas within the current review area.

Northern Southwest: Pueblos

The Pueblos of New Mexico and Arizona represent the cultural descendants of the Anasazi and peoples of the Mogollon cultural tradition who lived in highly nucleated villages and practiced an agrarian lifeway. Hence, when the Spanish explorers arrived in the region, they referred to the indigenous inhabitants as "Pueblos." Linguistically heterogeneous, present-day Puebloans speak a variety of languages and dialects grouped within the Uto-Aztecan, Tanoan, Keresan, and Zunian language families (Dozier 1983).

At the time of the initial Spanish *entradas* in the sixteenth century, the Pueblo world consisted of numerous villages along the Rio Grande and the Little Colorado River valleys, representing the Eastern and Western Pueblos respectively. In 1598, the Pueblo villages unwillingly became incorporated into the Spanish colony of Santa Fé de Nuevo México, and for eight decades the indigenous inhabitants of the region endured Hispanicization and missionary efforts led by the Catholic Church and the secular government in Santa Fe. Dissatisfaction among the Pueblos reached a climax with the Revolt of 1680, resulting in the expulsion of the Spanish colonists and

their native allies from the region. However, the Pueblo victory was short-lived, and in 1692 a military campaign of reconquest was undertaken, resulting in the submission of all of the Eastern Pueblos by 1696. The provincial authorities were unable to reassert control over the Hopi, Zuni, or Acoma-Laguna Pueblos due to the encroachment of Navajo and Ute raiders into the region. The Western Pueblos remained outside of the Spanish cultural sphere in the Rio Grande Valley for the remainder of the Spanish Colonial and subsequent Mexican periods (Dozier 1983; Kessell 2002).

Despite the negative aspects of colonization, the Spanish provincial government issued land grants to all of the existing New Mexico pueblos during the period 1598 to 1821 (Dory-Garduño 2010). Following the Mexican-American War of 1846-1848, the United States was bound by the Treaty of Guadalupe Hidalgo to recognize the rights and property of Mexican citizens. In a report to Congress in 1858, the surveyor-general for New Mexico recommended 17 of 21 Pueblos as having legitimate claim to their lands. Congress confirmed the Pueblo grants the same year, and confirmed the GLO-issued patents in 1864 (Brayer 1939). Conversely, the Hopi of the Arizona Territory had no legal claims to Mexican citizenship, and their lands were subsequently subject to claims made by the United States. In 1882, the Hopi Reservation was established by a presidential executive order by Chester A. Arthur (Whiteley 1988).

Presently, there are 19 Pueblos in New Mexico: Acoma, Cochiti, Isleta, Jemez, Kewa (Santo Domingo), Laguna, Nambe, Ohkay Owingeh, Picuris, Pojoaque, Sandia, San Felipe, San Ildefonso, Santa Ana, Santa Clara, Taos, Tesuque, Zia, and Zuni (Vlasich 2005). In addition, the people of Ysleta del Sur Pueblo in Texas were displaced from New Mexico during the Pueblo Revolt.

Southern Southwest

Ethnohistoric and archaeological evidence suggests that three general Native American groups occupied the southern Southwest at the time of the first *entradas*. The Canutillo and Cerro Rojo complexes are archaeological cultures that represent mobile adaptations based on hunting-and-gathering, and raiding and trading with the contemporaneous sedentary Sobaípuri-O'odham or Cayetano complex peoples. Interpretation of the Canutillo complex identified in southern New Mexico and Arizona proposes that the material culture and settlement pattern of this cultural group possesses similarities to known non-Apache (non-Athabaskan-speaking) traditions identified in Texas and northern Chihuahua. Therefore, it is possible that the Canutillo complex may represent historically known, non-Athabaskan groups such as the Jano, Jocome, Manso, and Suma. Interpretation of the Cerro Rojo complex suggests a proto-Apache (Athabaskan) cultural group based on an expedient technology, with the use of retouched tools, relatively distinct side-notched and tri-notched projectile points, and discrete modes of landscape use (Seymour 2009a, 2013a).

O'odham

The O'odham represent a Uto-Aztecan speaking group occupying portions of present-day southern Arizona and northern Mexico. The first European contact with the O'odham occurred in 1539, when the Niza expedition is thought to have traversed the San Pedro Valley in search of

the fabled Seven Cities of Cíbola (see below); however, sustained contact with Europeans did not occur until the initiation of a Jesuit mission building program under the direction of Father Eusebio Francisco Kino in the late-seventeenth century (Seymour 2009b; Sheridan 1995). Referring to all the indigenous inhabitants of this zone as Pimas, the Spanish identified several groups speaking different dialects living in *rancherías* (dispersed settlements) throughout the region, including the Pima situated along the Altar and Santa Cruz rivers; the Sobaípuri along the Santa Cruz, San Pedro, and Gila rivers; the Gileño along the middle Gila River; the Papago (now Tohono O'odham) of the western desert; and the Soba of the San Ignacio River and the Gulf Coast of California (Seymour n.d.; Wells 2006:8). However, the Pima used none of these terms, calling themselves O'odham, which translates roughly as "the people" (Fontana 1974), and using indigenous names for adjacent O'odham groups. The Spanish referred to the Santa Cruz, San Pedro, and Gila valleys as the Pimería Alta, and the western desert region as the Papaguería (Barnes 1988). Other extant O'odham-speaking groups at the time included the Kohatk, occupying the northeastern periphery of the Papaguería south of the Gila River, and the Sand Papago (Hia-Ced O'odham) living in the westernmost reaches of the Papaguería (Dobyns 1974; Fontana 1983).

The cultural affiliation between the O'odham and the antecedent culture of the region, the Hohokam, has been debated (Bostwick et al. 1996). The Historic Period O'odham were thought to have lived in dispersed *ranchería*-type settlements, although archaeological evidence has revealed that the Sobaipuri-O'odham lived in well-organized, planned settlements along the rivers. Still, these villages are dissimilar to the highly nucleated Hohokam villages of compound walls, platform mounds, and great houses of the preceding centuries. This dichotomy suggests a lack of social stratification that such public architecture might reflect. Moreover, historic Tohono O'odham and some of the Gila River residents forewent the irrigation canal systems used by the Hohokam in favor of floodwater farming (Hackenberg 1983; Winter 1973), although the Sobaipuri-O'odham situated along the Santa Cruz, San Pedro, and Gila rivers used irrigation, producing bountiful harvests (Seymour 2011, 2013a). Some anthropologists argue against cultural continuity, suggesting that the O'odham migrated into southern Arizona following the collapse of Hohokam society. Conversely, O'odham legends tell of social strife and internal rebellion that led to the collapse of the Hohokam (Bahr et al. 1994; Teague 1993; Seymour 2011). Since 1973, contemporary O'odham tribal groups have considered themselves descendants of the Hohokam.

The Pima of the Gila River (like those on the San Pedro) were not subject to European settlement, and remained free of the missionization efforts of the Jesuits, and later Franciscans. However, they did adopt domesticated plants and animals introduced by the Spaniards. Of particular significance was winter wheat, which increased farm production to meet market demands of Spanish settlers in the Tucson Basin (Doelle 1984; Ezell 1983). Targets of nomadic raiders, both the Gila River tribes and Sobaípuri allied themselves with the Spaniards in fighting the Apache and their mobile allies. Therefore, much credit goes to the O'odham in facilitating the survival of Hispanic settlement in southern Arizona during the Spanish Colonial Period (Ezell 1983; Sheridan 1995). Likewise, the O'odham played a role in fighting the Apache during the subsequent Mexican and American periods, and provided needed food supplies to the U.S. Army and settlers throughout the early American Period (Pritzker 2000; Trimble 1989).

Affected by disease and Apache depredations during the Spanish Colonial Period, the Sobaípuri increasingly interacted with Tohono O'odham populations, many of whom have moved into Sobaípuri settlements along the Santa Cruz (Di Peso et al. 1953; Dobyns 1976; Seymour 2011). Populations to the north along the Gila River were recognized as Akimel O'odham (Pima) (Wells 2006). The Akimel O'odham and the Pee Posh (Maricopa) primarily reside at the Gila River Indian Reservation, established in 1859 along the Gila River between its confluence with the Salt River and Florence, Arizona. In 1871, river flows were diverted via irrigation canals that were built by Mormon farmers settling on the Gila River in the Florence and Safford areas upstream. As a result, some Akimel O'odham and Pee Posh moved north to the Salt River where another reservation was established in 1879—the Salt River Pima Maricopa Indian Reservation (DeJong 1992). The Maricopa (now Ak-Chin) Indian Reservation was created in 1912 and settled by members of the Akimel O'odham, Tohono O'odham, and Yoeme (Yaqui) tribes.

The modern Tohono O'odham and descendants of the Sobaipuri occupy four reservations in southern Arizona: (1) the main Papago Indian Reservation west of Tucson and south of Gila Bend; (2) the San Lucy District approximately 6.0 miles north of Gila Bend; (3) the San Xavier Reservation located east of the main reservation and south of Tucson; and (4) the Florence Village District, a 22-acre reservation located 2.0 miles west of Florence. A small group that identifies themselves as Hia-Ced O'odham (though they are not federally recognized as a tribe) lives at the San Lucy District and in the Ajo, Arizona area (Northern Arizona University 2010).

Apache

Athabaskan-speaking Apache groups ranged across a significant portion of the Southwest in the Terminal Prehistoric and Historic periods. Specifically, this range extended from northern Mexico into eastern Arizona and western New Mexico, and across the southern Great Plains to southwest Texas (Gunnerson 1979). Linguistically, Athabaskan is a branch of the Na-Dene language family of northwestern North America. Geographically, Athabaskan speakers reside throughout the interior of Alaska and western Canada, with outliers along the Pacific Coast of Oregon and California, as well as in the Southwest, as represented by Navajo and Apache cultural groups (Ruhlen 1998).

It remains unclear when the first Athabaskan-speaking cultural group migrations to the region occurred, particularly in regards to groups that would become the Apache of Arizona and New Mexico. Traditional views hold that following the abandonment of Mogollon settlements in eastern Arizona and western New Mexico in the late fourteenth century, the region remained depopulated, resulting in the *despoblado* (unsettled/uninhabited land) encountered by later Spanish explorers (Cordell 1984; Haury 1985; Reid and Whittlesey 1997; Seymour 2008). This has led some scholars to suggest that Apache groups only arrived in the region in the mid-1600s (Schroeder 1974a; Seymour 2008); however, others suggest Athabaskan migrations occurred prior to the arrival of the Spanish to the area and that Apache, or proto-Apache groups, were present at the time of Coronado's *entrada* in AD 1540 (Forbes 1960; Goodwin 1942; Oakes 1996; Seymour 2008, 2009b, 2013b). Recent research that focused specifically on this question provided a suite of radiocarbon and luminescence dates that show a continuous ancestral Apache presence beginning in the AD 1300s (Seymour 2013a).

The first Spanish explorers to enter into east-central, present-day Arizona (1539 to 1542) described an unpopulated wilderness north of the Gila River (*despoblado*). However, archaeological evidence indicates that mobile cultural groups, particularly the Athabaskan (proto-Apache), ranged across this area during the Protohistoric, exploiting the uplands. Therefore, it remains unclear if the term *despoblado* stems from a lack of encounters with indigenous inhabitants in the area, or simply reflects a Spanish bias against the recognition of nomadic cultural groups. It appears most likely that mobile Apache and non-Athabaskan groups were present in the *despoblado* during this period (Seymour 2008, 2009b, 2012b).

The various groups of Apache in the Southwest differed in dialect, social organization, and subsistence practices, resulting in distinct tribal groups. Major groups include the Western Apache, Chiricahua, Mescalero, Jicarilla, Lipan, and Kiowa-Apache (Roberts and Roberts 2006). Three of these Apache tribal groups—the Western Apache, Chiricahua, and Mescalero—ranged within the current review area during the Terminal Prehistoric-Protohistoric-Historic Period. The Western Apache occupied east-central Arizona and consisted of several subtribal groups, including the Cibecue, Northern and Southern Tonto, San Carlos, and White Mountain Apaches (Goodwin 1942). The Chiricahua occupied parts of northwest Mexico, southeast Arizona, and southwest New Mexico. Schroeder (Schroeder 1974a,b,c) identified five Chiricahua subtribal groups: Mogollon, Copper Mine, Mimbres, Warm Spring, and Chiricahua. The numerous bands of the Mescalero ranged from the Texas panhandle across the Southern Plains to the Rio Grande in New Mexico, and throughout parts of northern Mexico (Sonnichsen 1958).

Regardless of the exact timing of the appearance of Athabaskan speakers, the Apache that laid claim to a large part of the Southwest practiced a very different lifestyle from the agricultural groups already in the region. Living in temporary ranchería-type settlements, the Apache were mobile hunter-gatherers skilled at exploiting seasonal and spatial variations in resource availability (Basso 1983; Sonnichsen 1958). Although some of the more northern Apache adopted some small-scale agricultural practices from their sedentary neighbors (i.e., cultivation of corn) (Goodwin 1935), those in the south seem to have practiced no agriculture until much later (Seymour 2012c). Raiding became a significant part of the culture following the adoption of the horse. Mountain camps provided a safe base from which to conduct raids for livestock and grain from agricultural groups in the valleys below (Basso 1971; Spicer 1962).

For nearly two centuries, the Apache successfully resisted Spanish efforts to settle in their lands. Moreover, with the collapse of the Spanish presidio system in the 1830s, Apache raiding resulted in a significant depopulation of northern Sonora as well as southern Arizona and New Mexico (Acuña 1974; Sweeney 1992). However, with the successful conclusion of the Mexican-American War (1846 to 1848), immigrants from the United States poured into the region. These circumstances lead to inevitable conflicts with the military forces of the United States as well as with Mexican and Anglo ranchers, who for the first time began to successfully encroach on Apache lands, in part due to the protections afforded by the U.S. Army (Trimble 1989). It is within the context of this uncertain atmosphere that one of the formative events in the shaping of United States policy towards the Apache occurred: the Camp Grant Massacre.

Camp Grant was located at the confluence of the San Pedro River and Aravaipa Creek, approximately 50 miles northeast of Tucson. Assuming command of the camp in early 1871, First Lieutenant Royal Emerson Whitman proved sympathetic to the Apache by instituting a

ration policy that attracted some 500 Aravaipa and Pinaleño Apaches, including Chief Eskiminzin, to the camp. Under these conditions, Whitman created the Camp Grant Reservation in Aravaipa Canyon some 5 miles east of Camp Grant proper, where the placated and disarmed Apache worked cutting hay for the post as well as harvesting barley at nearby ranches. Despite this arrangement with the Aravaipa and Pinaleños, other Apache bands, particularly the Chiricahua, continued to raid ranches throughout southern Arizona. This situation created a toxic atmosphere in Tucson, resulting in a belief that the Camp Grant Apaches were the source of all native depredations in southern Arizona (Sheridan 1995).

The event that pushed Tucsonans to violence against the Camp Grant Apaches occurred on April 10, 1871, when an Apache raid on San Xavier resulted in the loss of a significant number of livestock. Following this raid, a party of 94 Tohono O'odham and 48 Mexicans, incited and led by 6 Anglos, marched on the Camp Grant Reservation. At dawn on April 30, the Tucsonans attacked the slumbering Apache camp, killing some 140 women and children, and taking a number of survivors as slaves to be traded into Mexico. The Camp Grant Massacre highlighted the failure of United States Indian Policy in southern Arizona, and prompted President Grant to take action in bringing an end to the violence. A show trial conducted in Tucson against some 100 perpetrators of the massacre resulted in acquittals for all the defendants (Sheridan 1995; Trimble 1989). The survivors of the Camp Grant Massacre relocated almost immediately to the San Carlos Apache Reservation, which became federally recognized the following year. The present-day San Carlos Apache Tribe regards the area of Camp Grant, the Camp Grant Reservation, and the massacre site in Aravaipa Canyon as a place of special significance (Rambler 2012).

Following a successful winter campaign in 1872-1873, native resistance in the region essentially collapsed, though it would take a decade and several more military campaigns against rogue Apache bands to finally bring peace to the region (Sheridan 1995; Trimble 1989). Presently, the Western Apache occupy several reservations in Arizona, including Fort Apache White Mountain (1870), San Carlos (1871), Yavapai-Apache (1910), Tonto-Apache (1972), and Fort McDowell Yavapai (1904) (Sheridan 1995). Following their release as prisoners of war from Fort Sill, Oklahoma in 1913, the majority of the remaining Chiricahua, along with a number of Lipan, relocated to the Mescalero Reservation (1873) in southeastern New Mexico (Sheridan 1995; Sonnichsen 1958). Those Chiricahua that remained at Fort Sill were given an allotment of land, and formed the Fort Sill Apache Tribe of Oklahoma (Griffin-Pierce 2010).

Non-Apache Mobile Peoples

The first Spanish settlers to arrive to the area documented their encounters with three groups of people and their specific adaptations in what is today southern New Mexico and Arizona. These groups are believed to be the Sobaipuri-O'odham and the ancestral Apache, along with another lesser known group. This third group, encountered by Coronado and his men along the San Pedro, was a relatively poor mobile group who gifted cacti to the explorers upon their first meeting. Past researchers, such as Bolton (1949), viewed the O'odham of this region to be mobile as well, and so assumed that these poor hunter-gatherers were Sobaipuri-O'odham. As we have learned more about the archaeological signatures of groups residing in this area at this time, we now understand that the Sobaipuri–O'odham were riverside farmers living in planned and well-organized villages overlooking irrigated fields on the San Pedro, Santa Cruz, and Gila

rivers. Their mobile neighbors were the ancestral Apache, and this third group encountered was probably ancestral Jano, Jocome, Manso, or Suma.

These non-Athabaskan groups and others are known from the ethnohistoric record, and until recently this was the main information available on these mobile residents. Chroniclers documented their presence, briefly noting certain behavioral characteristics and geographic locations. More recently their archaeological identity has been isolated. Archaeologically these Jano, Jocome, Manso, and Suma are known as the Canutillo complex, which has only been defined in the last decade (Seymour 2002, 2004, 2009, 2011). Residing along rivers, near lakebeds and swamps and in mountain zones, these Canutillo complex groups fished, hunted birds, small game, and large animals, and gathered. Small, triangular, indented-base points tipped their arrows. Finely-crafted bifaces were hafted for knives and lance heads. They lived in expedient housing, wandered across the landscape in search of food and shelter, and made no pottery.

Dozens of mobile groups were mentioned in documentary sources by different names through the years. European chroniclers often used the geographic location to name the groups they referenced, while at other times they recognized behavioral or cultural differences, such as in language, clothing, tattoos, or hair-style. Unlike farming groups, mobile peoples traveled over wide expanses, often using overlapping territories that changed through time. Alliances between groups also shifted. Some of these groups allied themselves with the Spanish, serving as scouts and auxiliaries; therefore, their material culture, especially projectile points, are often found through an especially wide geographic range. Raiding and trading also brought mobile travelers to other areas, all the while confusing and intermixing the distributions of their material culture.

Through time, these small groups began to intermarry with neighboring tribes. Disease, warfare, and famine meant that their numbers were too small to sustain viable populations. Some intermarried with the O'odham and Apache, while others intermixed with the Tigua and Piro of the post-Pueblo Revolt era in the El Paso area. By the mid-1700s these Canutillo complex groups had lost their distinctive identities, though many people in the El Paso-Las Cruces area recognize their heritage with these earlier-named groups.

Early Spanish Explorations through the Mexican Period (1539 to 1848)

Although the Spanish first entered the present-day American Southwest in 1539, they did not maintain a permanent presence in the region until the establishment of a New Mexico colony at the start of the seventeenth century. Six decades of sporadic exploration, culminating in several unsuccessful attempts to gain a foothold in the region, preceded the foundation of the colony. The following section provides a context and background for these early explorations, the foundation of the New Mexico colony, and Spanish settlement of the Santa Cruz Valley in present-day Arizona.

The Niza and Coronado Expeditions (AD 1539 to 1542)

The first historic reference to the lands encompassing present-day Arizona and New Mexico occurs during Nuño Beltrán de Guzmán's conquest of western Mexico (1529 to 1531), as tales of seven great cities lying to the north in the land of Cíbola were brought back to the Spanish. In

1536, Alvar Nuñez Cabeza de Vaca and several other survivors of the failed Narváez expedition to conquer Florida (1527 to 1528) returned to Spanish territory across the northern frontier of Nueva Galicia. Although the survivors' tales were not particularly embellished, they did speak of great cities north of the frontier, with houses four and five stories tall. These accounts served to further exaggerate the growing legend of the Seven Cities of Cíbola. Influenced by these events, the viceroy of Nueva España, Antonio de Mendoza, selected Franciscan friar Marcos de Niza to lead a reconnaissance expedition into the north to find, and establish relations with, the inhabitants of Cíbola in 1539 (Farish 1915; Kessell 2002).

Consisting of Niza, Estéban de Dorantes, and a contingent of natives that had travelled with Cabeza de Vaca across the northern frontier, the expedition departed northward from San Miguel de Culiacán, Nueva Galicia in March of 1539. Estéban, a Moor and slave of one of the survivors of the failed Narváez expedition, served as the expedition party's guide. Skirting the Sierra Madre Occidental, which lay to the east, the party followed the coastline along the Gulf of California through the present-day states of Sinaloa and Sonora, Mexico before turning northeast to the San Pedro Valley (Farish 1915; Kessell 2002). Estéban, leading a forward party several days ahead of Fray Niza, continued beyond the Gila River northeast across the despoblado to the lower Little Colorado River in present-day western New Mexico (Bolton 1949; Farish 1915). Shortly upon arrival at what he believed to be Cíbola, Estéban and most of the native contingent were killed by the town's inhabitants. Fearing a similar fate, Fray Niza approached the town at a distance where he erected a cross, claiming the land in the name of Spain, and hastily returned to Nueva Galicia (Farish 1915; Kessell 2002). Fray Niza's journey across the San Pedro Valley represents the first European contact with natives (the Sobaípuri and Jano or Jocome) in the area that is present-day southern Arizona. The Sobaípuri, a sedentary O'odham-speaking cultural group known to the Spanish as the Pima, occupied the river valleys of the Santa Cruz and San Pedro rivers during the Protohistoric Period (Bolton 1949; Seymour 2009a; Wells 2006).

Encouraged by Niza's claims of abundant gold and silver, and by the vision of the great city he had observed from a distance, Viceroy Mendoza and his newly appointed governor of Nueva Galicia, Francisco Vásquez de Coronado, immediately organized a military expedition to take Cíbola. Departing from Nueva Galicia in the spring of 1540, Coronado rode at the head of an army consisting of approximately 300 Spanish soldiers and 1,000 native allies, including Mexica, Tlaxcalan, and Tarascan warriors. Niza led a religious contingent of five Franciscans. In support of the army were hundreds of servants and followers leading spare horses, driving the pack mules, and herding 5,000 cattle, sheep, and pigs (Flint 2003; Kessell 2002). The army encountered indigenous cultural groups along the upper San Pedro River, and at the ruin of Chichilticali. Although it has generally been accepted that these encounters represent further contact with the Sobaípuri (Bolton 1949), Seymour (2009a) suggests that groups encountered along the San Pedro River were the mobile groups that have been identified archaeologically as Canutillo complex peoples, and later referred to as Janos and Jocomes. Furthermore, Seymour suggests that the indigenous group encountered by Coronado's army at Chichilticali was the Apache.

Traversing the despoblado, Coronado's army crossed into present-day New Mexico. Upon reaching Cíbola, the army found a modest-sized Zuni town (Háwikuh) defended by some 200 warriors. Although not aware of it at the time, Coronado had reached the western edge of the Pueblo world. Taking the village in less than an hour of fighting, Coronado promptly established

a headquarters to send out further expeditions in search of the wealthy and high civilization described by Niza. Captains Don Pedro de Tovar and Garcia López de Cárdenas were sent to the west, while Hernando de Alvarado explored to the east. Tovar made contact with the Hopi pueblos as Cárdenas followed the Colorado River to the Grand Canyon. In the east, de Alvarado passed through the Acoma, Tiguex, and Cicuyé pueblos. In each case, Niza's claims of great riches in the land of Cíbola proved to be greatly exaggerated. Conscious of the army's resentment and feelings of betrayal, Fray de Niza promptly returned to Mexico City (Kessell 2002; Prince 1883).

While at Cicuyé, native informants told Alvarado of Quivira, a land rich in gold and silver that lay across the plains to the east. Renewing the Spaniard's hopes of great riches, Coronado subsequently moved his headquarters to winter at the Tiguex pueblos before continuing the campaign east. Initially received peaceably by the Tiwa inhabitants at Tiguex, tensions between the army and the natives quickly escalated into open war. The conflict with the Tiwa was quickly put to an end, resulting in the destruction of one village and the abandonment of at least another dozen villages for the duration of the Spaniard's winter stay. In the spring of 1541, Coronado's army set out for Quivira, travelling east as far as the Arkansas River in present-day Kansas. However, Coronado eventually learned that the tales of gold and silver were a native ruse to lure the army away from the Pueblo lands. Disillusioned and broken, Coronado led the army back into Nueva Galicia in 1542 (Kessell 2002; Prince 1883). The failure of the Coronado expedition dispelled any further notions of great cities beyond the northern frontier, and several generations would pass before Spain returned to the region (Dozier 1983).

Nuevo México (AD 1595 to 1848)

In 1595, Don Juan de Oñate Salazar was awarded the colonization contract for Nuevo México. Leading a colonial force of approximately 700 soldiers, 130 families, 80 wagons, and thousands of head of livestock, Oñate took formal possession of the province of Santa Fé de Nuevo México on April 30, 1598 (Kessell 2002; NMOSH 2010b; Prince 1883). Oñate established the first provincial capital at the Tewa pueblo of Ohkay Owingeh, which was renamed San Juan and remained the capital for only a couple of years before being moved to San Gabriel (Yunge Owingeh) in 1600. With the founding of San Gabriel, Oñate officially established an approximately 400-mile extension of the Camino Real de Tierra Adentro (Royal Road to the Interior Land), the Spanish government's inland highway extending north from Mexico City to Nueva Vizcaya (Levine 1999). In 1610, Don Pedro de Peralta, the third governor of the province, moved the capital to Santa Fé (NMOSH 2010a). Other important Spanish settlements during this early period were established at La Cañada in the Tewa Basin, and within the region between San Domingo Pueblo and the mission at Nuestra Señora de Socorro (present-day Socorro) (Dozier 1983; Julyan 1996).

The establishment of the Nuevo México colony represents the beginning of a period characterized by economic exploitation and forced religious conversions of the indigenous inhabitants (Dozier 1983; Kessell 2002). The Franciscans vigorously pursued a mission building program throughout the western and eastern Pueblo world, where they amassed large herds and flocks of livestock. Workshops that employed native labor in such fields as leatherworking and blacksmithing were established at the larger mission centers. Competing with the missionaries was the civil administration, which implemented the *encomienda* system; an exploitative labor

policy entitling Spanish *encomenderos* to services provided by natives in the form of direct labor and tribute (Dozier 1983). Concurrently, the Franciscans aggressively attempted to supplant indigenous beliefs with Catholicism by imposing harsh disciplinary actions against Pueblo villagers accused of, or caught in, performing native religious ceremonies (Dozier 1983).

Pueblo resentment of Spanish rule led to open rebellion in 1680. Popé, a Tewa religious leader from San Juan Pueblo, directed the revolt from his headquarters at Taos Pueblo, issuing clear and simple instructions to kill all of the colonists (*ibid*). Alerted to the uprising, the colonists in the north fought a defensive retreat south to El Paso del Norte. In total, 21 missionaries and 380 settlers out of a population of 2,500 colonists were killed in the revolt. The Pueblo country remained free of the Spanish for more than a decade, but continuing harassment from Nuevo Mexicanos intent on the *reconquista* (reconquest) of the lost province eventually wore down native resistance. In 1696, Spanish colonists reoccupied the Eastern Pueblos; however, increasing raids by Navajos and Utes along the western frontier severed contact with the Western Pueblos, resulting in their autonomy throughout the remainder of the Spanish Colonial Period (*ibid*).

Although many negative aspects of Spanish rule continued into the eighteenth century, civil and religious authorities did alter their most extreme policies (e.g., eliminating the *encomienda* system, ending the suppression of native ceremonies and rituals, and the inclusion of native leaders in the political process) (*ibid*). However, these new policies of tolerance did not stem from Spanish altruism as much as from a growing need for native allies to counter the increasingly mobile and hostile nomadic tribes of the Apache and Navajo, as well as the Shoshonean-speaking Utes and Comanches who migrated into the Southwest from the Great Basin region in search of horses (Kessell 2002). These circumstances led the government in Santa Fé to enter into numerous treaty agreements and alliances with nomadic tribes throughout the period in an effort to bring an end to instability in the region (Dozier 1983; Torrez 2010a).

Assuming the governorship of Nuevo México in 1778, Juan Bautista de Anza immediately focused on subduing the hostile nomadic tribes of the region. Although Anza's advisors insisted on alliance with the Comanche to combat the Apache, the governor chose to actively campaign against the Comanches led by "the cruelest scourge of the colony," Cuerno Verde, as a show of force (Kessell 2002). Campaigning in the fall of 1779, Anza's army consisted of approximately 400 soldiers, Hispanic militia, and Pueblo auxiliaries that were augmented en route by some 200 Ute and Jicarilla Apache. The army located and destroyed Cuerno Verde's main encampment near present-day Colorado Springs. Returning from a raid in Nuevo México, Cuerno Verde's light cavalry was intercepted by Anza's army. All of the Comanche, including Cuerno Verde and his second-in-command, Jumping Eagle, were killed. Although not immediate, Anza's campaign against Cuerno Verde eventually brought Comanche leaders to the peace table, and in 1786 Comanche representatives signed a formalized treaty granting trade rights and alliance with the Spanish Province. Within a month of signing the treaty with the Comanche, similar terms were accepted by the Navajo (*ibid*).

Throughout much of the eighteenth century, expansion of the province remained confined to the Rio Grande Valley. In an effort to expand the province beyond the river, the provincial government awarded community grants to groups who agreed to establish settlements and cultivate land on the frontier. The primary recipients of community grants to settle the frontier

were *mestizos* and the *genízaro*, a cultural group consisting of Native Americans who no longer held any tribal identity. Settlements established by community grants include Tomé (1739), Santa Rosa de Lima de Abiquiú (1742), and San Miguel del Vado (1794). These settlements and others like them provided a significant contribution to the overall defense of the provincial frontier well into the nineteenth century (Torrez 2010b).

In the early years following the reconquest, transportation costs restricted exports of material goods to the south, and self-supporting ranches limited the internal market (Mosk 1942). Due to these limitations, sheep (which could easily be driven to external markets) became a medium of exchange for imported consumer goods. The estates of the *ricos* (upperclass land owners awarded individual land grants) came to be predominantly operated as sheep ranches, and the *ricos* came to dominate the livestock market within the province, gaining significant control over the local economy (Baxter 1987; Mosk 1942).

The first significant mining operation in the region occurred in the Pinos Altos in 1800, when Lieutenant Colonel José Manuel Carrasco and Don Manuel Francisco Elguea obtained a land grant for a copper mine called Criadero de Cobre (Copper Nursery). By 1805, 600 workers and their families lived near the mine at the settlement of Santa Rita del Cobre. Throughout this period, mule and ox teams transported smelted copper from the mine 400 miles south to Chihuahua City via the Janos Trail, where the copper was further refined for shipment to Mexico City along the Camino Real (Couchman 1990; Sinclair 1985).

It is estimated that the indigenous population in 1600 consisted of approximately 30,000 to 40,000 Pueblo inhabitants. By the end of the revolt in 1680, the population had been reduced to 14,000, resulting in the abandonment of villages that had been previously occupied for centuries. Pueblo society, as well as that of their nomadic neighbors, was greatly affected by the introduction of Spanish material culture, domesticates, and craft techniques (Dozier 1983). Of particular significance was the acquisition of horses by the nomadic tribes of the region. Mastery of the horse provided the Apache and Navajo greater mobility within their home ranges, and ultimately provided the means by which they could retain their autonomy (Kessell 2002; Rothman 1991). In fact, livestock became so important to the Navajo and Apache that neither community wished to drive the Spanish from the country, but rather exploit the source of supply (Basso 1971; Spicer 1962).

Pimería Alta (1691 to 1821)

The first sustained contact with Europeans in the territory encompassing present-day Arizona began in 1691, with the establishment of Padre Eusebio Francisco Kino's Jesuit mission program in the Santa Cruz and San Pedro valleys, a region known as the Pimería Alta to the Spaniards of the day (Doelle 1984; Trimble 1989; Whittlesey et al. 1994a). At this time, European settlement consisting primarily of miners and ranchers remained confined to the Santa Cruz River valley, due to the threat of Apaches on the frontier east of the San Pedro River (Ezell 1983; Whittlesey et al. 1994a).

Immigration to the region increased, following the discovery of silver at Planchas de Plata near Bernardo de Urea's *Arizona* ranch in 1736 (NPS 2010a; Trimble 1989). As more settlers moved into the Pimería Alta, tensions between O'odham groups and Spanish settlers increased,

culminating in the Pima Revolt of 1751. The uprising was quickly put down, and in 1753 Spanish authorities established a *presidio* (fort) at Tubac (Presidio San Ignacio de Tubac) (Trimble 1989; Whittlesey et al. 1994a). Increasing hostilities with the Apache forced the provincial government to begin the construction of Presidio San Agustín del Tucsón in 1775; and in 1776 military forces were moved from Tubac to the Tucsón presidio (Dobyns 1976; Whittlesey et al. 1994a). During this period, a policy of aggressive military action known as the Galvez Plan, combined with bribery in the form of rations, was used to placate the Apache. The policy brought relative peace to the region by the 1790s, as many Apaches came to live at rancherías established near the presidios. With the Apache threat curtailed, a period of unimpeded regional development occurred, bringing increased settlement centered on cattle ranching and mining operations (Bancroft 1889; Trimble 1989).

Mexican Period (1821 to 1848)

Following independence from Spain in 1821, economic instability and periodic civil war greatly affected the newly established Mexican government's ability to maintain control in the far northern reaches of the country. In Nuevo México, these circumstances fostered an atmosphere of semiautonomy characterized by the strengthening of provincial institutions such as *partido*, settlement expansion, and increasing economic dependence on the United States. In northern Sonora (Pimería Alta), revenue was diverted to the capital in Mexico City, and state payrolls that included provisions for the presidios and rations for the Apache were cut. Discontented, the Apache left their presidio *rancherías*; and by 1831, almost all of the Chiricahua Apache bands went to war. From 1831 to 1848, 3,000 to 4,000 Hispanic settlers fled the northern frontier of Sonora in response to Apache raiding. No Mexican settlement remained in the region except at the Tucson and Tubac presidios, where a few settlers managed to live under the protection of the garrisons' troops (Bancroft 1889; Lavender 1980; Trimble 1989). Following the annexation of Texas in 1846, the United States exerted pressure on Mexico to cede New Mexican territory east of the Rio Grande. Mexico refused to recognize any of the United States' claims west of the Nueces River in Texas, and war quickly followed (Prince 1883). In August of 1846, American forces took Santa Fé; and in December of that same year, an American cavalry regiment engaged and defeated a Mexican force at the Battle of El Brazito, just south of Mesilla, ending any further military actions in New Mexico for the course of the war (Lavender 1980; Simmons 1977).

American Period (post-1848)

The Mexican-American War ended with the signing of the Treaty of Guadalupe Hidalgo in 1848. Under terms of the treaty, Mexico ceded all land north of the Gila River in present-day Arizona and its New Mexico territory. With the Gadsden Purchase of 1854, the United States acquired the rest of the land south of the Gila River to the present-day international boundary with Mexico. This newly acquired territory remained a part of the New Mexico Territory. Following annexation, the United States government quickly established a series of military forts and began the first inventories to map waterways and springs, soils and climate, and search for potential wagon and railroad routes. Prior to the arrival of American forces in southern Arizona, a mining party led by Charles Poston arrived in the region, reopening old mines and establishing new ones in the Santa Rita and Cerro Colorado mountains. Proving successful, the mining ventures attracted a number of Mexican settlers to the area, particularly around Tubac, which became a

thriving community for a number of years. In 1856, the Army established Fort Buchanan south of Tucson near present-day Sonoita (Trimble 1989). In 1858, the Butterfield Overland Mail began twice weekly stage and mail service in the region. From Franklin, Texas (present-day El Paso), the stage route crossed New Mexico along a new road constructed under the direction of the Secretary of the Interior to link up with portions of the previously established Gila Trail to Yuma in the Arizona Territory (Lavender 1980; Trimble 1989).

Upon the South's secession from the Union in the spring of 1861, many enlisted men and officers of the South serving in the Army in Arizona left to return home to fight for the Confederacy. The Arizona forts were abandoned, and many Union soldiers joined their compatriots in New Mexico in expectation of a Confederate invasion. At this time, the Butterfield Overland Mail discontinued service through the territory. At the start of the Confederacy's New Mexico campaign in 1862, a company of mounted infantry under the command of Captain Sherod Hunter took Tucson. Approximately 2,300 federal troops from California immediately threatened Hunter's position. Captain Hunter attempted to destroy the Union's supply stores along the Gila River, in anticipation of the federal troop's advance on the territory. These events lead to the westernmost battle of the Civil War, the Battle of Picacho Pass, a 90-minute skirmish between two patrols of the California Volunteers and Confederate pickets encamped in the vicinity of Picacho Peak. The battle resulted in four deaths (two Union and two Confederate) and several wounded. With the California army approaching Tucson, Hunter gathered his outnumbered forces and retreated east to Texas. Eight months later on February 24, 1863, President Abraham Lincoln signed legislation giving Arizona legal territorial status with its present-day boundaries (Lavender 1980; Trimble 1989).

Following the subsequent federal reoccupation of Arizona and New Mexico, immediate concerns focused on tribe removal and resettlement. Subjugation and resettlement of the Apache, particularly the Chiricahua, proved difficult for the United States government, and final peace would not be achieved until surrender of Geronimo and the last of his band of some two dozen followers in 1886 (Lavender 1980; Trimble 1989). Although the sedentary Pima and Papago of southern Arizona had provided supplies to immigrants bound for California during the gold rush, labored on Anglo ranches in the Santa Cruz Valley, and fought with troops against the Apache throughout the 1860s, Anglo settlers insisted on appropriating Pima and Papago lands. To that end, the United States government instituted a system of reservation lands for the various tribal groups (Pritzker 2000). The Navajo were restricted to ancestral lands in northwestern New Mexico, while the Kiowas, Arapahos, and southern Cheyennes were forced to relocate to a reservation at Fort Sill, Oklahoma (Lavender 1980). Subjugation and resettlement of the Apache, particularly the Chiricahua, proved difficult for the government, and final peace would not be achieved until the surrender of Geronimo and the last of his band of some two dozen followers in 1886 (Lavender 1980; Trimble 1989).

Rural and industrial development increased unimpeded throughout the western territories in the 1870s. During this period ranching and homesteading expanded throughout the territory. Although gold and silver initially attracted mining development, copper was needed for emerging technologies, such as electrical cable and telephone wire, and became the most important mineral resource in the region (Lavin 2001; Roberts and Roberts 2006; Williams 1986). Following the arrival of the railroad in the 1880s, settlement and agricultural and industrial development increased exponentially. Hundreds of new settlements emerged alongside

the various railroad stations, depots, and sidings (Myrick 1990; Roberts and Roberts 2006). Beginning in the 1890s, the first of numerous reclamation projects to come were undertaken by the federal government, involving the construction of dams, reservoirs, and canals throughout the region's river valleys (Clark 1987; Trimble 1989).

On January 6, 1912, the Territory of New Mexico became the forty-seventh state admitted to the United States (Lavin 2001; Roberts and Roberts 2006). Populations continued to increase during this period, yet the state remained rural in character and economically dependent on mining and agriculture. Tourism helped boost New Mexico's economy throughout the 1920s; however, the Great Depression of the 1930s hit, agricultural prices fell, mines closed, and populations declined. On February 14, 1912, the Arizona territory became the last contiguous state admitted to the United States (Lavin 2001; Roberts and Roberts 2006). Following the United States' entry into World War II, natural resources of the Southwest were in high demand, and production of raw materials increased; but the greatest changes occurred in the manufacturing and service industries. With the expanding manufacturing sector, a significant portion of the rural population migrated to the major centers at Phoenix and Tucson, contributing to the loss of their small-town characters (Nash 1987; Sheridan 1995).

Following the United States' entry into World War II, natural resources of the Southwest were once again in demand. Production of raw materials increased; but the greatest changes occurred in the manufacturing and service industries. With the expanding manufacturing sector, a significant portion of the rural population migrated to Albuquerque, contributing to the loss of its small-town character (Nash 1987; Sheridan 1995). In the post-war years, hundreds of thousands of acres of land were either withdrawn from the public domain or condemned for various military programs deemed crucial for national defense. To this day, the Los Alamos and Sandia laboratories, WSMR, and Holoman and Kirtland AFBs sustain much of New Mexico's economy (Chávez 2002; Simmons 1977).

3.8.2.4 Cultural Landscape and Historic Trails

The following briefly discusses the known cultural landscape associated with the Salinas Pueblo Missions National Monument, El Camino Real de Tierra Adentro NHT and the Butterfield Overland Mail Trail. Although numerous historic trails are known to be located within the review area (e.g., Coronado, Anza, Zuñiga), the exact routes for many of these trails remain unknown.

<u>Salinas Pueblo Missions National Monument – Gran Quivira</u>

The Salinas Pueblo Missions National Monument contains the remains of pueblo ruins and large Spanish colonial mission complexes. The monument has four different periods of significance, including Pit House (AD 800 to AD 1200), Ancestral Puebloan (AD 1200 to AD 1629), Spanish Mission (AD 1540 to AD 1672), and Settlement (AD 1875 to AD 1909) (NPS 2010b). Prehistoric archaeological features include pit houses, jacal structures, a pueblo, kivas, and plazas. The Salinas pueblos served as a contact point and center of the salt trade between the Pueblo Indians, Plains Indians, and Spaniards. Prehistorically, the Salinas basin was settled by Tiwa and Tompiro-speaking Puebloans (Ivey 1998). Gran Quivira was an early site of Spanish contact and missionary activity; Franciscan priests from other missions were assigned to the

village to convert the locals to Catholicism (*ibid*). During the nineteenth century, homestead grants provided land to settlers in the area (NPS 2010a). The site of Gran Quivira plays an important role in the development of Southwest archaeology because Adolph Bandelier and Edgar L. Hewett conducted studies at the site.

Salinas Pueblo Missions National Monument – Gran Quivira Cultural Landscape Inventory

The NPS conducted a Cultural Landscape Inventory of the Gran Quivira in 2010 that defined the landscape as a 610-acre parcel containing pueblo ruins and Spanish mission structures. It is one of three identified component landscapes within the larger parent landscape that also includes Abó and Quarai. A detailed review of the archaeological and historical significance of Gran Quivira is provided, emphasizing the interrelationship of the architectural remnants with the human modified landscape elements (*ibid*). The integrity of the property is evaluated based on the seven aspects of integrity: location, design, setting, materials, workmanship, feeling, and association. The cultural landscape for Gran Quivira includes the following 13 components:

- Archaeological sites
- Buildings and structures
- Circulation
- Cluster arrangement
- Constructed water features
- Cultural traditions
- Land use
- Natural systems and features
- Small-scale features
- Spatial organization
- Topography
- Vegetation
- Views and vistas

Gran Quivira, also known as Las Humanas, lies atop a ridge amidst the rolling piñon and juniper scrubland and grassland of central New Mexico. The site was historically used for hundreds of years by Native Americans, prior to Spanish colonization of the area in 1598. In that year, Franciscan missionary activity began with the designation of Las Humanas as a *visita* (settlement that lacked a resident priest) of the mission San Gregorio de Abó (Toms and Roop 2006:9). Missionary activities converted natives to Catholicism and used the native population to extract goods from the region following the encomienda system. Drought and famine resulted in the abandonment of the pueblos and mission by 1672; the pueblos remained so until the nineteenth century. From 1875 into the early twentieth century, homesteads were settled in the area, using the landscape for agricultural purposes. The first archaeological investigations of the site also began around this time. In 1909, Congress established the Gran Quivira National Monument, seeking to preserve the pueblo and mission ruins at Gran Quivira (NPS 2010b).

From its establishment, Gran Quivira has remained under federal management. Today, features at Gran Quivira include the buried remains of ancient pit houses; surface remnants of jacal structures; and a prehistoric and historic Tompiro Indian pueblo that developed over four hundred years, consisting of 20 house mounds (2 are fully excavated and 5 are partially

excavated), 14 kivas (6 stabilized), and several plazas. Also present are two Franciscan mission churches with accompanying conventos and a cemetery, which were part of the Spanish mission complex in place prior to the 1680 Pueblo Revolt. The pueblo and mission buildings are constructed of gray limestone, unique among the pueblos and missions. Additional resources include nineteenth- and twentieth-century homestead debris, archaeological excavations, dams, earthen detention basins, treasure pits, and contemporary visitor facilities (NPS 2010b). These features are listed either as contributing or non-contributing to the cultural landscape.

Interestingly, the site has no perennial water source, which causes much discussion of the survival strategies of the early village inhabitants. Apart from a modern well on NPS property, the nearest surface water source is a spring at Montezuma Ruin, 2 miles southwest of Gran Quivira (Hayes 1981:6; Toulouse 1943:3) (*ibid*).

The unit is categorized as both historic vernacular (Pueblo) and historic designed landscape (Spanish mission), and has national significance under National Register Criteria A, B, C, and D. There are four periods of significance associated with the site, including the Pit House Period (800-1200), Ancestral Puebloan Period (1200-1629), Spanish Mission Period (1598-1672), and Settlement Period (1875-1909) (*ibid*).

Overall, Gran Quivira is in good condition and retains integrity. The original materials and design are clearly evident in the ruins, although the height of the walls has lowered with time. The association with prehistoric people's adaptation to life in the landscape and with European exploration and colonization of North America is evident through the remaining landscape features (*ibid*). It is sited within a panoramic scenic vista with minimal visual intrusions or modifications to the south. Regional modifications to the north of Gran Quivira include a wind farm, pipelines, ranches, NM Highway 55, and other paved or unpaved roads.-

Gran Quivira is a contributing component of the NRHP-listed Salinas Pueblo Missions National Monument. The New Mexico SHPO concurred that the views from Gran Quivira to the surrounding landscape are a contributing element to the property as a whole.

Proposed transmission line corridor E84a/E86a/E86b extends east-west, approximately 4.3 miles north of Gran Quivira. Two alternative transmission line corridors (MOD-15 and MOD-10) remain under consideration. For a discussion of potential visual impacts, see Section 4.9.3.1.

Historic Roads and Trails

Contextually, Historic Period trails within the current study area represent transportation corridors associated with military exploration and economic activities. However, two specific historic properties (El Camino Real de Tierra Adentro [Royal Road to the Interior Land] NHT and the Butterfield Overland Mail Trail) are significant transportation corridors whose alignments are known with some degree of precision. The Camino Real has been designated a NHT, and the Butterfield Trail (AZ T:14:61[ASM]; LA 131080) has been determined to be eligible for the NRHP by both states.

In assessing potential effects to historic roads, Keane and Bruder (2003) suggest that if a linear property, such as a road, is largely eligible due to retaining its historic integrity in regards to

setting, then the installation of a new transmission line parallel to the property could be considered an adverse effect. As such, intact high potential segments of the Camino Real and Butterfield Trail that retain their historic integrity have the potential to be impacted not only through ground disturbing activities, but also visually by construction of transmission lines. Like many historic trails, the present-day alignment of these two trails consists of discontinuous segments, features, and associated sites that must be evaluated individually for integrity and significance; potential impacts can thus vary across the length of the trail. (The inventory and assessment of National Historic and Scenic Trails is included in Appendix L.)

El Camino Real de Tierra Adentro

Established at the turn of the seventeenth century, the New Mexico portion of the road represents an approximate 400-mile extension of the Royal Road that previously extended from Mexico City to Nueva Vizcaya (present-day Chihuahua, Mexico). As such, the road represented not only a means of support from the capital approximately 2,000 miles away, but a symbol of the Spanish Crown's commitment to the region. In the eighteenth century, the road became known as the Chihuahua Trail. From El Paso del Norte (present-day Ciudad Juarez), the road paralleled the Rio Grande north to San Gabriel, and later to Taos Pueblo (Levine 1999; Pike 2004). A present-day alignment derived from BLM and NMCRIS data and aerial photography indicates that the Camino Real trends along the eastern bank of the Rio Grande in southern New Mexico. At a fork just south of Mesa del Contadero, the Camino Real alignment splits into two separate roads. The westernmost alignment circles around the west side of the mesa, where it extends northwest across the Rio Grande and follows a northerly route approximately 1.0 mile west of the river. The easternmost alignment continues around the east side of the mesa and extends north along the east bank of the river. An east-west road connects the two Camino Real alignments on the north side of Mesa del Contadero.

Given the length of time the Camino Real was in service, it should exhibit a fairly strong archaeological signature at the surface. The predictive archaeological signature for the road includes, but is not limited to: a hard packed surface of varying width (up to 10.0 meters) that is largely devoid of vegetation; utilitarian and trade-ware ceramics/pottery attributable to Native American, Spanish/Mexican, and American producers spanning the sixteenth to the nineteenth centuries; weaponry (predominately Spanish); uniform paraphernalia, such as buttons, buckles, and cap devices; metal pots, pans, and flatware associated with food preparation and consumption; barrel hoops; glassware; metal wagon/cart parts; metal horse tack such as harness, bridle, and saddle parts; and trade goods. Spatially, these materials would be expected on the flanks of the road where clusters corresponding to campsites and springs (*parajes*) may also be encountered.

Proposed transmission line corridors E180 and A140 cross the Rio Grande near Socorro, New Mexico. The Camino Real closely parallels the river on the east and west banks.

Butterfield Overland Mail and Stage Route

Also known as the Butterfield Trail, this government-sponsored private enterprise began twice-a-week stage and mail service through the region in 1858. From Franklin, Texas

(present-day El Paso), the stage route crossed New Mexico along a new road constructed under the direction of the Secretary of the Interior to link up with portions of the previously established Gila Trail to Yuma. In Arizona, portions of the previously established Mormon Battalion Trail (later Gila) were used by the Butterfield Trail. Operating 24 hours a day, the twice-weekly stage crossed southern New Mexico and Arizona, stopping for fresh horse teams at stage stations located every 20 to 40 miles along the route. In service for 2.5 years, the stage only halted operations once during an episode of Chiricahua hostilities. Following the South's secession from the Union in the spring of 1861, the Butterfield Overland Mail discontinued service through the territories, and shifted its route north to the central overland route (Lavender 1980; Trimble 1989). Intersections of the proposed transmission line corridors with the Butterfield Trail are derived from BLM, AZSITE, and NMCRIS data, as well as from aerial photographs.

Short-lived as it was, the surface signature of the Butterfield Trail may not be as easily recognizable as the Camino Real; however, the material culture associated with the line may be quite substantial. According to Trimble (1989:98), many of the passengers drank excessively to pass the time on the long journey across Arizona, and modern pilots claim that the trail alignment is visible from the glitter of all the broken glass from the bottles tossed from the coaches. Although this anecdote may be hyperbole, the predictive archaeological signature for the trail includes, but is not limited to: remnants of the trail (i.e., ruts or unusual vegetative patterns associated with decayed ruts); architectural features associated with stage stations such as corrals/stables, water basins, packed-earth floors, masonry walls/foundations, and privies; tin, ceramic, and glass containers; and metal pots, pans, and flatware associated with food preparation and consumption.

The University of New Mexico, Office of Contract Archaeology, previously conducted survey along portions of the Butterfield Trail corridor in southern New Mexico. However, none of the previously recorded alignments (LA99184) was recorded in the proposed corridor segment locations (Gerow 1993).

Proposed transmission line corridors F40b, F600, B150a, B140, B111, B120b, A440, and A430/A481 cross segments of the Butterfield Overland Mail and Stage Route in New Mexico and Arizona.

3.8.3 Summary of Inventory Results

This section provides the results of the Class I study, Class II inventory, and sensitivity analysis within 0.25 mile of the route alternatives.

3.8.3.1 Class I Study Results

The Class I Study includes two components: the amount of previously inventoried area and the number of previously recorded cultural resource sites in the study corridor.

Previously Conducted Inventories

Approximately 8 percent of the Class 1 study corridors for all alternative subroutes have been inventoried for cultural resources. Table 3-36 highlights the small percentage of the area that has

been inventoried. Although there are data gaps for each of the subroutes, the Class I study does allow for calculations of site density for those sections of the subroutes that have been previously inventoried.

Table 3-36. Percentage of Previously Inventoried Areas within Study Corridors

Subroute	Total Acres	Acreage Not Inventoried	Acreage Inventoried	Percent Inventoried
1A1	73,270	67,349	5,921	8
1A2	73,744	67,729	6,015	8
1A	72,748	67,593	5,155	7
1B1	71,621	66,552	5,069	7
1B2	67,035	61,899	5,136	8
1B2a	68,162	62,304	5,858	9
1B3	66,072	61,018	5,054	8
3A2	39,774	38,512	1,262	3
3A	39,620	38,055	1,565	4
3B	41,244	39,123	2,121	5
4A	42,571	40,140	2,431	6
4B	42,593	41,588	1,005	2
4C1	44,541	41,711	2,830	6
4C2	48,650	43,168	5,482	11
4C2a	44,210	41,443	2,767	6
4C2b	47,207	43,863	3,344	7
4C2c	51,672	45,613	6,059	12
4C3	55,387	39,996	15,391	28
Percentage	**—**	**92**	**8**	**—**

Table 3-37 provides the information used to calculate the site density for each of the subroutes.

Table 3-37. Summary of Site Density by Subroute

Subroute	Acreage Not Inventoried	Acreage Inventoried	Sites in Area Inventoried [1]	Sites in Area Not Inventoried	Site Density (per 100 acres)
1A1	67,349	5,921	25	25	0.42
1A2	67,729	6,015	31	19	0.52
1A	67,593	5,155	33	39	0.64
1B1	66,552	5,069	34	38	0.67
1B2	61,899	5,136	35	27	0.68
1B2a	62,304	5,858	30	18	0.51
1B3	61,018	5,054	33	28	0.65
3A2	38,512	1,262	14	8	1.11
3A	38,055	1,565	22	11	1.41
3B	39,123	2,121	31	8	1.46
4A	40,140	2,431	53	29	2.18
4B	41,588	1,005	30	22	2.99
4C1	41,711	2,830	69	46	2.44
4C2	43,168	5,482	49	30	0.89
4C2a	41,443	2,767	51	11	1.84
4C2b	43,863	3,344	49	11	1.47

Table 3-37. Summary of Site Density by Subroute					
Subroute	**Acreage Not Inventoried**	**Acreage Inventoried**	**Sites in Area Inventoried [1]**	**Sites in Area Not Inventoried**	**Site Density (per 100 acres)**
4C2c	45,613	6,059	46	11	0.76
4C3	39,996	15,391	312	104	2.03

[1] Sites in this column only represent those sites that are identified within the previously inventoried area – so that the site density of inventoried areas could be calculated. Other sites are often located in other areas that have not been previously inventoried. Therefore, the total number of sites within this table will not be consistent with tables 3-35, 3-36, and 3-37.

Site density varies among the subroutes, ranging between 0.42 and 2.99 sites per 100 acres, and is not dependent on the amount of previous inventory or the length of the subroute.

Previously Recorded Sites

This section presents the previously recorded sites that were identified in the Class I records review. Results are presented by route group and subroute. Data include the types of sites present and their NRHP eligibility.

3.8.3.2 Route Group 1: SunZia East Substation to Midpoint Substation

The records review identified 124 cultural resources within the study corridors of Route Group 1 (Figure M8-1E). These resource types are listed in Table 3-38 and discussed by subroute (below).

Table 3-38. Cultural Resources within Route Group 1 Study Corridors				
Resource Type	**Quantity**	**Percent Eligible**	**Percent Ineligible**	**Percent Unevaluated**
Archaeological district	1	100	0	0
Archaeological site, poorly documented	9	0	22	78
Cemetery or burial(s)	1	0	0	100
Feature(s) of indeterminate age	3	0	0	100
Historic feature(s) with artifacts	6	0	0	100
Historic homestead or structure(s)	11	36	9	55
Historic trail	3	33	0	67
Historic transportation or utility feature(s)	1	0	0	100
Historic trash scatter	10	0	0	100
National Historic Trail	1	100	0	0
Prehistoric artifact scatter	46	17	9	74
Prehistoric habitation site	20	15	0	85
Prehistoric site with feature(s)	12	8	8	84
Total Sites/Average Percent	**124**	**24**	**4**	**72**

Note: Percentages have been rounded to the nearest whole number and may not total exactly.

Subroute 1A1 – North River Crossing

Subroute 1A1 begins at the proposed SunZia East Substation, heads west across Chupadera Mesa to the Rio Grande crossing at Socorro, then heads south through the Rio Grande Valley to the

proposed Midpoint Substation. Subroute 1A1 passes across or near (within 0.25 mile) several well-known cultural resources, including 1 NHT (El Camino Real de Tierra Adentro) and 3 historic trails (Gila Trail Route, General Cooke's Wagon Road/Mormon Battalion, and Butterfield). Another possible route for the El Camino Real de Tierra Adentro appears to parallel the subroute east of the Rio Grande for approximately 4 miles before it heads north through the Sevilleta NWR. Subroute 1A1 also passes through 2 habitation sites. Additional historic resources within 0.25 mile of Subroute 1A1 consist of 1 cemetery or burial, 8 homesteads or structures, 1 site with transportation or utility features, 2 trash scatters, 2 sites with features and artifacts, and 2 sites with features of indeterminate age. Prehistoric cultural resources within 0.25 mile of Subroute 1A1 consist of 15 habitation sites, 6 sites with features, 25 artifact scatters, and 3 sites for which little information is available.

Although not located within the Class I study area, the Gran Quivira is located approximately 4.25 miles south of Subroute 1A1. More discussion of potential visual impacts to the Gran Quivira is presented in Section 4.9.3.1.

Subroute 1A2 – BLM Preferred Alternative

Subroute 1A2 varies slightly from 1A1 by using links E86a and E86b, north of Subroute 1A1, from node 118 to node 143. Nine prehistoric and historic cultural resources are located within 0.25 mile of Subroute 1A2. Historic resources include 1 homestead and 1 site with features and artifacts; prehistoric sites include 1 habitation, 3 artifact scatters, and 3 multicomponent artifact scatters (including 1 with features). The historic homestead and one of the prehistoric artifact scatters are crossed by Subroute 1A2.

Subroute 1A – North River Crossing

Subroute 1A is similar to Subroute 1A1, with the exception of links A22, E80c, and A260. Another possible route for the El Camino Real de Tierra Adentro appears to parallel the subroute east of the Rio Grande for approximately 4 miles before it heads north through the Sevilleta NWR. Historic resources within the 0.25-mile-wide study corridor that are specific to Subroute 1A include 2 homesteads or structures; prehistoric sites within the 0.25-mile study corridor that are specific to Subroute 1A include 6 habitation sites, 2 sites with features, and 9 artifact scatters.

Additional resources identified within 5 miles of Subroute 1A that have the potential to be visually impacted are the Camino Real de Tierra Adentro NHT, the Gila Trail Route, the General Cooke's Wagon Road/Mormon Battalion Trail, and the Butterfield Trail. Although not located within the Class I study area, the Gran Quivira unit is located 5.6 miles north of Subroute 1A, and between 1.3 and 5.6 miles from several local alternatives of the subroute. More discussion of potential visual impacts to the Gran Quivira is discussed in Section 4.9.3.1.

Subroute 1B1 – San Antonio Crossing

Subroute 1B1 is similar to Subroute 1A1, except that the route follows the southern alternative around Gran Quivira, continues to Mesa Redonda (Link E90), and proceeds south to cross the Rio Grande at San Antonio (Figure M8-1E). Historic resources within the 0.25-mile study

corridor that are specific to Subroute 1B1 consist of 1 cemetery or burial, 6 homesteads or structures, and 2 trash scatters; prehistoric resources within the 0.25-mile study corridor that are specific to Subroute 1B1 include 8 habitation sites, 7 sites with features, 17 artifact scatters, and 3 sites for which little information is available.

Additional resources identified within 5 miles of Subroute 1B1 that have the potential to be visually impacted are the Camino Real de Tierra Adentro NHT, the Gila Trail Route, General Cooke's Wagon Road/Mormon Battalion Trail, the Butterfield Trail, and the Playas Pueblos Archaeological District. Although not located within the Class I study area, the Gran Quivira is located 5.6 miles north of Subroute 1B1, and between 1.3 and 5.6 miles from several local alternatives of Subroute 1B1. More discussion of potential visual impacts to Gran Quivira is discussed in Section 4.1.3.2.

Subroute 1B2 – San Antonio Crossing

Subroute 1B2 differs from Subroute 1A1 as it proceeds west then south from the SunZia East Substation until it crosses the Rio Grande at San Antonio. Historic resources within the 0.25-mile study corridor specific to Subroute 1B2 include 4 homesteads or structures and 4 trash scatters; prehistoric resources within the 0.25-mile study corridor specific to this subroute include 2 habitation sites, 5 sites with features, 16 artifact scatters, and 2 sites for which little information is available.

Additional resources identified within 5 miles of Subroute 1B2 that have the potential to be visually impacted consist of the Camino Real de Tierra Adentro NHT, Gila Trail Route, General Cooke's Wagon Road/Mormon Battalion Trail, Butterfield Trail, and Playas Pueblos Archaeological District.

Subroute 1B2a – San Antonio Crossing

Subroute 1B2a is similar to Subroute 1B2, with the exception of Link A260 in place of Link A270. Segment A260 follows an existing transmission line east of I-10 in Sierra County and crosses back west of I-10 and north of Truth or Consequences to reconnect with Subroute 1B2. Historic resources within the 0.25-mile study corridor specific to this subroute include 4 homesteads or structures, 7 trash scatters, and 1 site for which little information is available; prehistoric resources within the 0.25-mile study corridor specific to this subroute include 5 habitation sites, 5 sites with features, 23 artifact scatters, and 7 sites for which little information is available.

Additional resources identified within 5 miles of Subroute 1B2 that have the potential to be visually impacted consist of the Camino Real de Tierra Adentro NHT, Gila Trail Route, General Cooke's Wagon Road/Mormon Battalion Trail, Butterfield Trail, and Playas Pueblos Archaeological District.

Subroute 1B3 – San Antonio Crossing

Subroute 1B3 differs from Subroute 1A1 as it proceeds west then south from the SunZia East Substation until it crosses the Rio Grande at San Antonio. Subroute 1B3 crosses the Mockingbird Gap Archaeological District. Additional historic resources within the 0.25-mile study corridor specific to this subroute consist of 6 historic homesteads or structures, 4 historic trash scatters, and 2 sites of indeterminate age; prehistoric resources within the 0.25-mile study corridor specific to this subroute include 2 habitation sites, 4 sites with features, 11 artifact scatters, and 4 sites for which little information is available.

Additional resources identified within 5 miles of Subroute 1B3 include the Camino Real de Tierra Adentro NHT, Gila Trail Route, General Cooke's Wagon Road/Mormon Battalion Trail, Butterfield Trail, Zuñiga route, Janos Copper Road route, and Playas Pueblos Archaeological District.

Local Alternatives and Crossover Links for Route Group 1

Local alternatives for Route Group 1 include links A161b and A361-A430-A481, which include known prehistoric sites and historic trail alignments. One known site, LA 27569, which is a prehistoric artifact scatter with features, is located along Local Alternative Link A161b.

In the Las Cruces area (Link A430), field investigations for the Butterfield Overland Mail and Stage Route identified segments of a trail alignment west of Las Cruces with associated artifacts dating to the twentieth century. Link A430 does not parallel any existing transmission lines in this location.

Local alternative links A361-A430-A481 also extend across the Gila and General Cooke's Wagon Road/Mormon Battalion trail alignments. Field investigations were conducted along Local Alternative Link A430 for the presence of the Butterfield Trail, segments of which were identified in these areas. The Gila and General Cooke's Wagon Road/Mormon Battalion trails were not included in this study.

Crossover Link A70 for subroutes 1B2 and 1B3 connects with Link A50 from Subroute 1B2 and with Link A80 from Subroute 1B3. Crossover Link A70 includes the Mockingbird Gap Historic Archaeological District and known site LA 67452, a historic house foundation and associated trash scatter. Field investigations would be needed to identify whether the construction and operation of the Project would affect the cultural resources within the Mockingbird Gap Archaeological District and site LA 67452.

3.8.3.3 Route Group 3: Midpoint Substation to Willow-500 kV Substation

The records review identified 91 cultural resources within the study corridors of Route Group 3. These resources are listed in Table 3-39 and discussed by subroute (below).

Table 3-39. Cultural Resources within Route Group 3 Study Corridors				
Resource Type	**Quantity**	**Percent Eligible**	**Percent Ineligible**	**Percent Unevaluated**
Archaeological site, poorly documented	2	0	0	100
Cave or rock shelter	2	50	0	50
Historic feature(s) with artifacts	5	100	0	0
Historic homestead or structure(s)	2	0	60	40
Historic trail	4	0	0	100
Historic transportation or utility feature(s)	3	33	33	33
Historic trash scatter	4	0	33	67
Prehistoric artifact scatter	35	0	0	100
Prehistoric habitation site	5	28	3	70
Prehistoric site with feature(s)	29	52	4	45
Total Sites/Average Percent	**91**	**30**	**10**	**60**
Note: Percentages have been rounded to the nearest whole number and may not total exactly.				

Subroute 3A2 – BLM Preferred Alternative

Subroute 3A2 begins at the Midpoint Substation and proceeds west through the Deming area along links B60 and B90. From there it continues west along links B120a and B120b as it approaches the Lordsburg area, and then onto links B121, B160a, B160d, and B160c. No historic resources were identified within the 0.25-mile study corridor specific to Subroute 3A2. Prehistoric resources within the 0.25-mile study corridor specific to Subroute 3A2 include 4 habitation sites, 3 sites with features, and 14 artifact scatters.

Additional resources identified within 5 miles of Subroute 3A2 include the Gila Trail Route, General Cooke's Wagon Road/Mormon Battalion Trail, Butterfield Trail, Zuñiga route, and Janos Copper Road route.

Subroute 3A – North

Subroute 3A is the same as Subroute 3A2 from the Midpoint Substation to Link B160a near Lordsburg, where Subroute 3A takes B160b west instead of B160d to the Willow-500 kV Substation. Historic resources within the 0.25-mile study corridor specific to Subroute 3A include 2 sites containing features and artifacts; prehistoric resources within the 0.25-mile study corridor specific to Subroute 3A include 1 habitation site, 3 sites with features, 9 artifact scatters, and 2 sites for which little information is available.

Additional resources identified within 5 miles of Subroute 3A include the Gila Trail Route, General Cooke's Wagon Road/Mormon Battalion Trail, Butterfield Trail, Zuñiga route, Janos Copper Road route, and the ghost town of Shakespeare.

Subroute 3B – South

Subroute 3B is the same as Subroute 3A2, except from Lordsburg to the Midpoint Substation. Although Subroute 3A2 already crosses the Butterfield, Gila, and General Cooke's Wagon

Road/Mormon Battalion trails, and Janos Copper Road at Links B120a and B120b, Subroute 3B crosses them again at links B110a and B112. Additional historic resources within the 0.25-mile study corridor specific to Subroute 3B include 2 homesteads or structures, 1 site with historic transportation or utility features, and 3 sites with features and artifacts. Prehistoric resources within the 0.25-mile study corridor specific to Subroute 3B include 2 sites with features and 8 artifact scatters.

Additional resources identified within 5 miles of Subroute 3B include the Zuñiga route and the ghost town of Shakespeare.

Crossover Links for Route Group 3

Crossover Link B111 for subroutes 3A, 3A2, and 3B connect with Link B120b from Subroute 3A and Link B110a from 3B. Crossover Link B111 includes two historic trails (Butterfield and Gila). Field investigations conducted for the Butterfield Trail along Link B111 did not identify any physical segments of the trail (the Gila Trail alignments were not included in the study). Although no physical segments of the Butterfield Trail were observed, historic artifacts were recorded. No existing utilities were noted in the area.

Crossover Link B140 for subroutes 3A, 3A2, and 3B connects with Link B121 for Subroute 3A and Link B112 from Subroute 3B. Crossover Link B140 includes the Butterfield Trail. Field investigations conducted for the Butterfield Trail did not identify any physical segments; however, rock cairns were observed at this location. No existing utilities were noted in the area.

Tribal Concerns

In addition to the historic resources identified along subroutes 3A and 3B, consultation with the San Carlos and White Mountain Apache tribes revealed concerns regarding traditional plant gathering areas in the vicinity of Deming, New Mexico (see Section 3.8.4).

3.8.3.4 Route Group 4: Willow-500 kV Substation to Pinal Central Substation

The records review identified 501 cultural resources in the area of Route Group 4. These resource types are listed in Table 3-40 and discussed by subroute (below).

Table 3-40. Cultural Resources within Route Group 4 Study Corridors

Resource Type	Quantity	Percent Eligible	Percent Ineligible	Percent Unevaluated
Archaeological district	2	100	0	0
Archaeological site, poorly documented	11	0	0	100
Cave or rock shelter	1	0	0	100
Cemetery or burial(s)	2	50	0	50
Historic district	6	100	0	0
Historic feature(s) with artifacts	22	27	18	55
Historic homestead or structure(s)	22	36	14	50
Historic landmark	1	100	0	0

Table 3-40. Cultural Resources within Route Group 4 Study Corridors				
Resource Type	**Quantity**	**Percent Eligible**	**Percent Ineligible**	**Percent Unevaluated**
Historic monument	1	0	100	0
Historic trail	5	20	0	80
Historic transportation or utility feature(s)	49	45	34	20
Historic trash scatter	21	19	29	52
National Historic Trail	1	0	0	0
Petroglyph site	3	0	0	100
Prehistoric artifact scatter	141	16	2	82
Prehistoric habitation site	37	43	0	57
Prehistoric site with feature(s)	176	23	9	68
Total Sites/Average Percent	**501**	**26**	**10**	**64**
Note: Percentages have been rounded to the nearest whole number and may not total exactly.				

Subroute 4A – North of Mt. Graham

Historic resources within the 0.25-mile study corridor specific to Subroute 4A include the Tom Mix Historic Monument, 1 historic site with features (Klondyke), 1 homestead or structure, 9 transportation or utility features, 1 historic trash scatter, and 3 historic features with artifacts. Prehistoric resources within the 0.25-mile study corridor specific to Subroute 4A consists of 6 habitation sites, 24 sites with features, and 3 sites for which little information is available.

Additional resources identified within 5 miles of Subroute 4A include the Gila Trail Route, General Cooke's Wagon Road/Mormon Battalion Trail, Butterfield Trail, Southern Pacific Mail and Stage Line (Picacho to Florence route), Zuñiga route, Juan Bautista de Anza route, Verdugo Homestead Historic District, and Camp Grant, including the Camp Grant Reservation/Camp Grant Massacre site.

Subroute 4B – Sulphur Springs Valley

Historic resources within the 0.25-mile study corridor specific to Subroute 4B include the Tom Mix Historic Monument, 1 historic site with features (Klondyke), 1 homestead or structure, and 6 sites with transportation or utility features. Prehistoric resources within the 0.25-mile study corridor specific to the subroute include 12 sites with features and 1 site for which little information is available.

Additional resources identified within 5 miles of Subroute 4B include the Gila Trail Route, General Cooke's Wagon Road/Mormon Battalion Trail, Butterfield Trail, Southern Pacific Mail and Stage Line (Picacho to Florence route), Zuñiga route, Juan Bautista de Anza route, Verdugo Homestead Historic District, Fort Grant, and Camp Grant, including the Camp Grant Reservation/Camp Grant Massacre site.

Subroute 4C1 – East of San Pedro River

Subroute 4C1 differs substantially from Subroute 4C2c, sharing only the beginning and ending segments. Subroute 4C1 shares the same alignment from the Willow Substation to Willcox (Link 212) and then diverges until Link C830, where it shares the same alignment into the Pinal Central Substation. Historic resources within the 0.25-mile study corridor specific to Subroute 4C1 include the Tom Mix Historic Monument, 1 homestead or structure, 8 sites with transportation or utility features, and 1 trash scatter. Prehistoric resources within the 0.25-mile study corridor specific to Subroute 4C1 consist of 8 habitation sites, 24 sites with features, 11 artifact scatters, and 4 sites for which little information is available.

Additional resources identified within 5 miles of Subroute 4C1 include the Gila Trail Route, General Cooke's Wagon Road/Mormon Battalion Trail, Butterfield Trail, Southern Pacific Mail and Stage Line (Picacho to Florence route), Juan Bautista de Anza route, Zuñiga route, Verdugo Homestead Historic District, and Rancho Linda Vista Historic District.

Subroute 4C2 – West of San Pedro River

Subroute 4C2 shares most of the same alignment as Subroute 4C2c; it diverges at Willcox to cross the San Pedro River near Cascabel, and reconnects at Link 441 as it continues along the west side of the San Pedro River. Prehistoric resources within the 0.25-mile study corridor specific to Subroute 4C2 include 1 habitation site and 2 sites with features.

Additional resources identified within 5 miles of Subroute 4C2 include the Gila Trail Route, General Cooke's Wagon Road/Mormon Battalion Trail, Butterfield Trail, Southern Pacific Mail and Stage Line (Picacho to Florence route), Juan Bautista de Anza route, Zuñiga route, Verdugo Homestead Historic District, and Rancho Linda Vista Historic District.

Subroute 4C2a – West of San Pedro River

Subroute 4C2a is similar to 4C2, with the exception of the segment between Oracle and the Pinal Central Substation (C690, C691, C693, C760, and C780), which follows an existing pipeline corridor for approximately 30 miles in Pinal County. Historic resources within the 0.25-mile study corridor specific to Subroute 4C2a include the Tom Mix Historic Monument, 13 sites with transportation or utility features, and 1 trash scatter. Prehistoric resources within the 0.25-mile study corridor specific to Subroute 4C2a consist of 3 habitation sites, 2 petroglyph sites, 18 sites with features, 24 artifact scatters, and 2 sites for which little information is available.

Additional resources identified within 5 miles of Subroute 4C2a include the Gila Trail Route, General Cooke's Wagon Road/Mormon Battalion Trail, Butterfield Trail, Southern Pacific Mail and Stage Line (Picacho to Florence route), Juan Bautista de Anza route, Zuñiga route, Verdugo Homestead Historic District, and Rancho Linda Vista Historic District.

Subroute 4C2b – West of San Pedro River

Subroute 4C2b is similar to 4C2a, with the exception of the segment between a point north of Willcox and the San Pedro River where Subroute 4C2b continues parallel to the existing 345 kV transmission lines for approximately 20 miles, and crosses the San Pedro River south of the Three Links Ranch in Cochise County (links C260, C261, and C201). Historic resources within the 0.25-mile study corridor specific to Subroute 4C2b include the Tom Mix Historic Monument and 13 sites with transportation or utility features. Prehistoric resources within the 0.25-mile study corridor specific to Subroute 4C1 consist of 2 habitation sites, 15 sites with features, 24 artifact scatters, and 2 sites for which little information is available.

Additional resources identified within 5 miles of Subroute 4C2b include the Gila Trail Route, General Cooke's Wagon Road/Mormon Battalion Trail, Butterfield Trail, Southern Pacific Mail and Stage Line (Picacho to Florence route), Juan Bautista de Anza route, Zuñiga route, Verdugo Homestead Historic District, and Rancho Linda Vista Historic District.

Subroute 4C2c – BLM Preferred Alternative

Subroute 4C2c begins at the proposed Willow Substation, heads southwest toward Willcox, crosses the San Pedro River near Cascabel, proceeds north along the San Pedro River toward Oracle, then proceeds west along Link C680 toward the Tortolita Substation. At the Tortolita Substation, Subroute 4C2c heads north along Link C820, and at the northern end of the Picacho Mountains heads west into the Pinal Central Substation. Subroute 4C2c passes across or near (within 0.25 mile) three cultural resources, including 1 archaeological district (McClellan Wash) and 2 historic trails, the Butterfield, Southern Pacific Mail and Stage Line (Picacho to Florence route) and Zuñiga. Historic resources within 0.25 mile of Subroute 4C2c include 2 homesteads or structures, 15 historic transportation or utility features, and 2 sites with historic features and artifacts. Prehistoric cultural resources within 0.25 mile of the subroute include 1 cave/rockshelter, 2 petroglyph sites, 2 habitation sites, 20 sites with features, 16 artifact scatters, and 3 sites for which little information is available.

Additional resources identified within 5 miles of Subroute 4C2c include the Gila Trail Route, General Cooke's Wagon Road/Mormon Battalion Trail, Juan Bautista de Anza route, Verdugo Homestead Historic District, and Rancho Linda Vista Historic District.

Subroute 4C3 – Tucson

Subroute 4C3 is the same as Subroute 4C2c, except where 4C3 continues south around Tucson before heading north to the Tortolita Substation, and then north still to the Pinal Central Substation. Historic resources within the 0.25-mile study corridor specific to Subroute 4C3 include 6 historic districts (El Presidio, Rillito Race Track, Winterhaven, Barrio Anita, El Presidio, and Menlo Park), 2 historic landmarks (Fort Lowell and Colossal Cave Mountain Park), 2 cemeteries or burials, 20 historic homesteads or structures, 15 historic features with artifacts, 19 trash scatters, and 37 historic transportation or utility features. Prehistoric resources within the 0.25-mile study corridor specific to Subroute 4C3 consist of 17 prehistoric habitation sites, 117 sites with features, 109 artifact scatters, and 3 petroglyphs.

Additional resources identified within 5 miles of Subroute 4C2c include the Gila Trail Route, General Cooke's Wagon Road/Mormon Battalion Trail, Butterfield Trail, Southern Pacific Mail and Stage Line (Picacho to Florence route), Juan Bautista de Anza route, Zuñiga route, Saguaro National Park, Tumamoc Hill Archaeological District/Desert Laboratory NHL, Pascua Cultural Plaza, Binghampton Historic Rural Historic Landscape, and 24 historic districts (Verdugo Homestead, Rancho Linda Vista, Aldea Linda, Armory Park, Barrio Libre, Blenman-Elm, Catalina Vista, Colonia Solana, El Encanto Estates, El Montevideo, Indian House, Iron Horse Expansion, Jefferson Park, John Spring, Pie Allen, Rincon Heights, Sam Hughes, San Clemente, Santa Rosa, Speedway-Drachman, University of Arizona Campus, Warehouse, West University, and DeGrazia Gallery in the Sun).

Local Alternatives and Crossover Links for Route Group 4

Local Alternative Link C790 crosses known low and moderate sensitivity sites. Local alternative links for the proposed Pinal Central Substation for subroutes 4A, 4B, 4C1, 4C2, and 4C3 include C860, C870, and C890, which cross known low and moderate sensitivity sites as well as the Southern Pacific Mail Line (links C850 and C860). A proposed 500 kV transmission line would parallel the Project along this link.

Local Alternative Link C692 of Subroute 4C1 crosses two known high sensitivity sites: a habitation site (AZ AA:8:21[ASM]) and a petroglyph site (AZ AA:8:370[ASM]). Site AZ AA:8:21(ASM) is a large habitation site that contains 15 to 20 trash mounds, a ball court, and 2 structures. Site AZ AA:8:370(ASM) is an anthromorphic petroglyph located south of site AZ AA:8:21(ASM). Extents of the site boundaries are currently unknown, but would be identified through a Class III field study prior to construction of the Project.

Local Alternatives for Subroute 4C2

Local alternative links for 4C2 include variations around the Willow-500 kV and Tortolita substations. Local alternative links C260-C261-C201 cross known low and moderate sensitivity sites, as well as one moderate-high sensitivity site. Site AZ AA:8:331(ASM) is a rockshelter located along Link C680. Extents of the site boundaries are currently unknown, but would be identified through a Class III field study prior to construction of the Project.

Local alternative links C680-C820 of Subroute 4C2 include known low and moderate sensitivity sites as well as two moderate-high sensitivity sites. Site AZ AA:8:331(ASM) is a rockshelter located along Link C680. Site AZ AA:3:136(ASM) is a probable habitation site with possible adobe walls and a trash mound. Extents of the site boundaries are currently unknown, but would be identified through a Class III field study prior to construction of the Project.

Local Alternatives for Subroute 4C3

Local alternative links for 4C3 include variations along Pantano Wash and Rillito Creek. Local alternative links F40b-F51-F60a, F81a-F81b, and C812 for Subroute 4C3 include 3 historic trails, 3 habitation sites, and 2 historic districts. Known low and moderate sensitivity sites are also present in the local alternative links.

Local Alternative Link F40b crosses the Butterfield Trail, but field studies near Benson did not identify any physical segment of the trail. An existing 345 kV transmission line parallels the Project in this area.

Local Alternative Link F81b crosses 3 historic trails (Butterfield, Zuniga, and General Cooke's Wagon Road/Mormon Battalion), 3 habitation sites, and 2 historic districts (Fort Lowell Multiple Resource Area and Rillito Race Track). In this area, two existing 138 kV transmission lines and one existing 115 kV transmission line are perpendicular to Link F81b. Further evaluation of the Butterfield, Zuñiga, and General Cooke's Wagon Road/Mormon Battalion trails would require field studies to verify the presence or absence of segments in these locations along Link F81b.

Three known habitation sites (AZ AA:12:10[ASM], AZ AA:12:781[ASM], and AZ BB:9:14[ASM]) are located along Link F81b. Site AZ AA:12:10(ASM) is a prehistoric habitation site and historic homestead. The prehistoric habitation component includes pit structures, canals, an artifact midden, and burials. The historic homestead is the 1893 adobe house of Basilio Cuevas with associated trash scatter. Site AZ AA:12:781(ASM) is a burial eroding out of the bank of the Santa Cruz River. Site AZ BB:9:14(ASM) is a multicomponent site. The prehistoric component includes a habitation site with pit structures, pit features, trash mounds, a ball court, and cremations. The historic component of the site is Fort Lowell. Extents of the site boundaries are currently unknown, but would be identified through a Class III field study prior to construction of the Project.

Local Alternative Link F81b crosses the Fort Lowell Multiple Resources Area and Rillito Race Track historic districts. An existing 138 kV transmission line parallels the Project near the Fort Lowell Multiple Resources Area, but no known utilities are identified in the vicinity of the Rillito Race Track. Further evaluations of these historic districts would require field studies to verify the presence or absence of contributing components of the districts within the proposed tower locations.

Local Alternative Link C812 is compared to links C810-C816-C813-C814-C815 of Subroute 4C3. None of these links is associated with any known cultural resources.

Local Alternatives for Subroutes 4C1, 4C2, and 4C3

Local alternative links for subroutes 4C1, 4C2, and 4C3 include C72-C90-C121-C211. A known moderate sensitivity site is present in these alternative links.

Crossover links for subroutes 4A, 4B, and 4C1 include links C500, C501, C502, and C174. None of these links include any known cultural resource sites. Link C671 is the crossover link for subroutes 4A, 4B, 4C1, and 4C2, and includes one moderate sensitivity site.

Tribal Concerns

In addition to the historic resources identified along these subroutes, consultation with the San Carlos and White Mountain Apache tribes have identified tribal concerns regarding subroutes 4A and 4B through the San Simon and Sulphur Springs valleys due to proximity to Mount Graham, which they would like to be listed as a traditional cultural property. In addition, both tribes have

expressed similar concerns regarding subroutes 4A and 4B near Klondyke, Arizona, which represents a traditional plant gathering area. Both tribes, as well as the GRIC and the Tohono O'odham Nation, have expressed concern regarding subroutes through the San Pedro Valley (4A, 4B, 4C1, 4C2, 4C2a, and 4C2b) due to archaeological and natural resources in the area (see Section 3.8.4). The GRIC Tribal Historic Preservation Officer expressed a concern that electrical fields along transmission lines could interfere with spiritual communications between sacred sites. Of particular concern for the San Carlos Apache Tribe is the proximity of subroutes 4A and 4B to the former Camp Grant and Camp Grant Apache Reservation, site of the Camp Grant Massacre (see Section 3.8.2.2), which is of great cultural significance to the tribe.

3.8.3.5 Site Sensitivity Analysis Results

The site sensitivity analysis results are provided in Table 3-41. A majority of the Class I sites were ranked as moderate sensitivity.

Table 3-41. Sensitivity of Previously Recorded Sites by Subroute

	Site Sensitivity (number of sites and percentage)					
Subroute	**Low**	**Low-Moderate**	**Moderate**	**Moderate-High**	**High**	**Total**
1A1	10 (20%)	10 (20%)	17 (34%)	12 (24%)	1 (2%)	**50**
1A2	3 (6%)	27 (54%)	9 (18%)	9 (18%)	2 (4%)	**50**
1A	13 (18%)1	16 (23%)	24 (33%)	18 (25%)	1 (1%)	**72**
1B1	12 (17%)	17 (24%)	28 (39%)	14 (19%)	1(1%)	**72**
1B2a	8 (17%)	13 (27%)	22 (46%)	5 (10%)	–	**48**
1B2	11 (18%)	19 (31%)	25 (40%)	7 (11%)	–	**62**
1B3	15 (25%)	19 (31%)	20 (33%)	7 (11%)	–	**61**
3A2	–	7 (32%)	11 (50%)	3 (14%)	1 (4%)	**22**
3A	3 (9%)	7 (21%)	19 (58%)	4 (12%)	–	**33**
3B	7 (18%)	14 (36%)	16 (41%)	2 (5%)	–	**39**
4A	10 (12%)	8 (10%)	49 (60%)	12 (15%)	3 (3%)	**82**
4B	8 (15%)	7 (13%)	32 (62%)	5 (10%)	–	**52**
4C1	27 (23%)	16 (14%)	58 (50%)	11 (10%)	3 (2%)	**115**
4C2	7 (9%)	14 (18%)	49 (62%)	8 (10%)	1 (1%)	**79**
4C2a	12 (19%)	11 (18%)	36 (58%)	3 (5%)	–	**62**
4C2b	12 (20%)	13 (22%)	32 (53%)	3 (5%)	–	**60**
4C2c	6 (11%)	11 (19%)	31 (54%)	8 (14%)	1 (2%)	**57**
4C3	27 (7%)	103 (25%)	251 (60%)	18 (4%)	17 (4%)	**416**

[1]Percentages represent proportion of sites for each subroute within each sensitivity category (e.g., 18% of the sites in Subroute 1A have a low sensitivity ranking). Converting the site counts to proportions facilitates comparison among subroutes.

Route Group 1, Subroute 1A2, the BLM preferred alternative, has the lowest overall sensitivity. Although subroutes 1A2 and 1B2a have similar total number of sites, the majority of sites along the preferred alternative have low or low-moderate sensitivity. In Route Group 3, Subroute 3A2, the BLM preferred alternative, has a lower overall sensitivity for cultural resources than the other subroutes due to a lower number of sites. In Route Group 4, Subroute 4C2c, the preferred alternative, along with subroutes 4C2a and 4C2b, has lower sensitivity for cultural resources than Subroute 4C3.

3.8.3.6 Class II Inventory Results

A total of 42 sites were identified during the Class II inventory, ranging from small artifact scatters to large habitation sites, as well as intact components of the trail segments. The detailed results of the Class II inventory are provided in a separate report (Swanson and Rayle 2012).

The Class II inventory provides additional information about cultural resources at river and trail crossings for each of the alternative subroutes. These areas were selected for their high potential for cultural resources. River and trail crossings within each of the three route groups were investigated during the Class II inventory. In Route Group 1, Class II parcels included the northern and southern crossing of the Rio Grande as well as two crossings of the Butterfield Trail and four crossings of the El Camino Real de Tierra Adentro; Route Group 3 Class II parcels included two crossings of the Mimbres and San Simon rivers and four crossings of the Butterfield Trail; and Route Group 4 Class II parcels included one crossing of Aravaipa Creek, two crossings of Sulphur Springs, and four crossings of the San Pedro River. In addition, Route Group 4 had one crossing of the Butterfield Trail.

Portions of these Class II inventory areas could not be inventoried because landowner permission was denied or not obtained. Site density values for the Class II inventory (Table 3-42) area range from 0.61 to 3.5 sites per 100 acres, and are reflected in the portions that were actually surveyed.

Table 3-42. Site Density of Class II Inventory Areas by Subroute

Subroute	Acreage	Sites[1,2]	Site Density (per 100 acres)
1A[2]	308.9	6	1.9
1A1/1A2	198.9	6	3.0
1B1[2]	274.1	4	1.5
1B2[2]	274.1	4	1.5
1B3[2]	274.1	4	1.5
3A/3A2	487.1	19	3.9
3B	496.2	12	2.4
4A[2]	153.0	2	1.3
4B[2]	153.0	2	1.3
4C1[2]	182.3	4	2.2
4C2[2]	41.2	6	1.5
4C2c	284.5	5	1.8
4C3[2]	283.6	7	2.5

[1]The sites do not include the trail segments as part of the purpose of the Class II inventories were to evaluate whether the route alignment noted for the trails contained intact segments of the trails in the proposed Project areas. Trails were only added as sites, if there was an intact segment of the trail or associated feature.

[2] The subroutes share many of the same links, so if sites are identified on a particular link that is shared with more than one subroute, the site was counted for each subroute, artificially inflating the number of sites in the table. Therefore, the table will show more than the total number of sites that were recorded during the inventory.

Table 3-43 provides sensitivity values for cultural resource sites located within the Class II inventory areas. Most of the sites identified during the Class II inventories are within the moderate sensitivity category.

Table 3-43. Sensitivity of Sites Recorded during Class II Inventories						
	Sensitivity					
Subroute	Low Sensitivity	Low-Moderate Sensitivity	Moderate Sensitivity	Moderate-High Sensitivity	High Sensitivity	Total Sites
1A	—	1	1	4	—	**6**
1A1/1A2	—	1	1	4	—	**6**
1B1	—	—	3	—	1	**4**
1B2	—	—	3	—	1	**4**
1B3	—	—	3	—	1	**4**
3A	—	6	11	1	1	**19**
3A2	—	8	5	2	1	**16**
3B	—	8	3	1	—	**12**
4A	—	—	2	—	—	**2**
4B	—	—	2	—	—	**2**
4C1	—	2	2	—	—	**4**
4C2	—	1	5	—	—	**6**
4C2c	—	1	4	—	—	**5**
4C3	—	1	6	—	—	**7**
The total number of sites will not match the total number of sites that were recorded during the Class II inventory, since the subroutes share many of the same links; some sites will be counted more than once.						

The Class I and Class II data comprise the baseline inventory used for the analysis of impacts to cultural resources, as described in Chapter 4.

Camino Real de Tierra Adentro National Historic Trail

Survey of the two proposed transmission line corridors near Socorro, New Mexico (E140 and A180) revealed only one possible remnant trail alignment of the Camino Real. This alignment is on the east side of the Rio Grande and is the present-day Bosquecito Road. Bosquecito Road is a north-south trending, bladed-gravel and partially paved road that now occupies the former Camino Real trail corridor. Although no remnant trail was observed west of the river, SR 408 generally follows the Camino Real trail corridor on this side. No other traces of the trail were detected during the inventory.

Butterfield Overland Mail and Stage Route

The Butterfield Trail is crossed by eight proposed transmission line corridors and links. One crossing identified a modern road that follows what appears to be the same alignment as the Butterfield Trail (B150a). Several of the crossings did not identify any physical traces of the trail (F40b, F600), but did contain historic artifacts (B111); some have rock cairns (B120b, B140). Physical traces of the trail segments were identified at two crossings in New Mexico, west of Las Cruces (A440, A430/A481).

3.8.4 Tribal Consultation Meetings

The BLM has held 14 meetings with interested tribes. This section focuses on the cultural concerns expressed by tribes during those meetings. Following is a brief summary of the concerns and issues discussed. Consultation with the tribes is ongoing.

- July 21, 2009 meeting with the Four Southern Tribes Cultural Resource Working Group (Tohono O'odham Nation, Ak-Chin Indian Community, GRIC, and Salt River Pima-Maricopa Indian Community) of which representatives from the Tohono O'odham Nation and Ak-Chin Indian Community were present. The meeting identified requests for an ethnographic study and use of tribal members during the inventory.
- August 13, 2009 meeting with the Pueblo of Zuni identified requests for a field visit to discuss traditional use areas and other areas of concern. A better quality map showing the previously recorded sites was also requested.
- August 25, 2009 meeting with the Pueblo of Isleta identified concerns about the Bosque del Apache and Mesilla Valley areas, and the Rio Grande. The tribe noted that all things are sacred, but there was a specific concern regarding Golden and Bald eagles. The tribe also noted that they feel culturally connected to the Navajo, Mescalero, and Hopi, and therefore are also interested in sites located in Arizona.
- October 16, 2009 meeting with the Apache (Fort Sill Apache Tribe, Mescalero Apache Tribe, and San Carlos Apache Tribe) identified concerns regarding the Project either crossing or being in proximity to the tribe's proposed substation project near Akela. The tribe requested more detailed maps to evaluate their traditional use areas and inquired about the BLM hiring members of the tribe to conduct inventory for these areas. Ethnographic areas were internally divided by the Apache: San Carlos and White Mountain with the western area, Fort Sill with the central area, and Mescalero with the eastern area.
- April 14, 2010 meeting with the Tohono O'odham Nation resulted in a request for a formal presentation to their district council. There was an inquiry as to whether the Project could benefit the tribe. It was noted that previous projects that did not benefit the tribe did not receive approval.
- July 10, 2010 meeting with the Schuk Toak District Council of the Tohono O'odham Nation to present Project information. On November 6, 2010, the Schuk Toak District Council approved a resolution to oppose the SunZia Project.
- October 4, 2011 meeting with the Apache (San Carlos Apache Tribe and White Mountain Apache Tribe) identified concerns over routes within the San Simon and Sulphur Springs valleys, due to their proximity to Mount Graham, an area of great cultural significance that the tribes would like to be listed as a traditional cultural property. Plant gathering areas near Klondyke, Deming, and Duncan were also mentioned. In addition, the San Pedro Valley was noted to be of concern, due to the archaeological and natural resources in that area. The Apache noted that the Four Southern tribes, the Hopi Tribe, and the Pueblo of Zuni would also be concerned with these areas. Interest in using existing routes was expressed.

- July 20, 2012 meeting with the Four Southern Tribes Cultural Resource Working Group to present Project information, including the BLM preferred alternative as described in the Draft EIS. Representatives from all four tribes were present. The tribes inquired about the need for two similar projects in the same areas (SunZia Southwest Transmission Project and the Southline Transmission Project).
- August 28, 2012 meeting with the Pueblo of Zuni to present information regarding the Draft EIS. The tribe indicated support for solar renewable energy projects; however, they had concerns regarding impacts to landscapes by wind-generated renewable energy developments. In addition, concerns regarding improving access conditions to otherwise remote areas could increase OHV use, which the tribes try to limit where possible.
- October 15, 2012 meeting with the Ysleta del Sur Pueblo to discuss the Project and the identified BLM preferred alternative. Concerns regarding impacts to views and unexcavated cultural resources in the Salinas Pueblos area, including Gran Quivira, Abo and Quarai, were identified.
- October 18, 2012 meeting with the San Carlos Apache Tribe to discuss the Project and the identified BLM preferred alternative in the Draft EIS. General concerns were expressed regarding sacred places as identified by the tribe that could be impacted. The tribe suggested ongoing communication through consultation could help avoid these impacts.
- November 09, 2012 meeting with the Pueblo of Isleta to discuss the BLM preferred alternative as identified in Draft EIS. The tribe expressed concern about cultural resources west of Tenobo and near Deming.
- November 27, 2012 meeting with the Tohono O'odham Nation Cultural Preservation Committee to discuss the BLM preferred alternative as identified in Draft EIS. The committee expressed concern that a Class III cultural resource survey would not be completed before a right-of-way grant would be issued.
- December 6, 2012 meeting with the Tohono O'odham Nation Legislative Council to discuss rationale for the BLM preferred alternative as identified in the Draft EIS. The council discussed concerns regarding health impacts associated with living in proximity to high-voltage transmission lines (HVTL). Clarification was requested about the public participation process, and other alternatives analyzed in the Draft EIS (i.e., impacts to residences associated with routes through Tucson).

3.9 VISUAL RESOURCES

3.9.1 Introduction, Inventory Methods, and Regulatory Framework

3.9.1.1 Introduction

This section focuses on the inventory and characterization of the affected environment associated with visual resources potentially affected by the construction and operation of the proposed Project. Consistent with methods based on the BLM's VRM System (Manual H-8410-1), the visual resource inventory focused on the identification of Project and planning level information. Project level inventory included scenery, viewing locations, and associated key observation

points (KOP). Planning level inventory focused on resource information established in relation to BLM RMPs that include scenic quality, sensitivity levels, distance zones, visual resource inventory (VRI) classes, and VRM classes. All visual resource information, excluding viewing locations and associated KOPs, were mapped within a 6-mile-wide study corridor (3 miles on either side of the reference centerline). Viewing locations and KOPs were identified with regard to visibility of the Project, and will be used to assess effects to the viewing public resulting from the construction and operation of the Project.

Based on results of the public scoping process and in consultation with the BLM, the following areas of concern were identified:

- El Camino Real NHT and National Scenic Byway
- El Camino Real International Heritage Center
- Juan Bautista de Anza NHT
- Arizona National Scenic Trail
- CDNST
- Gran Quivira
- Bosque del Apache NWR
- Fort Craig
- CNF
- Saguaro National Park (East and West) and Saguaro Wilderness
- Special Recreation Management Areas (SRMA)
- Scenery associated with Rio Grande, Aravaipa Canyon, Gila Valley, Pinaleño Mountains, Redfield Canyon, Sulphur Springs Valley, San Pedro River Valley, Galiuro Mountains, Catalina Mountains, and Tucson Mountains
- Residential views from communities of Socorro, San Antonio, Deming, rural areas south of Mountainair, San Pedro River Valley, Klondyke, Cascabel, and Tucson; views from recreation areas, including trails, Cluff Ranch Wildlife Area, and Pima County River Parks

3.9.1.2 Inventory Methods

To inventory and characterize the affected environment for visual resources for all alternatives regardless of jurisdiction, the following visual components were considered: scenery and viewing locations, including associated KOPs. In addition, planning-level VRIs and BLM VRM classifications were collected for lands administered by the BLM. The following tasks were undertaken to inventory these visual resources for the Project:

- Documentation of existing regional landform, vegetation, and water features (scenery)
- Identification of viewing locations and KOPs
- Identification of BLM VRI and VRM classifications

Figures in the Map Volume illustrate scenery (Figure M 9-1), viewing locations and KOPs (Figure M 9-2), VRI Classifications (Figure M 9-3), and VRM Classifications (Figure M 9-4) in the study corridor.

Scenery

Scenery reflects natural landscapes that would be affected by the Project. Typically, every landscape comprises varying levels of landform, vegetation, existence of water, scarcity, adjacent scenery, and cultural modifications; all of which combine to exhibit landscape character (BLM Manual H-8410-1). Inherent to landscape character is scenic quality, which is defined by the BLM as the aesthetic appeal of a tract of land and is expressed as Class A, B, or C. Class A scenery typically has a higher degree of landscape relief, diversity of water, and vegetation, which harmoniously combine and result in a high level of aesthetic appeal. Class B scenery has less variety in the elements that comprise the landscape, but still has some diversity and visual interest. Class C scenery typically does not have much diversity in terms of landscape features, and rates the lowest from an aesthetic perspective.

Developed areas, including residences and other land uses such as agriculture or industrial facilities, modify the natural landscape. An inventory of scenery within each of the alternative corridors was completed at a level of detail consistent with the scale and dimensions of the Project facilities, then compared to planning-level (BLM-generated) scenic quality data and adjusted appropriately. Scenery is illustrated on Figure M 9-1 (see Map Volume), and detailed Scenic Quality Rating Worksheets are provided in Appendix D.

Existing conditions (i.e., cultural modifications) within the Project study area range from natural to completely modified, based on the occurrences of transmission lines, substations, pipelines, travel routes, and other structural features that can modify the quality of natural settings. Existing conditions were evaluated by means of aerial photography and field reconnaissance to determine the location where modifications have affected natural settings.

Viewing Locations and Key Observation Points

The term "viewing locations" pertains to public areas (including KOPs) within the landscape where the Project could be visible, and where concern for changes to the landscape exists (see Concern Levels, below). In this regard, viewing locations are typically associated with residences, travel routes, and recreation areas. Other areas associated with viewers that typically have concern for changes to the landscape include public facilities, such as schools and religious institutions, and resorts.

KOPs represent a critical or typical viewpoint within, or along, an identified viewing location, and are required by the BLM to assess and mitigate visual impacts of a proposed action and to demonstrate compliance with designated VRM classes. The selection of KOPs for the Project considered the following criteria specific to transmission line projects (BLM Manual 8431-Visual Resource Contrast Rating):

- Most critical viewpoints (views from communities and road crossings)
- Typical views encountered in representative landscapes (scenic quality rating units)
- Any special project or landscape features such as skyline crossings, river crossings, substations, etc.

Other factors considered when selecting KOPs were angle of observation, number of viewers (use volume), length of time the Project is in view (viewing duration), relative Project size, season of use, and light conditions. Viewing locations and KOPs were inventoried within an 8-mile-wide study corridor (4 miles on either side of the reference centerline) and beyond.

Viewing locations and KOPs are illustrated on Figure M 9-2 and Figure M 9-3 (see Map Volume). The first part of the identification number for the KOPs refers to its associated BLM Field Office (SO – Socorro; RO – Roswell; RP – Rio Puerco; LC – Las Cruces; SA – Safford; and TU – Tucson). A detailed list, including location and use of each viewing location and associated concern level, as well as KOPs and Simulation Locations, is included in Appendix D.

Concern Levels

Concern levels relate to the importance of maintaining existing scenic quality and/or viewsheds associated with a specific viewing location, and are considered when assessing viewer impacts. For example, a National Monument is a viewing location that is associated with viewers who have a high degree of concern for maintaining scenic quality and/or viewshed, because the landscape setting is typically a key component to monument designation. In contrast, a viewing location associated with a state route would have moderate concern, because viewers are traveling at a high rate of speed, and arrival at their destination takes priority over a recreational experience. Concern levels for each identified viewing location and associated KOP were assessed based on the following five criteria: (1) volume of use, (2) viewing duration, (3) concern for aesthetics, (4) scenic or historic status, and (5) special status or designations.

Viewing Conditions

Viewing conditions relate to how the landscape is viewed from a given location, based on two key elements; orientation and screening. Orientation refers to the relative elevation of the viewing location as compared to landscape being viewed, which is described as inferior (below), neutral (level), or superior (above). Screening reflects the degree to which elements in the landscape, such as vegetation, topography, and development, inhibit the visibility of the landscape.

<u>BLM Resource Management Plans – Visual Resource Inventory</u>

The BLM VRM system requires the inventory of scenic values and the establishment of management objectives for those values through a visual resource management planning process. The VRI process and its resulting information provide the information necessary to characterize the existing or affected environment, and are required for management and Project level decisions. BLM VRI classifications were inventoried within a 6-mile-wide study corridor centered on the Project. The BLM's Manual H-8410-1 defines the criteria that define VRI components of scenic quality, sensitivity level rating units, distance zones, and VRI classifications. VRI data was provided by the BLM field offices (Socorro, Roswell, Rio Puerco, and Las Cruces) and incorporated into the inventory; and VRI data gaps (i.e., where agency VRI data does not exist or the BLM determines that existing data is insufficient) were identified and updated by the BLM field offices for inclusion in the Draft EIS. VRI classifications for all field offices are illustrated on Figure M 9-4 (see Map Volume). VRI data shown on Figure M 9-4

extends the study corridor and includes lands that are not managed by the BLM. VRI data, including scenic quality, sensitivity level rating units, distance zones, and resulting classifications, were inventoried by EPG for the Tucson Field Office, per BLM direction (see Appendix D).

Scenic Quality

Scenic quality as defined by the BLM is the measure of the visual appeal of a tract of land. In the VRI process, public land is given an A, B, or C rating, based on the evaluation of the following seven key factors: landform, vegetation, water, color, adjacent scenery, scarcity, and cultural modifications.

Sensitivity Level Rating Units

Sensitivity levels are a measure of public concern for the maintenance of scenic quality associated with a given tract of BLM land. Public lands are assigned high, medium, or low sensitivity by analyzing the various indicators of public concern, including type of user, amount of use, public interest, adjacent land uses, and special areas, among other factors.

Distance Zones

Per BLM guidance, landscapes are subdivided into three distance zones based on relative visibility from KOPs. The three distance zones are foreground-middleground (0 to 5 miles), background (5 to 15 miles), and seldom seen (greater than 15 miles).

Visual Resource Inventory Classifications

VRI classes are created using GIS, incorporating the following components: (1) scenic quality, (2) sensitivity levels, and (3) distance zones. VRI classifications represent the inventoried scenic values of BLM-administered lands, and have similar objectives as compared to VRM classes.

Visual Resource Management Classifications

BLM VRM classifications and associated objectives define the levels of acceptable visual change (contrast) allowed on BLM-administered land, ranging from Class I to Class IV. These classifications are designated by the BLM, based in part on the inventoried scenic values (VRI) and other land use allocations during the resource management planning process. BLM VRM classifications were collected within a 6-mile-wide study corridor centered on the Project, and are used to demonstrate Project conformance with regards to established management plans.

Table 3-44 describes the management objectives associated with each class designation, per BLM Manual H-8410-1 (1986). VRM objectives are illustrated on Figure M 9-5 (see Map Volume). There are no formal guidelines for managing visual resources on state, private, or other nonfederal lands.

Table 3-44. BLM Visual Resource Management Objectives	
Class I Objective	The objective of this class is to preserve the existing character of the landscape. This class provides for natural ecological changes; however, it does not preclude very limited management activity. The level of change to the characteristic landscape should be very low and must not attract attention.
Class II Objective	The objective of this class is to retain the existing character of the landscape. The level of change to the characteristic landscape should be very low. Management activities may be seen, but should not attract attention of the casual observer. Any changes must repeat the basic elements of form, line, color, and texture found in the predominant natural features of the characteristic landscape.
Class III Objective	The objective of this class is to partially retain the existing character of the landscape. The level of change to the characteristic landscape should be moderate. Management activities may attract attention, but should not dominate the view of the casual observer. Changes should repeat the basic elements found in the predominant natural features of the characteristic landscape.
Class IV Objective	The objective of this class is to provide for management activities that require major modifications of the existing character of the landscape. The level of change to the characteristic landscape can be high. These management activities may dominate the view and be the major focus of viewer attention. However, every attempt should be made to minimize the impact of these activities through careful location, minimal disturbance, and repetition of the basic elements.

3.9.1.3 Regulatory Framework

Visual resources on BLM-administered land are managed within the context of the VRM system, as described in BLM Manual 8400 – Visual Resource Management. In keeping with the FLPMA, the BLM is required to consider scenic values of public land as a resource that merits management and preservation where appropriate—including electric power-related projects—as determined through the land use planning process. The BLM VRM system requires the inventory of scenic values and the establishment of management objectives for those values through the VRM planning process. Based on the issuance of BLM IM No. 2009-167 (BLM 2009d), a completed VRI is required to serve as part of the baseline for NEPA analyses on BLM land. All field offices must have current VRI and VRM classes delineated as part of the land use planning process. If a field office does not have VRI data, then an inventory will need to be completed to process permit applications (*ibid*).

The West-wide Energy Corridor Programmatic EIS establishes Interagency Operation Procedures for visual resources that apply to the BLM. This document states that if VRM objectives have not been completed, then they should be developed by the proper agency. The field office manager will determine the role of SunZia in completing this task (DOE 2008).

Resource management goals for the Rio Grande Wild and Scenic River 2004 Final General Management Plan/EIS include the conservation and restoration of "wildlife, scenery, natural sights and sounds, and other resources of the river corridor and its immediate environment."

The White Sands Resources Area 1986 RMP identifies general management guidelines for visual resources: "Visual resources will be evaluated as a part of activity and project planning. Such evaluation will consider the significance of the proposed project, the visual sensitivity of the affected area, and the projected impacts of the project. Stipulations will be attached as appropriate to ensure compatibility of projects with management objectives for visual resources."

The Corridor Management Plan for the Patagonia-Sonoita Scenic Road identifies conservation and enhancement management goals for natural and scenic resources. One of the objectives is to "protect the beautiful vistas and open spaces experienced along the Scenic Road, including clean air and starry nights, and minimize visual inconsistencies that detract from the area's rural and natural character."

The Comprehensive Plan for the CDNST (which is managed by a number of federal and state land management agency jurisdictions) established the following guiding principles based on the nature and purpose for the trail: "…to provide high-quality, scenic, primitive hiking and horseback riding opportunities and to conserve natural, historic, and cultural resources along the CDNST corridor."

The General Management Plan for the Salinas Pueblo Missions National Monument, managed by the NPS, recognizes the extensive viewsheds of the three units that comprise the park: Gran Quivira, Abó, and Quarai. Primarily used for grazing, these landscapes provide a setting that has not significantly changed since the Spanish Colonial Period (AD 1598 to 1821). One of the park service's primary management goals is "to preserve and, where possible, to restore the historic setting. Development of these lands for uses other than grazing could seriously affect the historic setting and visitor experience" (NPS 1984).

The inventory and assessment of National Historic and Scenic Trails is included in Appendix L.

County

Goals, policies, or objectives regarding visual resources are included in some counties' general or comprehensive plans. Specific policies regarding visual resources that may affect the construction and operation of the Project are detailed below.

Unincorporated areas of Graham County, Arizona, in the Project area are managed under the 2008 General Plan. An objective identified in the plan includes "a healthy environment with open spaces and visual qualities within the County" (Graham County 2008). Unincorporated areas of Greenlee County, Arizona, in the Project area are managed under the 2003 Comprehensive Plan (Greenlee County 2003). Goals identified in the plan include the following:

- Use open space to preserve the rural character and protect those areas having significant environmental, scenic, or cultural values.
- Preserve and enhance such facilities as mountain roads, bridges, scenic overlooks, and landscape views for public enjoyment.

Pinal County, Arizona, adopted the Open Space and Trails Master Plan (Pinal County 2009) as an amendment to the 2001 Comprehensive Plan. The Master Plan outlines site design strategies that "…fit its physical setting and preserve scenic, aesthetic, historic, and environmental resources."

Unincorporated areas of Pima County are managed under the SDCP, which includes a science-based conservation plan, a comprehensive land use plan, and a multiple species conservation plan. The SDCP gives "high priority to preserving and protecting (Pima County's) most

important natural resources." Goals and objectives for the biological element of the SDCP include the following:

- Promote long-term viability for species, environments, and biotic communities that have special significance to people in this region, because of their aesthetic or cultural values, regional uniqueness, or economic significance (Pima County 2010a).

New Mexico counties, including Hidalgo, Grant, Luna, Sierra, Socorro, Lincoln, and Torrance, as well as Cochise County in Arizona, do not have visual resource goals, policies, or objectives identified in their plans.

City

Some city plans include goals, policies, or objectives for visual resources management in their general plans. Among the cities within the affected area of the Project alternatives, only the Tucson General Plan includes a visual resource element. In the Tucson General Plan, community character and design policies focus on major elements that help define Tucson's natural and built environments, such as views and community landmarks. General Plan Policy 3 requires preservation of "scenic views of natural features and community landmarks" (City of Tucson 2001).

3.9.2 Regional Overview

3.9.2.1 New Mexico

The Project is located within the Mexican Highland and Datil subdivisions of the Basin and Range and Colorado Plateau physiographic provinces, respectively (Fenneman 1931). The Basin and Range Province is characterized by its isolated, roughly parallel mountain ranges separated by closed (undrained) desert basins. The mountain ranges often run 50 to 70 miles in length and generally trend north-south. The Mexican Highland subdivision is also characterized by basin and ranges and intervening desert plains; however, most of the area has external drainage as opposed to draining internally to basins or bolsons.

The Colorado Plateau province is characterized by sparsely vegetated, horizontal plateaus, mesas, and canyons (*ibid*). The Datil subdivision contains a greater number of domed, volcanic features than elsewhere in the province. Mountains within the Datil subdivision include the San Mateo, Magdalena, and Black Range mountains. Major ecosystems in the Project area include short-grass prairie, Chihuahuan semidesert grasslands, mixed-desert thorn scrublands, riparian woodlands, and piñon-juniper woodland hills, foothills, and mountains (Brown 1982a).

Regional landscapes range from developed landscapes in the central and western portion of the Project area, to more natural intact landscapes in the north and east. Urban and suburban development is primarily concentrated along the Rio Grande and the I-25 and I-10 corridors, in the central and western portions of the Project area. Municipalities within proximity to the Project include Socorro, Deming, and Lordsburg. Agricultural landscapes are also heavily concentrated along the Rio Grande, in the Uvas Valley, and east of Deming. Small-scale mining operations are located throughout the region. More intact and naturally appearing landscapes

occur in the northern portion of the Project area, including parts of the Cibola National Forest, Bosque del Apache Wilderness Area, and Sevilleta NWR.

Agricultural activities such as center-pivot farming and dryland agriculture occur primarily around urban areas such as Deming in the western portion of the Project area; and along the Rio Grande near and around Socorro and San Antonio. Grazing lands dominate much of the Rio Grande Valley and Jornada del Muerto Valley landscapes.

Vegetation outside of developed landscape areas are typically dryland or naturally appearing grazing land. North and east of Socorro, vegetation is predominantly prairie grasslands and rolling piñon-juniper woodland. Vegetation transitions to the south, where expanses of sagebrush, creosote, desert grasses, and succulents such as agave and yucca occupy large areas of the Rio Grande Valley and Jornada del Muerto Valley. Piñon-juniper woodlands and plains grasslands dominate the lower elevations of the San Mateo, Magdalena, and Black Range mountains, with montane conifer forests dominating the higher elevations. Riparian areas are limited primarily to the Rio Grande and its tributaries.

3.9.2.2 Arizona

The Project area is partially located within the Mexican Highland subdivision of the Basin and Range Province and contains the same general landscape characteristics found within southwestern New Mexico. In Arizona, the Project is also located within the Sonoran Desert subdivisions of the Basin and Range Province (Fenneman 1931). The Sonoran Desert subdivision is characterized by mountain ranges and intervening desert plains; however, the ranges are smaller, rock pediments are much more prevalent, and undrained basins are less general than those typically characterized by the Basin and Range Province, such as in Nevada. Mountain ranges in the Project area include the Tortolita, Rincon, Santa Catalina, Galiuro, and Pinaleño mountains. Major ecosystems in the Project area include Palo Verde-Mixed Cacti Desertscrub basins, Chihuahuan semidesert grasslands, semi-arid hills, and piñon-juniper woodland foothills and mixed evergreen forests (Brown 1982a).

Regional landscapes have a range of developed and natural landscapes, from the highly urbanized areas in the Tucson metropolitan area to the relatively intact wilderness of the Galiuro Mountains. Urban development is most dominant in and around the Tucson metropolitan area, with some smaller urban and suburban development concentrations occurring in and near Eloy, Oracle, San Manuel, Cascabel, Safford, and San Simon. More intensive and large-scale industrial development typically occurs near larger urban areas and is most heavily concentrated in the western portion of the Project area along the I-10 corridor in and near Tucson and Eloy. There are a number of mining operations concentrated in the northern portion of the San Pedro River Valley, including Tiger Mine, Copper Creek Mine, Black Hills Mine, and the San Manuel Copper Mine complex (mine, mill, and smelter). More intact and natural appearing landscapes occur in the central portion of the Project area. Topography and vegetation associated with the San Pedro River Valley and the Galiuro, Santa Catalina, and Pinaleño mountains provide a more diverse landscape than the surrounding valley plains, which are relatively flat and often uniformly covered with creosote or desert grasslands.

Agricultural activities such as dryland and irrigated agriculture dominate the valley landscapes in southern Pinal County, southern Graham County, and northern Cochise County in the Project area. Irrigated agriculture occurs in the Santa Cruz Flats, San Pedro River Valley, Sulphur Springs Valley, and San Simon Valley.

Vegetation outside of developed landscape areas is typically either arid or natural appearing grazing land of creosote, tarbush, and other desertscrub. Within the San Simon Valley and Sulphur Springs Valley, vegetation can vary but is typically dominated by creosote, tarbush, and desertgrasses, and can include scattered succulents such as agave or yucca. Vegetation is often open to sparse exposed bare soils, desert pavement, and bare rock. Mixed desert cacti landscapes, which typically include yucca, barrel cactus, prickly-pear, and ocotillo, occur along bajadas within the San Pedro River Valley and the lower slopes of the Galiuro, Pinaleño, and Santa Catalina mountains. Oak and piñon-juniper woodlands occur on foothills and higher up the mountain slopes, with coniferous and aspen forested areas typically associated with the upper reaches of the mountain ranges. Open stands of saguaro, cholla, ocotillo, and paloverde become more prevalent west of the San Pedro River Valley, primarily occupying hills and bajadas, and becoming less dense as the land transitions to valley plains.

Dense riparian areas are found concentrated along the San Pedro River, Santa Cruz River, Aravaipa Creek, Cienega Creek, Pantano Wash/Rillito River, and the canyons of the Santa Catalina, Galiuro, and Pinaleño mountains. Riparian areas are also found along drainage ways that cut across bajadas and into the surrounding valley landscapes. There tends to be less variety and density of riparian vegetation along these smaller drainage ways.

3.9.3 Summary of Inventory Results

3.9.3.1 Route Group 1: SunZia East Substation to Midpoint Substation

Subroute 1A1 – North River Crossing

Scenery

The majority of Subroute 1A1 (links E211, A161, A161a, A260, A330a, A330b) crosses Class B scenery associated with the Rio Grande Valley, characterized by slightly undulating terrain dissected by major tributaries of the Rio Grande. Other Class B landscapes crossed by Subroute 1A1 include juniper hills, rolling juniper-woodland savanna, rolling savanna plains, rolling savanna grasslands, gently sloping undulating bajadas, low mountain peaks north and east of Socorro, and agricultural landscapes within the Rio Grande floodplain (links A10, A21, E82, E84, E85, E80d, E101a, E101b, E133, E180, E200, and a portion of Link E211). Cultural modifications that have locally modified the landscapes associated with Class B scenery along Subroute 1A1 include HVTL (345 kV, 115 kV), pipelines, railroad corridors, unpaved roads, and major transportation corridors (e.g., I-25). Other cultural modifications associated with this Class B scenery include dispersed residences associated with Socorro, Mountainair, and the Rio Grande Valley. Link E180 also crosses the Rio Grande (Class A), which is characterized by the curvilinear form of the river and dense riparian vegetation along the river banks. There are no cultural modifications to the landscape associated with Class A scenery for Subroute 1A1. Class C landscapes crossed by Subroute 1A1 are primarily the large, expansive plains characteristic of

the region (links A400, A440, A530, A520, E133, E200, and a portion of Link E211). Cultural modifications that have locally modified the landscapes associated with Class C scenery along Subroute 1A1 include HVTLs (345 kV, 115 kV), railroad corridors, unpaved roads, and major transportation corridors (e.g., I-25). A total of 0.1 mile of Class A scenery, 188.6 miles of Class B scenery, and 40.1 miles of Class C scenery are crossed by Subroute 1A1 (see Figure M 9-1E, Map Volume).

Viewing Locations and KOPs

Dispersed rural residences are generally located along all portions of Subroute 1A1 and occur in large part within the Rio Grande Valley. A large concentration of high concern residential viewing locations was identified within the city of Socorro, along Link E180. High concern level recreation viewing locations (including Gran Quivira, Sevilleta NWR, Stallion WSA, Rio Grande, Veranito WSA, Johnson [Gordy's] Hill SRMA, Ladron Mountain/Devil's Backbone Complex ACEC, The Box SRMA, Cibola National Forest, Devil's Backbone WSA, Bosque del Apache NWR, Chupadera Wilderness, Indian Well Wilderness, El Camino Real International Heritage Center, El Camino Real Lands Recreation Trail and Trailhead, Fort Craig National Historic Site, Continental Divide Trail Society (CDTS) Route, and Butterfield Historic Trail have direct views of the landscapes in which the following links are located: E84, E101a, E101b, E133, E180, E200, E211, A161, A161a, A260, A330a, A330b, A400, and A440 (see Figure M 9-2, Map Volume). Elephant Butte State Park is associated with high concern recreation viewers; however, views of the landscape that are traversed by Subroute 1A1 would be limited due to terrain. High concern level travel routes with associated scenic designations include the Salt Missions Trail Scenic Byway (SR 55), Quebradas Back Country Byway, El Camino Real National Scenic Byway (portions of I-25, SR 478, SR 185, SR 187, US Route 85, and SR 1), Geronimo Trail National Scenic Byway (SR 152, SR 52), and the Lake Valley Back Country Byway (SR 27, SR 152). Generally, views of the landscape in which the Project would be located would be direct and unobstructed. Travel routes that provide access to recreation areas that have a focus on scenery include WSMR Route 3607, which provides access to the Stallion WSA, and WSMR Route 5, which traverses Johnson (Gordy's) Hill SRMA and provides access to the Veranito WSA. These travel routes provide predominately unobstructed viewing opportunities of the landscape in which Subroute 1A1 is located. Moderate concern level recreation viewers include the New Mexico Tech Golf Course located in Socorro near Link E180. Moderate concern level travel routes include I-25 (nonscenic portions), I-10, US Route 54, US Route 60, SR 14, SR 178 (Cienega Camp Road), SR 107, SR 142, SR 26, and Forest Road (FR) 255. Link A10 is near a US Route 54 rest area associated with a moderate concern level.

KOPs common to Subroute 1A1 include:

- SO4 – Route 7 Residence
- SO11 – Route 3607
- SO13 – Route 5
- SO14 – Johnson (Gordy's) Hill SRMA
- SO15 – Quebradas Back Country Byway SRMA
- SO16 – Rio Grande
- SO17 – El Camino Real/SR 408
- SO18 – Socorro

- SO19 – The Box SRMA
- SO24 – Willow Springs and Whispering Mountain Ranches
- SO27 – Fort Craig National Historic Site
- SO28 – Fort Craig Rest Area/El Camino Real/I-25
- SO30 – El Camino Real/SR 1
- RO1 – County Road A020 Residence
- RO2 – US Route 54 and Rest Area
- LC19 – El Camino Real/I-25
- LC20 – Elephant Butte State Park
- LC21 – Geronimo National Scenic Byway
- LC22 – Lake Valley Back Country Byway/Geronimo National Scenic Byway
- LC26 – SR 26 and Butterfield Historic Trail

KOPs specific to Subroute 1A1 include:

- SO4 – Route 7 Residence
- SO31 (b) – Gran Quivira

BLM VRI Classifications

Subroute 1A1 crosses 109 miles (approximately 47.6 percent) of BLM land within the Socorro, Roswell, and Rio Puerco field offices, and Las Cruces District office.

Scenic Quality: Subroute 1A1 primarily crosses Class C scenic quality on BLM land, most of which is associated with the Rio Grande Valley and an isolated portion in the Rio Puerco Field Office. North of the WSMR and near Socorro, this alternative crosses Class A and Class B scenic quality associated with the Rio Grande and rolling piñon-juniper areas, foothills, and small mountains.

Sensitivity Level Rating Units: Subroute 1A1 primarily crosses BLM land associated with low sensitivity north of the WSMR and an isolated BLM parcel in Rio Puerco Field Office. Moderate sensitivity BLM land crossed by this alternative is associated with BLM land near Socorro and an isolated parcel southeast of the Sevilleta NWR. Other isolated moderate sensitivity BLM lands include those associated with SR 107 (Link A161a) and the Deming Valley (links A440 and A530). Several areas containing BLM lands of high sensitivity crossed by this alternative include El Camino Real National Byway (Link A260), the Lake Valley Back Country Byway (links A400 and A440), and the Geronimo Trail Scenic Byway (links A330a and A330b).

Distance Zones: Subroute 1A1 is located in the foreground-middleground distance zone for all BLM land crossed.

VRI Classes: Overall, half of Subroute 1A1 crosses VRI Class IV land (3.3 miles of VRI Class II, 50.3 miles of VRI Class III, and 56.5 miles of VRI Class IV). No VRI Class I would be crossed by this route. In the Socorro Field Office, the BLM preferred alternative primarily crosses VRI Class IV land and a small portion of Class III land. In the Las Cruces District Office, Subroute 1A1 primarily crosses VRI Class III, and several parcels of VRI Class IV land. A limited area of VRI Class II land would be crossed in the Las Cruces District Office. An

isolated parcel of VRI Class IV land (E84b) in the Rio Puerco Field Office would be crossed by this alternative.

BLM VRM Classifications

Subroute 1A1 crosses approximately 11.1 miles of VRM Class II, 28 miles of VRM Class III, and 69.9 miles of Class IV lands within the Roswell, Rio Puerco, and Socorro field offices and the Las Cruces District Office. VRM Class II lands associated with Subroute 1A1 include terrain east of Socorro near the Veranito and Stallion WSAs, and northeast of Deming along the Butterfield Trail and in the Cooke's Range. Landscapes associated with VRM Class III include terrain north of Stallion WSA, Johnson (Gordy's) Hill SRMA, the foothills east of the Magdalena Mountains, and the valley plains west of Good Sight Mountains. VRM Class IV lands generally occur along all portions of this subroute.

Subroute 1A2 – BLM Preferred Alternative

Scenery

The majority of Subroute 1A2 (links E211, A161, A161a, A260, A330a, A330b) crosses Class B scenery associated with the Rio Grande Valley, characterized by slightly undulating terrain dissected by major tributaries of the Rio Grande. Other Class B landscapes crossed by the BLM preferred alternative include juniper hills, rolling juniper-woodland savanna, rolling savanna plains, rolling savanna grasslands, gently sloping undulating bajadas, low mountain peaks north and east of Socorro, and agricultural landscapes within the Rio Grande floodplain (links A10, A21, E82, E84, E86a, E86b, E101a, E101b, E133, E180, E200, and a portion of Link E211). Cultural modifications that have locally modified the landscapes associated with Class B scenery along the BLM preferred alternative include HVTLs (345 kV, 115 kV), pipelines, railroad corridors, unpaved roads, and major transportation corridors (e.g., I-25). Other cultural modifications associated with this Class B scenery include dispersed residences associated with the towns of Socorro, Mountainair, and the Rio Grande Valley. Link E180 also crosses the Rio Grande (Class A), which is characterized by the curvilinear form of the river and dense riparian vegetation along the river banks. There are no cultural modifications to the landscape associated with Class A scenery for the BLM preferred alternative. Class C landscapes crossed by the BLM preferred alternative are primarily the large, expansive plains characteristic of the region (links A400, A440, A530, A520, E133, E200, and a portion of Link E211). Cultural modifications that have locally modified the landscapes associated with Class C scenery along the BLM preferred alternative include HVTLs (345 kV, 115 kV), railroad corridors, unpaved roads, and major transportation corridors (e.g., I-25). A total of 0.1 mile of Class A scenery, 190.2 miles of Class B scenery, and 40.1 miles of Class C scenery are crossed by Subroute 1A2 (see Figure M 9-1E, Map Volume).

Viewing Locations and KOPs

Dispersed rural residences are generally located along all portions of Subroute 1A2 and occur in large part within the Rio Grande Valley. A large concentration of high concern residential viewing locations was identified within the city of Socorro, along Link E180. Similar to Subroute 1A1, dispersed rural residences would be located along links E86a and E86b where

views of the landscape are direct and primarily unobstructed. High concern level recreation viewing locations (including Gran Quivira, Sevilleta NWR, Stallion WSA, Rio Grande, Veranito WSA, Johnson [Gordy's] Hill SRMA, Ladron Mountain/Devil's Backbone Complex ACEC, The Box SRMA, Cibola National Forest, Devil's Backbone WSA, Bosque del Apache NWR, Chupadera Wilderness, Indian Well Wilderness, El Camino Real International Heritage Center, El Camino Real Lands Recreation Trail and Trailhead, Fort Craig National Historic Site, CDTS Route, and Butterfield Historic Trail) have direct views of the landscapes in which the following links are located: E84, E101a, E101b, E133, E180, E200, E211, A161, A161a, A260, A330a, A330b, A400, and A440 (see Figure M 9-2, Map Volume). Links E82a and E82b are generally associated with few recreation viewers, although local travel routes near these links may be used to access designated recreation areas such as WSAs and SRMAs near Socorro. Elephant Butte State Park is associated with high concern recreation viewers; however, views of the landscape traversed by Subroute 1A2 would be limited due to terrain. High concern level travel routes with associated scenic designations include the Salt Missions Trail Scenic Byway (SR 55), Quebradas Back Country Byway, El Camino Real National Scenic Byway (portions of I-25, SR 478, SR 185, SR 187, US Route 85, and SR 1), Geronimo Trail National Scenic Byway (SR 152, SR 52), and the Lake Valley Back Country Byway (SR 27, SR 152). Generally where the Project crosses these scenic travel routes, views of the landscape would be direct and unobstructed. Travel routes that provide access to recreation areas that have a focus on scenery include WSMR Route 3607, which provides access to the Stallion WSA; and WSMR Route 5, which traverses Johnson (Gordy's) Hill SRMA and provides access to the Veranito WSA. These travel routes provide predominately unobstructed viewing opportunities of the landscape in which Subroute 1A2 would be located. Moderate concern level recreation viewers include the New Mexico Tech Golf Course located in Socorro near Link E180. Moderate concern level travel routes include I-25 (nonscenic portions), I-10, US Route 54, US Route 60, SR 14, SR 178 (Cienega Camp Road), SR 107, SR 142, SR 26, and FR 255. Link A10 is near a US Route 54 rest area associated with a moderate concern level.

KOPs specific to the BLM preferred alternative include:

- SO11 – Route 3607
- SO13 – Route 5
- SO14 – Johnson (Gordy's) Hill SRMA
- SO15 – Quebradas Back Country Byway SRMA
- SO16 – Rio Grande
- SO17 – El Camino Real/SR 408
- SO18 – Socorro
- SO19 – The Box SRMA
- SO24 – Willow Springs and Whispering Mountain Ranches
- SO27 – Fort Craig National Historic Site
- SO28 – Fort Craig Rest Area/El Camino Real/I-25
- SO30 – El Camino Real/SR 1
- SO31 (c) – Gran Quivira
- RP2 – SR 55 Residences
- RP3 – SR 55 Salt Missions Trail Scenic Byway
- RP4 – County Road B001 Residence
- RO1 – County Road A020 Residence

- RO2 – US Route 54 and Rest Area
- LC19 – El Camino Real/I-25
- LC20 – Elephant Butte State Park
- LC21 – Geronimo National Scenic Byway
- LC22 – Lake Valley Back Country Byway/Geronimo National Scenic Byway
- LC26 – SR 26 and Butterfield Historic Trail

BLM VRI Classifications

The BLM preferred alternative crosses 108 miles (approximately 46 percent) of BLM land within the Socorro and Roswell field offices, and Las Cruces District office. The subroute would not cross BLM land within the Rio Puerco field office.

Scenic Quality: The BLM preferred alternative primarily crosses Class C scenic quality on BLM land, most of which is associated with the Rio Grande Valley. North of the WSMR and near Socorro, this alternative crosses Class B scenic quality associated with rolling piñon-juniper areas, foothills, and small mountains, and an isolated Class A area associated with the Rio Grande.

Sensitivity Level Rating Units: The BLM preferred alternative primarily crosses BLM land associated with low sensitivity north of the WSMR, as well as portions of the Rio Grande Valley. Moderate sensitivity BLM land crossed by this alternative is associated with land near Socorro and an isolated parcel southeast of the Sevilleta NWR. Other isolated moderate sensitivity BLM lands include those associated with SR 107 (Link A161a) and the Deming Valley (links A440 and A530). Several areas containing BLM lands of high sensitivity crossed by this alternative include El Camino Real National Byway (Link A260), the Lake Valley Back Country Byway (links A400 and A440), and the Geronimo Trail Scenic Byway (links A330a and A330b).

Distance Zones: The BLM preferred alternative is located entirely in the foreground-middleground distance zone for all BLM land crossed.

VRI Classes: Overall, half of Subroute 1A2 crosses VRI Class IV land (4.6 miles of VRI Class II, 86.1 miles of VRI Class III, and 111.5 miles of VRI Class IV). No VRI Class I would be crossed by Subroute 1A2. In the Socorro Field Office, the BLM preferred alternative primarily crosses VRI Class IV land and a small portion of Class III land. In the Las Cruces District Office, Subroute 1A2 primarily crosses VRI Class III and several parcels of VRI Class IV land. A limited area of VRI Class II land is crossed in the Las Cruces District Office, where Class B scenery associated with high sensitivity (designated scenic byway travel routes) would occur.

BLM VRM Classifications

The BLM preferred alternative crosses approximately 11.1 miles of VRM Class II, 28.6 miles of VRM Class III, and 68.4 miles of Class IV lands within the Roswell and Socorro field offices and the Las Cruces District Office. BLM land in the Rio Puerco Field Office would not be crossed by the BLM preferred alternative. VRM Class II lands associated with Subroute 1A2 include terrain east of Socorro near the Veranito and Stallion WSAs, and northeast of Deming along the Butterfield Trail and in the Cooke's Range. Landscapes associated with VRM Class III include terrain north of Stallion WSA, Johnson (Gordy's) Hill SRMA, the foothills east of the

Magdalena Mountains, and the valley plains west of Good Sight Mountains. VRM Class IV lands generally occur along all portions of the BLM preferred alternative.

Subroute 1A – North River Crossing

Scenery

The majority of Subroute 1A crosses Class B scenery associated with the Rio Grande Valley. This subroute is similar to the BLM preferred alternative, except that it includes links A22 and E80c in the Gran Quivira area, and Link A270 in the Rio Grande Valley. Links A22 and E80c would cross Class B scenery characterized by rolling juniper-woodland savanna and rolling savanna. Link A270 would also cross Class B scenery associated with the Rio Grande Valley. Cultural modifications that have locally modified the landscapes associated with Class B scenery along this subroute are similar to the BLM preferred alternative. A total of 0.1 mile of Class A scenery (Rio Grande), 179.4 miles of Class B scenery, and 40.1 miles of Class C scenery are crossed by Subroute 1A (see Figure M 9-1E, Map Volume).

Viewing Locations and KOPs

This subroute is similar to Subroute 1A1, except that it includes links A22 and E80c in the Gran Quivira area, and Link A270 in the Rio Grande Valley. In addition to the residences noted in the BLM preferred alternative, Subroute 1A would occur near smaller residential developments located in Claunch and Cuchillo, along links E80c and A330a. Similar to the BLM preferred alternative, high concern level recreation viewing locations associated with Subroute 1A (including the Salinas Pueblo Missions National Monument, Sevilleta NWR, Stallion WSA, Veranito WSA, Johnson [Gordy's] Hill SRMA, Ladron Mountain/Devil's Backbone Complex ACEC, The Box SRMA, Cibola National Forest, Devil's Backbone WSA, Bosque del Apache NWR, Chupadera Wilderness, Indian Well Wilderness, El Camino Real International Heritage Center, El Camino Real Lands Recreation Trail and Trailhead, Fort Craig National Historic Site, CDTS Route, and the Butterfield Historic Trail) have direct views of the landscapes in which the following links are located: E80c, E101b, E133, E180, E200, E211, A161, A161a, A270, A330a, A330b, A400, and A440 (see Figure M 9-2, Map Volume). High concern level travel routes with associated scenic designations include the Quebradas Back Country Byway, El Camino Real National Scenic Byway (portions of I-25, SR 478, SR 185, SR 187, US Route 85, and SR 1), Geronimo Trail National Scenic Byway (SR 152, SR 52), and the Lake Valley Back Country Byway (SR 27, SR 152). Generally, views of the landscape in which Subroute 1A would be located would be direct and unobstructed for these recreation viewers. Travel routes that provide access to recreation areas that have a focus on scenery include WSMR Route 3607, which provides access to the Stallion WSA; and Route 5, which traverses Johnson (Gordy's) Hill SRMA and provides access to the Veranito WSA. These travel routes provide predominately unobstructed viewing opportunities of the landscape in which Subroute 1A would be located. Moderate concern level recreation viewers include the New Mexico Tech Golf Course located in Socorro near Link E180. Moderate concern level travel routes include I-25 (nonscenic portions), I-10, US Route 54, US Route 60, SR 14, SR 178 (Cienega Camp Road), SR 107, SR 142, SR 26, and FR 255. Link A10 is near a US Route 54 rest area associated with a moderate concern level.

KOPs specific to Subroute 1A include:

- SO1 – Claunch
- SO2 (a) – Gran Quivira
- SO11 – Route 3607
- SO13 – Route 5
- SO14 – Johnson (Gordy's) Hill SRMA
- SO15 – Quebradas Back Country Byway SRMA
- SO16 – Rio Grande
- SO17 – El Camino Real/SR 408
- SO18 – Socorro
- SO19 – The Box SRMA
- SO24 – Willow Springs and Whispering Mountain Ranches
- SO27 – Fort Craig National Historic Site
- SO28 – Fort Craig Rest Area/El Camino Real/I-25
- SO30 – El Camino Real/SR 1
- RO1 – County Road A020 Residence
- RO2 – US Route 54 and Rest Area
- LC18 – SR 142 Residence
- LC21 – Geronimo National Scenic Byway
- LC22 – Lake Valley Back Country Byway/Geronimo National Scenic Byway
- LC26 – SR 26 and Butterfield Historic Trail

Local Alternative Link A161b viewing locations are similar to Subroute 1A, with the exception that A161b is located closer to the Ladron Mountain/Devil's Backbone Complex ACEC, Cibola National Forest, and Devil's Backbone WSA. Willow Springs (SO24) is the only KOP associated with a high concern level for this local alternative link.

BLM VRI Classifications

Subroute 1A crosses 104.9 miles (approximately 48 percent) of BLM land within the Socorro and Roswell field offices, and Las Cruces District office.

Scenic Quality: Subroute 1A primarily crosses Class C scenic quality on BLM land, most of which is associated with the Rio Grande Valley. North of the WSMR and near Socorro, this subroute crosses Class B scenic quality. These Class B landscape types are primarily made up of rolling piñon-juniper areas, foothills, and small mountains. Class A scenic quality would not be crossed by Subroute 1A.

Local alternative link A161b primarily crosses Class C scenic quality associated with the Rio Grande Valley. In addition, Local Alternative Link A161b crosses an isolated portion of Class B scenic quality associated with the foothills of the Magdalena Mountains. Local alternative links A361-A430-A481 primarily cross Class B scenic quality associated with Uvas Valley and the Good Sight Mountains. This local alternative also crosses a small portion of Class C scenic quality associated with the Deming and Rio Grande valleys.

Sensitivity Level Rating Units: Subroute 1A primarily crosses BLM land associated with low sensitivity north of the WSMR. Moderate sensitivity BLM land crossed by this subroute is associated with land near Socorro. Other isolated BLM land associated with moderate sensitivity crossed by Link A161a includes SR 107 and the Deming Valley (links A440 and A530). Several areas of high sensitivity crossed by this subroute include El Camino Real National Byway (Link A270), the Lake Valley Back Country Byway (Link A400), and the Geronimo Trail Scenic Byway (links A330a and A330b).

Local Alternative Link A161b crosses BLM land associated with low and moderate sensitivity. Local alternative links A361-430-A481 primarily traverse BLM land associated with low sensitivity, an isolated portion of moderate and high sensitivity along I-10.

Distance Zones: The subroutes and local alternative links are located in the foreground-middleground distance zone for all BLM land crossed.

VRI Classes: The majority of BLM land crossed by Subroute 1A in the Socorro Field Office is VRI Class IV, with isolated areas of VRI Class III near Socorro and east of the Rio Grande. In the Las Cruces District Office, this subroute primarily crosses VRI Class II. No VRI Class I is crossed by Subroute 1A. This subroute crosses several BLM parcels inventoried as VRI Class IV in the Las Cruces District Office (links A330A, A330b, A440, and A530).

Local Alternative Link A161b crosses similar VRI Classes as Subroute 1A. Local alternative links A361 and A430 cross VRI Class IV, and Local Alternative Link A481 cross VRI Class III.

BLM VRM Classifications

Subroute 1A crosses approximately 11.1 miles of VRM Class II, 26.6 miles of VRM Class III, and 66.2 miles of Class IV lands within the Roswell and Socorro field offices and the Las Cruces District Office. VRM Class II lands associated with this subroute include terrain east of Socorro near the Veranito WSA and Stallion WSA, as well as the Butterfield Trail and terrain near Cooke's Range. Landscapes associated with VRM Class III include terrain north of Stallion WSA, Johnson (Gordy's) Hill SRMA, the foothills east of the Magdalena Mountains, and the valley plains west of Good Sight Mountains. VRM Class IV lands generally occur along all portions of this subroute.

<u>Subroute 1B – San Antonio Crossing</u>

Scenery

Scenery crossed by Subroute 1B1 is identical to Subroute 1A, except for the area northwest of the WSMR (links E90, A90, A111, A112, A140, A143, and A160). In this area, Subroute 1B1 crosses similar Class A, B, and C rating scenery as Subroute 1A, including the Rio Grande, agricultural lands within the Rio Grande floodplain, and desert valley plains, respectively; however, it is located farther south, near San Antonio. Cultural modifications that have locally modified landscapes associated with Class B scenery include HVTLs (345 kV), pipelines, railroad corridors, unpaved roads, and major transportation corridors (e.g., I-25). Other cultural modifications associated with this Class B scenery include dispersed residences associated

with the town of San Antonio and the Rio Grande Valley. Cultural modifications that have locally modified the landscapes associated with Class C scenery along this subroute include HVTLs (345 kV, 115 kV), railroad corridors, unpaved roads, and major transportation corridors (e.g., I-25 and US 380). In addition, Subroute 1B1 crosses less Class B and more Class C scenery than does Subroute 1A. A total of 165.7 miles of Class B scenery, 57.8 miles of Class C scenery, and 0.1 mile of Class A scenery (Rio Grande) are crossed by this subroute.

Subroute 1B2 is identical to Subroute 1B1, except for links A30, A50, and A60 east of the proposed SunZia East Substation. These links are located to the south of Subroute 1B1, and cross similar Class B and Class C scenery, including juniper hills, rolling savanna grasslands, and desert valley plains. In addition, cultural modifications that have locally modified the landscapes along this subroute are identical to cultural modifications within Class B and Class C scenery associated with Subroute 1B1. A total of 153.0 miles of Class B scenery, 56.1 miles of Class C scenery, and 0.1 mile of Class A scenery (Rio Grande) are crossed by this subroute.

Subroute 1B3 is identical to Subroute 1B2, except for links A40, A41, and A80 west of the proposed SunZia East Substation. These links are located above the northern boundary of the WSMR and cross similar Class B and Class C scenery as Subroute 1B2. The total of Class B and Class C scenery crossed by this subroute is almost the same as that crossed by Subroute 1B2. A total of 154.6 miles of Class B scenery, 51.6 miles of Class C scenery, and 0.1 mile of Class A scenery (Rio Grande) are crossed by this subroute. Cultural modifications are similar to Subroute 1B2.

Local alternative links in the Gran Quivira area (links E81, E82, E83, E84, and E85) cross similar Class B scenery as Subroute 1A1 and 1A, including rolling juniper-woodland savanna and rolling savanna plains. Cultural modifications that have locally modified the landscape in this area include ranching, pipelines, paved and unpaved roads, and a wind farm.

Local alternative links A161b and A260 cross Class B scenery, including undulating bajadas supporting grasses and creosote, southern foothills of the Magdalena Mountains, and the Rio Grande Valley. Cultural modifications that have locally modified Class B scenery along these alternative links include HVTLs (115 kV), major transportation corridors (e.g., I-25), and paved and unpaved roads. Local alternative links also cross Class B scenery, including the Rio Grande Valley (Link A361), agricultural lands (Link A430), and undulating grassland hills (Link A481). Links A430 and A431 also cross Class C scenery associated with semidesert grassland plains.

Crossover Link A70, between subroutes 1B2 and 1B3, primarily crosses Class B landscapes, defined by gently to moderately rolling topography covered with grasses, yuccas, prickly-pear, and scattered stands of juniper. A small portion of the link crosses Class C landscape. Cultural modifications are similar to Subroute 1B1.

Viewing Locations and KOPs

Viewing locations from the proposed SunZia East Substation to links E90 and A161 to Midpoint Substation are similar to Subroute 1A. Subroute 1B1 residences associated with a high concern level are located in San Antonio, Laborcita, and San Antonito, along Link A140.

Smaller residential developments are located in Claunch near Link E80c. Dispersed rural residences are generally located along all portions of the subroute. High concern level recreation viewing locations associated with Subroute 1B1 (including Cibola National Forest, Bosque del Apache NWR, Little San Pasqual Wilderness, Chupadera Wilderness, Antelope WSA, Sierra de las Canas WSA, Gran Quivira, and the Stallion WSA) would generally have direct views of the landscape in which the Project would be located. There are no moderate concern level recreation areas along Subroute 1B1. Scenic designated travel routes associated with a high concern level include the southern portion of the Quebradas Back Country Byway and the El Camino Real National Scenic Byway (SR 1). Travel routes associated with moderate concern level viewing locations include US Route 54, SR 14, and US Route 380, near links A10, E80c, A140, A112, and A111. These travel routes provide viewing opportunities of the landscape in which Subroute 1B1 would be located. Link A10 is near a US Route 54 rest area associated with a moderate concern level; and Trinity Historic Marker along US Route 380 is near links A111 and A90.

KOPs specific to Subroute 1B1 include:

- SO1 – Claunch
- SO2 (a) – Gran Quivira
- SO4 – Route 7 Residence
- SO5 – Route 3617 Residence
- SO8 – Route 18 Residence
- SO9 – Quebradas Back Country Byway SRMA
- SO10 – Trinity Historic Marker
- SO20 – San Antonio West
- SO21 – San Antonio East
- SO22 – US Route 380
- SO23 – Bosque NWR
- RO1 – County Road A020 Residence
- RO2 – US Route 54 and Rest Area

KOPs common with Subroute 1A from Link A161 to Midpoint Substation include:

- SO24 – Willow Springs and Whispering Mountain Ranches
- SO27 – Fort Craig National Historic Site
- SO28 – Fort Craig Rest Area/El Camino Real/I-25
- SO30 – El Camino Real/SR 1
- LC18 – SR 142 Residence
- LC21 – Geronimo National Scenic Byway
- LC22 – Lake Valley Back Country Byway/Geronimo National Scenic Byway
- LC26 – SR 26 and Butterfield Historic Trail

Viewing locations for Subroute 1B2 are similar to Subroute 1B1 from Link A111 to Midpoint Substation.

KOPs specific to Subroute 1B2 include:

- RO1 – County Road A020 Residence
- SO6 – Route 3508 Residence
- SO8 – Route 18 Residence
- SO9 – Quebradas Back Country Byway SRMA
- SO10 – Trinity Historic Marker

KOPs common with Subroute 1B1 from Link A111 to Midpoint Substation include:

- SO20 – San Antonio West
- SO21 – San Antonio East
- SO22 – US Route 380
- SO23 – Bosque del Apache NWR
- SO24 – Willow Springs and Whispering Mountain Ranches
- SO27 – Fort Craig National Historic Site
- SO28 – Fort Craig Rest Area/El Camino Real/I-25
- SO30 – El Camino Real/SR 1
- LC18 – SR 142 Residence
- LC21 – Geronimo National Scenic Byway
- LC22 – Lake Valley Back Country Byway/Geronimo National Scenic Byway
- LC26 – SR 26 and Butterfield Historic Trail

Viewing locations for Subroute 1B3 are similar to Subroute 1B1 from Link A111 to Midpoint Substation. High concern level residences are located in the town of Bingham, near links A41 and A80. Travel routes associated with a moderate concern level include US Route 54, SR 14, and US Route 380 along links A10, A30, A41, and A80.

KOPs specific to Subroute 1B3 include:

- RO1 – County Road A020 Residence
- RO2 – US Route 54 and Rest Area
- SO7 – Bingham
- SO9 – Quebradas Back Country Byway SRMA
- SO10 – Trinity Historic Marker

KOPs common with Subroute 1B1 from Link A111 to Midpoint Substation include:

- SO20 – San Antonio West
- SO21 – San Antonio East
- SO22 – US Route 380
- SO23 – Bosque del Apache NWR
- SO24 – Willow Springs and Whispering Mountain Ranches
- SO27 – Fort Craig National Historic Site
- SO28 – Fort Craig Rest Area/El Camino Real/I-25
- SO30 – El Camino Real/SR 1
- LC18 – SR 142 Residence
- LC21 – Geronimo National Scenic Byway
- LC22 – Lake Valley Back Country Byway/Geronimo National Scenic Byway
- LC26 – SR 26 and Butterfield Historic Trail

Local Alternative and Crossover Links for Route Group 1

Local Alternative Links for Subroutes 1A, 1A1, and 1B1 (Gran Quivira area)

Scenery

The majority of the local alternative links near the Gran Quivira area traverse Class B landscapes that are characterized by juniper hills, rolling savanna grasslands, and gently sloping to undulating terrain. Cultural modifications south of the Gran Quivira area are limited to unpaved roads. North of the Gran Quivira area, modifications that have locally modified the landscape include pipelines, ranching, unpaved roads, and a windfarm.

Viewing Locations and KOPs

A cluster of dispersed residences are located to the north of Gran Quivira, near local alternative links E82, E83, E84a, E84b, and E85. Dispersed rural residences are generally located north of Claunch, near Local Alternative Link E81. High concern level recreation viewing locations include Gran Quivira, which has direct views of the landscapes where local alternative links E81, E83, E84a, and E84b are located. Scenic designated travel routes associated with a high concern level include the Salt Missions Scenic Byway (SR 55, north of Gran Quivira). Travel routes associated with moderate concern level viewing locations include SR 55 (south of the monument) and FR 167, which provides access to the Cibola National Forest. These travel routes provide viewing opportunities of the landscape in which these local alternatives are located.

KOPs specific to local alternative links for subroutes 1A, 1A1, 1A2, and 1B1 (Gran Quivira area) include:

- SO2 (b) – Gran Quivira
- SO31 (a, b) – Gran Quivira
- RP01 – SR 55 Salt Missions Trail Scenic Byway
- RP02 – SR 55 Residences

BLM VRI Classifications

Local alternatives E83, E84a, and E84b near the Gran Quivira area would cross Class C scenic quality, characterized by flat terrain occupied by grassland with some piñon-juniper. These local alternatives are within the foreground-middleground distance zone, and traverse low sensitivity BLM land (approximately 2 percent). Two small parcels of BLM land crossed by links E83 and E84 within the Rio Puerco Field Office cross VRI Class IV. Local alternative links E81, E82, and E85 do not cross BLM land.

BLM VRM Classifications

Local alternatives links for Gran Quivira (E83 and E84) cross interim VRM Class IV lands in the Rio Puerco Field Office. Local alternative links E81, E82, and E85 do not cross BLM land.

Local Alternative Links for 1A, 1B1, 1B2, 1B3

Scenery for local alternative links A161b, A260, A361, A430, and A481 are similar to Subroute 1A. Viewing locations for local alternative links A161b and A260 are similar to Subroute 1A. Dispersed rural residences occur in the Uvas Valley (Link A430). Moderate concern level travel routes include SR 26, along Link A430.

KOPs specific to local alternative links for subroutes 1A and 1B1 include:

- LC14 – County Road A030 Residence
- LC19 – El Camino Real/I-25
- LC20 – Elephant Butte State Park

Crossover Links for 1B2, 1B3

Scenery and viewing locations for Crossover Link A70 are similar to subroutes 1B2 and 1B3.

KOPs specific to Crossover Link A70 include:

- SO06 – Route 3508 Residence

BLM VRI Classifications

BLM land within the Socorro and Roswell field offices, and Las Cruces District office are crossed by subroutes 1B1, 1B2, and 1B3 for 113.9 miles (approximately 51 percent), 120.1 miles (approximately 57 percent), and 122.2 miles (approximately 59 percent), respectively. Local alternative links A161b and A260 cross 8.4 miles (approximately 45 percent) of BLM land within the Socorro Field Office and Las Cruces District office. Crossover Link A70 traverses 4 miles (approximately 52 percent) of BLM land in the Socorro Field Office.

Scenic quality, sensitivity level rating units, distance zones, and VRI classes for subroutes 1B1, 1B2, and 1B3, and Crossover Link A70 are similar to Subroute 1A. Subroutes 1B2 and 1B3 along links A30 and A111 cross Class B scenic quality associated with rolling piñon-juniper hills, and Class C scenic quality characterized by flat terrain occupied by grassland with some piñon-juniper. Subroutes 1B1, 1B2, and 1B3 are within the foreground-middleground distance zone. These subroutes primarily traverse low sensitivity BLM land and isolated areas associated with moderate sensitivity (links A41, A50, and A70). These links primarily cross VRI Class IV and isolated areas of VRI Class III.

BLM VRM Classifications

Subroutes 1B1, 1B2, and 1B3 cross 7.4 miles of VRM Class II land within the Roswell and Socorro field offices and the Las Cruces District Office. VRM Class II lands associated with these subroutes include the San Pedro ACEC, Rio Grande and adjacent agricultural land, Butterfield Historic Trail, and terrain near Cooke's Range. Subroute 1B1 crosses approximately 33.8 miles of VRM Class III and approximately 72.8 miles of Class IV land. Subroute 1B2 crosses approximately 34.4 miles of VRM Class III and 78.2 miles of Class IV land. Subroute 1B3 crosses approximately 42.6 miles of VRM Class III and 72.3 miles of VRM Class IV land.

Land associated with VRM Class III includes terrain east of San Antonio to Bingham and the valley plains, west of Good Sight Mountains. VRM Class IV land generally occurs along all portions of these subroutes.

Local alternative links A161b and A260 associated with Route Group 1B cross approximately 2.5 miles of VRM Class III and approximately 11.5 miles of VRM Class IV land.

Crossover Link A70 associated with Subroute 1B crosses approximately 2.9 miles of Class III and 1.1 miles of VRM Class IV land.

3.9.3.2 Route Group 3: Midpoint Substation to Willow-500 kV Substation

Subroute 3A2 – BLM Preferred Alternative

Scenery

Scenery crossed by Subroute 3A2 has been inventoried primarily as Class C, which includes the Animas and San Simon valleys. These Class C landscapes are characterized by relatively level topography and vegetation dominated by grasses, with scattered occurrences of succulents and short and tall shrubs such as creosote and mesquite. Cultural modifications that have locally modified the landscapes associated with Class C scenery include HVTLs (345 kV and 115 kV), local transportation routes, unpaved roads, and substations. Other cultural modifications associated with this Class C scenery includes development and residences associated with the town of Deming. Link B160a crosses the northern foothills of the Peloncillo Mountains (Class B), characterized by moderate slopes and undulating peaks covered with swaths of perennial grasses and succulents, with occurrences of juniper scattered about the upper slopes. Link B120a crosses a bajada (Class B), which is defined by gently sloping to rolling terrain covered with a variety of grasses, shrubs, succulents, and cacti. A total of 52.3 miles of Class B scenery and 71.6 miles of Class C scenery are crossed by this BLM preferred alternative; no Class A scenery is crossed.

Viewing Locations and KOPs

High concentration residential viewing locations, which are associated with a high concern level, are located in Deming, including related dispersed residences south of Link B90. Subroute 3A2 would be visible on links B120b and B121 from high concern level recreation viewers, including the CDNST, portions of the Gila National Forest, and Peloncillo Mountains Wilderness (including Peloncillo Mountains WSA and moderate concern Northern Peloncillo Mountains ACEC). Moderate concern level travel routes include portions of I-10; New Mexico SR 26, SR 90, and SR 464; and US Routes 70, 180, and 191. Link B120a is near the I-10 Rest Area, which is associated with a moderate concern level.

KOPs specific to Subroute 3A2 include:

- LC27 – SR 180
- LC28 – Unnamed County Road at Hidalgo
- LC29 – SR 90
- LC33 – CDNST

BLM VRI Classifications

BLM land within the Las Cruces and Safford field offices are crossed by Subroute 3A2 for 65.6 miles (approximately 40.7 percent).

Scenic Quality: The majority of Subroute 3A2 crosses Class C scenic quality in the Las Cruces District Office associated with the Deming and Lordsburg valleys. This subroute crosses Class B scenic quality associated with the San Simon Valley in the Las Cruces and Safford field offices.

Sensitivity Level Rating Units: Subroute 3A2 primarily crosses low to moderate sensitivity BLM land within the Las Cruces and Safford field offices. An isolated area of BLM land associated with moderate sensitivity is crossed by links B90 and B170, near each substation terminus. High sensitivity BLM land is associated with the I-10 corridor and Peloncillo Mountain ranges and is crossed by this BLM preferred alternative.

Distance Zones: Subroute 3A2 is within the foreground-middleground distance zone for all BLM land crossed.

VRI Classes: Overall, half of Subroute 3A2 crosses VRI Class IV land. The BLM preferred alternative crosses 12.6 miles of VRI Class II land, 9.7 miles of VRI Class III land, and 101.6 miles of VRI Class IV land.

BLM VRM Classifications

Subroute 3A2 crosses approximately 61.5 miles of BLM land within the Las Cruces District Office and Safford Field Office. This route crosses 0.5 mile of VRM Class II lands, 23.2 miles of VRM Class III lands, and 41.9 miles of VRM Class IV lands. The Butterfield Historic Trail is designated as VRM Class II and is crossed by the preferred alternative. VRM Class III lands occur near the I-10 corridor, and the towns of Deming, Lordsburg, and San Simon. Some isolated VRM Class IV lands crossed by Subroute 3A2 are associated with the Animas Valley east of Deming and the San Simon Valley. This BLM preferred alternative crosses the foothills of the Peloncillo Mountains, which are designated as VRM Class IV.

<u>Subroute 3A – North</u>

Scenery

Scenery along Subroute 3A has been inventoried primarily as Class C, which includes the Animas and San Simon valleys. This subroute is identical to Subroute 3A1 from the Midpoint Substation up to and including Link B121, and Link B170 located near the Willow-500 KV Substation. Links B160a and B160b cross similar Class C scenery, north of the BLM preferred alternative. Cultural modifications that have locally modified the landscapes associated with Class C scenery are similar to the BLM preferred alternative and include HVTLs (345 kV and 115 kV), pipelines, major transportation routes (e.g., U.S. Highway 70), local transportation routes, and unpaved roads. This subroute (Link B160a) also crosses the foothills of the Peloncillo Mountains (Class B), north of the BLM preferred alternative. There are no cultural modifications to the landscapes associated with Class B scenery for Subroute 3A (Links 160b and 160a). A

total of 4.9 miles of Class B scenery and 118.5 miles of Class C scenery is crossed by this subroute; no Class A scenery is crossed.

Viewing Locations and KOPs

Subroute 3A is identical to Subroute 3A1 from the Midpoint Substation up to and including Link B121, and Link B170 located near the Willow-500 kV Substation. Additional high concern level recreation viewers that would have views of the Project include the Hot Dunes Recreation Area – SRMA/Campground near Link B160b. Hackel Road is a moderate concern travel route near Link B160b.

KOPs specific to Subroute 3A include:

- LC27 – SR 180
- LC28 – CDNST
- LC29 – SR 90
- SA3 – Hackel Road

BLM VRI Classifications

BLM land within the Las Cruces and Safford field offices are crossed by Subroute 3A for 58.1 miles (approximately 47 percent).

Scenic Quality: Subroute 3A crosses Class C scenic quality in the Las Cruces District Office associated with the Deming and Lordsburg valleys. Subroute 3A crosses Class B scenic quality associated with the San Simon Valley in the Safford Field Office.

Sensitivity Level Rating Units: This subroute primarily crosses low sensitivity BLM land within the Las Cruces and Safford field offices. An isolated area of BLM land associated with moderate sensitivity is crossed by links B90 and B170, near each substation terminus. Two areas of high sensitivity are crossed along Link B160b in the Safford Field Office and are generally associated with the Peloncillo Mountains.

Distance Zones: Subroute 1A is within the foreground-middleground distance zone for all BLM land crossed.

VRI Classes: Subroute 3A crosses VRI Class IV land in both the Las Cruces and Safford field offices. Isolated portions of VRI Class III (links B160b and B170) and VRI Class II (Link B160b) are crossed by this subroute.

BLM VRM Classifications

Subroute 3A crosses approximately 13.1 miles of VRM Class III land and approximately 45.0 miles of Class IV land within the Las Cruces District Office and Safford Field Office. VRM Class III and Class IV lands crossed by this subroute are associated with the Animas Valley east of Deming and the San Simon Valley. Subroute 3A crosses the foothills of the Peloncillo Mountains, which are designated as VRM Class IV.

Subroute 3B – South

Scenery

Subroute 3B crosses primarily Class C scenery within the Animas and San Simon valleys. From Link B150a to the Willow-500 kV Substation, Subroute 3B is identical to Subroute 3A1. The remainder of this subroute (links B60, B80, B110a, B110b, and B112) crosses similar Class C scenery as Subroute 3A. Cultural modifications that have locally modified the landscapes associated with Class C scenery are similar to the BLM preferred alternative and include HVTLs (345 kV and 115 kV), pipelines, major transportation routes (e.g., I-10), local transportation routes, and unpaved roads. Other cultural modifications associated with this Class C scenery include development and residences associated with the town of Lordsburg. Class B scenery crossed by Subroute 3A includes rolling semidesert grassland hills just south of Lordsburg (Link B112), and the southern foothills of the Peloncillo Mountains (Link B150a). Cultural modifications that have locally modified landscapes associated with Class B include pipelines, paved and unpaved roads, and mining operations. Subroute 3B does not cross any Class A scenery. A total of 7.6 miles of Class B scenery and 121.0 miles of Class C scenery are crossed by this subroute.

Crossover Link B111 crosses 6.9 miles of Class C scenery associated with the Animas Valley. Crossover Link B140, also within the Animas Valley, crosses 0.2 mile of Class B scenery and 8.1 miles of Class C scenery. Cultural modifications that have locally modified the valley associated with Class C include HVTLs (115 kV), local transportation routes, and unpaved roads.

Viewing Locations and KOPs

Subroute 3B is identical to Subroute 3A1 from Link B150a to the Willow-500 kV Substation. Residential viewers would be identical to the BLM preferred alternative (and the eastern portion of Subroute 3A), with the exception of being in closer proximity to Subroute 3B. Links B112 and B110b could affect high concern level recreation viewing locations associated with the CDNST near Lordsburg. Moderate concern level recreation viewers include the Shakespeare Ghost Town near Link B112. Moderate concern level travel routes include Hackel Road.

KOPs specific to Subroute 3B include:

- LC27 – SR 180
- LC30 – Lordsburg
- LC31 – CDNST
- LC32 – Shakespeare Ghost town
- SA02 – San Simon Residences

Crossover links associated with the Midpoint Substation to Willow-500 kV Substation subroutes have a high concern level associated with smaller residential concentrations associated with Lordsburg, and are located to the west of Link B111. Similar conditions exist for the CDNST near Link B111 as for Link B112.

BLM VRI Classifications

BLM land within the Las Cruces and Safford field offices are crossed by Subroute 3B for 5.8 miles (approximately 43 percent). Crossover links B111 and B140 cross 2.8 miles (approximately 18 percent) of BLM land within the Las Cruces District Office.

Scenic Quality: Subroute 3B primarily crosses Class B scenic quality associated with the San Simon Valley, the Peloncillo Mountains, and the Pyramid Mountains. Class C scenic quality crossed by Subroute 3B is associated with the Deming and Lordsburg valleys.

Crossover links B111 and B140 cross Class C scenic quality associated with the Lordsburg Valley.

Sensitivity Level Rating Units: Subroute 3B primarily crosses BLM land inventoried as high sensitivity for land associated with I-10 (links B110a, B112, B150a, and B150b). The Hot Well Dunes Recreation Area (Link B150b) is associated with moderate sensitivity. Several smaller BLM parcels inventoried as low sensitivity are crossed by links B110b, B150a, B151, and B170.

Crossover links B111 and B140 cross high sensitivity areas associated with I-10.

Distance Zones: Subroute 3B and crossover links B111 and B140 are located in the foreground-middleground distance zone.

VRI Classes: Subroute 3B crosses VRI Class IV (links B110a, B150a, B150b, and B170), VRI Class III (links B110a, B150a, and B150b), and VRI Class II lands associated with the Pyramid Mountains (Link B112), the Peloncillo Mountains (Link B150a), and the I-10 corridor in the Safford Field Office (link B150a).

Crossover links B111 and B140 go through VRI Class III land.

BLM VRM Classifications

Subroute 3B crosses approximately 1.0 mile of VRM Class II land, approximately 19.3 miles of Class III land, and approximately 35.5 miles of Class IV land within the Las Cruces District Office and Safford Field Office. VRM Class II land is associated with the CDNST near Lordsburg. VRM Class III and IV lands crossed by this subroute are associated with the Animas Valley east of Deming and the San Simon Valley. Subroute 3B crosses the foothills of the Peloncillo Mountains, which are designated VRM Class IV.

Crossover Link B111 crosses approximately 1.6 miles of VRM Class IV land associated with valley plains east of Deming. Crossover Link B140 crosses approximately 0.5 mile of VRM Class II land, which is associated with the Butterfield Trail, and 0.7 mile of VRM Class III land within the Animas Valley west of Lordsburg.

3.9.3.3 Route Group 4: Willow-500 kV Substation to Pinal Central Substation

Subroute 4A – North of Mt. Graham

Scenery

Scenery along Subroute 4A is primarily Class B. Class C landscapes are crossed in the San Simon Valley (Link 153a) north of the Willow-500 kV Substation, and in the creosote dominated valley plains north of the Picacho Mountains (Link C850). Cultural modifications that have locally modified landscapes associated with Class C include HVTLs (345kV and 230 kV), pipelines, major transportation routes (e.g., US Route 191), and paved and unpaved roads. Other cultural modifications that occur within Class C scenery include development associated with Swift Trail Junction. Class B landscapes crossed by this subroute include the eastern foothills and piedmont of the Pinaleño Mountains, the southern portion of the Aravaipa Canyon and Aravaipa Creek, and the lower peaks of the northern Galiuro Mountains. This subroute also crosses the San Pedro River Valley (Class B), characterized by highly dissected bajadas and alluvial fans covered with a variety of vegetation ranging from succulents, desert cacti, and low shrubs, to piñon-juniper and mesquite. West of the San Pedro Valley, this subroute continues to cross Class B landscapes, including the Falcon Valley, characterized by gently to moderately rolling bajadas; juniper covered foothills of the Black Mountain; Sonoran Valley plains defined by the variety and density of vegetation; and irrigated lands near the planned Pinal Central Substation. Cultural modifications that have locally modified landscapes associated with Class B include HVTLs (500 kV and 115 kV), pipelines, local transportation routes (e.g., SR 77), unpaved roads, substations, mining operations, development associated with the town of Mammoth, and agricultural lands north of Eloy. Link C592 crosses the San Pedro River and Floodplain, which are the only Class A landscapes crossed by this subroute. These landscapes are characterized by the meandering form of the San Pedro River and the diverse riparian vegetation that is adjacent to and interwoven within the river itself. Cultural modifications that have locally modified landscapes associated with Class A scenery include pipelines, local transportation routes (SR 77), unpaved roads, a water treatment facility, and dispersed residences associated with the town of Mammoth. A total of 0.9 mile of Class A scenery, 99.5 miles of Class B scenery, and 32.4 miles of Class C scenery are crossed by Subroute 4A.

Local Alternative Link C790 is within the Sonoran Desert Valley landscape (Class B) characterized by level topography, densely vegetated with a wide variety of desert species including paloverde, mesquite, saguaro, cholla, ocotillo, prickly-pear, grasses, and other herbaceous species. A portion of this alternative parallels the Pinal Pioneer Parkway. Other cultural modifications that have locally modified this landscape include HVTLs (115 kV), pipelines, and unpaved roads.

Viewing Locations and KOPs

High concentration residential viewers, which are associated with a high concern level, are located in Eloy, Lebanon, La Palma, and Swift Trail Junction (including Artesia) along links C880a, B153b, B153a, and B153b. Smaller residential concentrations are located in Klondyke and Mammoth along links B153b, C170, C592, and C595. The Project would be visible on links B153a, B153b, C170, and C620, from high concern level recreation viewers, including the

Arizona Trail (National Scenic Trail); Arcadia Campground (CNF); Trails 313, 66, 70/Deadman Creek Trailhead (CNF); Aravaipa Canyon Wilderness; Santa Teresa Wilderness; Bear Springs Badlands ACEC; Roper Lake State Park; and the Dankworth Pond State Park.

Travel routes with associated scenic designations include Stockton Pass Road, Klondyke Road, Swift Trail Parkway (SR 366), Redington Road, and Pinal Pioneer Parkway (SR 79). The Anza NHT auto tour route is designated along SR 87 near Casa Grande. Recreation access travel routes associated with a high concern level includes Rug Road, which provides access to the Aravaipa Canyon Wilderness. Moderate concern level recreation viewers include the Frye Mesa Reservoir (CNF), Cluff Ranch Wildlife Area, Mount Graham Municipal Golf Course, and Tierra Grande Country Club near links B153b and C880a. Moderate concern level travel routes include US Routes 191 and 287, SR 77, 4 Mile Road, Cluff Ranch Road, Bluebird Mine Road, and Tripp Canyon Road/FR 286. Other areas of moderate concern level include the San Simon Rest Area, Tom Mix Memorial/Rest Area, and Table Mountain RNA ACEC near links B153a, C170, C760, and C780.

KOPs specific to Subroute 4A include:

- SA04 – Artesia
- SA05 – Swift Trail Parkway/SR 366
- SA06 – Lebanon Residences
- SA07 – Cluff Ranch Wildlife Area
- SA08 – Bear Springs Badlands ACEC
- SA12 – Klondyke Road East
- SA13 – Klondyke Road North
- SA14 – Rug Road
- TU01 – Mammoth Residences
- TU02 – SR 77
- TU03 – Arizona National Scenic Trail – Black Hills
- TU30 – Pinal Pioneer Parkway/SR 79
- TU31 – Tom Mix Memorial/Rest Area
- TU32 – St. Anthony's Greek Orthodox Monastery
- TU33 – Earley Road Residence
- TU36 – Freeman Road

Local Alternative Link C790 has similar viewing conditions to those identified for links C780 and C830. These conditions include a travel route with associated scenic designation, the Pinal Pioneer Parkway (SR 79), and moderate concern viewers associated with the Greek Orthodox Monastery.

BLM VRI Classifications

Subroute 4A crosses 11 miles (approximately 8 percent) of BLM land within the Safford and Tucson field offices. Local alternative links C790, C860, C870, and C890 do not cross BLM land.

Scenic Quality: In the Safford Field Office, Subroute 4A only crosses BLM land along Link B153a, which is a Class B landscape associated with the San Simon Valley.

Sensitivity Level Rating Units: Subroute 4A crosses moderate sensitivity BLM land associated with the Hot Well Dunes Recreation Area and US Route 191.

Distance Zones: Subroute 4A is located in the foreground-middleground distance zone for all BLM land crossed.

VRI Classes: The BLM land crossed by the subroute is VRI Class II.

BLM VRM Classifications

Subroute 4A crosses approximately 11 miles of VRM Class III land within the Safford and Tucson field offices; this subroute does not cross VRM Class II or Class IV lands. VRM Class III land crossed by this Subroute 4A is associated with the San Simon Valley south of Swift Trail Junction and Sonoran Desert Valley east of the Pinal Pioneer Parkway. Local Alternative Link C790 does not cross BLM land.

Subroute 4B – Sulphur Springs Valley

Scenery

Scenery crossed by Subroute 4B is identical to Subroute 4A in Aravaipa Canyon, San Pedro Valley, and Falcon Valley, and near the planned Pinal Central Substation. West of San Simon Valley, this subroute crosses the southern foothills of the Pinaleño Mountains (Class B) and up through the undeveloped landscape of the Sulphur Valley (Class C), defined by level topography dominated by grasses and creosote. This subroute also crosses Class B landscape at the southern end of the Aravaipa Canyon, defined by gently rolling bajadas covered with a variety of vegetation, including desert cacti and piñon-juniper at higher elevations. Cultural modifications along this alternative are similar to Subroute 4A, with the exception of Sulphur Valley, where the majority of the subroute crosses undeveloped landscapes. Areas where cultural modifications have locally modified the landscape associated with Class B scenery are concentrated south of the Pinaleño Mountains and Sulphur Springs Valley, and include HVTLs (345 kV), pipelines, unpaved roads, and local transportation corridors (e.g., SR 266). Other cultural modifications include development associated with Sulphur Springs Valley, which is primarily characterized by agriculture and associated residences/structures. A total of 0.9 mile of Class A scenery, 100.4 miles of Class B scenery, and 31.6 miles of Class C scenery are crossed by Subroute 4B.

Scenery for Local Alternative Link C790 is similar to Subroute 4A.

Viewing Locations and KOPs

High concentration residential viewers, which are associated with a high concern level, are located in Eloy, Lebanon, and La Palma along links C890, C880, and C880a. Smaller residential concentrations are located in Bonita, Klondyke, and Mammoth along links C130a, C130b, C170, and C592. Dispersed rural residences are generally located along links C71, C130a, C130b, C170, C592, C620, and C840. The Project would be visible on Link C170 and from high concern

level recreation viewers, including the Arizona Trail (National Scenic Trail); Trails 298, 305, 313, and 66, and Cottonwood Canyon Trailhead (CNF); Aravaipa Canyon Wilderness; and the Santa Teresa Wilderness. Travel routes with associated scenic designations include Stockton Pass Road, Bonita Aravaipa Road, Klondyke Road, Swift Trail Parkway (SR 366), Redington Road, and Pinal Pioneer Parkway (SR 79). Recreation access travel routes associated with a high concern level include Rug Road, which provides access to the Aravaipa Canyon Wilderness. Moderate concern level recreation viewers include the Tierra Grande Country Club near Link C880a. Moderate concern level travel routes include US Route 191, Fort Grant Road, 4 Mile Road, High Creek Road, and the Bluebird Mine Road. Other areas associated with a moderate concern level include the Tom Mix Memorial/Rest Area and the Table Mountain RNA ACEC near links C170, C760, and C780.

KOPs specific to Subroute 4B include:

- SA09 – Bonita Aravaipa Road East
- SA11 – Bonita Aravaipa Road West

KOPs common with Subroute 4A from Link C170 to the planned Pinal Central Substation include:

- SA12 – Klondyke Road East
- SA13 – Klondyke Road North
- SA14 – Rug Road
- TU1 – Mammoth Residences
- TU2 – SR 77
- TU3 – Arizona National Scenic Trail (Black Hills)
- TU30 – Pinal Pioneer Parkway/SR 79
- TU31 – Tom Mix Memorial/Rest Area
- TU32 – St. Anthony's Greek Orthodox Monastery
- TU33 – Earley Road Residence
- TU36 – Freeman Road

Viewing locations and KOPs for Local Alternative Link C790 is similar to Subroute 4A.

BLM VRI Classifications

Subroute 4B crosses 5 miles (approximately 4 percent) of BLM land within the Tucson Field Office. Local alternative links C790 and C692 do not cross BLM land. Subroute 4B does not cross BLM land in the Safford Field Office.

Scenic quality, sensitivity level rating units, distance zones, and VRI Class information for Subroute 4B is similar to Subroute 4A for the Tucson Field Office.

BLM VRM Classifications

Subroute 4B crosses approximately 5 miles of VRM Class III land associated with the Sonoran Desert Valley east of the Pinal Pioneer Parkway, within the Safford and Tucson field offices. This subroute does not cross VRM Class II or Class IV lands.

Local Alternative Link C790 does not cross BLM land.

Subroute 4C2c – BLM Preferred Alternative

Scenery

Primarily Class B scenery has been identified along this BLM preferred alternative. Class C landscapes crossed by Subroute 4C2c are limited to the Sulphur Springs Valley and plains south of the Galiuro Mountains (links C110 and C260, respectively), and in the creosote dominated valley plains north of the Picacho Mountains (links C850 and C860). Cultural modifications that have locally modified landscapes associated with Class C include HVTLs (345kV), pipelines, and paved and unpaved roads. Class B landscapes primarily crossed by Subroute 4C2c are associated with the San Pedro Valley, east of the Rincon and Santa Catalina mountains (links C201, C441, C450, and C661). This area is characterized by moderately to highly dissected bajadas covered with a wide range of vegetation, including desert cacti, piñon-juniper and oak, and riparian species. Cultural modifications that have locally modified landscapes associated with Class B scenery within the San Pedro Valley include HVTLs (115 kV), pipelines, Tiger Mine, San Manuel Substation, major transportation corridors (e.g., SR 77), and unpaved roads. Other cultural modifications include development associated with Cascabel and San Manuel, characterized by agriculture and associated residents/structures. Other Class B scenery crossed by Subroute 4C2c includes the southern foothills of the Pinaleño Mountains (links C71, C71a, C110) and the southern foothills of the Galiuro Mountains (Link C212). West of the San Pedro Valley, Subroute 4C2c continues to cross Class B landscapes, including the Falcon Valley, characterized by gently to moderately rolling bajadas; paloverde and cacti covered foothills of the Tortolita Mountains; Sonoran Valley plains defined by the variety and density of vegetation; and irrigated lands near the planned Pinal Central Substation. Cultural modifications that have locally modified landscapes associated with Class B include HVTLs (500 kV and 115 kV), pipelines, local transportation routes (e.g., SR 79), unpaved roads, substations, mining operations, development associated with the town of Oracle, and agricultural lands north of Eloy. Links C201 and C261 cross the San Pedro River and Floodplain, which are the only Class A landscapes crossed by this BLM preferred alternative. These landscapes are characterized by the meandering form of the San Pedro River and the diverse riparian vegetation that is adjacent to and interwoven within the river itself. Cultural modifications that have locally modified landscapes associated with Class A scenery include HVTLs, pipelines, local transportation routes (SR 77), and unpaved roads. A total of 0.9 mile of Class A scenery, 132.1 miles of Class B scenery, and 28.1 miles of Class C scenery are crossed by Subroute 4C2c.

Viewing Locations and KOPs

Subroute 4C2c high concentration residential viewers, which are associated with a high concern level, are located in Eloy, La Palma, Oracle, San Manuel, and Willcox, along links C110, C450, C670, C680, and C880a. Smaller residential concentrations are located in Cascabel along links C261 and C201, Redington along Link C441, and San Manuel along Link C450. Dispersed rural residences are generally located along all segments of Subroute 4C2c. The Project would be visible on links C441, C450, C661, C670, and C680 from high concern level recreation viewers, including: Arizona Trail Trailhead (Tiger Mine); Arizona Trail; CNF (including Last Chance Wilderness Trailhead, Trail 9 and associated trailhead); Rincon Mountains Wilderness; Saguaro

National Park (East); Oracle State Park (including Bellota Trail Loop, Granite Overlook Trail Loop, Manzanita Trail, Mariposa Trail, Nature Trail Loop, Wildlife Corridor Trail, and the Historic Kannally Ranch House); and the Biosphere. Travel routes with associated scenic or auto tour route designations include Redington Road, SR 79 (Pinal Pioneer Parkway), SR 87, and Control Road (Mount Lemmon Highway FR 38). Moderate concern level recreation viewers include the YMCA Triangle Y Ranch Camp and Retreat Center, Bellota Ranch (A7 Ranch), Saddlebrook Ranch Golf Club, San Manuel Golf Club, and Tierra Grande Country Club near links C441, C450, C680, and C880a. Moderate concern level travel routes include Fort Grant Road, US Routes 191 and 287, Three Links Road, Cascabel Road, Ocotillo Road, SR 76 (San Pedro River Road), and SR 77, and the Tom Mix Memorial Rest Area. Moderate concern level recreation access/four-wheel drive roads include Black Hills Mine Road/Catalina Ridge, Buehman Canyon Trail, and Muleshoe Ranch Road.

KOPs specific to Subroute 4C2c include:

- SA10 – Sulphur Springs Valley
- SA15 – Muleshoe Ranch Road
- TU4 – Oracle Residences
- TU5 – Arizona National Scenic Trail (Tiger Mine Trailhead)
- TU7 – San Manuel Residences
- TU8 – Control Road (Mount Lemmon Highway FR 38)
- TU9 – San Pedro River Valley North
- TU11 – Cascabel Road (South)
- TU27 – Biosphere
- TU28 – Longhoen Trail Residence (Red Rock)
- TU29 – Park Link Drive
- TU31 – Tom Mix Memorial Rest Area
- TU32 – St. Anthony's Orthodox Monastery
- TU33 – Earley Road Residences
- TU34 – SR 77
- TU35 – Pinal Pioneer Parkway/SR 79

BLM VRI Classifications

Subroute 4C2c crosses 14.9 miles of land (approximately 9.2 percent) in the Tucson Field Office. It does not cross BLM land in the Safford Field Office.

Scenic Quality: Subroute 4C2c primarily crosses Class B scenic quality, with an area of Class C in the Tucson Field Office on one large BLM parcel (links C680, C818, and C820).

Sensitivity Level Rating Units: Subroute 4C2c crosses moderate sensitivity BLM land for the majority of the route.

Distance Zones: Subroute 4C2c is located in the foreground-middleground distance zone for all BLM land crossed.

VRI Classes: Subroute 4C2c crosses 10.5 miles of VRI Class III and 4.3 miles of VRI Class IV land in the Tucson Field Office; VRI Class I and II land is not crossed. BLM land in the Safford Field Office is not crossed by the BLM preferred alternative.

Sensitivity Level Rating Units: Subroute 4C2c crosses the Pinal Pioneer Parkway (Link C693), an area associated with high sensitivity in the Tucson Field Office. This alternative also crosses areas associated with moderate sensitivity level rating units (links C680, C818, and C820), as well as a small area of high sensitivity in the Tucson Field Office (Link C820).

BLM VRM Classifications

Subroute 4C2c crosses approximately 14.9 miles of VRM Class III land. This alternative does not cross VRM Class I, II, or IV land. VRM Class III land crossed by the preferred alternative is primarily associated with the Sonoran Desert Valley east of the Picacho Mountains.

Subroute 4C – San Pedro Valley and Tucson

Scenery

Primarily Class B scenery has been identified along Subroute 4C1. Class C landscapes crossed by this subroute are identical to Subroute 4C2c in the Sulphur Springs Valley and north of the Picacho Mountains. Subroute 4C1 also crosses grassland plains (Class C) south of the Galiuro Mountains and the BLM preferred alternative (Link C270). Class B scenery crossed by this subroute within the San Pedro Valley is similar to Subroute 4C2c; however, Subroute 4C1 is located east of the San Pedro River near the base of the Galiuro Mountains. Cultural modifications within the San Pedro Valley are similar to Subroute 4C2c. The San Pedro River and floodplain crossing (Class A) is similar to Subroute 4A, but is located farther south and is adjacent to developed landscapes, including the San Manuel Copper Mine complex (Link C660). Other Class A scenery includes steep desert canyons with perennial streams and riparian species concentrated along the bottom. There are no cultural modifications to the desert canyon landscape associated with Class A scenery. West of the San Pedro Valley, landscape scenery crossed by this subroute is similar to Subroute 4A, but is located farther south. Cultural modifications west of the San Pedro Valley are also similar to Subroute 4A. Scenery is identical to Subroute 4A, beginning with Link C760, west to the planned Pinal Central Substation. A total of 2.9 miles of Class A scenery, 117.8 miles of Class B scenery, and 18.2 miles of Class C scenery are crossed by Subroute 4C1.

Local Alternative Link C692 crosses similar Class B scenery as does Subroute 4C1; however, it crosses a more natural setting than Subroute 4C1, as it does not parallel an existing pipeline route.

Scenery along Subroute 4C2 is identical to Subroute 4C2c, except south of the Winchester Mountains (links C111, C266, C276, and C270). Subroute 4C2 crosses similar Class B and Class C scenery as the BLM preferred alternative, but is located farther north. The San Pedro River and floodplain crossing (Class A) is also similar to the BLM preferred alternative, but is located farther north and is in a more natural setting (Link C276). A total of 0.6 mile of Class A scenery,

126.7 miles of Class B scenery, and 24.4 miles of Class C scenery are crossed by Subroute 4C2. Cultural modifications are similar to the BLM preferred alternative.

Local alternative links C72, C90, C121, and C211 cross similar Class B scenery as Subroute 4C2, south of the Pinaleño Mountains. These links also cross identical Class B and Class C landscapes within Sulphur Valley.

Crossover links C500, C501, C502, and C174 cross Class B landscapes within the eastern portion of the San Pedro Valley. Crossover Link C671 crosses Class B scenery on the western side San Pedro Valley; however, this link is adjacent to the Tiger Mine.

A large portion of Subroute 4C3 crosses developed landscapes associated with the Tucson metropolitan area (links F111, F112, and F510). In more natural settings north and south of Tucson, Class B scenery is typical. Subroute 4C3 is identical to Subroute 4C1 south of the Pinaleño Mountains, within the Sulphur Springs Valley and south of the Winchester Mountains (links C71a, C110, and C212). It is also identical to Subroute 4C2c from the Tortolita Substation, north to the planned Pinal Central Substation (links C820, C830, C840, C850, C880, and C880a). This subroute crosses similar Class A and Class B scenery in the San Pedro Valley as subroutes 4C1 and 4C2. The San Pedro River and floodplain crossing (Class A) is identical to the BLM preferred alternative (Link 261). Other Class B scenery crossed by this subroute includes the area south of the Rincon Mountains, characterized by rolling foothills and gently sloping to rolling bajadas (links F40a and F600), and the Sonoran Valley plains west of the Tortolita Mountains (Link F540). Cultural modifications that have locally modified the landscapes associated with Class B scenery include HVTLs (345 kV, 230 kV, 138 kV, and 115 kV), pipelines, the Winchester Substation, major transportation corridors (e.g., I-10), and unpaved roads. Class C landscapes along this subroute include the valley plains south of the Winchester Mountains (Link 260), and the creosote dominated valleys near the Tortolita Substation (links C810a and C810) and the Rincon Valley (links F60b, F82, and F80). Cultural modifications that have locally modified the landscapes associated with Class C include HVTLs (500 kV, 345 kV, 230 kV, 138 kV, and 115 kV), pipelines, substations (e.g., Vail and Tortolita), Saguaro Power Plant, major transportation corridors (e.g., I-10), and unpaved roads. Class A scenery crossed by this subroute includes Cienega Creek (Link F600) southeast of Vail, and is characterized by a meandering, perennial creek with dense, riparian vegetation, including cottonwood and willow trees, adjacent to and within the creek bed. This subroute crosses the Cienega Creek near the I-10 crossing. Cultural modifications that have locally modified this landscape setting include HVTLs (345 kV), pipelines, major transportation corridors (e.g., I-10), railroad corridors, and trails. A total of 0.8 mile of Class A scenery, 101.7 miles of Class B scenery, and 51.9 miles of Class C scenery are crossed by this alternative. This subroute crosses 18.5 miles of developed lands generally associated with Tucson.

Local Alternative Link C812 crosses 1.4 miles of Class B scenery, 1.5 miles of Class C scenery, and 0.5 mile of developed land.

Viewing Locations and KOPs

For Subroute 4C1, high concentration residential viewers, which are associated with a high concern level, are located in Eloy, La Palma, Oracle, San Manuel, and Willcox along links C110,

C660, C670, and C880a. Smaller residential concentrations are located in Cascabel, Redington, and Mammoth along links C331, C470, and C660. Dispersed rural residences are generally located along links C71, C110, C270, C470, C510, C690, and C693. Future residences include Willow Springs near links C690, C691, and C693. The Project would be visible on links C331, C361, C470, C661, and C670 from high concern level recreation viewers, including trails within the Muleshoe Ranch, the Arizona Trailhead (Tiger Mine), Arizona Trail, Trail 289 (CNF), Galiuro Wilderness, Redfield Canyon Wilderness, Bellota Trail Loop, Granite Overlook Trail Loop, Manzanita Trail, Mariposa Trail, Nature Trail Loop, Wildlife Corridor Trail, and the historic Kannally Ranch House at the Oracle State Park. Travel routes with associated scenic or auto tour route designations include the Pinal Pioneer Parkway (SR 79), I-10, and SR 87. Moderate concern level recreation viewers include the Tierra Grande Country Club near Link C880a; and travel routes include Fort Grant Road, Muleshoe Ranch Road, SR 76 (San Pedro River Road), SR 77, and US Routes 191 and 287. Other areas associated with moderate concern levels include the Willow Springs (future development) and the Tom Mix Memorial/Rest Area near links C690, C691, C693, C760, and C780.

KOPs specific to Subroute 4C1 include:

- SA10 – Sulphur Springs Valley
- SA15 – Muleshoe Ranch Road
- TU4 – Oracle Residences
- TU5 – Arizona Trail/Tiger Mine Trailhead
- TU6 – San Manuel/San Pedro River Valley
- TU9 – San Pedro River Valley North
- TU30 – Pinal Pioneer Parkway/SR 79
- TU31 – Tom Mix Memorial/Rest Area
- TU32 – St. Anthony's Greek Orthodox Monastery
- TU33 – Earley Road Residences
- TU34 – SR 77
- TU36 – Freeman Road

Local Alternative Link C692 has similar viewing conditions to those identified for links C690, C691, and C693. These conditions include a moderate concern level associated with Willow Springs (future development).

For Subroute 4C2, high concentration residential viewers, which are associated with a high concern level, are located in Eloy, La Palma, Oracle, San Manuel, and Willcox along links C110, C450, C670, C680, and C880a. Smaller residential concentrations are located in Cascabel and Redington along Link C441. Dispersed rural residences are generally located along links C71, C110, C276, C441, C450, and C680. The Project would be visible on links C441, C450, C661, C670, and C680 from high concern level recreation viewers, including the Arizona Trail Trailhead (Tiger Mine), Arizona Trail, Last Chance Wilderness Trailhead, Trail 9 and associated Trail Head, Rincon Mountains Wilderness, Bellota Trail Loop, Granite Overlook Trail Loop, Manzanita Trail, Mariposa Trail, Nature Trail Loop, Wildlife Corridor Trail, and the Historic Kannally Ranch House at the Oracle State Park, and the Biosphere. Travel routes with associated scenic or auto tour route designations include SR 87 and Control Road (FR 38). Moderate concern level recreation viewers include the YMCA Triangle Y Ranch Camp and Retreat Center,

Bellota Ranch (A7 Ranch), Saddlebrook Ranch Golf Club, San Manuel Golf Club, and Tierra Grande Country Club near links C441, C450, C680, and C880a. Moderate concern level travel routes include Fort Grant Road, US Routes 191 and 287, Park Link Drive (which provides access to dispersed recreation in the Desert Peak area), SR 76 (San Pedro River Road), and SR 77. Moderate concern level recreation access/four-wheel drive roads include Black Hills Mine Road/Catalina Ridge, Buehman Canyon Trail, and Muleshoe Ranch Road.

KOPs specific to Subroute 4C2 include:

- SA10 – Sulphur Springs Valley
- SA15 – Muleshoe Ranch Road
- TU4 – Oracle Residences
- TU5 – Arizona National Scenic Trail (Tiger Mine Trailhead)
- TU7 – San Manuel Residences
- TU8 – Control Road (FR 38)
- TU9 – San Pedro River Valley North
- TU10 – Cascabel Road (North)
- TU27 – Biosphere
- TU28 – Longhoen Trail Residence/Red Rock
- TU29 – Park Link Drive
- TU31 – Tom Mix Memorial/Rest Area
- TU32 – St. Anthony's Greek Orthodox Monastery
- TU33 – Earley Road Residences
- TU34 – SR 77
- TU35 – Pinal Pioneer Parkway/SR 79

Local alternative links C72, C90, C121, and C211 have similar viewing conditions to those identified for links C71a and C110. Local Alternative Link C90 is a common link with Subroute 4B, and Local Alternative Link C790 is a common local alternative with the Sulphur Springs Valley Subroute. High concentration residential viewers, which are associated with a high concern level, are north of Willcox near Local Alternative Link C121. Moderate concern level travel routes include Fort Grant Road.

As previously described, Local Alternative Link C790 could affect viewers in a similar manner to those viewers identified for links C780 and C830. Specific viewing locations associated with this link include a travel route with associated scenic designation, the Pinal Pioneer Parkway (SR 79), and a moderate concern level associated with the Greek Orthodox Monastery.

Crossover links C500, C501, C502, C174, and C671 are associated with similar viewing locations as those identified for links C510, C173, C661, and C670. High concern level recreation viewing locations associated with Link C671 include the Arizona Trail, Bellota Trail Loop, Granite Overlook Trail Loop, Manzanita Trail, Mariposa Trail, Nature Trail Loop, Wildlife Corridor Trail, and the Historic Kannally Ranch House at the Oracle State Park. Moderate concern level recreation access/four-wheel drive roads includes the Copper Creek Road.

For Subroute 4C3, high concentration residential viewing locations, which are associated with a high concern level, are located in Eloy, La Palma, Tucson (including the associated cities of Mountain View, Vail, Little Town, Drexel-Alvernon, South Tucson, Flowing Wells, Cortaro, Casas Adobes, Rillito Tortolita, Dobson), and Marana along links C880a, F40a, F80, F82, F111, F112, F510, F540, and F600. Smaller residential concentrations are located in Pantano along Link F600. Dispersed rural residences are generally located along links C71, C110, C260, C810a, C810, C813, C816, C817, F40A, F600, and F540. The Project would be visible on links F40a, F60b, F80, F111, F112, F510, and F600, from high concern level recreation viewing locations that include Saguaro National Park West, Saguaro National Park East, Arizona Trail, Juan Bautista de Anza NHT, Rincon Mountain Wilderness, Arthur Pack Regional Park, Augie Acuña-Los Niños Park, Cienega Creek Preserve, Colossal Cave Mountain Park, Feliz Paseos Park, Rillito River Park (includes Mehl, Brandi Fenton, Children's Memorial, Curtis, Dan Felix Memorial, and Flowing Wells parks), Santa Cruz River Park (includes El Paseo de los Arboles Commemorative Park), Sunset Pointe Park, Tucson Mountain Park, Sentinel Peak Park, Christopher Columbus Park, Greasewood Park, John F. Kennedy Park, Silverbell Regional Park, Juhan Park, Joaquin Murrieta Park, Southwest Regional Park (Pima County Fairgrounds), and the Sweetwater Wetlands Park. Travel routes with associated scenic or auto tour route designations include I-10 (isolated segments through Tucson), SR 87, Patagonia-Sonoita Scenic Road (SR 83), Gates Pass Road, Marsh Station Road, Old Sonoita Highway, Houghton Road (I-10 to Sahuarita Road, and isolated portions near Escalante and Tanque Verde roads), Silverbell Road (isolated portions), Sunset Road, Valencia Road (Alvernon Way to east of Kolb Road), Vail Road/Wentworth Road (Colossal Cave Road to Sahuarita Road), and West Pictured Rock Road. Moderate concern level recreation viewing locations include the Urban Loop Trail System (planned), CAP National Recreation Trail, Silverbell Golf Course, Pines Golf Club at Marana, and the Tierra Grande Country Club near links F111, F112, F510, and C880a. Moderate concern level travel routes include I-10 (non-scenic portions), I-19, US Routes 191 and 287, Ocotillo Road, Three Links Road, Fort Grant Road, and Cascabel Road. Other areas associated with moderate concern levels include the JW Marriott Starr Pass Resort and Spa Tucson, Omni Tucson National Golf Resort and Spa, and Ritz-Carlton Resort Dove Mountain Golf Course near links F112, F510, and F540.

KOPs specific to Subroute 4C3 include:

- SA10 – Sulphur Springs Valley
- SA15 – Muleshoe Ranch Road
- TU11 – Cascabel Road (South)
- TU12 – Wrong Mountain Road Resident
- TU13 – Arizona National Scenic Trail (Cienega Creek)
- TU14 – I-10
- TU17 – Alvernon Residences
- TU18 – Gates Pass Road
- TU19 – Santa Cruz River Park/Anza NHT
- TU24 – Silverbell Road Residences
- TU25 – Saguaro National Park West
- TU26 – Ritz-Carlton Resort
- TU28 – Longhoen Trail Residence
- TU29 – Park Link Drive

- TU31 – Tom Mix Memorial/Rest Area
- TU32 – St. Anthony's Greek Orthodox Monastery
- TU33 – Earley Road Residences
- TU37 – Arizona National Scenic Trail – Davidson Canyon

No viewing locations are associated with Local Alternative Link C812.

BLM VRI Classifications

Within the Safford and Tucson field offices, BLM land would be crossed by Subroute 4C1, Subroute 4C2, and Subroute 4C3 for 5.2 miles (approximately 4 percent), 14.9 miles (approximately 10 percent), and 13.1 miles (approximately 7 percent), respectively. Local alternative links C260, C261, C201, C680, C810a, C812, C813, C814, C815, C816, and C817 cross 5.7 miles (approximately 8 percent) of BLM land within the Tucson Field Office. Local Alternative Link C692 for Subroute 4C1 does not cross BLM land within the Tucson Field Office. Local alternative links C72, C90, C211, and C121 do not cross BLM land within the Safford Field Office. Crossover links C500, C501, C502, and C174 cross 0.1 mile (approximately 0.5 percent) of BLM land within the Tucson Field Office. Crossover Link C671 does not cross BLM land. Local alternative links F40b, F51, F60a, F81a, and F81b for Subroute 4C3 do not cross BLM land within the Tucson Field Office.

Scenic Quality: In the Safford Field Office, Subroute 4C1 only crosses BLM land along Link C361, which is Class A scenic quality associated with Redfield Canyon. In the Tucson Field Office, Subroute 4C1 crosses Class B scenic quality in two areas (link C510, C660, and C693). Subroute 4C2 primarily crosses Class B scenic quality with an area of Class C in the Tucson Field Office on one large BLM parcel (links C680, C818, and C820). Subroute 4C3 mainly crosses Class B scenic quality (links F540, C810, C813, C816, C817, and C820) and an area of Class C scenic quality in the Tucson Field Office (C820). Crossover Link C502 crosses a small area of Class B scenic quality in the Tucson Field Office (approximately 0.1 mile).

Sensitivity Level Rating Units: Subroute 4C1 crosses an isolated area of high sensitivity associated with Muleshoe Ranch in the Safford Field Office. Subroute 4C1 also crosses two areas of high sensitivity in the Tucson Field Office. One area is associated with the San Pedro River Valley (links C510 and C660), and the other area is associated with the Pinal Pioneer Parkway (Link C693). Subroute 4C2 primarily crosses moderate sensitivity level rating units (links C680, C818, and C820) and a small area of high sensitivity in the Tucson Field Office (Link C820). Subroute 4C3 primarily crosses moderate sensitivity areas (links F540, C810, C813, C816, C817, and C820) and a small area of high sensitivity in the Tucson Field Office (Link C820). Crossover Link C502 crosses a small area of high sensitivity in the Tucson Field Office (approximately 0.1 mile).

Distance Zones: Subroute 4C1 is in the foreground-middleground distance zone where BLM land is crossed, with the exception of a small isolated area (approximately 0.2 mile) in the Tucson Field Office, due to landform screening (Link C693). Subroutes 4C2 and 4C3 and Crossover Link C502 are in the foreground/middleground distance zone on BLM land.

VRI Classes: Subroute 4C1 crosses primarily VRI Class II BLM land in the Safford and Tucson field offices, and a small isolated area of Class III (approximately 0.2 mile, Link C693). Subroute 4C2 crosses mainly Class III (links C680, C818, C820) and an area of Class IV (Link C820). Subroute 4C3 crosses two areas of Class IV (links F540 and C820) and three areas of Class III in the Tucson Field Office (links F540, C810, C813, C816, C817, and C820). Crossover Link C502 crosses a small area of VRI Class II in the Tucson Field Office (approximately 0.1 mile).

BLM VRM Classifications

Subroute 4C1 crosses approximately 1.4 miles of VRM Class II and approximately 3.9 miles of VRM Class III lands within the Safford and Tucson field offices. This subroute does not cross VRM Class IV land. Subroute 4C1 crosses the southwestern edge of the Muleshoe Ranch CMA ACEC, which is associated with VRM Class II land. VRM Class III land crossed by this subroute is associated with the Sonoran Desert Valley east of the Pinal Pioneer Parkway.

Subroute 4C2 crosses approximately 14.8 miles of VRM Class III land, and Subroute 4C3 crosses approximately 13.2 miles of VRM Class III land. These subroutes do not cross VRM Class II or Class IV lands. VRM Class III land crossed by these subroutes is primarily associated with the Sonoran Desert Valley east of the Picacho Mountains.

All local alternative and crossover links for Subroute 4C do not cross BLM land; therefore, VRM classifications are not applicable.

<u>Local Alternative for Subroute 4C2 (Winchester Substation)</u>

Scenery

This local alternative is identical to Subroute 4C3 south of the Winchester Mountains (links C260 and C261). It also crosses similar landscapes within the southwestern portion of the San Pedro Valley (Class B), as do subroutes 4C1 and 4C2; however, this local alternative for Subroute 4C2 also crosses alluvial fans and the southeastern foothills of the Rincon Mountains (Link C201). Class A scenery crossed by this local alternative subroute includes the San Pedro River and floodplain, and is similar to the Subroute 4C3 crossing. Cultural modifications are similar to Subroute 4C2.

Viewing Locations and KOPs

Dispersed rural residences associated with a high level of concern are generally located along links C260, C261, and C201. The Project would be visible on Link C201 from high concern level recreation viewing locations of the Rincon Mountain Wilderness. Moderate concern level local access travel routes include Ocotillo Road, Three Links Road, Cascabel Road, and Muleshoe Ranch Road.

KOPs specific to the Winchester Substation subroute include:

- TU10 – Cascabel Road, North
- TU11 – Cascabel Road, South
- SA15 – Muleshoe Ranch Road

BLM VRI Classifications

The Winchester Substation is not associated with BLM land; therefore, VRI data is not identified.

BLM VRM Classifications

The Winchester Substation is not associated with BLM land; therefore, VRM classifications are not applicable.

Local Alternative Links for Subroute 4C2 (Tortolita Substation)

Scenery

Scenery along this alternative was inventoried as primarily Class B and is associated with the Sonoran Valley plains. Link C810a and portions of links C810 and C812 cross level valley plains dominated by creosote (Class C). Link C810a is also immediately adjacent to the Saguaro Power Plant.

Cultural modifications are similar to Subroute 4C3.

Viewing Locations and KOPs

Dispersed residences associated with high concern levels are located east of Red Rock near the Tortolita Substation. Viewing locations associated with moderate concern levels include I-10. There are no recreation areas or KOPs associated with the Tortolita Substation.

BLM VRI Classification

The Tortolita Substation is not associated with BLM land; therefore, VRI data is not identified. The local alternatives near the Tortolita Substation for 4C2 links pass through approximately 7.2 miles of BLM land in the Tucson Field Office. Where BLM land is crossed, the local alternatives pass through Class B scenery, moderate sensitivity level rating units, the foreground/middleground distance zone, and Class III VRI classes (links C680b, C810, C813, C814, C815, C816, and C817).

BLM VRM Classifications

The Tortolita Substation is not associated with BLM land; therefore, VRM classifications are not applicable. The local alternatives for 4C2 pass through approximately 7.2 miles of Class III VRM (links C680b, C810, C813, C814, C815, C816, and C817).

Local Alternative Links (Pinal Central Substation)

Scenery

Local alternative links C860, C870, and C890 are located to the north of subroutes 4B and 4C, and cross similar Class B and Class C scenery.

Cultural modifications are similar to Alternative 4A.

Viewing Locations and KOPs

Dispersed rural residences associated with a high level of concern are generally located along links C860, C870, and C890. KOPs associated with high concern levels include the Earley Road Residence (TU33).

High concern level travel routes include SR 87 which is a designated auto tour route for the Anza NHT. Moderate concern level travel routes include US Highway 287.

BLM VRI Classifications

The local alternative links are not associated with BLM land; therefore, VRI data is not identified.

BLM VRM Classifications

The local alternative links are not associated with BLM land; therefore, VRM classifications are not applicable.

Local Alternative Links for Subroute 4C3 (Pantano-Rillito)

Scenery

A large portion of this local alternative crosses developed landscapes (approximately 23.2 miles) in the Tucson metropolitan area (links F81a and F81b), similar to Subroute 4C3; except this alternative is located to the east near the Santa Catalina Foothills. Link F81a crosses Class C scenery similar to Subroute 4C3 in the Rincon Valley. Links F40b, F51, and F60a are located in Class B scenery similar to Subroute 4C3, south of the Rincon Mountains. Link F51 crosses the Cienega Creek (Class A) northeast of Vail in a more natural setting than the Subroute 4C3 crossing. Cultural modifications are similar to Alternative 4C3.

Viewing Locations and KOPs

High concentration residential viewing locations, which are associated with a high concern level, are located in Tucson (including the associated cities of Mountain View, Vail, Catalina Foothills, Flowing Wells, and Casas Adobes) and Oro Valley, along links F40b, F51, F60b, F81a, and F81b. The Project would be visible on links F40b, F51, F60b, F81a, and F81b, from high concern level recreation viewing locations, including Saguaro National Park West Trailhead (36th Street and Valley View Overlook Trail), Tucson Mountain Park (Gates Pass Overlook Trail), Arizona Trail, Sabino Canyon Trail, Rincon Mountain Wilderness, Cienega Creek Preserve, Colossal Cave Mountain Park, Rillito River Park, Chuck Ford Lakeside Park, Lincoln Park, and Michael Perry Park. Travel routes with associated scenic or auto tour route designations include I-10 (isolated segments through Tucson), Mt. Lemmon Highway (Catalina Highway/Sky Island Parkway), Redington Road, Oracle Road, Colossal Cave Road, Freeman Road, Marsh Station Road, Old Spanish Trail, Houghton Road, Ina Road, Kolb Road/Craycroft Road, River Road, Sabino Canyon Road, Skyline Drive, Snyder Road, Sunrise Road, and Swan

Road. Moderate concern level recreation viewing locations include the Pantano River Park (planned) and the Urban Loop Trail System (planned), near links F81a and F81b. Other areas associated with moderate concern levels include Omni Tucson National Golf Resort and Spa near Link F81a.

KOPs specific to Pantano-Rillito local alternative include:

- TU13 – Arizona National Scenic Trail (Cienega Creek)
- TU15 – Civano Residence
- TU14 – I-10
- TU16 – Saguaro National Park East
- TU20 – Sky Island National Scenic Byway
- TU21 – Mehl Park Residence
- TU22 – River Road
- TU23 – Oracle Road
- TU24 – Silverbell Road Residence

BLM VRM Classifications

The Pantano-Rillito local alternative is not associated with BLM land; therefore, VRM classifications are not applicable.

3.10 LAND USE AND RECREATION RESOURCES

3.10.1 Introduction, Methods, and Regulatory Framework

3.10.1.1 Introduction

This section summarizes land use and recreation resources within the Project area. Existing and planned uses have been documented for the entire 6-mile-wide study corridor (3 miles on either side of the reference centerline) on federal, state, county, city, and private land. Land uses are shown on figures M 10-1 to M 10-4 (see Map Volume).

Based on results of the public scoping process and in consultation with the BLM, the following areas of concern were identified regarding land use:

- BLM RMP right-of-way exclusion and avoidance areas
- Maximize use of existing utility corridors
- Right-of-way conflicts with existing residential areas, irrigated farmland, and commercial/industrial areas
- Recreation uses, including OHV areas
- Military testing and training operations
- Pima County conservation lands
- TNC allotments/easements
- Muleshoe Ranch CMA, Swamp Springs-Hot Springs Watershed ACEC

- Winkelman and Redington NRCD plans restrict new utilities within the San Pedro River and Aravaipa Creek watersheds (NRCD boundaries include 814,279 acres of lands within the relevant study corridors)
- Ranching and livestock grazing

3.10.1.2 Methods

Land and resource use data (i.e., primary data) that identify existing and planned land uses were collected within the study corridor; while the collection, review, and refinement of additional secondary data was used to conduct the inventory. Information was obtained from various federal, state, and local agency staff and documents, including:

- BLM land and RMPs and information concerning land use classifications, special management areas (SMA), SRMAs, active mining sites, prior existing rights-of-way, designated OHV areas, WSA, and other authorized land uses
- DOD base plans and Memoranda of Understanding (MOU)
- New Mexico and Arizona state parks and lands
- City and county land use plans, and NRCD plans
- Private development plans
- Aerial Imagery
  - Digital Globe Satellite Imagery
  - Esri

Field investigations were conducted throughout the study corridors for all of the transmission line subroutes. Federal, state, regional, and local governmental agencies and organizations were contacted to obtain and discuss specific land use data and plans. Existing and future land use categories that occur within the study corridor include:

Residential – low, medium, and high density single-family residential, multi-family residential (e.g., apartment complex), rural residential, and mobile home parks. Residences are found scattered throughout the Project study corridor, with concentrations near towns and cities such as Deming, New Mexico, and Tucson, Arizona. For the purpose of this inventory, residential densities were defined as:

- Rural residential/low density: 0 to 2 dwelling units per acre
- Medium density: >2 to 8 dwelling units per acre
- High density: >8 dwelling units per acre

Commercial – restaurants, gas stations, banks, grocery stores, motels and hotels, and other businesses. Within the Project study corridor, concentrations of commercial use mainly occur in populated areas (e.g., Lordsburg, New Mexico and Tucson, Arizona) and along major transportation corridors (e.g., I-25 and I-10).

Grazing/Multi-Use/Vacant – all land uses that did not fit under a specific category, or were not specifically designated for a specific use by the responsible jurisdiction or land management agency.

Industrial – warehouse businesses, manufacturing companies, storage facilities, and other uses. Industrial uses occur near populated areas such as Socorro, New Mexico, and Tucson, Arizona.

Public/Quasi Public – places of worship such as churches, community centers, and libraries. Public/quasi-public uses occur near populated areas such as Deming, New Mexico and Tucson, Arizona.

School/Educational Facilities – preschools, primary schools, secondary schools, and colleges. Schools/educational facilities are typically located near population centers such as Deming, New Mexico, and Tucson, Arizona.

Air Facilities – airports, airstrips, and heliports, such as Tucson International Airport in Arizona.

Military – managed by the DOD and includes bases, missile launch facilities, and firing ranges such as the WSMR in New Mexico.

Agriculture – ranching, farming, and dairy operations. Agricultural land uses within the Project study corridor are primarily ranching and grazing.

Utilities – power plants, substations, transmission lines, pipelines, canals, designated utility corridors, and wind and solar farms. Utility land uses are found throughout the study corridor and include pending right-of-way applications for solar and wind projects proposed on BLM-administered land in New Mexico.

Communication Facilities – cellular, radio, and television facilities. A variety of communication facilities are scattered throughout the study corridor.

Transportation – minor roads (county highways, city streets); major roads (interstates, state highways); railroads; trails; etc. Though transportation land uses occur throughout the study area, the main features are I-10, I-25, and the UPRR.

Recreation – federal, state, and local recreational trails and designated OHV areas. Recreation land uses within the study corridor include BLM SRMAs designated for multiple recreational activities such as rock climbing and bouldering.

Parks/Preservation – federal, state, and local parks, open areas, and areas protected from development. Parks and preservation areas within the study corridor include the Sevilleta NWR in New Mexico, and the Catalina and Orange state parks in Arizona.

Performance Zone District – a specific zoning classification established by Doña Ana County, New Mexico, to allow flexibility for land use activities in rural areas of the county while protecting residents and property values. In the Performance Zone District, any use may be approved, provided all standards are met for that particular use and the use is consistent with the character of the surrounding areas (Doña Ana County 2005). These areas are located within the 6-mile-wide study corridor.

Rural Preservation – a zoning classification, modified from the Cochise County Comprehensive Plan. A large majority of the land in Cochise County is Rural Zoning, which was established to

preserve the character of designated rural areas in the County. These designations were also established to preserve the agricultural character of areas that were capable of resource production, and to preserve the rural environment of outlying unincorporated areas.

3.10.1.3 Regulatory Framework

The following BLM, National Forest Service land, state regulations, and county and local plans were reviewed.

BLM

New Mexico

Las Cruces District Office, Mimbres Resource Management Plan (BLM 1993). This plan was prepared to formally record the BLM's decisions for managing approximately 3 million acres of public land in Doña Ana, Grant, Luna, and Hidalgo counties.

Las Cruces District Office, White Sands Resource Area Resource Management Plan (BLM 1986; amended by McGregor Range RMP in 2006). This plan establishes land use decisions, terms, and conditions for guiding and controlling future management actions in Sierra and Otero counties.

Rio Puerco (Albuquerque) Resource Management Plan Revision and Environmental Impact Statement (BLM 1985). This plan was prepared to formally record the BLM's decisions for managing approximately 8.6 million acres of land; including 896,480 acres of public land in Bernalillo, Cibola, Torrance, Valencia, Sandoval, McKinley, and Santa Fe counties.

Socorro Field Office, Socorro Resource Management Plan and Record of Decision (BLM 2010b). This plan has been prepared to allocate resources and provide a comprehensive framework for the BLM's management of 1.5 million acres of public land within Socorro and Catron counties.

Arizona

Phoenix Field Office, Phoenix Resource Management Plan and Final Environmental Impact Statement (BLM 1988a). This plan was developed to guide the BLM in its management of the Phoenix Resource Area, which consists of approximately 911,000 acres of public land within two distinct geographic regions of Arizona, and includes portions of Pima and Pinal counties located within the Project study corridors. This area is now managed by the Tucson Field Office.

Safford District Office, Safford District Resource Management Plan and Environmental Impact Statement (BLM 1991). This plan has been prepared to guide the management of 1.4 million acres of public land in the Safford District (southeastern Arizona) for the next 15 years, including Graham, Greenlee, Cochise, Pinal, Pima, and Gila counties.

Safford Field Office, Environmental Assessment/Gila Box Riparian National Conservation Area Management Plan (BLM 1998a). This plan provides for the appropriate management of the Gila

Box Riparian Area for approximately 15 years (from 1998). It includes portions of Graham and Greenlee counties.

Tucson Field Office, Muleshoe Ecosystem Management Plan and Environmental Assessment (BLM 1998b). This plan was prepared to manage the riparian areas, and associated aquatic, plant, and animal communities.

Tucson Field Office, Las Cienegas Resource Management Plan and Record of Decision (BLM 2003). This plan was prepared to manage the 49,000 acres of public land, resources and uses within the Las Cienegas National Conservation Area and Sonoita Valley Acquisition Planning district.

National Forest

New Mexico

National Forest Service Southwestern Region, Cibola National Forest Land and Resource Management Plan (USFS 1985). This plan defines the direction for managing the Cibola National Forest for the next 10 to 15 years, including management direction for the Kiowa, Rita Blanca, McClellan Creek, and Black Kettle National Grasslands.

National Forest Service Southwestern Region, Lincoln National Forest Land and Resource Management Plan (USFS 1986a, with last amendment in 2009). This plan defines the direction for managing the Lincoln National Forest for the next 10 to 15 years.

Arizona

National Forest Service Southwestern Region, Coronado National Forest Land and Resource Management Plan (USFS 1986b, with last amendment in 2005). This plan defines the direction for managing the CNF for the next 10 to 15 years.

State

New Mexico

New Mexico Certificate of Public Convenience and Necessity. The New Mexico Public Regulation Commission controls all aspects of transmission line siting within the state. Three permits are required to build a transmission line greater than or equal to 230 kV: (1) Certificate of Public Convenience and Necessity; (2) Location Permit; and (3) Right-of-Way Width Determination, which establishes, under New Mexico statute, the requirement for Public Regulation Commission approval on all proposed transmission lines with a right-of-way width greater than 100 feet, regardless of voltage, in cases other than a fee-simple acquisition.

Arizona

Arizona Corporation Commission. In 1971, the Arizona Legislature required that the Arizona Corporation Commission (ACC) establish the Power Plant and Transmission Line Siting Committee, after it found that existing law did "not provide adequate opportunity for individuals,

groups interested in conservation and the protection of the environment, local governments, and other public bodies to participate in timely fashion the decision to locate a specific major facility at a specific site." The Committee provides a single, independent forum responsible for evaluation of applications to build power plants (of 100 MW or more) or transmission projects (of 115 kV or more) in the state.

Utilities with proposed power plants or transmission lines subject to Commission/Committee jurisdiction are required to make an application to the ACC for a Certificate of Environmental Compatibility (CEC). During open public hearings, the Committee considers the matter(s) contained in the application relative to a series of factors specified in Section 40-360.06, ARS. Following deliberations, the Committee makes a recommendation to the ACC regarding approval of the CEC, and may propose conditions and/or restrictions for inclusion in the CEC. Subsequently, the ACC makes a final determination on the CEC application and may accept, reject, or modify the Committee's recommendations.

Arizona State Land Department. ASLD's purpose is to manage State Trust lands and resources to enhance value and optimize economic return for the trust beneficiaries, consistent with sound stewardship, conservation, and business management principles supporting socioeconomic goals for citizens here today and for generations to come (ASLD 2012). Rights-of-way are granted across State Trust Land for a variety of public and private uses, such as access roads, infrastructure, power lines, communication lines, and public roadways. The ASLD has jurisdiction over rights-of-way that would cross State Trust land.

Counties and Cities

New Mexico

New Mexico does not have any state laws requiring comprehensive land use plans. Therefore, the counties of Socorro, Luna, and Hidalgo do not have any future land use designations. City and county plans within the state of New Mexico can be found in Section 3.10.4.

Arizona

Arizona State Law requires that all counties prepare and adopt a comprehensive plan. According to state law, "[t]he purpose of the plan is to bring about coordinated physical development in accordance with the present and future needs of the county. The comprehensive plan shall be developed so as to conserve the natural resources of the county, to ensure efficient expenditure of public funds and to promote the health, safety, convenience and general welfare of the public" (ARS 11-806). City and county plans for the state of Arizona can be found in Section 3.10.4.

Conservation Initiatives and Programs

Middle Rio Grande Conservation Initiative

The Middle Rio Grande Conservation Initiative was created in response to the *America's Great Outdoors* initiative, the goals of which were to enhance conservation, recreation, and education in the Middle Rio Grande.

Middle Rio Grande Bosque Initiative

The primary objective of the Middle Rio Grande Bosque Initiative is "to protect, enhance, and restore biological values by addressing ecological functions." The USFWS received a total of $9.3 million between 1994 and 2009, and this funding accomplished a total of 317 projects, including research, monitoring, habitat enhancement, and education/outreach efforts.

Middle Rio Grande Endangered Species Collaborative Program

The Middle Rio Grande Endangered Species Collaborative Program is a partnership "organized to protect and improve the status of endangered species…along the Middle Rio Grande while simultaneously protecting existing and future regional water uses." Congress appropriated $115.8 million to the BOR between 2001 and 2009 to support the program, along with $12.7 million in non-federal matching funds.

Middle Rio Grande Revitalization Project

The Middle Rio Grande Revitalization Project is focused on ecosystem restoration and recreation enhancement. The USACE has appropriated $20 million in funding for habitat restoration and recreation projects.

Lower San Pedro River Collaborative Conservation Initiative

The Lower San Pedro River Collaborative Conservation Initiative is a voluntary landowner-driven initiative that "would focus on restoring and conserving rural working landscapes while enhancing local economies along the Lower San Pedro River corridor." The USFWS would support the landowners by offering facilitation and conservation grant support for projects, and as funding becomes available, could also offer conservation easement opportunities. The USFWS would also work with willing sellers to purchase lands to be added to a future NWR. This initiative is currently at the initial scoping stage; however, until an EIS has been prepared, the level of impact to initiative measures cannot be determined.

Sonoran Desert Conservation Plan

Pima County, Arizona created the *Sonoran Desert Conservation Plan* to manage rapid urban expansion, while preserving large areas with high conservation value. The elements of the plan identify and provide goals, objectives, and strategies for managing biological corridors and critical habitat, riparian areas, mountain parks, cultural resources, and working ranch lands. The SDCP includes strategies to "focus future growth and associated infrastructure expansion in areas in closest proximity to existing urbanized areas, not in areas of highest biological richness." The SDCP provides guidelines used to classify conservation lands within the CLS in Pima County's Comprehensive Plan. CLS category designations and Conservation guidelines apply to lands under the jurisdiction of Pima County and Pima County Flood Control District. The CLS identifies various conservation categories, including Important Riparian Areas, Biological Core Management Areas, and Multiple Use Management Areas. The SDCP also provides the

framework for a future multiple species conservation plan to support an incidental take permit for 10 species listed under the ESA.

Working Lands for Wildlife Habitat Initiative

The Working Lands for Wildlife Habitat Initiative is sponsored by the partnership between the USDA NRCS and the USFWS. In Arizona, the initiative "will focus on cooperative efforts to assist ranchers and farmers in preserving their heritage and way of life while strengthening rural economies and conserving the federally endangered Southwestern Willow Flycatcher." The initiative is proposed "to use agency technical expertise combined with $33 million in financial assistance from the Wildlife Habitat Incentive Program to combat the decline of seven specific wildlife species whose decline can be reversed and will benefit other species with similar habitat needs," in multiple states.

Natural Resource Conservation Districts

Redington Natural Resource Conservation District

The Redington NRCD encompasses approximately 290,381 acres in the San Pedro River Valley of southeastern Arizona in Cochise, Pima, Pinal, and Graham counties. Approximately 185,286 acres are located within the Project study corridor. The Redington NRCD's *Long Range Natural Resource Conservation Plan, 2010-2016*, includes adopted management recommendations in response to the NRCD's major concerns and objectives. The primary objective of the Redington NRCD "is to provide leadership in promoting the conservation of all natural resources within the district." Major identified concerns addressed in the plan include soil erosion and sedimentation (design and construction practices), upland vegetation (grazing practices), water availability/quantity/quality (BMPs), noxious and invasive plants, wildlife and fish (discourage habitat fragmentation, education), and conservation planning/education. The plan includes management direction to "discourage habitat fragmentation and stream sedimentation created by utility or major transportation corridors."

In 2010, the Redington NRCD formalized this management direction through adoption of a Major Utility/Transportation/Communication Corridors Policy, which states "[i]t is the policy of the Redington Natural Resource Conservation District to oppose the construction of any new major energy, transportation, or communication corridors through the Redington NRCD. In order to minimize impacts of such actions all future construction of such corridors should be along existing corridors of similar capabilities that would only require an upgrade from what currently exists."

Winkelman Natural Resource Conservation District

The Winkelman NRCD encompasses approximately 1,609,464 acres in the San Pedro River Valley of southeastern Arizona in Pinal, Pima, Gila, and Graham counties. Approximately 628,993 acres are located within the project study corridor. The Winkelman NRCD's *Land Management Plan* includes management direction to "provide guidance to rural property owners, farmers and ranchers for the protection, restoration and conservation of land, water and soil

resources of the District and state to include the preservation of water rights and the control and prevention of soil erosion." The management direction also includes assisting "private property owners in conserving natural resources, fish and wildlife and their habitat, rivers and streams and associated riparian habitats, protecting the tax base, [and] protecting public lands…" The plan includes strategies to coordinate with federal agencies through "being involved with the agencies at the earliest date as the agency begins moving forward" on a project, "insuring [*sic*] that all property owners are aware of proposed actions," "coordinating public meetings," "recruiting experts" when appropriate, "insisting on…compliance with NEPA," and "insuring [*sic*] that all actions pertaining to species are good for all species including the human species." The plan also states that all actions should "protect the economic base of the district."

In 2010, the Winkelman NRCD added a policy to formalize management of proposed major corridors, titled Policy 1 – Major Corridors Policy, which states that "[i]t is the policy of the Winkelman Natural Resource Conservation District to oppose the construction of any new major energy, transportation or communication corridors through or across District lands." Further, the policy states that "…all future major new transmission installations should be planned to follow existing rights-of-way," and "…considerations be made for upgrading existing facilities rather than construction of new facilities."

3.10.2 Regional Overview

3.10.2.1 New Mexico

Agriculture, including livestock grazing, is the predominant land use within the study corridors. Irrigated agriculture is commonly found in the Rio Grande Valley, and near other populated areas.

North of the WSMR, land within the study area is mostly open range used for grazing, with ownership a mix of BLM, state, and private. The DOD also owns a small amount of land in this area. LC 94, a cruise missile launch site approximately 14 miles south of US 60 and 22 miles north of US 380, near the extended east/west midpoint of the WSMR, is leased by the WSMR. The Gran Quivira ruins are located south of SR 55, approximately 20 miles southeast of the town of Mountainair.

The town of Socorro, a community of more than 8,800 people, is in the Rio Grande Valley 20 miles northwest of the WSMR and 20 miles south of the Sevilleta NWR. Socorro is the County seat and home to New Mexico Tech University. South of Socorro is the town of San Antonio, whose major land uses include single-family residential, commercial, and agriculture (near the Rio Grande). The Bosque del Apache NWR is located south of San Antonio and contains three separate wilderness areas.

South of the Bosque del Apache NWR is the 358,000-acre Armendaris Ranch, which is bordered to the east by the WSMR and to the west by the Rio Grande. The towns of Truth or Consequences and Elephant Butte are located approximately 15 miles west of the southern portion of the Armendaris Ranch.

Southwest of Truth or Consequences is the city of Deming, one of the larger cities in Luna County, with an estimated population of 14,000 residents. The city of Lordsburg is approximately 60 miles west of Deming, along I-10.

3.10.2.2 Arizona

In Arizona, the study corridor includes various land uses and recreational opportunities. With the exception of the city of Tucson, the study area has a predominantly rural character, with center pivot and flood irrigated farmland and livestock grazing being the primary land uses. Irrigated agriculture is commonly found in the Sulphur Springs Valley, along the San Pedro River; and near the terminus of the Project, near the planned Pinal Central Substation in Pinal County.

Approximately 10 miles east of the Arizona and New Mexico border along I-10 is the town of San Simon, a small agricultural based community surrounded by center pivot and flood irrigated agricultural fields. The Bowie townsite, an agricultural based community similar to San Simon, is approximately 16 miles west of San Simon.

The planned Willow-500 kV Substation would be located approximately 14 miles northwest of the Bowie townsite and in the eastern foothills of the Pinaleño Mountains. Two subroutes surround the Pinaleño Mountains unit of the CNF. Subroute 4A is adjacent to the eastern and northern national forest boundary and parallels a portion of US Route 191, south of the city of Safford. Subroute 4B is south and west of the forest boundary through the Sulphur Springs Valley, bordered on the west by the Galiuro Mountains. Single-family residential properties and center-pivot sprinkler-irrigated agricultural fields are located in portions of the Sulfur Springs Valley north of Willcox.

Part of the CNF, the Galiuro Mountains also contain the Galiuro Wilderness Area and the Muleshoe Ranch CMA, which is cooperatively managed by the BLM, TNC, and USFS. Near the northern edge of the Galiuro Mountains is Aravaipa Canyon; to the north of which is the Aravaipa Canyon Preserve, managed by TNC. West of the Galiuro Mountains is the San Pedro River and San Pedro River valley. Within the study area, the communities of Cascabel, San Manuel, and Mammoth lie along the San Pedro River, surrounded by irrigated farmland. Cascabel is located near the southern end of the study area, and San Manuel and Mammoth near the north. On the west side of the San Pedro River near the town of Cascabel, Pima County owns several parcels of land that, in cooperation with TNC, have been set aside as grazing allotments to preserve the natural state of the land. These parcels of land are bordered by the Rincon Mountains and CNF to the west.

The Rincon and Catalina mountains are also part of the CNF. Situated west of the San Pedro River, the Rincon Mountains contain the Rincon Mountain Wilderness Area and the eastern portion of the Saguaro National Park. To the north of Tucson, the Catalina Mountains contain the Pusch Ridge Wilderness Area, just southeast of Catalina State Park. Oracle State Park is located near the northern end of the Catalina Mountains, close to the town of Oracle.

The city of Tucson is a large population center with multiple land uses, including single- and multi-family residential, commercial, industrial, military, public, and recreation. Tucson

International Airport is located on the south side of Tucson; Davis-Monthan AFB is located north of the airport.

The remainder of Saguaro National Park, which also contains the Saguaro Wilderness Area, is in the Tucson Mountains. Ironwood Forest National Monument is north of the Saguaro National Park, in the town of Marana. The Tortolita Substation is also located in Marana, on the east side of I-10. The terminus of this Project, the planned Pinal Central Substation, is located farther north in Pinal County.

3.10.3 Existing Land Use and Recreation

Land Jurisdiction and Ownership – The study corridors are within the following counties in New Mexico: Hidalgo, Grant, Luna, Sierra, Socorro, Lincoln, and Torrance. In Arizona, the study corridors are within portions of the following counties: Pinal, Pima, Graham, Greenlee, and Cochise. The study corridors include five incorporated cities and towns and at least four unincorporated communities in New Mexico; and nine incorporated cities and towns and at least five unincorporated communities in Arizona (Table 3-45). Federal and state agencies with land ownership or management responsibilities within the study corridors are listed in Table 3-46 and Table 3-47.

Table 3-45. Counties and Towns in the Vicinity of the Study Corridors

County	Towns/Communities
New Mexico	
Hidalgo	Lordsburg
Grant	*The study corridor passes near no towns or unincorporated communities in Grant County*
Luna	Deming
Sierra	Elephant Butte, Truth or Consequences
Socorro	Bingham (unincorporated), Lemitar (unincorporated), Luis Lopez (unincorporated), San Antonio (unincorporated), Socorro
Lincoln	Corona (unincorporated)
Torrance	Mountainair
Arizona	
Cochise	Bowie (unincorporated), Benson, San Simon (unincorporated), Willcox
Graham	Safford, Thatcher
Greenlee	Duncan (unincorporated)
Pima	Avra Valley (unincorporated), Marana, Tucson
Pinal	Eloy, Marana, Oracle, San Manuel (unincorporated)

Table 3-46. Federal Land Management Agencies within the Study Corridors			
Department	Agency	Office/Management Responsibility	
		New Mexico	Arizona
U.S. Department of the Interior	Bureau of Land Management	New Mexico State Office, Roswell, Rio Puerco, and Socorro Field Offices, and Las Cruces District Office	Safford and Tucson Field Offices
	National Park Service	Salinas Pueblo Missions National Monument	Saguaro National Park
	Bureau of Reclamation	—	Central Arizona Project
	U.S. Fish and Wildlife Service	Bosque del Apache NWR and Sevilleta NWR	—
U.S. Department of Agriculture	U.S. Forest Service	Lincoln, Cibola, and Gila National Forests	Coronado National Forest
U.S. Department of Defense	U.S. Department of the Army, Air Force, and National Guard	White Sands Missile Range	Fort Huachuca Buffalo Soldier Electronic Proving Ground, Davis-Monthan AFB, Silverbell Heliport Western Army National Guard Aviation Training Site, and Picacho Auxiliary Army Airfield #1

Table 3-47. State Land Management Agencies within Study Corridor	
Department	Management Responsibility
New Mexico	
New Mexico State Land Office	New Mexico State Lands
New Mexico State Parks	Elephant Butte Lake State Park
Arizona	
Arizona Game and Fish Department	Cluff Ranch Wildlife Area
Arizona State Land Department	Arizona State Trust Lands
Arizona State Parks	Roper Lake State Park and Oracle State Park

3.10.3.1 General Developed Land Uses

The study corridors and subroutes traverse numerous government jurisdictions, with residential, commercial, industrial, recreational, and agricultural land uses. Major transportation routes include three interstate highways, and state and local transportation routes. International airports, military airports, and municipal/community airports are also located within the study area. Existing land uses on federal, state, county, and private lands have been documented within the study corridors and are summarized in the following sections.

3.10.3.2 Agriculture and Range

Land within the Project study corridors is mainly federal and state owned, and largely undeveloped. These lands are leased to ranchers to graze livestock. Smaller-scale private

agricultural operations within the study corridors mainly occur near populated areas. Active dairy farms are also located within the study corridors.

The BLM's objective for grazing lands is to ensure the long-term health and productivity of these lands, and to create multiple environmental benefits that result in healthy watersheds (BLM 2010j). Livestock grazing is managed in accordance with Rangeland Health Standards. The number of authorized Animal Unit Months (AUM) on BLM land can vary depending upon factors such as drought, wildfire, and market conditions. The BLM field and district offices manage grazing allotments within the study area, as indicated below.

New Mexico

- Las Cruces District Office: manages 347 grazing allotments. The allotments are administered by MOU, between the Safford and Las Cruces districts. This MOU also provides for the administration of a portion of one allotment located in Cochise County, Arizona, by the Mimbres Resource Area (BLM 1993).
- Socorro Field Office: manages approximately 252 grazing allotments that are located completely or partially within the field office (BLM 2010c).

Arizona

- Safford Field Office: manages 109 allotments in their field office, and another 118,000 acres of rangeland in New Mexico, in cooperation with the BLM Las Cruces District Office (BLM 1991).
- Tucson Field Office: does not have a specific RMP, and currently uses the Eastern Arizona Grazing EIS (BLM 1987) for management of rangeland. The Tucson Field Office manages 136 grazing allotments.

In addition to BLM-managed grazing allotments, state trust lands in New Mexico and Arizona are leased for grazing within the study area, according to Title 10, Chapter 2, Part 8 of the NMAC, and Section 37-281.01 of the ARS. The acreages below represent the amount of state trust lands per county in New Mexico and Arizona, with the assumption that any state trust lands can be leased for the purpose of livestock grazing.

New Mexico

- Grant/Sierra Counties: 64,097 acres
- Hidalgo County: 486,960 acres
- Lincoln County: 359,081 acres
- Luna County: 713,208 acres
- Socorro County: 649,638 acres
- Torrance County: 449,746acres

Arizona

- Cochise County: 1,327,382 acres
- Graham County: 484,361 acres
- Greenlee County: 169,605 acres
- Pima County: 711,404 acres
- Pinal County: 1,101,467 acres

Irrigation types that occur within the study corridors include center-pivot sprinklers, flood, and row configurations. Irrigated farmlands have been identified because of the potential for transmission towers to conflict with or impede center-pivot sprinkler systems. Center-pivot sprinklers are anchored to one location and swivel up to 360 degrees to irrigate a complete circle, typically 160 acres or larger.

3.10.3.3 Conservation Easements

A recorded conservation easement on a property may define future types of development allowable on the property, or may restrict all types of development, depending on the particular type of easement recorded. A number of existing and proposed conservation easements are known to occur throughout the study area, with particular concentrations along the Rio Grande and the San Pedro River, as well as large areas identified for conservation purposes in Pima County, Arizona. Various agencies and groups fund and/or help manage these conservation easements for a variety of conservation purposes, including reclamation, rehabilitation, riparian protection, habitat and species protection, invasive species removal, among others. These agencies include, but are not limited to, the DOI, USFWS, BOR, USACE, USDA, NRCD, Middle Rio Grande Conservancy District, Rio Grande Agricultural Land Trust, Socorro Soil and Water Conservation District, and NM State Forestry.

It is possible that the Project, when designed, will cross land with a recorded conservation easement. In order to obtain a right-of-way across property with a conservation easement, the Project proponent would be required to review the nature of the easement recorded. If the specific type of right-of-way being sought is not restricted, then the acquisition of the right-of-way would be handled as a negotiation between the property owner and the Project proponent, on a case-by-case basis, similar to an unrestricted property.

3.10.3.4 Parks and Recreation

The study corridors cross a vast majority of rural and undeveloped land, with limited formal recreation opportunities, except in the vicinity of populated areas. The majority of undeveloped areas provide many dispersed recreation opportunities, including hiking, biking, horseback riding, hunting, fishing, and bird watching. Formal recreation opportunities occur near cities and towns, including but not limited to parks, ball fields, golf courses, rodeo arenas, and fairgrounds. Near Truth or Consequences, Elephant Butte and Caballo reservoirs provide ample water-based recreational opportunities such as boating, fishing, and swimming.

Gran Quivira, located north of the WSMR and south of Mountainair, is the only national monument within the SunZia study corridor. However, there are no direct land use impacts to Gran Quivira, as none of the Project alternatives crosses land that is part of the monument.

Arizona State Trust Lands leased for agriculture, mining, commercial, or military purposes are not open to recreational use. Other State Trust Lands may be closed to some or all recreational uses due to hazardous conditions or dust abatement, in coordination with the AZGFD or based on certain state, county, or local laws or ordinances.

3.10.3.5 Transportation and Access

Three major interstate highways lie within the study corridors: I-10, I-25, and I-19. I-25 generally parallels a main railroad line in a north-south direction, along the west side of the WSMR. I-10 crosses a majority of the Project's southern corridor; from the Anthony, New Mexico area on the east, through Tucson, Arizona near the Project's terminus, the planned Pinal Central Substation. I-19 splits off from I-10 in south Tucson, and heads south to Nogales, Arizona.

Multiple railroad lines also lie throughout the study corridors, most of which parallel existing interstates and state highways, including I-10, I-25, and US Route 54.

ADOT's long-range statewide planning process, known as Building a Quality Arizona, involved local/regional leaders in formulating the Statewide Transportation Planning Framework Program that evaluated roadway, public transit, and rail improvements. Through this process, the Regional Framework Study identified three potential transportation improvement scenarios through the year 2050. These include Scenario A: Personal Vehicle Mobility; Scenario B: Transit Mobility; and Scenario C: Focused Growth. Each scenario presented different types of potential transportation improvements between now and 2050, based on different types of development outcomes.

There are numerous municipal and international airports in or near most cities and towns throughout the study area. Table 3-48 lists public and military air facilities within the study corridors.

Table 3-48. Public and Military Air Facilities within the Study Area

New Mexico	Arizona	
• Deming Municipal Airport • Lordsburg Municipal Airport • Picacho Auxiliary Army Airfield • Socorro Municipal Airport • Truth or Consequences Municipal Airport	• Benson Municipal Airport • Cochise County Airport • Davis-Monthan AFB • Eloy Municipal Airport • Marana Airport/Pinal Airpark	• Marana Regional Airport • Safford Municipal Airport • San Manuel Airport • Silverbell Heliport • Tucson International Airport

3.10.3.6 Mining and Minerals

Scattered mining operations occur within approximately 31 mining districts within the Project study corridors; 20 of these districts are located in New Mexico (New Mexico Bureau of Mines

and Mineral Resources/USGS 2009) and the remaining 11 are located in Arizona (AZGS 2011). Generally, land use agencies favor locating new infrastructure elements near disturbed land areas. Different mining techniques can allow for transmission infrastructure to be located near or across the mine (e.g., types of underground mining that can include coal), while other types may not be compatible (e.g., sand and gravel mines). There are numerous different leases occurring within the study corridors that were not observed on aerial imagery, due to the underground nature of the mines. Mines described in the summary of inventory results are visible surface mines within the study corridors that could be considered conflict areas for the Project. Pre-1955 mining claims also were documented and include BLM mining claims, which gave claimants certain surface rights. PL 84-167 required the BLM to publish each township in each state where the United States wished to acquire complete surface management rights; most townships were published between 1955 and 1968. The Master Title Plat for a particular township (and the Historical Index) will show if the township was published, give the date of publication, and list the claimants (by claim name) that responded or were adjudicated surface rights under PL 84-167. To maintain these surface rights under this determination, the chain of title cannot be broken (BLM 2010c). The lists of mining claims and mining districts are provided in Appendix E.

Mineral resources typically are divided into three broad categories: (1) locatable, (2) leasable, and (3) salable. *Locatable* minerals include a broad category of economically important minerals that include precious and base metals, such as gold and copper; fissionable products, such as uranium; industrial minerals; and rocks that bear precious stones. *Leasable* resources typically are extracted for use in energy production and include oil, natural gas, coal, and geothermal deposits. Mining leasable mineral resources on federal land require a lease of set duration with the responsible land management agency. *Salable* mineral resources typically are used for construction and industrial purposes and include sand and gravel. They may be acquired from federally owned or controlled lands via a permit or contract, or through small-scale collection, such as recreational rock collecting. See Section 3.3 for more information on mining.

The New Mexico Tech Energetic Materials Research and Testing Center (EMRTC), located in the mountains adjacent to the New Mexico Tech Campus in Socorro, New Mexico, is a research and training facility, specifically for explosives research and testing. The EMRTC includes a 40-square-mile field laboratory that contains more than 30 test sites and ranges, and has the ability to conduct tests involving more than 20,000 pounds of explosives[1].

3.10.3.7 Military Installations and Airspace

There are multiple military installations and airspace restrictions throughout the Project study corridors; however, none of the major military installations in New Mexico (WSMR, Holloman AFB, Fort Bliss-McGregor Range, and Fort Bliss-Doña Ana Range) falls within the study corridors. Military installations and airspace designations are shown in the Map Volume (Figure M 10-3E and M 10-3W). The Northern Call-up Area is located directly north of the WSMR, covers approximately 1.5 million acres, and includes BLM land, New Mexico state land, and private land. The WSMR conducts missile test firings onto the range from the LC 94

[1] http://www.emrtc.nmt.edu. Accessed March 30, 2012

launch site near Subroute 1A, and the Sulf Site in the northwest portion of WSMR. Missile test firings were conducted 47 times between the two sites in 2009, but can be many more or less per year (WSMR 2009). Pursuant to evacuation agreements, residents and businesses located in this area are required to evacuate their properties for periods of 12 hours, with at least 48 hours between consecutive evacuation periods during these tests. No evacuations can occur during the cattle shipping period (October 15 through November 15) or on a holiday and the preceding day. Evacuations are scheduled at least 30 days in advance of a test event. There are four designated evacuation areas, all of which fall within the study area: FIX, A-350, ABRES 4A, and ABRES 4A Extension. The number of evacuations is limited to 25 per year per evacuation area, with no more than six per month (*ibid*)[1]. WSMR states that there is an average of 15 evacuations per year.

The majority of the airspace units above and near the WSMR, including airspace units R5107C, R5107H, and R5107E, are classified as joint use. These airspace units are designated a Special Use Airspace, in which the controlling agency is the FAA and the using agency is a military installation. With respect to the Special Use Airspace, when in use by the military installation designated as the using agency, air traffic control is provided by Holloman AFB. The military installation may prohibit civilian aircraft or projectiles from traversing the airspace without permission. When not in active use by the DOD, control of the airspace units is returned to the FAA.

These airspace units are scheduled and mainly used for research, development testing and experimentation, military training, and civilian contract program development and testing. In addition, aircraft from Holloman AFB, Kirtland AFB, and Fort Bliss Army Airfield operate within the restricted airspace at various times. Civilian and commercial air traffic may enter the restricted airspace only with permission of WSMR Range Control. The major activities conducted within the WSMR restricted airspace include air-to-air and surface-to-air weapons systems tests. Other activities include the operation of aerial drone targets, towed aerial targets, unmanned air systems, space probes, safety chase, aerial photography, and fixed- and rotary-wing security patrols. Training activities in the WSMR airspace include NASA crew training, aircraft weapons delivery, air-to-air combat maneuvers, and other military exercises. A large amount of the airspace is used as safety buffer zones for missile and rocket firings (*ibid*).

The Electronic Proving Ground is a facility headquartered at Fort Huachuca in Sierra Vista, Arizona that conducts noise tests for electronic combat and electronic warfare equipment. These tests are performed under a variety of circumstances and configurations (Electronic Proving Ground 2010). The current infrastructure within the Electronic Proving Ground study area, such as power lines, cell phone towers, radio stations, and other "emitters," have been measured and taken into account to form a "zero point" for testing purposes.

Davis-Monthan AFB is home to the 355th Fighter Wing, which trains pilots to operate the A-10 Thunderbolt II aircraft. Pinal Air Park is home to the Silver Bell Army Heliport, a U.S. Army

[1]Along with residential and business evacuations, the WSMR has an MOU with the NMDOT to allow closure of selected highways affected during particular missions. The agreement allows for road closures up to an hour, but no longer than 80 minutes in duration on US Route 54 and US 70, and up to 2 hours in duration on US 380. Notice is given by the WSMR to the NMDOT District Engineer at least 48 hours prior to setting up roadblocks.

helicopter training facility. There are multiple military training routes throughout southern Arizona, with many converging near the town of Redington. The Jackal Low Military Operations Area is located near Aravaipa Canyon, with the lowest altitude of operation at 100 feet above ground level. The Army National Guard trains helicopter pilots near the Tortolita Substation and in the vicinity of the Picacho Mountains. The training area includes approximately 3,600 square miles of low-level training areas, including military training flights between 1,000 and 10,000 feet above mean sea level. The Army National Guard uses a site referred to as Square Field, which is located within the study corridor, for emergency training exercises.

3.10.3.8 Energy Facilities, Canals, Designated Utility Corridors, Communication Sites, BLM Right-of-Way Avoidance Areas

Existing linear energy facilities, such as transmission lines and pipelines, can provide opportunities to site new linear energy facilities, as the consolidation of infrastructure within common or parallel corridors can reduce visual and ground disturbance. Energy facilities observed within the Project study corridors included distribution and transmission lines of 115 kV or larger, natural gas/petroleum pipelines with 6-inch diameters or larger, major and minor substations, and power plants.

Existing substations found within the study corridors include the Luna, Hidalgo, Winchester, San Manuel, Vail, Irvington, Tortolita, and Saguaro. The future permitted Pinal Central Substation is also located within the study corridor. Four new substations are proposed as part of the Project: SunZia East, Midpoint, Lordsburg, and Willow-500 kV.

Existing power plants found within the study corridors for the Project alternative routes include the Saguaro (Pinal County), Irvington (Pima County), and Luna (Luna County) natural gas power plants. The Bowie Power Station and associated 345 kV gen-tie transmission line and Willow 345 kV Substation have been permitted. The Bowie Power Station site is located in Cochise County, approximately 4 miles south of Subroute 3B (centerline of Link B150b), and the Willow 345 kV substation site is located west of the proposed SunZia Willow-500 kV Substation in Graham County. The Afton (Doña Ana County) and Apache (Cochise County) power plants are located within the Project study area, but outside the 6-mile-wide study corridors.

Existing transmission lines, pipelines, and electrical facilities within the study area are owned and/or operated by numerous different utilities, including Arizona Public Service Company, BOR, Chevron Pipeline Company, El Paso Electric Company, El Paso Natural Gas Company, Kinder Morgan, Public Service Company of New Mexico, Southwest Transmission Co-op Incorporated, SRP, TransWestern Pipeline Company, TEP, Tri-State G & T Association, and Western Area Power Administration.

In response to increasing interest in the development of renewable energy resources, in 2013 the DOE and DOI finalized a map identifying solar energy zones (SEZ) and variance areas identified in 2013. Some of the SEZs identified in New Mexico are located in the study area near the study corridors, including the Afton SEZ; 29,964 acres, located southwest of the city of Las Cruces, New Mexico; and west of I-10.

In addition to the SEZs, in the Solar Programmatic EIS, variance areas were also established. Variance areas are areas that may be available for a utility-scale solar energy right-of-way, with special stipulations or considerations. These areas are BLM land outside of exclusion areas and SEZs. Variance areas that are established within the study area and/or crossed by the study corridors are within the Las Cruces District Office in New Mexico and Safford and Tucson Field Offices in Arizona.

Using the Legacy Rehost 2000 BLM Search System, pending solar projects were identified within the Project study corridors, including two projects awaiting federal right-of-way decisions. Iberdrola Renewables has a pending right-of-way application for a 24,320-acre solar facility just east of the New Mexico and Arizona border, northwest of the I-70 and I-10 interchange. Link B160a runs east to west, immediately south of the right-of-way area. Solar Reserve, LLC, has a pending right-of-way application for an approximately 5,300-acre solar facility northeast of Lordsburg, New Mexico. Links B111 and B121 both cross the pending right-of-way area, and Link B120b is adjacent to the right-of-way boundary (BLM 2011a). Additional research was completed that identified other potential and proposed solar projects in the study area, discussed in Section 4.17.3.2. Additional research was also completed for wind projects, which identified other potential and proposed wind projects in the study area, discussed in Section 4.17.3.2.

In addition to proposed renewable projects, new transmission facilities are planned near the study corridors. The planned Pinal Central Substation to Tortolita Substation 500 kV transmission line, proposed by TEP, would parallel links C810a, C820, C813, C816, C817, C820, C830, C840, C850, C880, and C880a. This project is currently in the permitting stage. The proposed San Manuel Interconnect Project, a 230 kV transmission line proposed by Southwest Transmission Co-op, would parallel Link C660. There are additional proposed projects in the area that are in the early stages of development, including the Southline Transmission Project located in and to the south of the Project study area. These proposed projects are also discussed in Section 4.15.4.9, Land Use and Recreation Resources.

Utility corridors are designated as such by federal, state, or county agencies, but are usually determined through coordination between multiple agencies to help ensure continuity of the corridors between different jurisdictions or land ownership. Utility corridors are areas where existing utilities are located and provide an opportunity to place new facilities in parallel corridors, which in turn helps to minimize impacts. Some Project subroutes follow existing corridors established by the Las Cruces BLM Field Office and the West-wide Energy Corridors established by the BLM. The DOE West-wide Energy Corridors were created by Section 368 of the EPAct, which directs the secretaries of Agriculture, Commerce, Defense, Energy, and the Interior to designate corridors on federal land in 11 western states, including New Mexico and Arizona. Section 368 corridors allow for oil, gas, and hydrogen pipelines, and electricity transmission and distribution facilities (West-wide Energy Corridor Programmatic EIS Information Center 2011). Existing corridors and their proximity to the subroutes are described in Table E-3 in Appendix E.

Canals for transportation of water for municipal and irrigation purposes are located throughout the study area. The Middle Rio Grande Conservation District and BOR administer canals, including the Rio Grande Conveyance Channel in New Mexico. The Central Arizona Water

Conservation District manages the CAP facilities on federal lands administered by the BOR in Arizona. The San Carlos Irrigation and Drainage District administers the San Carlos Irrigation Project facilities, under BIA jurisdiction, also located in Arizona. San Carlos Irrigation Project canals are located within the Pinal County portion of the study area, north of the Picacho Reservoir, and include the Florence Canal, Casa Grande Canal, and Florence-Casa Grande Canal. The CAP and San Carlos Irrigation Project Canals are shown on Figure M 10-1W (Map Volume).

Communication facilities, including microwave stations, radio towers, and cellular/digital towers, are found scattered throughout the study corridors. Communication cables, typically fiber optic bundles, are used for transmission of voice, data, and utility signals. Fiber optic cables may also be buried or installed on overhead electrical transmission structures. Communication cables are typically installed within utility rights-of-way, or adjacent to them. Major interstate communication cables in the Southwest are located along I-10 and railroads between New Mexico and Arizona.

Right-of-way avoidance areas designated by the BLM have been identified within the study area for each of the alternative subroutes. Where the Project right-of-way would cross an avoidance area, an RMP amendment may be required. If required, one of two alternative plan amendments would be adopted: (1) a utility corridor of 400 feet (to allow for the Project right-of-way) or (2) a utility corridor 2,500 feet wide (utility corridor to be used for the Project as well as other future projects). A third alternative, No Action, would apply where a subroute crosses an avoidance area if it is found that the Project would not conflict with management objectives. The information below details the avoidance areas that are crossed, including where they are generally located and, if the information was available, for what the area is managed.

- Route Group 1 – all subroutes cross avoidance areas that are designated in the Socorro and Mimbres RMPs. Links that cross these areas are:
  - E101b and E133, which cross an avoidance area south of the Sevilleta NWR that is managed by the Socorro RMP to manage VRM Class II
  - E211, which crosses an avoidance area to the west of San Antonio that is displayed on the Socorro RMP Lands and Realty map
  - A80, which crosses an avoidance area to the north of the WSMR that is displayed on the Socorro RMP Lands and Realty map
  - A111 and A112, which cross an avoidance area north of the Bosque del Apache NWR that is managed by the Socorro RMP for VRM Class II, as well as the San Pedro SMA
  - A140, A160, A161, and A161b, which cross an avoidance area to the west of San Antonio that is displayed on the Socorro RMP Lands and Realty map
  - A440, which crosses an avoidance area managed in the Mimbres RMP for the Butterfield Trail northeast of Deming, and another directly south that is managed for VRM Class II (also Link A530)
- Route Group 3 – all subroutes cross avoidance areas designated in the Mimbres RMP. The links that cross these areas include:

- B120b and B110a, which cross avoidance areas to the east of Lordsburg that are displayed on the Right-of-Way Avoidance/Exclusion Area map in the Mimbres RMP
- B112 and B140, which cross avoidance areas to the west of Lordsburg that is managed for VRM Class II

- Route Group 4, Subroute 4C1 – links C331 and C361 cross an avoidance area northeast of the Saguaro National Park (east), managed in the Safford RMP for the Muleshoe Ecosystem Management Area

3.10.4 Planned Land Use

Designated planned and future land uses were identified within the study area, on federal, state, county, and private land; a large majority of the study area is designated as grazing/mixed use/vacant. However, as the subroutes pass through populated areas, a variety of future land use designations occur, including residential, commercial, industrial, and open space. The majority of designated future land use is located in and around populated areas; because these categories are the same as existing land use, they will remain unchanged. The counties of Socorro, Luna, and Hidalgo do not have any future land use plans; therefore, the inventory assumes that existing land use in the area would continue. Data for the planned land use section have been obtained from the following city and county comprehensive land use plans and general plans:

New Mexico

- Doña Ana County Comprehensive Plan (1994)
- Grant County Comprehensive Plan (2004)
- Hidalgo County Comprehensive Plan (2004)
- Lincoln County Comprehensive Plan (2007)
- Sierra County Comprehensive Plan (2006)
- Belen Comprehensive Land Use Plan (2003)
- City of Deming Comprehensive Plan (2003)
- City of Elephant Butte Comprehensive Plan (2003)
- City of Las Cruces Comprehensive Plan (1999)
- City of Lordsburg Comprehensive Plan (2001)
- City of Socorro Comprehensive Plan (2003)
- City of Truth or Consequences Comprehensive Plan (2007)
- Town of Carrizozo Comprehensive Plan (2008)
- Village of Hatch Comprehensive Plan (2007)

Arizona

- Cochise County Comprehensive Plan (2006)
- Graham County Comprehensive Plan (1996)
- Greenlee County Comprehensive Plan(2003)
- Pima County Comprehensive Plan (2007)
- Pinal County Comprehensive Plan(2009)

- City of Casa Grande General Plan (2010)
- City of Tucson General Plan (2001)
- City of Safford General Plan (2004)
- City of Willcox General Plan (2009)
- City of Benson General Development Plan (2002)
- Town of Marana General Plan Update (2007)
- Sonoran Desert Conservation Plan (1999)
- Redington NRCD Long Range Natural Resource Conservation Plan, 2010-2016 (2010)
- Land Management Plan of the Winkelman NRCD (revised 2010)

3.10.5 Summary of Inventory Results

The following section identifies the present land uses within the study corridors and their proximity to each subroute.

3.10.5.1 General Land Use Subroute Summary

Route Group 1: SunZia East Substation to Midpoint Substation

Subroute 1A1 – North River Crossing

Subroute 1A1 traverses Torrance, Lincoln, Socorro, Sierra, and Luna counties, and can generally be categorized as rural residential and vacant undeveloped, with widely dispersed residences occurring throughout the study corridor. Residential densities are predominantly rural, with higher densities occurring along the Rio Grande, approximately 3 miles north of Socorro, New Mexico. Although this subroute is in close proximity (less than 0.5 mile) to residences, it crosses no residential structures. Commercial and industrial uses are also widely dispersed throughout this portion of the study corridor. The majority of these uses occur along I-25, near Socorro. Commercial uses in this part of the study corridor include retail businesses, small offices, and hotels/motels. Industrial uses include automotive repair garages, mini-storage facilities, and wreckage/salvage yards. This subroute does not cross commercial or industrial land uses.

Subroute 1A2 – BLM Preferred Alternative

Subroute 1A2 crosses the same counties as Subroute 1A1, and can generally be categorized the same as Subroute 1A1, with rural residential and vacant undeveloped areas and widely dispersed residences occurring throughout the study corridor. Commercial and industrial uses are also widely dispersed throughout this portion of the study corridor. Similar to Subroute 1A1, the majority of these uses occur along I-25, near Socorro and San Antonio, as well as areas near Elephant Butte and Truth or Consequences. Subroute 1A2 does not cross commercial or industrial land uses but, as with Subroute 1A1, does cross agricultural areas near Socorro.

Subroute 1A – North River Crossing

Subroute 1A crosses the same counties as the BLM preferred alternative and Subroute 1A1, except for Torrance County, and can generally be categorized the same as the BLM preferred alternative and Subroute 1A1, with rural residential and vacant undeveloped areas and widely dispersed residences in the study corridors. Commercial and industrial uses are also widely

dispersed throughout this portion of the study corridor. Similar to the BLM preferred alternative and Subroute 1A1, the majority of these uses occur along I-25, near Socorro and San Antonio, as well as areas near Elephant Butte and Truth or Consequences. Subroute 1A does not cross commercial or industrial land uses but, similar to the BLM preferred alternative and Subroute 1A1, does cross agricultural areas near Socorro.

Subroute 1B – San Antonio Crossing

This subroute is similar to the BLM preferred alternative, and primarily crosses rural and undeveloped land. However, where Link A140 crosses the Rio Grande, the subroute is in close proximity (less than 0.3 mile) to approximately six rural residential dwellings.

Local Alternative and Crossover Links for Route Group 1

Local alternative links for 1A and 1B1 (Gran Quivira) primarily cross rural and undeveloped land. However, Link E81 crosses in close proximity (less than 0.3 mile) to approximately one residence.

Local alternative links for 1A, 1B1, 1B2, and 1B3 primarily cross rural and undeveloped land. Links A161b and A260 cross in close proximity (less than 0.3 mile) to approximately three residences and one residence, respectively. Links A361 and A430 cross an area of existing dense agriculture.

Route Group 3: Midpoint Substation to Willow-500 kV Substation

Subroute 3A2 – BLM Preferred Alternative

Subroute 3A2 runs primarily through vacant/undeveloped land in Luna, Grant, and Hidalgo counties in New Mexico; and Cochise, Graham, Greenlee, and Cochise counties in Arizona. This subroute is more than 6 miles north of the cities of Deming and Lordsburg, New Mexico, and has two industrial structures within 0.5 mile.

Subroute 3A – North

Subroute 3A is similar the BLM preferred alternative and runs primarily through vacant/undeveloped land, with two industrial structures within 0.5 mile of the subroute centerline.

Subroute 3B – South

Subroute 3B is similar to the BLM preferred alternative, but is located closer to Lordsburg, New Mexico. Although residential, commercial, industrial, and various quasi-public uses occur in Lordsburg, the subroute is approximately 2 miles south of Lordsburg. As it crosses into Arizona along I-10, Subroute 3B is approximately 2 miles north of the rural agricultural community of San Simon.

Crossover Links for Route Group 3

Crossover links 3A and 3B are located in areas that are primarily vacant/undeveloped land.

Route Group 4: Willow-500 kV Substation to Pinal Central Substation

4A – North of Mt. Graham

Subroute 4A is located in Graham, Cochise, Pima, and Pinal counties in Arizona. A large majority of this study corridor can be characterized as rural residential, with large areas of vacant land. There are no commercial or industrial uses within this segment of the study corridor for this subroute. As the route approaches the Project terminus at the planned Pinal Central Substation, Link C850 crosses a residential property, and links C880 and C880a pass within 0.5 mile of a rural residence and agriculture areas, but does not directly affect any residential dwellings. (This portion of the study corridor is common to all of the alternatives in Route Group 4.)

Subroute 4B – Sulphur Springs Valley

This subroute is similar to 4A. It primarily crosses vacant undeveloped land, with no direct crossings of residential, commercial, or industrial uses. No residential dwellings are encountered, except for the area near the planned Pinal Central Substation.

Subroute 4C2c – BLM Preferred Alternative

Link C110 crosses two large rural residential properties and continues south, and crosses the San Pedro River with links C261 and C201, avoiding impacts to residential, commercial, and industrial uses. The remainder of the BLM preferred alternative crosses vacant undeveloped land until it approaches the Pinal Central Substation, where the route crosses a residential property, and links C880 and C880a pass within 0.5 mile of a rural residence and agriculture areas; it does not directly affect any residential dwellings.

Subroute 4C1 – East of San Pedro River

This segment of the study corridor is similar to subroutes 4A and 4B. However, Link C110 located north of Willcox crosses two rural residential properties. Link C660 is adjacent to a mine in San Manuel for approximately 2.5 miles. The remainder of the land in this subroute is vacant and undeveloped.

Subroute 4C2 – West of San Pedro River

As stated above, a portion of Link C110 crosses two rural residential properties. However, instead of turning north to San Manuel, the subroute crosses the San Pedro River south of Cascabel. In this area, Link C266 is less than 0.5 mile from approximately 11 rural residential dwellings. The remainder of the subroute passes west of San Manuel and approximately 3.6 miles north of the town of Oracle, which includes low to medium residential densities, as well as limited commercial, industrial, and quasi-public uses (local government buildings, post office, etc.).

Subroute 4C3 – Tucson

Subroute 4C3 crosses a densely populated urban area in and around the city of Tucson, which has a population of approximately 1,020,200 people. Residential uses within the city vary in density from low to high and include single- and multi-family homes, townhouses, apartments, mobile home parks, and subdivisions under construction. Multiple churches and educational facilities, such as daycare and preschools, are located throughout the urban areas. School and quasi-public uses such as local, state, and federal government buildings are located within this study corridor, but are not crossed by subroutes in the Rillito and Santa Cruz River basins. Links F111 and F112 traverse the seasonal Santa Cruz River, crossing approximately 44 residential properties; including a manufactured home park, a medium density residential subdivision that is under construction, and approximately 8 commercial and industrial properties.

Major commercial and industrial parks are located throughout the city, with concentrations near the Tucson International Airport and Davis-Monthan AFB, and along the I-10 corridor. As this subroute proceeds north from the Tortolita Substation, Link C817 is directly adjacent to one single-family residential property.

Local Alternative and Crossover Links for Route Group 4

Local alternative links for 4A, 4B, 4C1, 4C2, and 4C3 are located in areas where agriculture is the primary land use. Link C860 crosses within 0.3 mile of a residence. Link C890 crosses through irrigated agriculture areas for almost the entire link.

Local alternative links for 4C2 cross largely undeveloped land used for ranching and grazing. Link C680 crosses within 0.3 mile of 12 residences; Link C812 parallels approximately 1.3 miles of a canal; and Link C817 passes to the west of a residence within 0.1 mile.

Local alternative links for 4C3, links F81a and F81b, do not directly cross any residential, commercial, industrial, or quasi-public uses; however, multiple high density single-family residential subdivisions, and commercial and industrial land uses occur less than 0.1 mile (500 feet) from the subroute.

3.10.5.2 Agriculture and Range Subroute Summaries

Route Group 1: SunZia East Substation to Midpoint Substation

Subroute 1A1 – North River Crossing

A major portion of this subroute crosses undeveloped land used for ranching and grazing, primarily through grazing leases on federal and state land. These uses occur along links A10, A21, E80d, E101a, and E101b, along the northern portion of the WSMR, also known as the Northern Call-up Area; and along Link E133, bordering the Sevilleta NWR. Link E180 crosses through the Rio Grande Valley, as well as flood and row irrigated farmland.

Subroute 1A2 – BLM Preferred Alternative

As with Subroute 1A1, a major portion of this subroute crosses undeveloped land used for ranching and grazing, primarily through grazing leases on federal and state land. These uses occur along links A10, A21, E86a, E86b, and E101b, along the northern portion of the WSMR; and along Link E133, bordering the Sevilleta NWR. Link E180 crosses through the Rio Grande Valley, as well as flood and row irrigated farmland.

Subroute 1A – North River Crossing

Similar to the BLM preferred alternative and Subroute 1A1, Subroute 1A crosses undeveloped land used for ranching and grazing, primarily through grazing leases on federal and state land, along the same links described above, as well as links A22 and E80c along the northern portion of the WSMR. Link E180 traverses the Rio Grande Valley, and directly crosses flood and row irrigated farmland.

Subroute 1B – San Antonio Crossing

Subroute 1B is similar to 1A, with the addition of links E90 through A80, which cross lands primarily used for ranching and livestock grazing. This land is mostly privately- or BLM-owned, with smaller interspersed portions of state-owned land. Local Alternative Link A260 crosses a large portion of BLM land; Link A140 crosses the Rio Grande and directly crosses flood and row irrigated farmland; and Local Alternative Link A161b crosses a large parcel of private land that is subdivided ranch land, and is in the process of residential development.

Local Alternative and Crossover Links for Route Group 1

A portion of the Midpoint Substation Local Alternative Link A430 crosses flood irrigated agricultural land, and was designed to bypass fields irrigated with center pivots.

Route Group 3: Midpoint Substation to Willow-500 kV Substation

Subroute 3A2 – BLM Preferred Alternative

The majority of Subroute 3A2 crosses BLM and State Trust land used for ranching and grazing. There is very little farmland along this segment, except near Link B90.

Subroute 3A – North

Similar to the BLM preferred alternative, the majority of this subroute crosses BLM and State Trust land used for ranching and grazing. There is very little farmland along this segment, except near the Midpoint Substation and Link B90.

Subroute 3B – South

Subroute 3B is similar to the BLM preferred alternative, with the addition of irrigated farmland near Lordsburg and San Simon. Link B80, just west of the Midpoint Substation, crosses the outer edge of a center pivot irrigated field and two flood irrigated fields.

Crossover Links for Route Group 3

There are no apparent agricultural areas crossed by crossover links associated with Route Group 3.

Route Group 4: Willow-500 kV Substation to Pinal Central Substation

Subroute 4A – North of Mt. Graham

The majority of this subroute crosses mountainous terrain, comprising state land used for ranching and grazing. Link C592 at the San Pedro River, and links C880 and C880a, all near the planned Pinal Central Substation, cross irrigated farmland.

Subroute 4B – Sulphur Springs Valley

This subroute is similar to 4A, but includes links C130a and C130b through the Sulphur Springs Valley. Link 130a is adjacent to irrigated farmland near Bonita, but would not conflict with center pivot sprinkler irrigation.

Subroute 4C2c – BLM Preferred Alternative

The majority of Subroute 4C2c crosses undeveloped areas used for ranching and grazing. Links C110, C880, and C880a cross, and Link C850 is adjacent to, irrigated farmland. Link C680 is adjacent to a small agricultural operation.

BLM preferred alternative links C450 and C441 cross State Trust lands leased to Pima County for grazing, as described above for Subroute 4C2.

Subroute 4C1 – East of San Pedro River

The majority of this subroute crosses undeveloped areas used for ranching and grazing. Links C110, C880, and C880a cross, and Link C850 is adjacent to, irrigated farmland.

Subroute 4C2 – West of San Pedro River

This subroute is similar to 4A and 4B, although links C111 and C270 cross undeveloped areas used for ranching and grazing.

Subroute 4C2 crosses State Trust lands leased to Pima County for grazing. Pima County proposes to acquire the Six Bar Ranch (Link C450) and A7 Ranch (links C276 and C441) for preservation in the future.

Subroute 4C3 – Tucson

This subroute encounters the same agricultural areas as 4C1. Links C260 and C261 cross undeveloped areas used for ranching and grazing.

Local Alternative and Crossover Links for Route Group 4

Pinal Central Substation local alternatives cross primarily undeveloped land used for ranching and grazing. Local Alternative Link C890 for 4A, 4B, 4C1, 4C2, and 4C3 crosses flood irrigated farmland.

For Local Alternative 4C2 (Tortolita Substation area), Link C680 passes adjacent to a small agricultural operation, and Link C810 crosses within 0.3 mile of an agricultural area.

Local Alternative Link F40b for 4C3 crosses an area west of the San Pedro River that is used for ranching and grazing. Local Alternative Link C121 (4C1, 4C2, and 4C3) crosses agricultural lands for approximately 5.5 miles, and crosses center pivot sprinkler irrigated farmland near Bonita.

3.10.5.3 Parks and Recreation Subroute Summaries

Route Group 1: SunZia East Substation to Midpoint Substation

Subroute 1A1 – North River Crossing

Dispersed recreation opportunities are located throughout the Subroute 1A1 study corridor. Numerous community parks and community, senior, and recreational centers are located within Socorro (City of Socorro 2003). A small community park that offers opportunities for camping, picnicking, fishing, and biking is located approximately 5 miles north of Socorro and is approximately 0.5 mile north of Link E180. A portion of Subroute 1A1 crosses the Johnson (Gordy's) Hill SRMA (links E180 and E133), which is used for OHV recreation. No parks or recreational centers are crossed by this subroute.

Subroute 1A2 – BLM Preferred Alternative

Dispersed and formal recreation opportunities are similar to those described in Subroute 1A1. No parks or recreational centers are crossed by this subroute.

Subroute 1A – North River Crossing

Subroute 1A is similar to the BLM preferred alternative and Subroute 1A1, but also has areas of recreation located in Truth or Consequence (City of Socorro 2003; City of Truth or Consequences 2007). Subroute 1A is located approximately 5 miles north of Socorro and crosses a portion of the Johnson (Gordy's) Hill SRMA, as does the BLM preferred alternative and Subroute 1A1.

Subroute 1B – San Antonio Crossing

Subroute 1B is similar to 1A1; however, San Antonio has no community parks or areas for organized recreation. Dispersed recreation opportunities on BLM land near the community include geocaching, camping, hiking, horseback riding, hunting, OHV opportunities, and rock hounding.

Local Alternative and Crossover Links for Route Group 1

This area is largely undeveloped and limited to dispersed recreation on BLM land.

Route Group 3: Midpoint Substation to Willow-500 kV Substation

Subroute 3A2 – BLM Preferred Alternative

Only dispersed recreation occurs along Subroute 3A2. The majority of the formal recreational facilities are located in and around Deming and Lordsburg, New Mexico, within Luna and Hidalgo counties, respectively. The closest recreational facilities are limited to existing educational facilities, primarily in Greenlee and Luna counties, which are open for the public's use when school is not in session (Greenlee County 2003).

Subroute 3A – North

Subroute 3A has similar recreation opportunities as the BLM preferred alternative.

Subroute 3B – South

This segment of the subroute is similar to Subroute 3A2. However, Lordsburg, New Mexico contains a special events center that also functions as the city's convention center; as well as four parks with playground equipment, picnic areas, and softball fields (City of Lordsburg 2001). Near Lordsburg, but within the jurisdiction of Hidalgo County, are the Hidalgo County fairgrounds and rodeo arena (*ibid*). Located within Deming is the Voires Pit Park, a large amphitheater with a 6,100-square-foot covered pavilion, as well as the Sam Baca Aquatic Center, Hooten Park, and the Rio Mimbres Golf Club. Subroute 3B is approximately 2.3 miles south of Lordsburg and approximately 5 miles north of Deming.

Crossover Links for Route Group 3

This area is largely undeveloped and limited to dispersed recreation on BLM land.

Route Group 4: Willow-500 kV Substation to Pinal Central Substation

Subroute 4A – North of Mt. Graham

Dispersed recreation on BLM land is the extent of opportunities available in this subroute, such as bird watching and hiking in and around the ephemeral riverbed, as the subroute crosses the seasonal San Pedro River/Wash wildlife corridor (Link C592).

Subroute 4B – Sulphur Springs Valley

This subroute has similar recreational opportunities as Subroute 4A.

Subroute 4C2c – BLM Preferred Alternative

There are dispersed recreational opportunities along the San Pedro River, including hiking, bicycling, equestrian, fishing, birding, and other wildlife watching activities. Formal recreational opportunities are located in the Willcox and Benson communities, 7 to 11 miles south of the study corridor. Willcox has a sports park with a rodeo/fairground arena and athletic fields; and two municipal parks, one of which contains a community swimming pool. Both of the parks contain walking paths and picnic areas. The city of Benson has a community pool and three public parks that contain basketball and volleyball courts, horseshoes stakes, a skate park, walking trails, ramadas, grills, and playgrounds (City of Benson 2011).

In the northern portion of the study corridor, the rural communities of San Manuel, Oro Valley, Picacho, and Eloy each contain small community parks allowing for a variety of recreational uses. Pinal County has community parks, including the Pinal County Fairgrounds located adjacent to the proposed Pinal Central Substation (Pinal County 2009). There are dispersed recreational opportunities near the Santa Cruz River on BLM land in south-central Pinal County that include hiking, bicycling, and equestrian activities.

Subroute 4C1 – East of San Pedro River

Subroute 4C1 is similar to the BLM preferred alternative Subroute 4C2c.

Subroute 4C2 – West of San Pedro River

This subroute is similar to Subroute 4C1.

Subroute 4C3 – Tucson

This subroute is within the densely populated Tucson urban area. Recreational opportunities abound, including municipal and regional parks, community centers, community pools, trails for hiking, wildlife viewing, mountain biking, camping, river parks, and equestrian access. Link F112 crosses the Silverbell Regional Park, and crosses within 0.2 mile of the Silverbell Golf Course. In addition, the Pines Golf Club at Marana is less than 0.1 mile from Link F510.

The Sweetwater Wetlands Park, less than 0.3 mile from Link F112, is an urban wildlife habitat and park that doubles as a water reclamation facility (City of Tucson 2011). Along I-10, Link F112 is parallel to the Santa Cruz River Park, which offers biking, running, walking paths, and equestrian access in the seasonally dry riverbed. The El Paseo de los Arboles Commemorative Park is also located along the Santa Cruz River Park, adjacent to Link F112. Sam Lena Park, part of the Kino Sports Complex, is located on the north side of Ajo Way and is adjacent to I-10; it offers a number of amenities for public use and is less and 0.2 mile from Link F111 (Natural Resources, Parks and Recreation 2010).

Winchester and Tortolita Substations

The area is largely undeveloped and limited to dispersed recreation on BLM land.

Local Alternative and Crossover Links for Route Group 4

The Pinal County Fairgrounds are located adjacent to the planned Pinal Central Substation. Dispersed recreational opportunities in this area include trails that run through the Santa Cruz River on BLM land in south-central Pinal County.

Rillito River Park is a large recreational facility located in the vicinity of the local alternative links for 4C3, with walking paths along the north and south banks of the seasonally dry riverbed. The existing multi-use trails are parallel to Link F81b, and the historic Rillito Race Track is adjacent to Link F81b. Numerous private and municipal golf courses are located less than 0.5 mile from this subroute. In addition to Link F81b, Link F51 crosses part of the Pima County-managed Cienega Creek Natural Area.

3.10.5.4 Transportation and Access Subroute Summary

Route Group 1: SunZia East Substation to Midpoint Substation

Subroute 1A1 – North River Crossing

The roadways in this portion of the subroute include I-25, US Routes 54 and 60/85, and SRs 1, 55, 27, and 26. I-25 is a regional transportation route, while the others are alternative routes; all are under the jurisdiction of the NMDOT. The Burlington Northern Santa Fe and Atchison, Topeka, and Santa Fe railroads are generally parallel to I-25. There are no designated scenic highways within this portion of the study area.

Aviation facilities near this subroute include the Socorro Municipal Airport 3 miles south of the town of Socorro and 6 miles south of Link E180. Link A260 is approximately 5 miles north of the Truth or Consequences Municipal Airport, and approximately 7 miles north of Truth or Consequences.

Subroute 1A2 – BLM Preferred Alternative

The transportation routes and aviation facilities near to or crossed by Subroute 1A2 are the same as for Subroute 1A1.

Subroute 1A – North River Crossing

The transportation routes and aviation facilities near to or crossed by Subroute 1A are the same as the BLM preferred alternative and Subroute 1A1, except for the Truth or Consequences Municipal Airport located near Link A260.

Subroute 1B – San Antonio Crossing

Subroutes 1B1, 1B2, and 1B3 are similar to 1A. There are no additional roads or aviation facilities along this subroute.

Midpoint Substation

SR 26 is parallel to links A440 and A530 near the Midpoint Substation.

Local Alternative and Crossover Links for Route Group 1

Link A260 is approximately 5 miles north of the Truth or Consequences Municipal Airport, and approximately 7 miles north of Truth or Consequences. The Hatch Municipal Airport is located approximately 3 miles west of Hatch, New Mexico, and 9 miles east of Link A361.

Route Group 3: Midpoint Substation to Willow-500 kV Substation

Subroute 3A2 – BLM Preferred Alternative

The major roadways along Subroute 3A2 include I-10 and US Route 70, which run east and west through the Bowie townsite; San Simon, Arizona; and Lordsburg and Deming, New Mexico. This route is under the jurisdiction of both NMDOT and ADOT, as it crosses the state line. The UPRR parallels I-10 through this segment of the study corridor. There are no designated scenic highways within the study corridor.

There are several private airstrips used for agricultural purposes and to access private land within the study corridor, but no public aviation facilities. Link B90 is approximately 6 miles north of the Deming Municipal Airport.

Subroute 3A – North

The transportation routes and aviation facilities that Subroute 3A crosses or is near are the same as for Subroute 3A2.

Subroute 3B – South

Subroute 3B is similar to Subroute 3A2, except for the presence of two large aviation facilities. The Deming Municipal Airport is approximately 2 miles east of Deming, New Mexico, and 5 miles south of Link B80. Lordsburg Municipal Airport is approximately 0.5 mile southeast of Lordsburg, New Mexico, and less than 1 mile north of Link B112.

Crossover Links for Route Group 3

The crossover and local alternative links for Route Group 3 are not located near or parallel to transportation facilities.

Route Group 4: Willow-500 kV Substation to Pinal Central Substation

Subroute 4A – North of Mt. Graham

The major roadways along this subroute include US Route 191 and SRs 77, 79, and 87; all under ADOT jurisdiction. US Route 191 and SRs 77 and 79 are alternate primary routes that run north and south in the study area. Link B153a parallels US Route 191. The Arizona Eastern Railroad, which runs from the Bowie townsite north into Safford, is also located along this subroute.

Link C850 is approximately 5 miles south of the Coolidge Municipal Airport, and Link C880a is approximately 5 miles northeast of the Eloy Municipal Airport.

Subroute 4B – Sulphur Springs Valley

The transportation facilities along Subroute 4B are the same as those described for Subroute 4A, although Subroute 4B would not be adjacent to US Route 191.

Subroute 4C2c – BLM Preferred Alternative

Subroute 4C2c is similar to Subroute 4A for the roads that it is adjacent to or crosses, and the Arizona Eastern Railroad that runs from the Bowie townsite north into Safford, as well as for the Coolidge and Eloy Municipal Airports near links C850 and C880a.

Subroute 4C2c is near the Cochise County and San Manuel Airports, as described above for Subroute 4C1 and 4C2.

Subroute 4C1 – East of San Pedro River

In addition to the major roads mentioned for Subroute 4A, I-10 and I-19 occur along this subroute. I-10 is the main east-west transportation route running from Willcox through Tucson, and is in close proximity to the planned Pinal Central Substation. I-19 is a major north-south route, running from Tucson south to Nogales (outside of the study area). Links C693 and C760 are parallel to SR 79.

The Cochise County Airport is located near this subroute. It is approximately 3 miles west of Willcox and 8 miles southeast of Link C212.

Subroute 4C2 – West of San Pedro River

Subroute 4C2 is similar to Subroute 4C1. San Manuel Airport is approximately 3 miles north of San Manuel, 2 miles northeast of Link C660, and less than 1 mile west of Link C450.

Subroute 4C3 – Tucson

In Tucson's metropolitan area, I-10 and I-19 are located along this subroute. I-10 is the main east-west transportation route running from Willcox through Tucson, and is in close proximity to the planned Pinal Central Substation. I-19 is a major north-south route running from Tucson, south to Nogales (outside of the study area). Multiple aviation facilities are located within the

study area, including Davis-Monthan AFB and Tucson International Airport. Davis-Monthan AFB is 2 miles southeast of Tucson, 5 miles west of Link F81a and 2 miles east of Link F111. Tucson International Airport is approximately 6 miles south of Tucson and 2 miles south of Link F111. Benson Municipal Airport is approximately 3 miles northwest of Benson and 5 miles southeast of Link F40A. At the north end of the study area, the Marana Regional Airport is approximately 3 miles west of Marana and 5 miles southwest of Link F540. Marana Airport/Pinal Airpark is approximately 7 miles northwest of Marana and 3 miles southwest of Link C810a. There are numerous private airstrips for agricultural and private use located primarily in the eastern and northern portions of the study corridor.

Local Alternative and Crossover Links for Route Group 4

Local Alternative Link C790 for 4A, 4B, and 4C1 parallels SR 79.

Local alternative links for 4A, 4B, 4C1, 4C2, and 4C3 include Link C890, which parallels roughly 1.0 mile of SR 287 for approximately 0.5 mile to the east.

I-10 is approximately 0.3 mile west of link C810a, which is associated with the Winchester Substation and Tortolita Substation local alternatives.

Local alternative links for 4C3 include Link F81a, which parallels 0.7 mile to the northeast of I-10 for roughly 3.0 miles. Link F81b follows local roads through the downtown portion of Tucson.

3.10.5.5 Mining and Minerals Subroute Summaries

Mining sites, claims, and prospects are scattered throughout the study corridors for each of the alternatives. The following descriptions include locations of concentrated mine sites.

<u>Route Group 1: SunZia-East Substation to Midpoint Substation</u>

Subroute 1A1 – North River Crossing

Surface mining sites are adjacent to or crossed by Subroute 1A1 at links E200 and E211. E211 is also adjacent to a gravel pit. There is a surface mining operation adjacent to Link A260. The subroute crosses approximately 5 miles of the EMRTC, but is not anticipated to conflict with current test areas. Moreover, minor site-specific subroute adjustments during the project design, if a right-of-way is granted, are likely to further reduce any potential conflicting uses.

Subroute 1A2 – BLM Preferred Alternative

Surface mining sites adjacent to or crossed by Subroute 1A2 are similar to those described for Subroute 1A1. The subroute crosses approximately 5 miles of the EMRTC, but is located outside the active testing areas.

Subroute 1A – North River Crossing

Surface mining sites are adjacent to or crossed by the subroute at links E200, E211, and A270, which are adjacent to a gravel pit. The subroute crosses approximately 5 miles of the EMRTC, but is located outside the active testing areas.

Subroute 1B – San Antonio Crossing

There is a concentration of mine sites, claims, and prospects along Link A80, and a gravel pit is adjacent to Link A270.

Local Alternative and Crossover Links for Route Group 1

There is a surface mining operation adjacent to Link A260.

Route Group 3: Midpoint Substation to Willow-500 kV Substation

Subroute 3A2 – BLM Preferred Alternative

There is a concentration of mine sites, claims, and prospects adjacent to Link B170. This subroute crosses an authorized locatable mineral mine site on Link 160a, northwest of Lordsburg.

Subroute 3A – North

The concentration of mine sites, claims, and prospects for Subroute 3A are the same as for the BLM preferred alternative.

Subroute 3B – South

There is a concentration of mine sites, claims, and prospects adjacent to links B112, B150a, B150b, and B170. Surface mining and material sites are adjacent to or crossed by links B110a, B112, B150a, and B150b.

Crossover Links for Route Group 3

There are no surface mining or gravel pit sites located within crossover links for Route Group 3.

Route Group 4: Willow-500 kV Substation to Pinal Central Substation

Subroute 4A – North of Mt. Graham

There is a concentration of mine sites, claims, prospects, and a surface mining site adjacent to Link C170.

Subroute 4B – Sulphur Springs Valley

There is a concentration of mine sites, claims, and prospects adjacent to links C130b and C170. There are no surface mining and material sites adjacent to or crossed by the subroute.

Subroute 4C2c – BLM Preferred Alternative

There is a concentration of mine sites, claims, and prospects adjacent to links C110, C441, and C680.

Subroute 4C1 – East of San Pedro River

There is a concentration of mine sites, claims, and prospects adjacent to Link C110. Surface mining and material sites adjacent to or crossed by the subroute include Link C660.

Subroute 4C2 – West of San Pedro River

There is a concentration of mine sites, claims, and prospects adjacent to links C110, C441, and C680. There are no surface mining and material sites adjacent to or crossed by the subroute.

Subroute 4C3 – Tucson

There is a concentration of mine sites, claims, and prospects adjacent to Link C110. Surface mining and material sites adjacent to or crossed by the subroute include links F111, F112, and F510.

Local Alternative and Crossover Links for Route Group 4

There is a concentration of mine sites, claims, and prospects adjacent to links C680 and C671. Surface mining and material sites are adjacent to links F81a and F81b.

3.10.5.6 Military Installations and Airspace Subroute Summaries

Route Group 1: SunZia East Substation to Midpoint Substation

Subroute 1A1 – North River Crossing

Links E80d, E101a, and E101b cross the Northern Call-up Area north of the WSMR. Pursuant to evacuation agreements, residents and businesses located in this area are required to evacuate their properties during missile tests. Adjacent to the north and west sides of the WSMR in Socorro County, the DOD has delineated and designated four areas as safety evacuation areas (i.e., areas evacuated of residents and nonresidents prior to and during missile firing on the WSMR).

Within the Northern Call-up Area, the DOD controls two areas of airspace known as R5107C and R5107H. These cover the same geographic region, one on top of the other. The lower level R5017C starts at the surface and extends to 9,000 feet above ground level, and is used for low-level flight operations. The upper level R5107H extends from 9,001 feet to 60,000 feet above ground level and is used for high altitude flight operations.

Link E80d is approximately 1 mile east of LC 94, which is used to test-fire missiles onto the WSMR.

The policy of the Air Force regarding training and testing around the Gran Quivira is to avoid the airspace within a 5-nautical-mile radius of the center of the Gran Quivira (links E82, E84, and E85).

Subroute 1A2 – BLM Preferred Alternative

Links E86a, E86b, and E101b cross the Northern Call-up Area north of the WSMR, as described for Subroute 1A1. Subroute 1A2 is along the northern boundary of the R5107C and R5107H airspace.

Link E86b is approximately 5 miles north of LC 94.

Subroute 1A2 crosses within the 5-mile radius of the center of the Gran Quivira (links E82, E84a, E84b, and E86a).

Subroute 1A – North River Crossing

Subroute 1A is similar to the BLM preferred alternative and Subroute 1A1, but includes Link E80c, which also crosses the Northern Call-up Area north of the WSMR.

Subroute 1B – San Antonio Crossing

The land uses associated with this subroute are similar to the BLM preferred alternative and Subroute 1A, between the SunZia East Substation and the point where Link E90 diverges to the south. Link E90 is approximately 1 mile west of LC 94. Links A90, A111, A30, A50, A60, A40, A41, and A80 are located within the Northern Call-up Area. Subroute 1B3 (Link A41) crosses a 1-mile segment of DOD land approximately 3 miles north of the WSMR.

Local Alternative and Crossover Links for Route Group 1

The Air Force policy regarding training and testing around the Gran Quivira is to avoid the airspace within a 5-nautical-mile radius of the center of the National Monument.

<u>Route Group 3: Midpoint Substation to Willow-500 kV Substation</u>

Subroute 3A2 – BLM Preferred Alternative

There are no military installations or airspace near or crossed by Subroute 3A2.

Subroute 3A – North

Subroute 3A is the same as the BLM preferred alternative.

Subroute 3B – South

Subroute 3B crosses a parcel of land owned by the DOD and used by the Army National Guard as a shooting range. This parcel of land is located approximately 8 miles northwest of Deming on the south side of US Route 80.

Route Group 4: Willow-500 kV Substation to Pinal Central Substation

Military installations or airspace in Route Group 4 are near Subroute 4C3 and the Pantano-Rillito local alternative subroute. Link F111 is within 3 miles of Davis-Monthan AFB, parallel to the main runway. Link F540 is approximately 3 miles east of the Pinal Air Park, which is home to the Silver Bell Army Heliport. Link C820 is approximately 2 miles east of Square Field, an area used by the U.S. Army during helicopter training exercises. Links C760, C780, C817, C818, C830, C840, C850, and C860 all cross a military training route associated with the Silver Bell Army Heliport.

Subroutes 4C1, 4C2, 4C2a, 4C2b, 4C2c, and 4C3 cross the northern portion of the Buffalo Soldier Electronic Proving Ground. This facility, headquartered at Fort Huachuca, conducts noise tests for electronic combat and electronic warfare equipment (see Section 3.10.3.7).

Local Alternative and Crossover Links for Route Group 4

Local alternative links for 4C3 include links F81a and F81b, which are within 3.0 miles of the Davis-Monthan AFB, parallel to the main runway.

3.10.5.7 Energy Facilities, Utility Corridors, and Communication Sites Subroute Summaries

Each of the subroutes is parallel to existing linear utilities or is located in designated utility corridors. Existing electrical generating facilities and substations are also located within the alternative study corridors. Planned energy facilities are discussed in Section 4.17, Cumulative Impacts (Table 4-36). Further description of the subroutes in relation to the parallel utility corridors and other linear energy features is provided in Appendix E.

Route Group 1: SunZia East Substation to Midpoint Substation

Subroute 1A1 – North River Crossing

Subroute 1A1 parallels or crosses pipeline, existing utilities, and designated utility corridors, including the planned SunZia East Substation, which is a beginning point for the Project. Subroute 1A1 parallels existing utilities and designated utility corridors for approximately 140.7 miles, and is within the DOE West-wide Energy Corridor along links E211, A161, and A161a. Link E180 crosses portions of a BLM-designated utility corridor, and Link A260 is parallel to the DOE West-wide Energy Corridor.

Subroute 1A2 – BLM Preferred Alternative

Subroute 1A2 parallels or crosses similar existing utilities and designated utility corridors as Subroute 1A1. The BLM preferred alternative parallels linear energy facilities and designated utility corridors for approximately 140.7 miles, and is within the DOE West-wide Energy Corridor along links E211, A161, and A161a. Link E180 crosses portions of a BLM-designated utility corridor, and Link A260 is parallel to the DOE West-wide Energy Corridor.

Subroute 1A – North River Crossing

Subroute 1A is similar to the BLM preferred alternative and Subroute 1A1, except that the total mileage equals 113.5 and does not include Link A260.

Subroute 1B – San Antonio Crossing

These three subroutes parallel existing utilities and designated utility corridors for approximately 88.6 to 98.6 miles, depending on the subroute. Subroute 1B is within the BLM designated utility corridor with Link A140, and within the West-wide Energy Corridor with links A161, A161a, and A260.

Local Alternative and Crossover Links for Route Group 1

Portions of the crossover and local alternative links are parallel to existing utilities and designated utility corridors for approximately 11.2 to 20.7 miles. Link A260 is parallel to the DOE West-wide Energy Corridor.

Route Group 3: Midpoint Substation to Willow-500 kV Substation

Subroute 3A2 – BLM Preferred Alternative

Subroute 3A2 is parallel to existing utilities and designated utility corridors for approximately 42.4 miles. The existing Hidalgo and Lordsburg substations are adjacent to Link B121.

Subroute 3A – North

Subroute 3A is parallel to existing utilities and designated utility corridors for approximately 42.4 miles. Subroute 3A is similar to the BLM preferred alternative.

Subroute 3B – South

The subroute parallels existing utilities and designated utility corridors for approximately 76.2 miles. Links B110a, B110b, B112, and B150a are located in the West-wide Energy Corridor. Power plants observed along the subroute include the Evergreen Power Plant, adjacent to Link B112.

Crossover Links for Route Group 3

Crossover Link B111 parallels existing utilities and designated utility corridors for 7.2 miles, and Link B140 is within the West-wide Energy Corridor for 0.3 mile.

Route Group 4: Willow-500 kV Substation to Pinal Central Substation

Subroute 4A – North of Mt. Graham

This subroute parallels existing utilities and designated utility corridors for approximately 27.6 miles. No substations or power plants are adjacent to this subroute.

Subroute 4B – Sulphur Springs Valley

This subroute parallels existing utilities and designated utility corridors for approximately 21.6 miles. No substations or power plants are adjacent to this subroute.

Subroute 4C2c – BLM Preferred Alternative

Subroute 4C2c parallels existing utilities and designated utility corridors for approximately 90.4 miles. The Oracle Junction Substation is adjacent to Link C680. Links C260 and C261 are adjacent to the Winchester Substation.

Subroute 4C1 – East of San Pedro River

Subroute 4C1 parallels existing utilities and designated utility corridors for approximately 66.5 miles. This subroute parallels the proposed San Manuel 230 kV transmission line project at Link C660.

Subroute 4C2 – West of San Pedro River

Subroute 4C2 parallels existing utilities and designated utility corridors for approximately 74.8 miles. No power plants are adjacent to this subroute. The Oracle Junction Substation is adjacent to Link C680.

Subroute 4C3 – Tucson

This subroute parallels pipeline, existing utilities, and designated utility corridors for approximately 125.3 miles. The minor substations adjacent to this subroute include: Adonis Substation adjacent to Link F540; Tucson and Rillito substations adjacent to Link F112; Vail Substation adjacent to links F80 and F60b; and Cienega Substation adjacent to links F60b and F82. Irvington Generating Station and Substation is adjacent to Link F111, the North Loop Generating Station and Substation is adjacent to Link F510, and the DeMoss Petrie Generating Station and Substation is adjacent to Link F112.

Local Alternative and Crossover Links for Route Group 4

The crossover and local alternative links for Route Group 4 parallel existing utilities and designated utility corridors for approximately 1.6 to 46.2 miles. Local alternative links for 4C2 (Winchester and Tortolita substations) include links C260 and C261, which are adjacent to the existing Winchester Substation. For local alternative links for 4C2 (Tortolita Substation), Link C810a is adjacent to the existing Tortolita Substation.

Local alternatives links for 4C3 include links F81a and F81b, which are adjacent to the East Loop Substation. The Northeast Substation is adjacent to Link F81b.

Communication facilities such as microwave stations, radio towers, and cellular/digital towers located within the study corridors are identified in Table 3-49.

Table 3-49. Communication Facilities within the Study Corridors	
Subroute	**Communication Facility Link Locations**
Group 1	
1A1 – North River Crossing	A161a, A330b, E82, A260
1A2 – BLM Preferred Alternative	A161a, A330b, E82, A260
1A – North River Crossing	A161a, E80c, A330b, A270
1B – San Antonio Crossing	A140, A161a, A41, A270, E80c, A330b, A270
Local Alternative and Crossover Links for Route Group 1	E81, E82, A260
Group 3	
3A2 – BLM Preferred Alternative	B120a
3A – North	B120a
3B – South	B112, B150b
Crossover Links for Route Group 3	None
Group 4	
4A – North of Mt. Graham	B153b, C170
4B – Sulphur Springs Valley	None
4C2c – BLM Preferred Alternative	C450,C441, C260
4C1 – East of San Pedro River	None
4C2 – West of San Pedro River	C450, C441
4C3 – Tucson	F112, F510
Local Alternative and Crossover Links for Route Group 4	C260, F81b, F40b

3.10.5.8 Planned Land Use Subroute Summaries

Summaries of planned land uses for each of the alternative subroutes are described below. Descriptions of BLM RMP right-of-way avoidance areas are provided in Chapter 2, Section 2.6.

Route Group 1: SunZia East Substation to Midpoint Substation

Subroute 1A1 – North River Crossing

Similar to the existing land uses, planned land use along the majority of Subroute 1A1 is vacant/mixed use/grazing. In Socorro County, no planned land uses have been identified and existing uses are expected to continue. For approximately 13.0 miles, Link A161 crosses a planned residential development that is adjacent to the Bosque del Apache NWR. Pending projects crossed by this alternative include the New Mexico Copper Corporation mining lease area (Link A330b), located adjacent to Highway 152, and the AT&T Corporation communication facility lease area (Link E211). These leases are not addressed in Section 4.10 of Chapter 4, Land Use and Recreation Impacts, due to the preliminary status of the leases, but are addressed as reasonably foreseeable future activities in Section 4.17 of Chapter 4, Cumulative Effects.

Subroute 1A2 – BLM Preferred Alternative

Planned land use for Subroute 1A2 is similar to Subroute 1A1.

Subroute 1A – North River Crossing

Subroute 1A is similar to the BLM preferred alternative and Subroute 1A1.

Subroute 1B – San Antonio Crossing

Similar to 1A, the planned land use along this subroute is expected to be a continuation of the existing grazing and agricultural land uses. Link A161 passes directly through the approved Willow Springs Ranch residential development.

Local Alternative and Crossover Links for Route Group 1

The area is largely undeveloped; existing uses of grazing/mixed use/vacant are expected to continue. Local alternative links for 1A, 1B1, 1B2, and 1B3 include Link A161b, which runs adjacent to the west side of the Willow Springs Ranches, a plat-approved residential development approximately 26 miles south of Socorro, New Mexico, and 2 miles west of I-25.

Route Group 3: Midpoint Substation to Willow-500 kV Substation

Subroute 3A2 – BLM Preferred Alternative

Existing land uses, primarily for grazing and agriculture, are expected to continue; particularly since no long-range comprehensive plans exist for much of Luna and Hidalgo counties. Aven Associates, LLC mine lease area (Link B160a) is a pending mining lease, located approximately 3.5 miles west of Highway 70[1].

Subroute 3A – North

Subroute 3A is similar to the BLM preferred alternative.

Subroute 3B – South

Subroute 3B is similar to the BLM preferred alternative, with existing mixed/vacant/grazing land uses expected to continue. Link B150b crosses through low residential future land use for Cochise County. Entrée Gold Inc. mine lease area crossed by Link B112, south of City of Lordsburg[1].

Crossover Links for Route Group 3

Link B111 crosses a proposed solar farm (see Section 3.10.3.8), with existing mixed/vacant/grazing land uses expected to continue.

[1] This lease is pending and is not addressed in Section 4.10 of Chapter 4, Land Use and Recreation Impacts, due to its preliminary status, but is addressed as a reasonably foreseeable future activity in Section 4.17 of Chapter 4, Cumulative Effects.

Route Group 4: Willow-500 kV Substation to Pinal Central Substation

Subroute 4A – North of Mt. Graham

The primary existing land uses along this subroute are grazing/mixed use/vacant; these and other existing uses are expected to continue into the future. A conceptual new roadway between Safford and Pima is proposed under the ADOT Regional Framework Study 2050 Scenario A, which would be in a similar corridor to portions of Link B153b (ADOT 2011). Land along Link C620 is designated for residential and park uses (Pinal County 2009); Link 760 is near a small area of land designated for residential uses; links C850 and C880 are in a study corridor for a planned future freeway, identified in the ADOT Regional Framework Study 2050 Scenario A, that would connect US Route 60 (outside of the study area) and I-10 near Picacho State Park (ADOT 2011); and Link C880a crosses over land designated for commercial and residential uses, where it then crosses SR 87 and terminates at the planned Pinal Central Substation adjacent to planned/existing residential areas (Pinal County 2009).

Subroute 4B – Sulphur Springs Valley

The planned land use for this segment of the route is similar to the planned land use for Subroute 4A. There are no specific development plans for the portion of the subroute crossing Graham and Cochise counties.

Subroute 4C2c – BLM Preferred Alternative

Subroute 4C2c passes through and near multiple areas designated for residential uses. Link C670 crosses land designated for residential uses north of Oracle, Arizona; as does Link C450 approximately 2 miles southwest of San Manuel (Pinal County 2009). West of the San Pedro River, Link C441 is less than 0.5 mile east of land designated for future residential development. Between SR 79 and the town of Oracle, Arizona, Link C680 crosses land planned for residential development with an existing golf course, and passes less than 1 mile north of land designated for residential development (*ibid*). Existing homes in this area are widely dispersed.

Subroute 4C1 – East of San Pedro River

The San Pedro Valley subroutes cross areas with the most active of the future planned land uses. Link C660 is near an existing mine; surrounding land is planned for continued industrial uses as the mine expands its operating area (Pinal County 2009). Link C670 crosses land designated for residential uses north of Oracle, Arizona; land along Link C691 is designated for residential and park uses (*ibid*); and Link C691 crosses directly through the plat-approved Willow Springs Ranch residential development. The remainder of this subroute is similar in planned land use to Subroute 4A.

Subroute 4C2 – West of San Pedro River

Subroute 4C2 is similar to the BLM preferred alternative.

Subroute 4C3 – Tucson

Subroute 4C3 is different from other subroutes in Route Group 4 that traverse developed and densely populated areas. Link F40a, approximately 9 miles north of Benson, Arizona, passes northwest of land with existing agriculture and residential uses that are expected to continue (Cochise County 2006).

Through the Santa Cruz River, this subroute is nearly identical to the Pantano Rillito local alternative. Link F510 passes through approximately 2.3 miles of land designated for parks/preservation; however, there are currently no plans or pending approvals for parks in this area (Pima County 2010b). Near the Tortolita Substation, sporadic parcels of land are designated for residential development; however, the majority of land between Tucson and the Tortolita Substation is managed by the BLM and planned for grazing/mixed use/vacant. North of the Tortolita Substation, Link C816 passes through land designated for residential development. The planned Pinal Central Substation to the Tortolita Substation 500 kV transmission line owned by TEP parallels the following links: C810a, C813, C816, C817, C820, C830, C840, C850, C880, and C880a. This project is currently in the environmental permitting process, with an approximate construction date of 2013. Links C850, C880, and C880a cross land designated for agriculture, commercial, parks and preservation, and low density residential. With the exception of the commercial designation, these land uses will continue.

Local Alternative and Crossover Links for Route Group 4

This area is largely undeveloped; existing uses of grazing/mixed use/vacant are expected to continue.

Local Alternative Link C790 crosses through an area designated for low density residential.

Local alternative links C680 and C816 cross through an area designated for low density residential, and C810a crosses a planned commercial area.

Local Alternative Link F40b passes through undeveloped and developed land designated for residential uses (Pima County 2010b), and within 0.5 mile of existing and planned residential development. Prior to crossing into the Rillito River, Link F81a passes approximately 0.1 mile to the east of a planned medium-density residential subdivision that has not reached full build-out. The remainder of Link F81a passes through the Rillito River, an existing recreation area designated for parks and preservation (City of Tucson 2011).

The local alternative links in the vicinity of Tucson include C860, C870, and C890. They cross a mix of planned land uses within the urban area of the Tucson Valley that are a continuation of existing uses, including urban residential, office, commercial, mixed, and industrial (*ibid*).

3.11 SPECIAL DESIGNATIONS

3.11.1 Introduction

This section identifies special designations within the study area for the proposed Project alternatives. Special designations are identified in BLM land use planning documents and are

either administratively or congressionally designated. Congressionally designated areas may include wilderness areas, WSAs, wild and scenic rivers, national conservation areas, and national scenic or historic trails. Administrative designations may include ACECs and SRMAs. Special designations protect values and land uses unique to an area, which typically require a more intensive management emphasis than is applied to surrounding public land. Specific management prescriptions are identified for these areas, including the avoidance or exclusion of some activities or uses (i.e., right-of-way leases or grants). Wilderness areas, WSAs, and lands with wilderness characteristics are described in Section 3.12.

3.11.2 Areas of Critical Environmental Concern

According to the FLPMA, ACEC are "…areas within the public land where special management attention is required (where such areas are developed or used or where no development is required) to protect and prevent irreparable damage to important historic, cultural, or scenic values; fish and wildlife resources, or other natural systems or processes; or to protect life/provide safety from natural hazards."

The following ACEC are located within the 6-mile-wide study corridor for each of the alternative subroutes:

- The Ladron Mountain/Devil's Backbone Complex ACEC is located in New Mexico and is managed to maintain viable populations of Desert Bighorn Sheep through activities such as habitat improvements and coordination with the NMDGF on Desert Bighorn Sheep transplants and reintroductions. It is also managed to maintain and/or implement closure to domestic sheep and goats within 10 miles of bighorn habitat and to exclude grazing on land that has not been allotted.
- The Mockingbird Gap Proprietary ACEC is located in New Mexico and is managed to research, study, and protect cultural resource sites.
- The Uvas Valley ACEC is located in New Mexico and is managed to protect biological values.
- The Bear Springs Badlands ACEC is located in Arizona and is managed to protect paleontological and scenic resources.
- The Swamp Springs-Hot Springs Watershed ACEC is located in Arizona and is co-managed by the BLM, USFS, and AZGFD to protect riparian areas, threatened and endangered species, bighorn sheep, native fish, and cultural resources.
- The Aravaipa Watershed ACEC is located in Arizona and is managed to maintain or restore the natural ecological processes, biological communities, and cultural resources.
- The Muleshoe Ranch CMA, ACEC is located in Arizona and is co-managed by the BLM, USFS, and AZGFD to protect riparian areas, threatened and endangered species, bighorn sheep, native fish, and cultural resources.
- The South Rim ACEC is located in Arizona and is co-managed by the BLM, USFS, and AZGFD to protect riparian areas, threatened and endangered species, bighorn sheep, native fish, and cultural resources.

- The Table Mountain RNA, ACEC is located in Arizona and is managed to protect the Alligator Juniper savanna vegetation system that is of extremely restricted range.
- The Turkey Creek ACEC is located in Arizona and is managed to protect two riparian woodlands.
- The Desert Grasslands RNA ACEC is located in Arizona and is managed to protect vegetation (desert grasslands).

3.11.3 BLM National Back Country Byways

BLM national backcountry byways are designated under the BLM's Byways Program, established in 1989 as a component of the National Scenic Byways Program (BLM 2009e). In the New Mexico portion of the study corridors, the Quebradas Backcountry Byway is an unpaved county road traversing approximately 24 miles of rugged, colorful landscape east of Socorro (*ibid*). There are no backcountry byways located in the Arizona portion of the study corridors.

3.11.4 Research Natural Areas

RNAs are established and maintained for the primary purpose of research and education, because the land is: (1) a typical representation of a common plant or animal association; (2) an unusual plant or animal association; (3) a threatened or endangered plant or animal species; (4) a typical representation of common geological, soil, or water features; or (5) outstanding or unusual geological, soil, or water features (BLM 1993).

The Lordsburg Playa RNA, located in the New Mexico portion of the study corridors, is approximately 4,500 acres of land managed to protect biological and research values. It provides an important stop-off or wintering site for migrating shorebirds and waterfowl in some wet years (*ibid*).

The Desert Grasslands RNA, ACEC, located in the Arizona portion of the study corridors, is being managed to protect desert grasslands that provide critical habitat for 13 state-listed wildlife species and are important for watershed stabilization (BLM 1991).

The Table Mountain RNA, ACEC, also located in the Arizona portion of the study corridors, is approximately 1,220 acres of land managed to protect two important plant communities: the alligator juniper savanna and a white oak woodland containing Mexican blue oak (*ibid*)

3.11.5 Special Management Areas

SMAs are areas that have been identified by the BLM for the management of a specific resource(s). A total of three SMAs are located in the New Mexico portion of the study corridors: San Pedro (proprietary), located east of San Antonio; Stallion, located approximately 11 miles northeast of San Antonio; and Penjeacu, located south of Socorro. The San Pedro SMA includes 1,201 acres of public land (BLM 2010b) and is managed to protect Fugate's Blue Star, a special-status species. The Stallion SMA includes 10,883 acres of public land and is designated for the

management of watershed resources (*ibid*). The Penjeacu SMA includes 11 acres designated for the protection and management of cultural resources (*ibid*).

3.11.6 Wild Horse Management Areas

Wild horse management areas are designated in 10 western states to protect and preserve the herds of wild horses and burros roaming public lands. Herd areas include those where wild horses and burros were located when the Wild Free-Roaming Horses and Burros Act of 1971 was signed. Herd management areas (HMA) are areas where populations of wild horses and burros are being managed. The Bordo Atravesado HMA is located on approximately 19,605 acres of federal, state, and private lands roughly 15 miles northeast of Socorro, New Mexico. The HMA is being managed for approximately 50 wild horses and burros and is located in the Project study area (BLM 2010k).

3.11.7 Special Recreation Management Areas

An SRMA is "a public lands unit identified in land use plans to direct recreation funding and personnel to fulfill commitments made to provide specific, structured recreation opportunities (i.e., activity, experience, and benefit opportunities). The BLM recognizes three distinct types of SRMAs: community-based, intensive, and undeveloped big open" (BLM 2010c).

The SRMAs listed below are located in the New Mexico portion of the study corridors and are managed by the BLM Socorro Field Office.

- *The Box* – managed to enhance the area's unique recreational values, primarily rock climbing and bouldering; maintain scenic quality; and ensure protection for cultural sites, Desert Bighorn Sheep, and bats and their habitat.
- *Johnson (Gordy's) Hill* – managed for recreation uses that include OHV races and group events.
- *Quebradas Back Country Byway* – managed for a variety of recreation opportunities and experiences, including driving for pleasure, high scenic quality, geological sightseeing, interpretation and environmental education, mountain biking, and access to hiking areas such as the Presilla and Sierra de Las Canas WSAs.
- *Socorro Nature Area* – managed for recreational use and to provide environmental education and interpretation opportunities. Experiences will be primarily picnicking, hiking, sightseeing in Bosque Habitat, access to the Rio Grande, camping, and mountain biking (*ibid*).

3.11.8 National Monuments

National monuments are designated under the Antiquities Act of 1906 and are managed mainly by the NPS; however, some are managed by the BLM USFWS and other federal, state, and local agencies. The only national monument located within the SunZia study corridors is the Gran

Quivira in New Mexico[1]. Originally designated as a national monument by President William Taft, it now protects 1,100 acres of land that contains the ruins of four mission churches and pueblos that date back to early contact between the Pueblo Indians and Spanish Colonials[2]. None of the Project alternative routes crosses within the boundaries of any national monument within the study area.

3.11.9 National Trails

National trails are designated under the National Trails System Act of 1968. According to the NPS, this system comprises:

- National recreation trails that provide a variety of outdoor recreation uses in or accessible to urban areas
- National scenic trails that are designated to (1) allow outdoor recreation opportunities; (2) protect nationally significant scenic, historic, natural, or cultural qualities of areas; and (3) represent desert, marsh, grassland, mountain, canyon, river, forest, and other areas, as well as landforms that are characteristic of a region
- National historic trails that follow as closely as possible and practicable to the original trails or routes of national historic significance

There are also connecting and side trails designated to provide additional points of public access to, or connections between, national recreation, scenic, or historic trails (NPS 2010c).

The following trails would cross or be located parallel to alternative subroutes within study corridors:

- Juan Bautista de Anza NHT – a trail comprising the overland route traveled by Captain Juan Bautista de Anza of Spain during the years 1775 and 1776, from Sonora, Mexico, to the vicinity of San Francisco, California (BLM 2011b)
- El Camino Real de Tierra Adentro NHT – designated in 2000 for its cultural significance, the trail is the primary route between the colonial Spanish capital of Mexico City and the Spanish provincial capitals (present-day Mexico and New Mexico), between the sixteenth and nineteenth centuries (*ibid*)
- Arizona National Scenic Trail – a non-motorized trail extending 820 miles across the state of Arizona from the United States–Mexico international border to the Arizona–Utah border. The trail is intended to be a primitive, long distance trail that highlights the state's topographical, biological, historical, and cultural diversity (BLM 2011b)
- Continental Divide National Scenic Trail – part of the National Scenic Trail System, a 50-mile-wide corridor on either side of the actual continental divide, established by Congress to protect significant scenic values (BLM 2011b)

The inventory and assessment of National Historic and Scenic Trails is included in Appendix L.

[1]http://www.cr.nps.gov/history/hisnps/npshistory/monuments.htm
[2]http://www.nps.gov/sapu/index.htm

3.11.10 National Wildlife Refuges

The USFWS is the principal agency for the conservation, protection, and enhancement of fish and wildlife and their habitats. Within the USFWS, the NWR System administers a network of lands and waters for the conservation, management, and (where appropriate) restoration of fish, wildlife, and plant resources and their habitats within the United States, for the benefit of present and future generations of America. The NWR System provides compatible wildlife-dependent recreational uses; including hunting, fishing, wildlife observation, photography, interpretation, and education (USFWS 2010b).

Two NWRs are located in the New Mexico portion of the study corridors; the Sevilleta and Bosque del Apache. The approximately 230,000-acre Sevilleta NWR is managed to maintain natural processes of flood, fire, and succession that sustain its diverse ecosystem. It is home to more than 1,200 species of plants, 89 species of mammals, 225 species of birds, 58 species of reptiles, and 15 species of amphibians (USFWS 2011d). The Bosque del Apache NWR is approximately 57,000 acres and includes three wilderness areas and five RNAs. It provides habitat for tens of thousands of birds, including Sandhill Cranes, geese, and ducks that migrate there in the autumn to make the NWR their winter home (USFWS 2011e).

3.11.11 Summary of Inventory Results

The following summary describes the special designations that are located within the study corridors for alternative subroutes.

3.11.11.1 Areas of Critical Environmental Concern Subroute Summaries

Route Group 1: SunZia East Substation to Midpoint Substation

Subroute 1A1 – North River Crossing

Link E200 is directly south of the Ladron Mountain/Devil's Backbone Complex ACEC, which comprises several noncontiguous parcels of land.

Subroute 1A2 – BLM Preferred Alternative

Subroute 1A2 is the same as Subroute 1A1.

Subroute 1A – North River Crossing

Subroute 1A is the same as Subroute 1A1 and Subroute 1A2, the BLM preferred alternative.

Subroute 1B – San Antonio Crossing

There are no ACECs within or near the links in Subroute 1B.

Local Alternative and Crossover Links for Route Group 1

Local alternative links for subroutes 1A, 1B1, 1B2, and 1B3 include links A430 and A481, which are approximately 2.75 miles east and southeast of the Uvas Valley ACEC, northeast of Deming, New Mexico. Local Alternative Link A161b borders the eastern edge of the Ladron Mountain/Devil's Backbone Complex ACEC, near the Willow Springs Ranch Subdivision.

Route Group 3: Midpoint Substation to Willow-500 kV Substation

There are no ACECs within or near the subroutes or the crossover and local alternative links in Route Group 3.

Route Group 4: Willow-500 kV Substation to Pinal Central Substation

Subroute 4A – North of Mt. Graham

Link B153b is less than 1 mile south of the Bear Springs Badlands ACEC, west of the city of Safford, Arizona. Link C170 is approximately 3 miles south of the Turkey Creek ACEC, and less than 2 miles south of the Table Mountain RNA, ACEC, near Aravaipa Canyon.

Subroute 4B – Sulphur Springs Valley

This subroute is similar to Subroute 4A, but does not include the Bear Springs Badlands ACEC near Safford, Arizona.

Subroute 4C2c – BLM Preferred Alternative

There are no ACECs within or near Subroute 4C2c.

Subroute 4C – San Pedro Valley and Tucson

Link C331 crosses the southwest corner of the Muleshoe Ranch CMA, ACEC, and the Swamp Springs-Hot Springs Watershed ACEC, near the Muleshoe Ranch area north of Benson, Arizona.

Local Alternative and Crossover Links for Route Group 4

Crossover links for 4A, 4B, and 4C1 include Link C500, which is approximately 2.25 miles from the Desert Grasslands RNA, ACEC, near Mammoth, Arizona.

3.11.11.2 National Back Country Byways Subroute Summaries

Route Group 1: SunZia East Substation to Midpoint Substation

Subroute 1A1 – North River Crossing

Subroute 1A1 is less than 0.5 mile (Link E180) from the Quebradas Back Country Byway.

Subroute 1A2 – BLM Preferred Alternative

Subroute 1A2 is the same as Subroute 1A1.

Subroute 1A – North River Crossing

Subroute 1A is the same as Subroute 1A1 and Subroute 1A2, the BLM preferred alternative.

Subroute 1B – San Antonio Crossing

Links A90 and A111 are approximately 2 miles from the southern portion of the Quebradas Back Country Byway.

Local Alternative and Crossover Links for Route Group 1

There are no Back Country Byways in or near the local alternative and crossover links for Route Group 1.

Route Group 3: Midpoint Substation to Willow-500 kV Substation

There are no Back Country Byways in or near the subroutes or the crossover and local alternative links in Route Group 3.

Route Group 4: Willow-500 kV Substation to Pinal Central Substation

There are no Back Country Byways in or near the subroutes or the crossover and local alternative links in Route Group 4.

3.11.11.3 Research Natural Areas Subroute Summaries

Route Group 1: SunZia East Substation to Midpoint Substation

Subroute 1A1 – North River Crossing

There are no RNAs located near Subroute 1A1.

Subroute 1A2 – BLM Preferred Alternative

There are no RNAs located near Subroute 1A2.

Subroute 1A – North River Crossing

There are no RNAs located near Subroute 1A.

Subroute 1B – San Antonio Crossing

There are five RNAs in Subroute 1B, all within the Bosque del Apache NWR: Apache Camp, Chupadera, Jornada del Muerto, Rio Grande Marsh, and San Pasqual. The RNAs are within 3 miles of links A160 and A111.

Local Alternative and Crossover Links for Route Group 1

There are no RNAs in or near the local alternative and crossover links for Route Group 1.

Route Group 3: Midpoint Substation to Willow-500 kV Substation

Subroute 3A2 – BLM Preferred Alternative

The Lordsburg Playa RNA, approximately 1.0 mile from Link B150a, parallels Link B150a for approximately 2.0 miles.

Subroute 3A – North

There are no RNAs in or near Subroute 3A.

Subroute 3B – South

Subroute 3B includes the parallel Lordsburg Playa RNA.

Local Alternative and Crossover Links for Route Group 3

There are no RNAs in or near the local alternative and crossover links for Route Group 3.

Route Group 4: Willow-500 kV Substation to Pinal Central Substation

Subroute 4A – North of Mt. Graham

Link C170 is located to the south, within 2 miles of Table Mountain RNA, ACEC, and approximately 3 miles from Turkey Creek ACEC.

Subroute 4B – Sulphur Springs Valley

Subroute 4B would affect the same special designations as Subroute 4A.

Subroute 4C – San Pedro Valley and Tucson

There are no RNAs in or near any of the 4C subroute groups, including the BLM preferred alternative.

Local Alternative and Crossover Links for Route Group 4

Crossover links for 4A, 4B, and 4C1 include Link C500, which is located to the southwest, within 3 miles of the Desert Grasslands RNA, ACEC.

3.11.11.4 Special Management Areas

Route Group 1: SunZia East Substation to Midpoint Substation

Subroute 1A1 – North River Crossing

There are no SMAs located near Subroute 1A1.

Subroute 1A2 – BLM Preferred Alternative

There are no SMAs located near Subroute 1A2.

Subroute 1A – North River Crossing

Subroute 1A is the same as Subroute 1A1 and Subroute 1A2, the BLM preferred alternative.

Subroute 1B – San Antonio Crossing

Link A111 borders the northern edge of the San Pedro SMA, and Link A90 is within 1 mile of the Stallion SMA.

Local Alternative and Crossover Links for Route Group 1

There are no SMAs in or near the local alternative and crossover links for Route Group 1.

Route Group 3: Midpoint Substation to Willow-500 kV Substation

There are no SMAs located near Route Group 3.

Route Group 4: Willow-500 kV Substation to Pinal Central Substation

There are no SMAs located near Route Group 4.

3.11.11.5 Wild Horse Management Areas

Route Group 1: SunZia East Substation to Midpoint Substation

Subroute 1A1 – North River Crossing

The Bordo Atravesado HMA is located within approximately 3.0 miles of Link E101b.

Subroute 1A2 – BLM Preferred Alternative

The Bordo Atravesado HMA is located within approximately 3.0 miles of Link E101b.

Subroute 1A – North River Crossing

Subroute 1A is the same as Subroute 1A1 and Subroute 1A2, the BLM preferred alternative.

Subroute 1B – San Antonio Crossing

There are no herd areas or HMAs located near Subroute 1B.

Local Alternative and Crossover Links for Route Group 1

There are no herd areas or HMAs in or near the local alternative and crossover links for Route Group 1.

Route Group 3: Midpoint Substation to Willow-500 kV Substation

There are no herd areas or HMAs located near Route Group 3.

Route Group 4: Willow-500 kV Substation to Pinal Central Substation

There are no herd areas or HMAs located near Route Group 4.

3.11.11.6 Special Recreation Management Areas Subroute Summaries

Route Group 1: SunZia East Substation to Midpoint Substation

Subroute 1A1 – North River Crossing

The Johnson (Gordy's) Hill SRMA is crossed by links E180 and E133, and the Quebradas Back Country Byway SRMA is located approximately 1.0 mile from links E180 and E133. The Socorro Nature Area is located approximately 2.0 miles north of Link E180; and The Box SRMA, located approximately 2.0 miles west of Link E211, parallels Link E211 for approximately 2.0 miles.

Subroute 1A2 – BLM Preferred Alternative

This subroute uses the same alignment as Subroute 1A1 in the affected parts of these SRMAs.

Subroute 1A – North River Crossing

This subroute uses the same alignment as Subroute 1A1 and Subroute 1A2, the BLM preferred alternative, in the affected parts of these SRMAs.

Subroute 1B – San Antonio Crossing

The Quebradas Back Country Byway SRMA is located approximately 1.0 mile from Link A90 and approximately 2 miles south of Link A111 for subroutes 1B1 and 1B2. Link A111 is approximately 2 miles north of Subroute 1B3.

Local Alternative and Crossover Links for Route Group 1

There are no SRMAs in or near the local alternative and crossover links for Route Group 1.

Route Group 3: Midpoint Substation to Willow-500 kV Substation

There are no SRMAs in or near the subroutes or the local alternative and crossover links for Route Group 3.

Route Group 4: Willow-500 kV Substation to Pinal Central Substation

There are no SRMAs in or near the subroutes or the local alternative and crossover links for Route Group 4.

3.11.11.7 National Monuments

Route Group 1: SunZia East Substation to Midpoint Substation

There are no national monuments near Route Group 1 subroutes.

Local Alternative and Crossover Links for Route Group 1

Local alternative links for 1A and 1B1 (Gran Quivira area) include links E81 and E83, which are located within 2 miles of the Salinas Pueblo Missions National Monument.

Route Group 3: Midpoint Substation to Willow-500 kV Substation

There are no national monuments near the subroutes or the local alternative and crossover links for Route Group 3.

Route Group 4: Willow-500 kV Substation to Pinal Central Substation

There are no national monuments near the subroutes or the local alternative and crossover links for Route Group 4.

3.11.11.8 National and Historic Trails Subroute Summaries

Route Group 1: SunZia East Substation to Midpoint Substation

Subroute 1A1 – North River Crossing

The historic El Camino Real de Tierra Adentro National Trail is directly crossed by Link E180 of Subroute 1A1. Link A440 crosses the Butterfield historic trails.

Subroute 1A2 – BLM Preferred Alternative

Subroute 1A2 is the same as Subroute 1A1.

Subroute 1A – North River Crossing

Subroute 1A is the same as Subroute 1A2, the BLM preferred alternative, and Subroute 1A1.

Subroute 1B – San Antonio Crossing

The historic El Camino Real de Tierra Adentro National Trail is directly crossed by Link A140 of this subroute. Link A400 is adjacent to General Cooke's Wagon Road Trail, and Link A440 crosses the historic Butterfield Trail.

Local Alternative and Crossover Links for Route Group 1

Local alternative links for 1A, 1B1, 1B2, and 1B3 include Link A431, which crosses the historic Butterfield Trail.

Route Group 3: Midpoint Substation to Willow-500 kV Substation

Subroute 3A2 – BLM Preferred Alternative

Subroute 3A2 crosses two national trails. Link B120b crosses the CDNST and the historic Butterfield Trail, and Link B140 crosses the historic Butterfield Trail.

Subroute 3A – North

Subroute 3A crosses two national trails. Link B120b crosses the CDNST and the historic Butterfield Trail.

Subroute 3B – South

Subroute 3B crosses two national trails. Link B112 crosses the CDNST, and Link B150a crosses the historic Butterfield Trail.

Local Alternative and Crossover Links for Route Group 3

Links B111 and B140 cross the historic Butterfield Trail.

Route Group 4: Willow-500 kV Substation to Pinal Central Substation

Subroute 4A – North of Mt. Graham

Subroute 4A crosses the Arizona National Scenic Trail at Link C620. Link C880a crosses the historic Butterfield Trail at the planned Pinal Central Substation.

Subroute 4B – Sulphur Springs Valley

Subroute 4B is the same as Subroute 4A.

Subroute 4C2c – BLM Preferred Alternative

Subroute 4C2c is similar to Subroute 4A, except that 4C2c crosses the Arizona National Scenic Trail at Link C670. This trail is within 3.0 miles of links C661 and C450. Link C880a crosses the historic Butterfield Trail and is adjacent to the Juan Bautista de Anza NHT.

Subroute 4C1 – East of San Pedro River

Subroute 4C1 is the same as Subroute 4C2c, except that the Arizona National Scenic Trail is also within 3.0 miles of Link C661.

Subroute 4C2 – West of San Pedro River

Link C450 is located within 3.0 miles of the Arizona National Scenic Trail.

Subroute 4C3 – Tucson

This subroute crosses the Arizona National Scenic Trail at Link F600. The historic Butterfield Trail is paralleled for approximately 13.0 miles with Link F540, 4.0 miles with Link F510, and 3.0 miles with Link F112; crossed by links F600, F112, F510, and C880a; and is within 3.0 miles of Link C810a. The subroute also parallels the Juan Bautista de Anza NHT for approximately 13.0 miles with links F112 and F510, and crosses the trail at links F510 and F112.

Local Alternative and Crossover Links for Route Group 4

Local Alternative Link C890 is located within 3.0 miles of the historic Butterfield Trail, and local alternative links F40b, F81a, and F81b are parallel to the Trail for approximately 4 to 7 miles, eventually crossing it. Link F51 crosses the Arizona National Scenic Trail.

3.11.11.9 National Wildlife Refuge Subroute Summaries

Route Group 1: SunZia East Substation to Midpoint Substation

Subroute 1A1 – North River Crossing

The Sevilleta NWR is within 3.0 miles of links E101b and E133.

Subroute 1A2 – BLM Preferred Alternative

Similar to Subroute 1A1, the Sevilleta NWR is within 3.0 miles of links E86b, E101b, and E133.

Subroute 1A – North River Crossing

Subroute 1A is the same as Subroute 1A1.

Subroute 1B – San Antonio Crossing

The Bosque del Apache NWR is within 3.0 miles of links A160 and A111.

Local Alternative and Crossover Links for Route Group 1

There are no NWRs in or near the local alternative and crossover links for Route Group 1.

Route Group 3: Midpoint Substation to Willow-500 kV Substation

There are no NWRs located in or near the subroutes or local alternative and crossover links in Route Group 3.

Route Group 4: Willow-500 kV Substation to Pinal Central Substation

There are no NWRs located in or near the subroutes or local alternative and crossover links in Route Group 4.

3.12 WILDERNESS, WILDERNESS STUDY AREAS, AND LANDS WITH WILDERNESS CHARACTERISTICS

3.12.1 Introduction

This section identifies wilderness areas and WSAs within the Project study area and identifies lands with wilderness characteristics that are crossed by the proposed Project alternatives. Wilderness areas and WSAs are specially designated. Special designations protect values and land uses unique to an area that typically require a more intensive management emphasis than is applied to surrounding public land. Lands with wilderness characteristics are not administratively or congressionally designated, but are BLM lands that have been identified to contain wilderness characteristics. The BLM conducts and maintains inventories regarding the presence or absence

of wilderness characteristics. According to Section 201 of the FLPMA, the preparation and maintenance of the inventories does not change or prevent change of the management or use of the lands. BLM lands identified as having wilderness characteristics are considered when analyzing projects under the NEPA.

3.12.2 Wilderness Areas

Designated by Congress to be included in the National Wilderness Preservation System, wilderness areas are managed either independently or cooperatively by the BLM, NPS, USFWS, and USFS. Wilderness areas protect the habitat, serve as a sanctuary from modern day conflicts for diverse species of plants and animals, and provide a source of clean water for numerous plant and wildlife species. They are also used for science and education by providing sites for field trips and study areas for student research. Wilderness areas may also provide recreational opportunities such as hiking and camping in a primitive setting (BLM 2011c). Section 2(a) of the 1964 Wilderness Act states that wilderness areas "shall be administered for the use and enjoyment of the American people in such manner as will leave them unimpaired for future use and enjoyment as wilderness, and enjoyment as wilderness, and so as to provide for the protection of these areas, the preservation of their wilderness character."

Wilderness areas located within the study corridors include the Bosque del Apache and White Mountains in New Mexico; and the Peloncillo Mountains, Santa Teresa Mountains, Aravaipa Canyon, Galiuro Mountains, Redfield Canyon, Rincon Mountains, Saguaro, and Pusch Ridge wilderness areas in Arizona.

3.12.3 Wilderness Study Areas

BLM WSAs are identified through the FLPMA, which directed the BLM to inventory and study its roadless areas for wilderness characteristics. Until Congress makes a final determination on a WSA, they are managed so as not to impair the suitability of such areas for preservation as wilderness. A WSA must have the following:

- Size – roadless areas of at least 5,000 contiguous acres of public land or of manageable size
- Naturalness – generally appear to have been affected primarily by the forces of nature (unaffected by man-made influences)
- Solitude – provide outstanding opportunities for solitude or primitive and unconfined types of recreation

In addition, WSAs often have special qualities such as ecological, geological, educational, historical, scientific, and scenic values (BLM 1978g).

WSAs within the New Mexico portion of the study corridors include Stallion, Veranito, Presilla, Devil's Backbone, Cooke's Range, Sierra de las Canas, Antelope, Jornada del Muerto, and Sierra de las Uvas. There are no WSAs in the Arizona portion of the study corridors.

3.12.4 Lands with Wilderness Characteristics

Section 201 of the FLPMA requires the BLM to maintain on a continuing basis an inventory of all public lands and their resources and other values, including information regarding wilderness characteristics.

BLM Manual 6310 "Conducting Wilderness Characteristics Inventory of BLM Lands" and Manual 6320 "Considering Lands with Wilderness Characteristics in the BLM Land Use Planning Process" direct BLM offices to continue to conduct and maintain inventories regarding the presence or absence of wilderness characteristics, and to consider identified lands with wilderness characteristics in land use plans and when analyzing projects under NEPA. BLM Manual 6310 provides the BLM with guidance and general procedures for doing so under Section 201 of the FLPMA. The BLM has determined that updated inventories were necessary for the evaluation of the Project in conjunction with NEPA analysis.

For the purpose of this study, the inventories for each BLM district and field office were conducted in accordance with the BLM manuals. In order to be classified as lands with wilderness characteristics, the inventory unit must possess sufficient size, naturalness, and outstanding opportunities for either solitude or primitive and unconfined recreation, and may possess supplemental values. Specifically, the inventory evaluates wilderness characteristics as defined in Section 2(c) of the Wilderness Act of 1964 (see Section 3.12.3).

In September 2011, BLM field and district offices completed a wilderness characteristics inventory update for the portions of the proposed Project where route segments crossed BLM lands. Citizens' Wilderness Inventory Units have been reviewed as part of the inventory of Lands with Wilderness Characteristics on BLM land. The status of inventories of lands with wilderness characteristics for each of the BLM districts or field offices crossed by the proposed Project is summarized below.

Safford Field Office: The current inventory represents an update of previous wilderness characteristics inventories conducted in 1979 and 1980. Link C361 of Subroute 4C1 crosses Inventory Unit 4-90 (Muleshoe), which was found to have characteristics meeting each of the three criteria noted in Section 3.12.3. No other inventory units that would be crossed by the proposed Project were found to have wilderness characteristics, due to fragmentation by roads and land ownership and/or not meeting the size or naturalness criteria.

Tucson Field Office: The Bogard Wash and Suizo Wash inventory units, crossed by Link C820, were found to have wilderness characteristics in the initial inventory conducted in 1979. However, based upon the updated inventory, these units were found to no longer contain wilderness characteristics due to not meeting the naturalness and/or size criteria. No other inventory units that would be crossed by the proposed Project were found to have wilderness characteristics, due to fragmentation by roads and land ownership and/or not meeting the size criteria.

Socorro Field Office: According to inventory conducted in September 2011, there is a pending land with wilderness characteristics unit adjacent to the Stallion WSA..

Las Cruces District Office: According to the district offices current inventory, the Nutt Grassland inventory unit, crossed by Link A361, was found to have wilderness characteristics. No other inventory units that would be crossed by the proposed Project were found to have wilderness characteristics.

3.12.4.1 Wilderness Areas Subroute Summaries

Route Group 1: SunZia East Substation to Midpoint Substation

Subroute 1A1 –North River Crossing

Link 161 is approximately 3.5 miles west of the Indian Well and Chupadera portions of the Bosque del Apache Wilderness Area.

Subroute 1A2 – BLM Preferred Alternative

The BLM preferred alternative is similar to Subroute 1A1.

Subroute 1A – North River Crossing

This subroute is similar to the BLM preferred alternative.

Subroute 1B – San Antonio Crossing

Links A111 and A160 are approximately 2 to 3 miles north of the Little San Pascual and Indian Well portions of the Bosque del Apache Wilderness Area.

Local Alternative and Crossover Links for Route Group 1

There are no wilderness areas in or near the local alternative and crossover links for Route Group 1.

Route Group 3: Midpoint Substation to Willow-500 kV Substation

Subroute 3A2 – BLM Preferred Alternative

Link B160a is just over 3 miles north of the Peloncillo Mountains Wilderness Area, just west of the New Mexico-Arizona border.

Subroute 3A – North

Link B160a is just over 3 miles north of the Peloncillo Mountains Wilderness Area, just west of the New Mexico-Arizona border.

Subroute 3B – South

Link B150a is approximately 0.5 mile south of the Peloncillo Mountains Wilderness Area, just west of the New Mexico-Arizona border.

Local Alternative and Crossover Links for Route Group 3

There are no wilderness areas in or near the local alternative and crossover links for Route Group 3.

Route Group 4: Willow-500 kV Substation to Pinal Central Substation

Subroute 4A – North of Mt. Graham

Links B153b and C170 are approximately 3 miles south of the Santa Teresa Wilderness Area, 4.75 miles south of the North Santa Teresa Wilderness Area, and 3.75 miles south of the Aravaipa Canyon Wilderness Area.

Subroute 4B – Sulphur Springs Valley

This subroute is similar to Subroute 4A, in terms of Link C170.

Subroute 4C2c – BLM Preferred Alternative

Links C441 and C201 are approximately 2 to 3 miles east of the Rincon Mountain Wilderness Area in the CNF.

Subroute 4C – San Pedro Valley and Tucson

Link C470 is approximately 3 miles west of and parallel to the Galiuro Wilderness Area; and is approximately 1.5 miles west of the Redfield Canyon Wilderness Area, which is north of the Muleshoe Ranch. Link C441 is approximately 2 miles east of the Rincon Mountain Wilderness Area, in the CNF; while Link F40a borders the southern boundary of the Rincon Mountain Wilderness Area. Link F510 is approximately 3 miles west of the West Saguaro Wilderness Area, near the northwest portion of Tucson.

Local Alternative and Crossover Links for Route Group 4

Local Alternative Link C201 is approximately 3 miles east of the Rincon Mountain Wilderness Area in the CNF.

Local alternative links for 4C3 include Link F40b, which follows the southern boundary of the Rincon Mountain Wilderness Area. Link F81a is approximately 1.25 miles west of the East Saguaro Wilderness Area, near the east side of Tucson. Link F81b is approximately 4.75 miles south of the Pusch Ridge Wilderness Area, near the north side of Tucson in the CNF.

3.12.4.2 Wilderness Study Areas Subroute Summaries

Route Group 1: SunZia East Substation to Midpoint Substation

Subroute 1A1 – North River Crossing

Link E101b is less than 0.5 mile north of the Stallion WSA; Link E133 borders the southern edge of the Veranito WSA; Link E180 is approximately 3 miles north of the Presilla WSA, northeast of the town of Socorro; and Link A440 is approximately 5.25 miles southeast of the Cooke's Range WSA, north of the Midpoint Substation site.

Subroute 1A2 – BLM Preferred Alternative

This subroute is similar to Subroute 1A1.

Subroute 1A – North River Crossing

This subroute is similar the BLM preferred alternative.

Subroute 1B – San Antonio Crossing

This subroute is similar to Subroute 1A1, except that links E90 and A90 are approximately 1 mile east and 1.75 miles south of the Stallion WSA, respectively; links A90 and A111 are approximately 3.25 miles east of the Sierra de las Canas WSA; and Link A111 is approximately 2.5 miles north of the Antelope WSA, which is near the northeast corner of the WSMR.

Local Alternative and Crossover Links for Route Group 1

Local Alternative Link A161b is approximately 2 miles east of the Devil's Backbone WSA and approximately 5 miles east of the Devil's Reach WSA, southwest of San Antonio. Link A430 is approximately 5.25 miles west of the Sierra de Las Uvas WSA, near Hatch.

Route Group 3: Midpoint Substation to Willow-500 kV Substation

Subroute 3A2 – BLM Preferred Alternative

Subroute 3A2 – Links B60 and B90 are approximately 4.5 miles south of the Cooke's Range WSA. Link B160a is approximately 3 miles north of the Peloncillo Mountains WSA, which borders the east side of the New Mexico-Arizona border.

Subroute 3A – North

Links B60 and B90 are approximately 4.5 miles south of the Cooke's Range WSA.

Subroute 3B – South

Link B150a is approximately 2.5 miles south of the Peloncillo Mountains WSA, which borders the east side of the New Mexico-Arizona border.

Local Alternative and Crossover Links for Route Group 3

There are no WSAs within the study corridors for the local alternative and crossover links for Route Group 3.

Route Group 4: Willow-500 kV Substation to Pinal Central Substation

There are no WSAs within the study corridors for the subroutes, or for the local alternatives and crossover links in Route Group 4.

3.12.4.3 Lands with Wilderness Characteristics Subroute Summaries

Route Group 1: SunZia East Substation to Midpoint Substation

Route Group 1 crosses a pending land with wilderness characteristics unit adjacent to Stallion WSA.. The centerline of Link A400 is approximately 350 feet west of the Nutt Grassland inventory unit.

The centerline of links A160 and A140 are located approximately 2 miles northwest and 3 miles north, respectively, from the Chupadera #2 inventory unit.

Local Alternative and Crossover Links for Route Group 1

Link A361 crosses approximately 0.15 mile of the northeast corner of the Nutt Grassland inventory unit.

Route Group 3: Midpoint Substation to Willow-500 kV Substation

There are no lands with wilderness characteristics crossed by the subroutes, or by the local alternative and crossover links in Route Group 3.

Route Group 4: Willow-500 kV Substation to Pinal Central Substation

Subroute 4A – North of Mt. Graham

There are no lands with wilderness characteristics crossed by Subroute 4A.

Subroute 4B – Sulphur Springs Valley

There are no lands with wilderness characteristics crossed by Subroute 4B.

Subroute 4C2c – BLM Preferred Alternative

There are no lands with wilderness characteristics crossed by the BLM preferred alternative.

Subroute 4C1 – East of San Pedro River

Links C331 and C361 cross approximately 1.3 miles of the southwestern portion of Inventory Unit 4-90 (Muleshoe).

Subroute 4C2 – West of San Pedro River

Subroute 4C2 is the same as the BLM preferred alternative.

Subroute 4C3 – Tucson

Subroute 4C3 is the same as the BLM preferred alternative.

Local Alternatives for Route Group 4

There are no lands with wilderness characteristics crossed by the local alternatives.

3.13 SOCIAL AND ECONOMIC CONDITIONS

3.13.1 Introduction

This section describes the existing social and economic conditions within the study area of the proposed Project, as well as the broader host region that includes portions of counties throughout the states of New Mexico and Arizona.

The baseline conditions and existing environment focus on demographics and social trends that comprise the study area (see Figure 1-1).

The FLPMA requires the BLM to integrate physical, biological, economic, and other sciences in land use planning, and to analyze social, economic, and institutional information. The NEPA requires federal agencies to integrate "the natural and social sciences in planning and decision making" (42 USC 4332[2][A]).

The study area was developed with an overall consideration of areas within New Mexico and Arizona that would most likely be directly impacted by Project construction. Social and economic conditions vary across the study area, and are assessed with county-level data where data sources are consistent across the Project study area. Data for cities and towns were used to bring clarification to local socioeconomic conditions. The following subsections address population demographics, housing, and employment and the economy within the route groups. Table 3-50 represents the route group distribution by county.

Where possible, New Mexico and Arizona are discussed separately, in order to compare data most effectively and maintain consistent methodology. Adopted planning documents and sources

such as the U.S. Census Bureau (2000, 2010), U.S. Census Bureau American Community Survey[1] (2005-2009), Arizona Department of Commerce, New Mexico State University (NMSU), and U.S. Bureau of Labor Statistics provided data and background information. Though no alternative corridors are located within Doña Ana County, it is included in the socioeconomic analysis because the Project could influence socioeconomic aspects of the County in various ways (e.g., job creation, need for housing, and material supplies); in addition, Doña Ana County is expected to house the operations activities for the Project.

Table 3-50. Route Groups Breakdown by County

Location	Route Group 1	Route Group 3	Route Group 4
New Mexico			
Luna County	●	●	
Sierra County	●		
Socorro County	●		
Lincoln County	●		
Doña Ana County	●	●	
Grant County		●	
Hidalgo County		●	
Torrance County	●		
Arizona			
Cochise County		●	●
Graham County		●	●
Greenlee County		●	
Pima County			●
Pinal County			●

3.13.2 Regional Overview

The following sections describe the counties within New Mexico and Arizona that would be affected by the Project. When combined, these sections present a regional overview of the geographic characteristics and historic settings in the study area.

3.13.2.1 New Mexico

The Project study corridors cross seven New Mexico counties, beginning in the central portion of the state at the proposed SunZia East Substation in Lincoln County, continuing west and south (crossing through Torrance, Socorro, and Sierra counties toward Doña Ana) and due west (crossing through Luna, Grant, and Hidalgo counties), where it crosses into southeastern Arizona. According to the 2005-2009 American Community Survey, the population density in New Mexico was 16.2 persons per square mile (Table 3-51). Overall, New Mexico population

[1]The U.S. Census American Community Survey estimates are based on data collected over a 5-year time period. The estimates represent the average characteristics of population and housing between January 2005 and December 2009 and January 2006 and December 2010 and do not represent a single point in time.

densities are much lower than the United States average of 85.2 persons per square mile; however, New Mexico population density is representative of lower density development across many states in the Southwest (U.S. Census 2000a).

Table 3-51. Geographic Characteristics of Study Corridors: New Mexico

Location	Land Area (millions of acres)	Land Area (square miles)	Persons per square mile (2009)
United States	**2,264**	**3,537,438**	**85.2**
State			
New Mexico	77.67	121,356	16.2
Counties			
Doña Ana County	2.44	3,807	52.0
Grant County	2.54	3,966	7.5
Hidalgo County	2.21	3,447	1.5
Lincoln County	3.09	4,831	4.3
Luna County	1.90	2,965	9.0
Sierra County	2.68	4,180	3.0
Socorro County	4.25	6,646	2.7
Torrance County	2.14	3,345	5.0

Source: New Mexico State University 2008; 2009 American Community Survey

New Mexico County Summaries

Doña Ana County was created in 1852, 6 years after New Mexico became part of the United States (Doña Ana County Historical Society 2001). Historically, communities within the County were agriculturally based. Over time, industries such as health care and social assistance; professional, scientific, and technical services; and growth-related industries (including construction and retail trade) have emerged. Doña Ana has been characterized as one of the fastest-growing counties in the United States over the past decade. Las Cruces, the county seat, is the largest community in Doña Ana. Other communities include Sunland Park, Anthony, and Mesilla; unincorporated communities include Hatch, Chaparral, and Mesquite.

Grant County was established by an act of Territorial Legislature in 1868; created from a portion of land that was formerly part of Doña Ana County (Bennet 2011). Historically, Grant County's economy was based on mining, ranching, and agricultural activities. Silver City, the county seat, is the largest municipality and is home to a majority of the County's residents. Economic activities include retail trade, government, health care and social assistance, accommodations, and food services. Other municipalities located in Grant County include Bayard and Hurley, with Santa Clara, Cliff, and Gila representing some of its unincorporated communities.

Hidalgo County was formed from Grant County in 1919 (Hidalgo County 2010); Lordsburg is the county seat. Following the Gadsden Purchase of 1853, the Butterfield Stagecoach Company route passed through what is now Hidalgo County. Historically, the County's economy revolved around mining, ranching, and farming. Recent major economic activities have grown to include tourism and construction, associated with the development of retirement communities. Lincoln County is home to the town of Carrizozo and numerous unincorporated towns (Town of Carrizozo 2008). The county seat was previously located in the town of Lincoln, but was moved

to Carrizozo in 1909. Much of Lincoln County's early economy was based on the presence of the El Paso and Northeast Railroad; today, the Lincoln County government is among its employers. Unincorporated communities include Ruidoso, Ruidoso Downs, Lincoln, and White Oaks.

Luna County was created by an act of the New Mexico Legislature adopted on March 16, 1901 (Luna County 2011); Deming is the county seat. Luna County was created from the eastern portion of Grant County and the western portion of Doña Ana County. Known as a railroad transportation hub, it was the site of the historic completion of the second transcontinental railroad. Farming, ranching, and copper mining and refining were common forms of economic activity across the County during the twentieth century. Unincorporated communities located in Luna County include Columbus and Gage.

Sierra County was formed in 1884 from portions of Socorro, Grant, and Doña Ana counties. Sierra County has two incorporated communities; county seat Truth or Consequences and Elephant Butte. Historically the County's economy was based on agriculture, mining, and tourism to the hot springs. Since the 1960s, the economy has become dependent on retirement communities and recreation around Elephant Butte and Caballo Lakes. Unincorporated communities include Williamsburg, Arrey, Hermosa, and Hillsboro.

Socorro County was created by Territorial Legislation in 1852; at one point, it had the greatest land area of any county in New Mexico (Socorro County Chamber of Commerce 2011). With respect to population, its largest city is the county seat Socorro. The first Spanish settlement took place in Socorro in the late 1500s, because explorers found that the area offered fertile soil to grow corn. In later years, the County was further established for military and mining purposes. Unincorporated communities in Socorro County include Alamo, Bingham, Lemitar, Luis Lopez, and San Antonio.

Torrance County was created from the eastern part of Valencia County in 1903; Estancia is the county seat. Named after Francis J. Torrance, one of the promoters of the building of the New Mexico Central Railroad, the County is recognized for its high level of agricultural productivity (Torrance County 2010). Crops such as pinto beans, corn, alfalfa, and pumpkins are harvested year round. Torrance County is home to the Manzo Mountains, Salinas Pueblo National Monument, and a vast and undisturbed rangeland. Mountainair is the nearest incorporated town in proximity to the alternative routes in Torrance County.

3.13.2.2 Arizona

The Project study corridors cross five Arizona counties, beginning in the southeastern portion of the state (crossing Cochise, Greenlee, and Graham counties) and heading west (through Pima and Pinal counties) until it reaches the planned Pinal Central Substation in Pinal County. According to the 2009 U.S. Census, population densities within the study area were highest in Pima County, with nearly 108 persons per square mile; much higher than the state's estimate of 55.7 persons per square mile (Table 3-52). Overall, Arizona densities are much lower than the United States average of 85.2 persons per square mile. While population density in Arizona is low relative to the country's average, it is representative of lower density development across many states in the Southwest. Additional population data for Arizona counties are discussed in this section.

Table 3-52. Geographic Characteristics of Study Corridors: Arizona			
Location	**Land Area (millions of acres)**	**Land Area (square miles)**	**Persons per square mile (2009)**
United States	**2,264**	**3,537,438**	**85.2**
State			
Arizona	72.73	113,635	55.7
Counties			
Cochise County	3.98	6,219	20.5
Graham County	2.96	4,630	7.5
Greenlee County	1.18	1,837	4.2
Pima County	5.88	9,184	107.8
Pinal County	3.44	5,374	55.1
Sources: Arizona Department of Commerce 2009; 2009 U.S. Census			

Arizona County Summaries

Cochise County was established in 1881, by the 11th Territorial Legislature, prior to Arizona becoming a state. Historically, the County's economic activity included mining operations in the towns of Tombstone and Bisbee, the county seat. Government, trade, transportation, utilities, professional and business services, mining, and educational and health services make up a majority of the County's economy; agriculture is both a historic and current contributor to its economy. The largest employers in Cochise are Fort Huachuca, Sierra Vista School District, and the Cochise County government (Arizona Department of Commerce 2009). Communities include Benson, Sierra Vista, Willcox, Douglas, and Huachuca City.

Graham County was also established in 1881, by the 11th Territorial Legislature, prior to Arizona becoming a state; Safford is the county seat. Graham County was split from portions of Apache and Pima counties, and was named after Mount Graham, the highest peak in the area (10,516 feet). Early visitors to the area were primarily explorers; however, farming communities began to develop along the Gila River in the 1870s. Primary employment industries include private services, trade, transportation, public utilities, and government. The largest employers in Graham County are the Arizona State Prison in Safford, Eurofresh Bonita (a hydroponic tomato nursery), the City of Safford, Freeport McMoRan (a mining company formerly owned by Phelps Dodge Corporation), and Eastern Arizona College in Thatcher (*ibid*). Thatcher, Safford, and Pima are major communities in the County.

Greenlee County was created in 1909, by an act of the 25th Territorial Assembly. Formed from a portion of Graham County, Greenlee is largely government-owned. The discovery of copper ore in Clifton, the county seat, contributed to growth in the area. Today, Freeport McMoRan is a major employer in the County. Clifton Elementary and Clifton High School, Duncan Public Schools, Fairbanks School, and the Greenlee County government are the County's primary employers. Other notable industries include government, private services, trade, transportation, and utilities (*ibid*).

Pima County was created in 1864, and is the second largest of Arizona's four original counties. Spanish settlement in Pima County dates back to 1690, when the Spaniards encountered tribes living in the area. Early Euro-American settlers discovered gold and silver in the mid-eighteenth

century, opening the door to mining and ranching across the County. Major communities in Pima County include county seat Tucson, Marana, Oro Valley, and Sahuarita. Primary industries include government, education and health services, trade, transportation, utilities, and professional and business services. The UA, Amphitheater Unified School District, Pima Community College, Raytheon Missile Systems, and Davis-Monthan AFB are among Pima County's major employers (*ibid*).

Pinal County was formed in 1875 from portions of Maricopa and Pima counties; Florence is the county seat. Larger than the state of Connecticut, Pinal County is characterized by two distinct regions; a mountainous eastern region and low desert valleys in the west. Its mountainous regions resulted in development of Mammoth, Oracle, San Manuel, and Kearny, where copper mining, smelting, milling, and refining industries are still active. Desert and lower elevation landscapes shaped the agricultural communities of Arizona City, Apache Junction, Maricopa, Picacho, Eloy, Red Rock, and Stanfield. In recent years, Apache Junction, Arizona City, Coolidge, Eloy, and Casa Grande have diversified their local economies from mining activities to include manufacturing, trade, and services. Government, trade, transportation and utilities, leisure and hospitality, and education and health services make up Pinal County's major industries. Some of the County's major employers include the Arizona State Prison in Florence, Evergreen Air Center in Marana, Frito-Lay in Casa Grande, and numerous school districts and government operations in Florence, Eloy, Casa Grande, and Apache Junction (*ibid*).

3.13.3 Jurisdiction and Ownership

The following section identifies land ownership across all counties crossed by the Project. Ownership percentages are not limited to the study area. The proposed Project would cross BLM, BOR, state, and private lands.

3.13.3.1 New Mexico

Table 3-53 represents land ownership across the eight counties previously described.

Table 3-53. Land Ownership in New Mexico Counties within the Study Area (Percent of Total County Acreage[1])

Location	BLM	BOR	USDA	USFS	DOD	USFWS	Indian Res.	NPS	State	Private	Local or State Parks
Doña Ana County	45.7	—[3]	4.5	—	20.2	2.3	—	2.2	9.2	15.9	—[3]
Grant County	13.4	—	—	34.2	0.1	—	—	—	13.9	38.4	—
Hidalgo County	38.7	—	—	3.5	0.0	—	—	—	17.1	40.8	—
Lincoln County	16.8	—	—	12.8	5.9	—	—	—	9.7	54.9	—
Luna County	40.0	—	—	0.0	0.1	—	—[3]	—	28.8	31.1	—[3]
Sierra County	28.3	—[3]	—	14.0	19.1	—	—	—	11.0	25.3	2.3
Socorro County[2]	21.6	0.0	0.0	14.4	10.4	6.7	3.6	—[3]	12.5	30.5	0.4
Torrance County	0.8	—	—	7.2	—	—	0.8	—[3]	14.7	76.5	—

[1] Percentages are rounded and therefore may not total 100 percent.
[2] Socorro County is the only county with New Mexico Game and Fish land, consisting of 95 acres.
[3] Land is present, but is less than 0.01 percent.
Source: BLM 2009f

3.13.3.2 Arizona

Table 3-54 represents land ownership across the five counties previously described.

Table 3-54. Land Ownership in Arizona Counties within the Study Area (Percent of Total County Acreage[1])

Location	BLM	BOR	USFS	DOD	USFWS	Indian Reservation	NPS	County	State	Private	Local or State Parks	AZGFD
Cochise County	10.0	—	12.3	2.71	0.1	—	0.4	—	34.5	39.9	—[2]	0.1
Graham County	24.2	—	12.8	—[2]	—	36.3	—	—	16.7	10.0	—[2]	—[2]
Greenlee County	13.3	—	63.7	—	—	—	—	—	14.7	8.4	—	—
Pima County	6.4	0.1	5.7	1.2	8.7	42.1	7.0	—[2]	14.7	13.7	0.3	—[2]
Pinal County	11.2	1.1	6.4	0.2	—	20.3	0.1	—[2]	35.0	25.6	0.1	—[2]

[1] Percentages are rounded and therefore may not total 100 percent.
[2] Land is present, but is less than 0.01 percent.
Source: ALRIS 2009
Note: Land ownership designated as 'Other' is not represented in this table, Cochise and Pima counties have 61 and 192 acres of land that falls into this category, respectively.

3.13.4 Population and Demographics

The following section describes population and demographic data for New Mexico and Arizona. Population estimates and projections for counties within each route group are meant to give a general overview of counties, cities, towns, and unincorporated communities, and do not differentiate individual subroutes.

3.13.4.1 Past, Current, and Projected Population

New Mexico

Table 3-55 represents population estimates and growth rates for those portions of New Mexico that fall within the study area. The largest city in New Mexico's portion of the study area was Las Cruces, located in Doña Ana County. Overall, a large majority of New Mexico routes cross areas that can be characterized as rural areas, with low population densities.

Table 3-55. Population Estimates and Growth: New Mexico				
Location	**2000**	**2010**	**Percent Change (2000 to 2010)**	**Percent Annualized Growth**
State				
New Mexico	1,819,046	1,964,860	8.0	0.8
Counties				
Doña Ana County	174,682	209,233	13.2	2.0
Grant County	31,002	29,514	-4.8	-0.5
Hidalgo County	5,932	4,894	-17.4	-1.7
Lincoln County	19,411	20,497	5.6	0.6
Luna County	25,016	25,095	0.0	0.0
Sierra County	13,270	11,988	-9.7	-0.1
Socorro County	18,078	17,866	-1.2	-0.1
Torrance County	16,911	16,383	-3.1	-0.3
Total Population	**304,302**	**335,470**	**10.2**	**1.0**
Cities and Towns				
Anthony (Doña Ana County)	7,904	9,360	18.4	1.8
Carrizozo (Lincoln County)	1,036	996	-3.9	-0.4
Corona (unincorporated; Lincoln County)	165	172	4.2	0.4
Deming (Luna County)	14,116	14,855	5.2	0.5
Elephant Butte (Sierra County)	1,390		2.9	0.3
Hatch (unincorporated; Doña Ana County)	1,673	1,648	-1.5	-0.1
Las Cruces (Doña Ana County)	74,267	97,618	31.4	3.1
Lordsburg (Hidalgo County)	3,379	2,797	-17.2	-1.7
Socorro (Socorro County)	8,877	9,051	2.0	0.2
Truth or Consequences (Sierra County)	7,289	6,475	-11.2	-1.1
Sources: U.S. Census 2000; U.S. Census 2010				

Based on 2005 estimates, New Mexico counties within the Project study area are expected to grow to approximately 441,223 by 2025, an increase of 30 percent from the 2005 population estimate (Table 3-56). Most of this growth is expected in Doña Ana, Grant, Luna, and Hidalgo counties. Because these estimates were based on data gathered through 2005, it is important to note that projections for 2015 and 2025 could be overestimated. Still, the potential for further growth across the state should be recognized; New Mexico grew by 8 percent between 2000 and 2010 (see Table 3-52).

Table 3-56. Population Projections: New Mexico Counties[1]				
Location	**2005**	**2015**	**2025**	**Percentage of Expected Growth (2005 to 2025)**
Doña Ana County	192,474	237,241	274,661	42.7
Grant County	31,511	35,748	39,589	25.6
Hidalgo County	5,966	6,667	7,420	24.4

Table 3-56. Population Projections: New Mexico Counties[1]				
Location	**2005**	**2015**	**2025**	**Percentage of Expected Growth (2005 to 2025)**
Lincoln County	21,898	23,574	24,518	12.0
Luna County	26,394	29,755	32,919	24.7
Sierra County	13,657	13,793	13,959	2.2
Socorro County	18,513	20,012	21,167	14.3
Torrance County	18,282	22,184	26,990	47.6
Total Projected Population	**328,695**	**388,974**	**441,223**	**30.0**

[1] Projections based on 2005 baseline data.
Sources: Bureau of Business and Economic Research, University of New Mexico 2008

Arizona

Table 3-57 represents population estimates and growth rates for those portions of Arizona that fall within the study area. The most densely populated areas crossed by Arizona routes are found in the Tucson metropolitan area.

Table 3-57 Population Estimates and Growth: Arizona				
Location	**2000**	**2010**	**Percent Change (2000 to 2010)**	**Percent Annualized Growth**
State				
Arizona	5,130,632	6,392,017	24.6	2.5
Counties				
Cochise County	117,755	131,346	11.5	1.2
Graham County	33,489	37,220	11.1	1.1
Greenlee County	8,547	8,437	-1.3	-0.1
Pima County	843,746	980,263	16.2	1.6
Pinal County	179,727	375,770	109.1	10.9
Total Population	**1,183,264**	**1,533,036**	**29.6**	**3.0**
Cities and Towns				
Benson (Cochise County)	4,711	5,105	8.4	0.8
Casa Grande (Pinal County)	25,224	48,571	92.6	9.3
Duncan (Greenlee County)	812	696	-14.3	-1.4
Eloy (Pinal County)	10,375	16,631	60.3	6.0
Marana (Pima and Pinal counties)	13,556	34,961	157.9	15.8
Oracle (Pinal County)	3,563	3,686	3.5	0.3
Safford (Graham County)	9,232	9,566	3.6	0.4
Thatcher (Graham County)	4,022	4,865	21.0	2.1
Tucson (Pima County)	486,699	520,116	6.9	0.7
Willcox (Cochise County)	3,733	3,757	0.6	0.1

Sources: U.S. Census 2000, U.S. Census 2010

Arizona counties within the Project area are expected to grow by nearly 900,000 by 2025; an increase of 24.3 percent from the 2006 population estimate (Table 3-58). Most of this growth is

expected in Pinal and Pima counties. Similar to the data presented for New Mexico, these projections are based on older data and therefore could be overestimated, based on the rapid pace of growth that took place in Arizona through 2006. Unlike New Mexico, Arizona grew by nearly 25 percent between 2000 and 2010. Though growth is not likely to increase at the same rate as it did between 2000 and 2010, significant growth can be expected over the coming years.

Table 3-58. Population Projections: Arizona Counties [1]

Location	2006	2015	2025	Percentage of Expected Growth (2006 to 2025)
Cochise County	134,789	158,650	179,317	33
Graham County	35,873	39,307	42,848	19.4
Greenlee County	8,281	8,188	8,205	-0.9
Pima County	980,977	1,175,967	1,360,157	38.7
Pinal County	269,892	486,363	732,282	171.3
Total Projected Population	**1,429,812**	**1,868,475**	**2,322,809**	**24.3**

[1] Projections based on 2006 baseline data
Sources: Arizona Department of Economic Security 2006

3.13.4.2 Age Distribution

The age distribution of a population is important to determine the number of eligible working residents. It can also be a key indicator in the types of services a community will need to provide to its population. Common services for any community include hospitals, schools, grocery stores, and utilities. The following section briefly discusses the median age of populations within the study area.

New Mexico

Age characteristics within the New Mexico portion of the study area vary greatly between communities and counties, from older populations to younger. The estimated median age[1] across the state of New Mexico was 40.2 in 2009. Counties with the youngest population are Doña Ana and Socorro, with estimated median ages of 31 and 34.9, respectively (U.S. Census, American Community Survey 2009). Within these counties, the youngest populations can be found in the cities of Anthony, Hatch, Socorro, and Las Cruces, with estimated median ages of 24.5, 25.8, 27.4, and 30.8, respectively. Sierra County is home to the oldest population in the New Mexico portion of the study area, representing a median age of 51.5 years. Lincoln and Grant counties are also home to older populations, 47.3 and 44.6 years, respectively.

[1] Median age denotes the age of population at the midpoint of the total distribution across the entire population. In other words, 50% of the population is above or below this age. Median age is often a better indicator than average age because average numbers can be skewed by a large number or high or low ages across the population.

Arizona

Estimated median ages in Arizona counties in the study area do not vary greatly from one to another, ranging between 32.0 and 40.4 years. The estimated median age across the state was 36.2 in 2009 (U.S. Census, American Community Survey 2009). The counties with the youngest population include Graham and Pinal, with estimated median ages of 32.0 and 35.3, respectively. Within these counties, the youngest populations can be found in the cities of Thatcher, Eloy, and Casa Grande, with estimated median ages of 28.6, 30.4, and 32.9, respectively. Tucson is also home to a young population, estimated at 32.0 years of age. Cochise County is home to the oldest population in the Arizona portion of the study area, representing a median age of 40.4 years.

3.13.4.3 Race and Ethnic Characteristics

The following section presents a breakdown of all race and Hispanic or Latino ethnic groups for counties, cities, and towns that fall within or near the Project study area. In accordance with the U.S. Office of Management and Budget's 1997 *Revisions to the Standards for the Classification of Federal Data on Race and Ethnicity*, Hispanic or Latino populations are considered an ethnicity and not a race; therefore, it is possible for one who was surveyed to select any race (i.e., White alone or African American) and also to have chosen Hispanic or Latino as their ethnicity. These data must be analyzed separately from racial data.

New Mexico

Table 3-59 illustrates that a large white population—approximately 84 percent—resides across the New Mexico portion of the study area. Native American Indians or Alaska Natives make up 1.8 percent of the population, while African Americans make up 1.4 percent, and people identifying themselves as "some other race, or two or more races" make up 11.8 percent of the population. The greatest proportion of American Indian or Alaska Natives is located in Socorro County, totaling nearly 13 percent of the population. Asians and Native Hawaiians and Pacific Islanders made up the smallest percentage of the population, each representing less than 0.1 percent of the total population across study area counties. Approximately 56 percent of the population considers themselves Hispanic or Latino.

Arizona

Table 3-60 illustrates a somewhat more diverse population in terms of race in the Arizona counties within the study area than in the New Mexico counties. Pima and Pinal counties represent more diverse populations relative to the other Arizona counties throughout the study area; larger cities typically have populations that are more diverse.

Native American Indians or Alaska Natives make up 5.6 percent of the population, while African Americans, Asians, and Native Hawaiians and Pacific Islanders make up 3.3 percent, 2.1 percent, and 0.2 percent of the population, respectively. People identifying themselves as "some other race, or two or more races" make up 15.2 percent of the population. The greatest percentage of American Indian or Alaska Natives is located in Graham County, totaling nearly 28.8 percent of the total population. The Hispanic/Latino population across all counties was

estimated to be 31.0 percent in 2009. A majority of these populations is located in the southern portions of the Tucson metropolitan area; but communities such as Oracle, Mammoth, and San Manuel in Pinal County have large percentages of Hispanic or Latino residents as well (42.8 percent, 76.2 percent, and 56.7 percent, respectively) (U.S. Census, American Community Survey 2005–2009).

3.13.5 Housing

Housing unit and occupancy data provide the information necessary to evaluate an area's ability to withstand temporary or permanent growth. Table 3-59 and Table 3-60 illustrate the number of total housing units, rental costs, and the number of vacant housing units estimated in 2010. Together, these data describe housing options for counties, cities, and towns across the study area.

3.13.5.1 New Mexico

Table 3-61 presents housing vacancy and rent data across the New Mexico portion of the study area. In 2010, the greatest number of vacant residences could be found in Lincoln and Doña Ana counties. The median gross rent across each New Mexico county was between approximately $400 and $700 per month, with the lowest rents in Hidalgo, Sierra, and Grant counties.

3.13.5.2 Arizona

Table 3-62 presents housing vacancy and rent data across the Arizona portion of the study area. In 2010, the greatest number of vacant residences could be found in Pima and Pinal counties. The median gross rent across each Arizona county was between approximately $400 and $850 per month, with the lowest rents in Greenlee and Graham counties.

3.13.6 Employment and the Economy

New Mexico employed approximately 1.1 million people across the state in 2008. Doña Ana County had the largest total employment in the study area, employing approximately 91,977. In Arizona, more than 3 million people were employed in 2008. Pima County represents the greatest number of employment across the Arizona portion of the study area, with approximately 466,000 employed.

Across all of New Mexico, the average annual wage was just over $34,000, with finance and insurance listed as the highest paying industry, at approximately $57,000 annually. In Arizona, the average annual wage was slightly higher, approximately $38,000 in 2008. The highest paid sector in the state was management of companies and enterprises, at approximately $67,000.

Table 3-59. New Mexico: Resident Population by Race [1]

Location	Total Population	White Alone	% Total Population	Black or African American Alone	% Total Population	American Indian and Alaska Native Alone	% Total Population	Asian Alone	% Total Population	Native Hawaiian and Other Pacific Islander Alone	% Total Population	Some Other Race, or two or more races	% Total Population	Hispanic or Latino [2]	% Total Population
State															
New Mexico	1,964,860	1,381,186	70.3	43,332	2.2	183,098	9.3	26,774	1.4	971	0.0	329,499	16.8	879,480	44.5
Counties															
Doña Ana	197,819	171,780	86.8	3,760	1.9	2,268	1.1	1,898	1.0	52	0.0	18,061	9.1	128,258	63.8
Grant	29,723	20,805	70.0	171	0.6	525	1.8	196	0.0	0	0.0	8,026	0.3	14,270	46.8
Hidalgo	5,001	3,600	72.0	69	1.4	35	0.7	0	0.0	0	0.0	1,297	0.3	2,764	53.9
Lincoln	20,888	17,987	86.1	74	0.4	126	0.6	33	0.0	0	0.0	2,668	0.1	6,122	27.6
Luna	26,724	23,784	89.0	191	0.7	254	1.0	86	0.0	0	0.0	2,409	0.1	16,108	58.7
Sierra	12,645	11,370	89.9	40	0.3	81	0.6	0	0.0	0	0.0	1,154	0.1	3,763	28.6
Socorro	18,163	13,664	75.2	188	1.0	1,934	10.6	410	0.0	30	0.2	1,937	0.1	8,634	45.8
Torrance	16,566	12,394	74.8	83	0.5	628	3.8	152	0.0	14	0.1	3,295	0.2	6,342	38.3
Totals	**327,529**	**275,384**	**84.1**	**4,576**	**1.4**	**5,851**	**1.8**	**2,775**	**0.0**	**96**	**0.0**	**38,847**	**11.8**	**186,261**	**56.1**
Cities and Towns															
Anthony (Doña Ana)	**9,270**	8,207	88.5	37	0.4	58	0.6	0	0	0	0	968	10.4	8,367	9.3
Carrizozo (Lincoln)	**1,418**	996	70.2	35	2.5	213	15	0	0	1	0.1	173	12.2	728	5.3
Corona (unincorporated; Lincoln)	**146**	125	85.6	0	0	3	2.1	0	0	0	0	18	12.3	39	2.7
Deming (Luna)	**15,668**	13,782	88	327	2.1	294	1.9	65	0.4	0	0	1,200	7.7	10,509	6.1
Elephant Butte (Sierra)	**1057**	990	93.7	0	0	4	0.4	0	0	0	0	63	6.4	127	12.0
Hatch (unincorporated; Doña Ana)	**1,187**	1,149	96.8	0	0	3	0.3	0	0	0	0	35	2.9	1,067	89.9
Las Cruces (Doña Ana)	**90,586**	77,197	85.2	2,542	2.8	2,134	2.4	1,633	1.8	18	0	7,062	7.8	49,536	54.7
Lordsburg (Hidalgo)	**2,791**	1,776	63.6	85	3	33	1.2	0	0	0	0	897	32.1	2,062	73.9
Socorro (Socorro)	9,379	7,096	75.7	109	1.2	576	6.1	360	3.8	60	0.6	1,178	12.6	4,934	52.6
Truth or Consequences (Sierra)	7,513	6,186	82.3	248	3.3	324	4.3	131	1.7	0	0	624	8.3	2,047	27.2

Sources: U.S. Census 2009: 2005-2009 ACS
[1] Percentages for races are rounded and may not total 100 percent
[2] Hispanic or Latino populations are considered an ethnicity and therefore are not included in the race data.

Table 3-60. Arizona: Resident Population by Race [1]

Location	Total Population	White Alone	% Total Population	Black or African American Alone	% Total Population	American Indian and Alaska Native Alone	% Total Population	Asian Alone	% Total Population	Native Hawaiian and Other Pacific Islander Alone	% Total Population	Some Other Race, or two or more races	% Total Population	Hispanic or Latino [2]	% Total Population
State															
Arizona	6,324,865	4,906,936	77.6	227,282	3.6	284,265	4.5	153,301	2.4	11,045	0.2	742,036	11.7	1,881,878	29.8
Counties															
Cochise	127,613	105,718	82.8	5,372	4.2	1,368	1.1	2,341	1.8	401	0.3	12,413	9.7	40,211	30.2
Graham	127,312	77,420	60.8	1,497	1.2	36,719	28.8	1,583	1.2	225	0.2	9,868	7.8	9,646	27.2
Greenlee	7,723	6,617	85.7	38	0.5	185	2.4	36	0.5	10	0.1	837	10.8	3,544	44.8
Pima	990,213	731,847	73.9	33,194	3.4	32,920	3.3	24,612	2.5	1,054	0.1	166,586	16.8	324,836	31.8
Pinal	296,113	217,795	73.6	10,339	3.5	16,173	5.5	4,106	1.4	1,370	0.5	46,330	15.6	88,387	28.8
Totals	1,548,974	1,139,397	73.6	50,440	3.3	87,365	5.6	32,678	2.1	3,060	0.2	236,034	15.2	**466,624**	**31.0**
Cities and Towns															
Benson (Cochise)	5,086	4,574	89.9	123	2.4	65	1.3	11	0.2	86	1.7	227	4.5	846	16.6
Casa Grande (Pinal)	40,064	28,057	70	1,889	4.7	2,161	5.4	1,000	2.5	170	0.4	6,787	16.9	15,250	38.1
Duncan (Greenlee)	719	630	87.6	0	0	80	11.1	0	0	0	0	9	1.3	172	23.9
Eloy (Pinal)	12,807	6,505	50.8	746	5.8	622	4.9	132	1	28	0.2	4,774	37.3	9,300	72.6
Marana (Pima and Pinal)	32,705	26,191	80.1	1,260	3.9	272	0.8	1,373	4.2	21	0.1	3,588	11	7,060	21.6
Oracle (Pinal)	2,860	2,172	75.9	0	0	0	0	0	0	0	0	688	24.1	1,182	41.3
Safford (Graham)	9,438	7,552	80	433	4.6	221	2.3	14	0.1	0	0	1,218	12.9	3,356	35.6
Thatcher (Graham)	4,582	4,152	90.6	22	0.5	182	4	56	1.2	7	0.2	163	3.6	1,267	27.7
Tucson (Pima)	554,022	386,946	69.8	28,897	5.2	22,707	4.1	18,146	3.3	1,158	0.2	96,168	17.4	213,609	38.6
Willcox (Cochise)	4,007	3,583	89.4	16	0.4	0	0	204	5.1	0	0	204	5.1	1,374	34.3

Sources: U.S. Census; 2005-2009 ACS
[1] Percentages for races are rounded and may not total 100 percent
[2] Hispanic or Latino populations are considered an ethnicity and therefore are not included in the race data.

Table 3-61. New Mexico: Housing and Occupancy Costs (2010)						
Location	**Total Housing Units**	**Total Occupied Units**	**Total Vacant Units**	**% Occupied Units**	**% Vacant Units**	**Median Gross Rent[1]**
State						
New Mexico	901,388	791,395	109,993	87.8	12.2	683
Counties						
Doña Ana	81,492	75,532	5,960	92.7	7.3	631
Grant	14,693	12,586	2,107	85.7	14.3	541
Hidalgo	2,393	1,936	457	80.9	19.1	393
Lincoln	17,519	9,219	8,300	52.6	47.4	701
Luna	10,999	9,593	1,406	87.2	12.8	487
Sierra	8,356	5,917	2,439	70.8	29.2	513
Socorro	8,059	7,014	1,045	87.0	13.0	562
Torrance	7,798	6,264	1,534	80.3	19.7	589
Totals	151,309	128,061	23,248	84.6	15.4	–
Cities and Towns						
Anthony (Doña Ana)	2,809	2,635	174	93.8	6.2	481
Carrizozo (Lincoln)	558	430	128	77.1	22.9	438
Corona (unincorporated; Lincoln)	120	83	37	69.2	30.8	473
Deming (Luna)	6,226	5,582	644	89.7	10.3	538
Elephant Butte (Sierra)	1,316	772	544	58.7	41.3	373
Hatch (unincorporated; Doña Ana	555	500	55	90.1	9.9	674
Las Cruces (Doña Ana)	42,370	39,433	2,937	93.1	6.9	395
Lordsburg (Hidalgo)	1,269	1,070	199	84.3	15.7	552
Socorro (Socorro)	4,066	3,649	417	89.7	10.3	500
Truth or Consequences (Sierra)	4,226	3,247	979	76.8	23.2	–

[1] Median gross rent represents the midpoint rent of the total distribution across all renter-occupied housing units. In other words, 50% of the population pays either above or below this rent value. Median rent is often a better indicator than average rent because average numbers can be skewed by a large number or high or low rents across the paid by the population in a given area." This data is based on a 5-year average of median gross rent values between 2006 and 2010.

Sources: U.S. Census 2010

Table 3-62. Arizona: Housing and Occupancy Costs (2010)						
Location	**Total Housing Units**	**Total Occupied Units**	**Total Vacant Units**	**% Occupied Units**	**% Vacant Units**	**Median Gross Rent**
State						
Arizona	2,844,526	2,380,990	463,536	83.7	16.3	856
Counties						
Cochise	59,041	50,865	8,176	86.2	13.8	713
Graham	12,980	11,120	1,860	85.7	14.3	604
Greenlee	4,372	3,188	1,184	72.9	27.1	385
Pima	440,909	388,660	52,249	88.1	11.9	737
Pinal	159,222	125,590	33,632	78.9	21.1	848
Totals	676,524	579,423	97,101	85.6	14.4	–
Cities and Towns						
Benson (Cochise)	2,941	2,369	572	80.6	19.4	638
Casa Grande (Pinal)	22,400	17,651	4,749	78.8	21.2	801
Duncan (Greenlee)	398	289	109	72.6	27.4	538
Eloy (Pinal)	3,691	2,984	707	80.8	19.2	523
Marana (Pima and Pinal)	14,726	13,073	1,653	88.8	11.2	1,143
Oracle (Pinal)	1,772	1,515	257	85.5	14.5	499
Safford (Graham)	3,908	3,385	523	86.6	13.4	591
Thatcher (Graham)	1,840	1,606	234	87.3	12.7	610
Tucson (Pima)	229,762	205,390	24,372	89.4	10.6	690
Willcox (Cochise)	1,659	1,421	238	85.7	14.3	366

[1] Median gross rent represents the midpoint rent of the total distribution across all renter-occupied housing units. In other words, 50% of the population pays either above or below this rent value. Median rent is often a better indicator than average rent because average numbers can be skewed by a large number or high or low rents across the paid by the population in a given area." This data is based on a 5-year average of median gross rent values between 2006 and 2010.

Sources: U.S. Census 2010

3.13.6.1 Basic and Nonbasic Industry Sectors within the Project Study Area

Basic industry sectors are those industries or businesses that are considered the economic drivers of the study area. Typically, basic industries export their product out of the local area, and therefore do not rely on local business conditions to sustain operations; whereas nonbasic industry sectors are those that supply the local area with goods and services, and therefore do rely on local business conditions to sustain operations. In addition, nonbasic industries provide services that help support the basic industry sectors.

Basic Industry Sectors within the Project Study Area

The following descriptions were adapted from the Economic Impact Assessment (EIA) (see Appendix G) to describe the businesses and industries that comprise the basic industry sectors within the Project study area.

Agriculture and Related Industries

Farm proprietor's employment and farm employment are important sectors in all the potentially affected counties, with the exception of Pima County. Although Pima County has substantial agricultural activities, it has become urbanized to the extent that its agricultural sector has been outgrown by other industries, and is no longer identified as an export-base industry. Other agrarian-based industries (e.g., forestry, fishing, and related activities) are identified as basic in four counties; Doña Ana and Lincoln counties in New Mexico, and Cochise and Pinal counties in Arizona.

Tourism

Tourism is an important industry in both New Mexico and Arizona and supports local businesses for accommodation, food services, and retail. Both New Mexico and Arizona are tourist-destination locations, and almost all counties within the study area have National Forests, National and State Parks, recreational and wilderness areas, or other natural attractions within their borders, or are in close proximity to these attractions. In New Mexico, domestic and international travelers spent a total of $5.4 billion in 2009; generating a total payroll of $1.1 billion and approximately $800 million in revenues for federal, state, and local government services (U.S. Travel Association 2010). In Arizona, domestic and international travelers spent a total of $13.4 billion in 2009; generating a total payroll of $4.1 billion and approximately $2.1 billion in revenues for federal, state, and local government services (*ibid*). In 2009, total tourism related employment across New Mexico and Arizona was 55,900 and 146,800, respectively (*ibid*).

Tourism is frequently high in counties that have specific areas of interest, such as Grant County (Gila National Forest and Gila Cliff Dwellings National Monument); Graham County (CNF, Tombstone); Pima County (Saguaro National Monuments, CNF, and destination resorts); and Lincoln County (ski resorts). Some of the affected counties have major interstate traffic (Hidalgo in New Mexico, and Cochise and Pinal in Arizona), and others are close to (or are part of) major urban tourism destinations (Pinal, which is in close proximity to Phoenix). Other counties such as Luna in New Mexico, and Cochise and Pima in Arizona, attract numerous visitors from Mexico because of their proximity to the border and for shopping availability.

Mining

Mining is an important industry in some counties within the Project study area, particularly in Grant County in New Mexico, and Graham and Greenlee counties in Arizona. Mining, which typically creates relatively high paying jobs in rural areas, was also identified as a basic industry in Lincoln County New Mexico and in Pinal County Arizona.

Utilities

Both New Mexico and Arizona are net exporters of utilities, which represent a broad category of services, including water, sewer, electricity, and natural gas. Typically, water and sewer provision provide services to a local population, and export-base utilities are likely to represent electricity generation. Doña Ana, Grant, and Lincoln counties in New Mexico, and Cochise, Greenlee, Pima, and Pinal counties in Arizona have utilities identified as export-base industries.

Health Care and Social Assistance

Health care and social assistance was identified as a basic industry for Doña Ana and Pima counties within the Project study area. Doña Ana is home to the Memorial Medical Center, Mesilla Valley Hospital, and the UNM Cancer Center. Pima County is home to the Tucson Medical Center, Northwest Medical Center, Carondelet St. Mary's Hospital, Carondelet St. Joseph's Hospital, University Medical Center (a teaching and research hospital), and Arizona Cancer Center. These medical facilities serve patients from a much broader region than just the county in which they are located, and several of them conduct major research, attracting research money from outside the area.

Military and Federal Civilian

Military is identified as basic industry in two counties: Cochise (Fort Huachuca, an Army installation) and Pima (Davis Monthan AFB). Federal civilian employment was also identified as an export industry in these two counties. Military bases hire substantial numbers of federal civilians for various types of support positions, both technical and nontechnical.

Although many of the analyzed counties are relatively close to some type of military installation, some are also identified exporters of forestry, fishing, and related activities. Since park rangers and other BLM officials are federal employees, counties with substantial outdoor recreational activities and federal forest lands have relatively high levels of federal civilian employees (Doña Ana, Hidalgo, and Luna counties in New Mexico; and Graham County in Arizona).

Relatively high levels of federal civilian employees also occur in larger urban areas, where federal facilities such as the justice department and federal courts are concentrated (Doña Ana in New Mexico; and Pima in Arizona). It should be noted that professional, scientific, and technical services were identified as basic sectors in two of the analyzed counties: Socorro and Cochise. Highly skilled professional employees in the professional, scientific, and technical service industries are supporting the military bases in each county.

State Government

State government typically services the population of the state and therefore is nonbasic. The exception to this is where educational facilities serve populations from outside the counties in which they are located; including major universities that draw students worldwide and engage in major research projects that bring substantial research dollars into the county (e.g., NMSU in Doña Ana County and UA in Pima County). Another exception of state government representing a basic industry is with the presence of substantial state correctional facilities (e.g., Arizona State Prison Complex located in Pinal County).

Nonbasic Industry Sectors within the Project Study Area

The following descriptions were adapted from the EIA (see Appendix G) to describe the businesses and industries that comprise the nonbasic industry sectors Project study area.

Construction and Construction-related Sectors

As shown previously, New Mexico and Arizona grew considerably between 2000 and 2010 (approximately 8 and 25 percent, respectively). Construction is usually considered a nonbasic industry, because it responds to population growth.

Local Government

Local government employment reflects local voter preferences and the political environment of the local area. However, state government can be basic, particularly in education, if the region exports education services to out-of-state students or if the education institutions attract out-of-state funding for research.

Retail Industries

Retail businesses are typically aimed at serving local populations. If there is substantial tourism to an area, retail can represent an export-base industry. For the purpose of identifying economic base industries, a strong tourism sector will be identified through the accommodation and food services category of employment rather than the retail category.

Health Care

Health care and related industries are usually not an export-base industry, because they also depend greatly on an existing population. The exception is when there are major health centers in the region that conduct research projects and/or provide state-of-the art services that cannot be found in nearby states. These are usually found in larger counties, such as Pima (Tucson) and Doña Ana (Las Cruces).

Social Services and Social Assistance

Social services and social assistance are typically nonbasic local services, such as housing and welfare assistance, that provide specialized services to local residents throughout the Project study area.

Industries with Relatively Few Employees

Small businesses typically provide services to the local residents, and were not identified as export-base industries. A very small industry, even if its share of employment is higher than the United States' share, cannot be a significant factor in the local economy.

Summary of Basic and Nonbasic Industry Sectors

Most of the counties through which the Project crosses rely on export base industries that are related either to land endowments (agriculture; forestry, fishing, and related activities; mining; tourism) or are related to federal military/defense installations (military; federal civilian; professional, scientific, and technical employment). For some of the counties, utilities (electricity) represent an export base sector. The state government provides export base activities

in a few counties that have education centers or corrections facilities. Health and social assistance represent an export industry in the two largest counties included in this study.

3.13.6.2 Unemployment

New Mexico

Table 3-63 displays unemployment rates for 2000, 2005, and 2010 for the United States and the state of New Mexico, as well as for the counties that fall within the New Mexico portion of the study area.

Table 3-63. Unemployment Rates: New Mexico (percentage)

Location	2000	2005	2010[1]	Rate Change (2005 to 2010)
United States	3.9	4.9	9.4	4.5
State				
New Mexico	4.9	4.7	8.4	3.7
Counties				
Doña Ana	6.1	5.7	8.3	2.6
Grant	5.8	6.0	11.3	5.3
Hidalgo	6.8	4.8	7.5	2.7
Lincoln	4.2	4.5	6.8	2.3
Luna	15.5	12.8	19.0	6.2
Sierra	4.4	5.4	6.7	1.3
Socorro	5.1	4.5	6.1	1.6
Torrance	5.0	5.5	10.3	4.8

[1] Annual percentage based on 11 months of data (January to November)
Source: U.S. Bureau of Labor Statistics 2010

Arizona

Table 3-64 displays unemployment rates for 2000, 2005, and 2010 for the United States and the state of Arizona, as well as for the counties that fall within the Arizona portion of the study area.

Table 3-64. Unemployment Rates: Arizona (percentage)

Location	2000	2005	2010[1]	Rate Change (2005 to 2010)
United States	3.9	4.9	9.4	4.5
State				
Arizona	4.0	4.5	9.5	5.0
Counties				
Cochise County	4.5	4.8	8.1	3.3
Graham County	5.5	6.0	13.7	7.7
Greenlee County	4.3	4.8	11.1	6.3
Pima County	3.7	4.5	8.7	4.2
Pinal County	4.6	5.6	11.7	6.1

[1] Annual percentage based on 11 months of data (January to November)
Source: U.S. Bureau of Labor Statistics 2010

3.13.7 Fiscal Conditions: Tax Rates and Revenues

Taxes are collected in New Mexico and Arizona, resulting in state and local tax revenues that are then used to provide public services to populations. Sales and income tax collected by the state of Arizona is shared with counties and incorporated towns, regardless of where the taxes are collected. New Mexico does not have a state-shared tax revenue program, therefore tax revenue benefits would remain within closer proximity to the Project. The tax revenue estimates for subroutes in New Mexico include those generated by sales tax, income tax, and corporate income tax. In Arizona, tax revenue estimates are based on sales tax (Transaction Privilege Tax), personal income tax, corporate income tax, and property taxes.

The average tax rates and revenues for each state, including counties crossed by the study corridor are included in Table 3-65 and Table 3-66.

Table 3-65. New Mexico: Revenue and Income Summary (2009)

	Gross Receipts and Selective Sales Taxes	Personal Income Taxes[1]	Net Corporate Income Taxes
Average Effective Tax Rates	4.8%	2.2%	0.5%
Total Revenues	**$2,493,029,000**	**$932,442,000**	**$203,584,000**

[1] Personal income taxes are based on an adjusted total personal income for New Mexico. Adjusted personal income is defined to be equal to total personal income minus most transfer payments and minus two components of dividends, interest and rent (see Appendix D of the EIA).
Source: SunZia Southwest Transmission Project Economic Impact Assessment-Revised 2012

Table 3-66. Arizona: Revenue and Income Summary (2010)

	Gross Transaction Privilege Tax (Sales Taxes) Collections	Net Personal Income Taxes	Net Corporate Income Taxes
Average Effective Tax Rates	3.3%	2.5%	0.5%
Total Revenues	**$5,981,605,185**	**2,423,214,707**	**$413,280,938**

Source: SunZia Southwest Transmission Project Economic Impact Assessment-Revised 2012; Arizona Department of Revenue 2011 Annual Report

3.13.8 Emergency Services

The following sections provide information for fire and medical emergency services by county throughout the New Mexico and Arizona portions of the Project study area. While it is important that law enforcement agencies throughout the study area are notified of construction locations and schedule prior to work beginning, the likelihood that law enforcement services would be in considerable demand is minimal, due to the distribution of relatively small construction crews across a linear, 500-mile corridor.

3.13.8.1 Fire Services

New Mexico

There are 18 fire stations that serve areas within the Project corridors, in addition to fire management units of the BLM, USFWS, and New Mexico State Forestry. Due to the remoteness and low population density of some portions of the Project corridor, some areas are underserved relative to others. These areas will be described in Section 4.13.

Fire services across the New Mexico portion of the Project study area are presented in Table 3-67.

Table 3-67. Fire Services: New Mexico

Location	Fire Station	Location
Doña Ana County	BLM Las Cruces District Office	1800 Marquess St., Las Cruces, NM 88005 (575) 525-4300
	Hatch Volunteer Fire Department	207 Franklin, Hatch, NM 87937
Grant County [1]	—	—
Hidalgo County	Hidalgo County Fire Department District [1]	300 S Shakespeare St., Lordsburg, NM 88045 (505) 542-8212
	Lordsburg Fire Department	404 Wabash St., Lordsburg, NM 88045 (505) 542-9261
Lincoln County	White Oaks Volunteer Fire Department	Hwy 349, Carrizozo, NM 88301
	Carrizozo Fire Department	400 8th Ave., Carrizozo, NM 88301
Luna County	Cooks Peak Fire District 403	2470 Tulip Dr. NE, Deming, NM 88030 (505) 544-8729
	Deming Fire Department	309 S Gold Ave., Deming, NM 88031 (505) 546-8848
Sierra County	Arrey-Derry Fire Department	1021 Percha Dam Rd., Arrey, NM 87930 (505) 740-2527
	Caballo Fire and Rescue	Highway 187 mi. 26, Caballo, NM 87931 (505) 743-3488
	Lakeshore Fire Department	301 S Lost Canyon, Elephant Butte, NM 87935 (505) 744-4172
	Hillsboro Fire/Rescue Department	State Rd., 27 RT, Hillsboro, NM 88042 (505) 895-5368
	Monticello-Placita Volunteer Fire Department	PO Box 22, Monticello, NM 87939 (505) 743-2146
	Truth or Consequences Volunteer Fire Department	300 E 9th Ave., Truth or Consequences, NM 87901 (505) 894-2132
	Las Palomas Volunteer Fire Department	101 W. Las Palomas Rd., Williamsburg, NM 87942 (505) 894-3742
Socorro County	BLM Socorro Field Office	901 S. Highway 85, Socorro, NM 87801 (575) 835-0412
	BLM Rio Puerco Field Office	435 Montano Rd., NE Albuquerque, NM 87107
	San Antonio Fire Department	1770 ST RD 1,San Antonio, NM 87801 (505) 835-2114
	New Mexico State Forestry Division (Socorro Division)	1701 Enterprise Socorro, NM 87801 (575) 835-9359

Table 3-67. Fire Services: New Mexico		
Location	**Fire Station**	**Location**
	Socorro Fire Department	200 Fisher Street, Socorro, NM 87801 (575) 835-3969
	Midway Fire Department	13 Chambon Rd., Lemitar, NM 87823 (575) 835-0985
	U.S. Fish and Wildlife Service, Bosque del Apache NWR	NM HWY 1, San Antonio, NM 87832 (575) 835-1828
Torrance County	Mountainair Volunteer Fire Department	304 N Summit, Mountainair, NM 87036 (505) 847-0147
[1] Given the distance of Silver City (30+ miles) and other Grant County communities, it is unlikely that fire services would come from Grant County. Services to portions of Grant County would likely come from Lordsburg in Hidalgo County. Sources: www.firedepartmentdirectory.com 2011		

Arizona

Twenty-seven fire stations are located within proximity to the Project corridor, most of which are located in Pima County in the Tucson metropolitan area. Services are also provided by the BLM and other land management agencies. Fire services across the Arizona portion of the Project corridor are represented in Table 3-68.

Table 3-68. Fire Services: Arizona		
Location	**Fire Station**	**Location**
Cochise County	Bowie Volunteer Fire District	118 West Kinchilla Street, Bowie, AZ 85605 (520) 847-2553
	Mescal Volunteer Fire Department	448 N Warren Rd., Benson, AZ 85602 (520) 586-7007
	Willcox Rural Fire Department	522 N Haskell Ave., Willcox, AZ 85643 (520) 384-3271
Graham County	Pima Rural Fire Department	86 S 200 W, Pima, AZ 85543 (928-485-2402)
	Thatcher Fire Department	1150 N College Ave., Thatcher, AZ 85552 (928) 428-1200
	BLM Safford Field Office	711 S 14th Ave., Safford, AZ 85546 (928) 348-4400
Greenlee County[1]	—	Cochise and Graham Counties
Pima County	BLM Tucson Field Office	3201 E. Universal Way, Tucson, AZ 85756 (520) 258-7200
	BLM Lower Sonoran Field Office	21605 N 7th Ave., Phoenix, AZ 85027 (623) 580-5500
	Avra Valley Fire District	15790 W Silverbell Rd., Marana, AZ 85653 (520) 682-3255
	Mountain Vista Fire District	2292 W Magee Rd., #190, Tucson, AZ 85742 (520) 575-4087
	Golder Ranch Fire District	3885 E Golder Ranch Dr., Tucson, AZ 85739 (520) 825-9001
	Tucson Fire Department	300 S Fire Central Pl., Tucson, AZ 85701 (520) 791-4502
	Rincon Valley Fire Department	14550 E Sands Ranch Road, Vail, AZ 85641 (520) 647-3760
	Northwest (NW) Fire District Station #39	12095 Thornydale Rd., Marana, AZ 85653

Table 3-68. Fire Services: Arizona		
Location	**Fire Station**	**Location**
	NW Fire District #38	8475 Stargrass Dr., Marana, AZ 85742
	NW Fire District #37	13001 N Tortolita Rd., Marana, AZ 85653
	NW Fire District #36	13475 Marana Main St., Marana, AZ 85653
	NW Fire District #35	3220 N Camino de Oeste, Marana, AZ 85745
	NW Fire District #34	8165 N Wade Rd., Marana, AZ 85743
	NW Fire District #32	4151 W El Camino del Cerro, Tucson, AZ 85745
	NW Fire District #31	4701 N La Cholla Blvd., Tucson, AZ 85705
	NW Fire District #30	1520 W Orange Grove, Tucson, AZ 85704
Pinal County	Casa Grande Fire Department	101 E 5th St., Casa Grande, AZ 85222 (520) 421-8777
	Eloy Fire District	4010 N Toltec Rd., Eloy, AZ 85231 (520) 466-3544
	Fire Station #586 (Regional Fire and Rescue Department, Inc.)	7951 W McCartney Rd., Casa Grande, AZ 85294 (520) 723-4680
	Mammoth Volunteer Fire District	114 Copper St., Mammoth, AZ 85618 (520) 487-2050
	Florence Fire Department	72 E First St., Florence, AZ 85232 (520) 868-7609
	San Manuel Fire Department Association	565 S Redington Rd., San Manuel, AZ 85631 (520) 385-9231
	Oracle Volunteer Fire Department	1475 W American Ave., Oracle, AZ 85623 (520) 896-2980
[1] Fire services to Greenlee County will likely come from Cochise and Graham counties. Sources: www.firedepartmentdirectory.com 2011; www.northwestfire.org 2011		

3.13.8.2 Medical Services

New Mexico

With the exception of Hidalgo and Torrance counties, 24-hour emergency services can be found in all New Mexico counties within the Project corridor. Residents and visitors in need of emergency services in Hidalgo and Torrance counties are taken to Silver City and Albuquerque, respectively. Hospitals in Las Cruces and Albuquerque can accommodate helicopter transportation, should an emergency situation call for these measures.

Table 3-69 lists the emergency medical services that are located throughout the New Mexico portion of the Project corridor.

Table 3-69. Emergency Medical Services: New Mexico			
Location	**Hospital**	**Address**	**Capabilities Summary**
Bernalillo County	University of New Mexico Hospital	2211 Lomas Blvd. NE, Albuquerque, NM 87106 (505) 272-2111	Level 1 Trauma Center
Doña Ana County	Mountain View Regional Medical Center	4311 E Lohman Ave., Las Cruces, NM 88011 (575) 556-7600	15,000 square-foot facility, 168 beds, 24-hour emergency services and intensive care unit, 625 employees.

Table 3-69. Emergency Medical Services: New Mexico			
Location	**Hospital**	**Address**	**Capabilities Summary**
	Memorial Medical Center	2450 S Telshor Blvd., Las Cruces, NM 88011 (575) 522-8641	24-hour emergency services and intensive care unit. Helicopter transportation for emergency situations.
Grant County	Gila Regional Medical Center	1313 E 32nd Street, Silver City, NM 88061 (575) 538-4000	40 physicians and dentists, 24-hour physician staffed emergency room
Hidalgo County[1]	—	—	—
Lincoln County	Lincoln County Medical Center	211 Sudderth, Ruidoso, NM 88345 (575) 257-8200	24-hour emergency services with intensive care unit
Luna County	Mimbres Memorial Hospital	900 W Ash Street, Deming, NM 88030 (575) 546-5800	24-hour emergency services with 7,500 square-foot emergency room with 9 beds and a triage area. 6-bed intensive care unit and 66 skilled nursing long-term beds. 25 active physicians and a total of 325 employees.
Sierra County	Sierra Vista Hospital	800 E 9th Ave., Truth or Consequences, NM 87901 (575) 894-2111	24-hour emergency services. 25-bed hospital with ambulance, surgery, and anesthesiology services.
Socorro County	Socorro General Hospital	1202 Highway 60 West (PO Box 1009) Socorro, NM 87801 (575) 835-1140	General and acute care hospital and 24 hour emergency room. Hospital provides 15 staffed inpatient beds. The staff consists of five family practice physicians (including three who offer obstetric services), one surgeon, one internist, two pediatricians, and a certified nurse midwife.
Torrance County	Mountainair Family Health Center	105 E Piñon St., Mountainair, NM 87036 (505) 847-2271	The Mountainair Health Center offers helicopter service to hospitals in Albuquerque, because it is unable to handle emergency services.

[1] Hidalgo County does not have a facility capable of accommodating medical emergencies. Those needing medical emergency services are taken north to Silver City.

Sources: The Agape Center 2011, Mountain View Regional Medical Center 2010, Socorro General Hospital 2011, Gila Regional Medical Center 2006, Mimbres Memorial Hospital 2009, Memorial Medical Center 2011, Gerald Champion Regional Medical Center 2011, Lincoln County Medical Center 2011, Sierra Vista Regional Health Center 2011. Personal Communication Patricia Autrey 2011.

Arizona

With the exception of Greenlee County, 24-hour emergency services can be found in all Arizona counties within the study area. In the event that a helicopter is needed to transport an injured worker, it is likely that one of three hospitals in Tucson would be able to provide medical services. Similar to fire services, routes in uninhabited portions of Graham and Pinal counties will have the least access to medical services.

Table 3-70 displays emergency medical services that are located within proximity to the Arizona portion of the study area.

Table 3-70. Emergency Medical Services: Arizona			
Location	**Hospital**	**Address**	**Capabilities Summary**
Cochise County	Benson Hospital	450 S Ocotillo Rd., Benson, AZ 85602 (520) 586-2261	24-hour emergency services, 8-bed specialized unit, 6 local physicians.
	Northern Cochise Community Hospital	901 Rex Allen Dr., Willcox, AZ 85643 (520) 384-3541	24-hour emergency service, level-four trauma center.
Graham County	Mt. Graham Regional Medical Center	1600 20th Ave., Safford, AZ 85546 (928) 348-4000	24-hour emergency services, 17 treatment bays and triage center (nationwide compliant)
Greenlee County[1]	—	—	—
Pima County	University of Arizona Medical Center	1501 N Campbell Ave., Tucson, AZ 85724 (520) 694-0111	24-hour emergency services, level-one trauma center, helicopter transportation, 41,000 square-foot, 61-bed facility.
	Tucson Medical Center	5301 E Grant Rd., Tucson, AZ 85712 (520) 327-5461	24-hour emergency services, 40 treatment rooms (10 critical care rooms), triage services, helicopter transportation.
	Northwest Medical Center	6200 N La Cholla Blvd., Tucson, AZ 85741 (520) 742-9000	24-hour emergency services, helicopter transportation.
	St. Joseph's Hospital	350 N Wilmot Rd., Tucson, AZ 85711 (520) 873-3000	24-hour emergency services, helicopter transportation, emergency rehabilitation services, 460 active and provisional physicians.
	Kino Community Hospital	2800 E Ajo Way, Tucson, AZ 85713 (520) 874-2000	24-hour emergency services and helicopter transportation.
	Oro Valley Hospital	1551 East Tangerine Road Oro Valley, AZ 85755 (520) 901-3500	24-hour emergency services
Pinal County	Casa Grande Regional Medical Center	1800 E Florence Blvd., Casa Grande, AZ 85122 (520) 381-6300	24-hour medical services, trauma services, 20 physicians on staff.

[1] Greenlee County does not have a medical facility within close proximity to the Project Area. Therefore, medical emergencies would likely be accommodated in Cochise or Graham counties.

Sources: Arizona Department of Commerce 2009, Benson Hospital 2010, Mt. Graham Regional Medical Center 2010, University of Arizona Medical Center 2011, Tucson Medical Center 2011, Carondelet St. Joseph's Hospital 2011, Casa Grande Regional Medical Center 2011, Northern Cochise Community 2011, Kino University Physicians Hospital 2006, Northwest Hospital 2010

3.13.9 Summary of Inventory Results

This section summarizes the social and economic situation in New Mexico and Arizona, identifying key similarities and differences between various subroutes across the study area. Overall, populations across New Mexico can be characterized as rural, low-density communities. With the exception of the subroutes in the Tucson region, a majority of the routes within Arizona cross rural, low-density communities. Social and economic conditions for local alternative and crossover links are consistent with those of the subroutes, and are not discussed separately in the following summaries.

3.13.9.1 Route Group 1: SunZia East Substation to Midpoint Substation

Subroute 1A1 and Subroute 1A2, the BLM preferred alternative, pass through unincorporated portions of Lincoln and Torrance counties, and near to the cities of Socorro (Socorro County) and Truth or Consequences (Sierra County). Subroute 1A is similar to Subroute 1A1 and 1A2, except there are no portions of Subroute 1A that cross Torrance County. Subroute 1B traverses smaller communities, including San Antonio. Social and economic conditions throughout each of the subroutes are relatively consistent, characterized by small employment centers with nonbasic industries, including retail, accommodation and food services, and health care. The presence of small communities limits the amount of housing and lodging available in an area.

3.13.9.2 Route Group 3: Midpoint Substation to Willow-500 kV Substation

Social and economic conditions in the New Mexico portion of Route Group 3 (which includes Subroute 3A2, the BLM preferred alternative, and subroutes 3A and 3B) in the study area are similar to Route Group 1. The route passes through Luna, Grant, and Hidalgo counties. Economically, the small communities along these routes (including Deming in Luna County and Lordsburg in Hidalgo County) depend largely on nonbasic employment based on retail, accommodation and food services, and health care. A majority of population and available housing in the region is located north of the subroutes within Grant County near Silver City and its surrounding communities. The Arizona portion of Route Group 3 passes through Cochise, Graham, and Greenlee counties. Communities in this area depend mostly on nonbasic employment seen in other rural communities, but also have a high concentration of professional scientific/technical basic sector jobs. A majority of these jobs is found in Cochise County. Cochise and Graham counties have a large amount of available housing, as compared to Greenlee County.

3.13.9.3 Route Group 4: Willow-500 kV Substation to Pinal Central Substation

Subroutes 4A and 4B cross in proximity to the same Graham County and Pinal County communities; and pass near Safford and Mammoth before rejoining all other subroutes east of Casa Grande in Pinal County. Both subroutes are characterized by similar social and economic conditions. The economy in Safford serves as the primary provider of retail, accommodation and food services, and health care for Graham County. In Pinal County, Mammoth is similar to Safford in that the community relies on retail and accommodation and food services for its populations and nearby communities. A majority of employment can be found near Casa Grande and Safford. Housing vacancies are highest in Casa Grande, with a small number of vacant units located in Safford and Thatcher.

Subroute 4C2c, the BLM preferred alternative, Subroute 4C1, and Subroute 4C2 come within proximity of the small communities of San Manuel, Mammoth, and Oracle in Pinal County. These communities have traditionally depended on mining, and still have active operations today. Subroute 4C3 in the Tucson metropolitan area of Pima County represents the most densely populated and economically diverse portion of the entire study area and of Route Group 4. The economy in this region is based heavily on tourism-related industries (such as food service and lodging), health care, professional/technical, and manufacturing jobs. Much of

Cochise County within Route Group 4 is sparsely populated. A majority of available housing is located in Pima County near Tucson and in Pinal County near Casa Grande.

3.14 ENVIRONMENTAL JUSTICE CONDITIONS

3.14.1 Introduction

This section describes the existing environmental justice conditions within closest proximity to the Project study area, including portions of counties throughout the states of New Mexico and Arizona.

EO 12898 (U.S. Department of Housing and Urban Development 1994) requires federal agencies to address high and disproportionate environmental impacts on minority and low-income populations. Should potentially significant and adverse impacts attributable to the proposed Project fall disproportionately on these populations, environmental justice impacts would result. The required analysis involves screening the proposed Project study area to determine if environmental justice populations exist, and to assess the degree to which those populations might be expanding within the area. The analysis further involves determining whether the proposed Project impacts would be significant, and if they would disproportionately affect any environmental justice populations.

The race, ethnic, and poverty data reported in this section were acquired from the U.S. Census Bureau's American Community Survey[1], and represent estimates based on data collected between 2005 and 2009 (presented on the census tract level). Census 2010 information was used to update American Community Survey data where applicable (U.S. Census 2011a, and Census 2011b). Census tracts vary in spatial size, typically contain between 2,500 and 8,000 people, and do not cross county boundaries. In 2009, the average total census tract population across the seven New Mexico counties and five Arizona counties within the study corridors were 3,503 and 5,538, respectively.

CEQ guidance suggests that an environmental justice population may be identified if "the minority population percentage of the affected area exceeds 50 percent, or if the minority population percentage of the affected area is meaningfully greater than the minority population in the general population or other appropriate unit of geographic analysis" (CEQ 1997a). Minority populations are defined as "individual(s) who are members of the following population groups: American Indian or Alaskan Native; Asian or Pacific Islander; Black, not of Hispanic Origin; or Hispanic" (*ibid*). In order to set a conservative threshold for identifying potential environmental justice populations, those who were American Indian or Alaskan Native, Asian, Black, other race, or two or more races were aggregated and divided by the total population for each census tract to determine which areas were greater than 50 percent minority. It is important to note that the "other race" U.S. Census category consists of all single race populations other than White, Black or African American, American Indian or Alaska Native, Asian, and Native Hawaiian or Other Pacific Islander race categories. This category comprises write-in entries, and

[1] The U.S. Census American Community Survey estimates are based on data collected over a 5-year time period. The estimates in this section represent the average characteristics of population and housing between January 2005 and December 2009 and do not represent a single point in time.

could include Hispanic or Latino populations if the respondent considered this to be their race. Given the demographics in New Mexico and Arizona, it is expected that many people in the "other race" category are Hispanic or Latino. Hispanic or Latino populations were only counted as an ethnicity in the U.S. Census' American Community Survey 2005-2009 estimates; therefore, this number is divided by the total population separately from other minority population groups. Census tracts with greater than 50 percent Hispanic or Latino populations were also considered to be potential environmental justice populations.

The CEQ defines low-income populations based on an annual statistical poverty threshold. In identifying low-income populations, poverty thresholds do not vary geographically and are identical across the United States (Census 2011c). In 2009, the poverty threshold for an individual living alone was $10,956. For a family of four (two adults and two children), the poverty threshold was $21,576. If the income for a family of four was below $21,576, each person in the household was considered to be below the poverty level. For the purposes of identifying low-income populations within 3 miles of each Project subroute, all census tracts with an equal or greater percentage of population below the poverty level for New Mexico and Arizona was considered a potential environmental justice population. In 2009, the percentage of New Mexico and Arizona individuals that were below the poverty level was 18.1 percent and 14.7 percent, respectively. Special note for census tracts with low densities, such as those in rural areas, will be made throughout the inventory section.

3.14.2 Study Area Overview

Table 3-71 includes race, ethnicity, and poverty percentages statewide for New Mexico and Arizona, and for the counties within the Project study area. Arizona and New Mexico populations are primarily white and Hispanic or Latino. Overall, neither of these states is home to a diverse population; much of these populations are identified as either White or Hispanic.

Table 3-71. Race, Ethnicity, and Poverty: New Mexico and Arizona (Percent of total population)

	White Alone and Non-Hispanic	Hispanic or Latino	Other Racial and Ethnic Minorities	Total Racial and Ethnic Minorities	Variation in Percentage to Statewide Average[1].	Total population below poverty level
Arizona	57.3	30.3	12.5	42.7	–	15.3
Cochise	58.0	32.8	9.2	42.0	0.7	15.7
Graham	51.8	31.2	17.0	48.2	-5.5	20.0
Greenlee	47.0	49.0	4.0	53.0	-10.3	13.5
Pima	54.7	35.2	10.1	45.3	-2.6	16.4
Pinal	57.8	29.4	12.8	42.2	0.6	13.5
New Mexico	40.1	46.9	13.0	59.9	–	18.4
Grant	48.2	48.7	3.1	51.8	8.1	14.8
Hidalgo	41.4	56.6	2.0	58.6	1.2	22.6
Lincoln	65.6	30.5	3.9	34.4	25.4	12.9
Luna	35.6	61.7	2.8	64.4	-4.6	32.8
Sierra	67.5	28.8	3.7	32.5	27.4	22.5

Table 3-71. Race, Ethnicity, and Poverty: New Mexico and Arizona (Percent of total population)						
	White Alone and Non-Hispanic	**Hispanic or Latino**	**Other Racial and Ethnic Minorities**	**Total Racial and Ethnic Minorities**	**Variation in Percentage to Statewide Average[1].**	**Total population below poverty level**
Socorro	37.4	48.8	13.7	62.6	-2.7	26.8
Torrance	55.0	40.1	4.9	45.0	14.8	19.4

[1] Variation of county to state non-minority populations
Source: U.S. Census Bureau 2011a and 2011b.
Note: Census respondents may choose one or more races, and therefore census tallies may overlap.

3.14.3 Summary of Inventory Results

Potential environmental justice populations are identified for each route group in this section[1].

3.14.3.1 Route Group 1: SunZia East Substation to Midpoint Substation

Subroute 1A – North River Crossing

Subroutes 1A, 1A1, and 1A2 (BLM preferred alternative) are in proximity to or cross seven census tracts with potential environmental justice populations. These tracts include the western portion of census tract 9602 in Lincoln County, the southern portion of census tract 96730 in Torrance County, the northern portions of census tracts 9781, 9783.01, 9783.02, and 9783.03 (including part of the city of Socorro) in Socorro County, and census tract 5 in Luna County (located north of Deming). Census Tract 9781, which covers a majority of Socorro County, has a greater percentage of population below the poverty level than the state average and is characterized by a low population density (1.6 people per square mile). Approximately 1,031 individuals (or 21.7 percent) were below the poverty level in 2009. Census tract 9783.01 contains a large percentage of low-income individuals, estimated at approximately 40 percent of the tract's total population. Located 1.5 miles south of Subroute 1A2, tract 9783.02 contains 801 individuals, or 28.7 percent of individuals of low-income status. Tract 9783.03 contains a large number of Hispanic or Latino individuals, approximately 64 percent or 2,170 people; only a small portion of this tract is crossed by Subroute 1A2 (approximately 0.9 mile). In 2009, overall population densities for census tracts 9783.01, 9783.02, and 9783.03 were 43.3, 2,089.6, and 179.1 people per square mile, respectively. Tract 5 comprises a high percentage of low-income populations, approximately 33 percent or 1,450 individuals. However, the population density in this census tract was low; just 2.6 people per square mile. Subroute 1A2 does not pass near any communities within Luna County and ends approximately 7.5 miles northeast of Deming.

[1] Text has been updated where environmental justice conditions changed from American Community Survey 2005 to 2009 to Census 2010.

Subroute 1B – San Antonio Crossing

With the exception of census tract 9783.01, Subroute 1B1 includes similar potential environmental justice populations as Subroute 1A. Subroute 1B1 crosses through the southern portion of census tract 9783.03 that is not crossed by Subroute 1A, which crosses through the northern portion of the tract near the city of Socorro. Subroute 1B1 is located approximately 8 miles south of the city of Socorro, near the unincorporated community of San Antonio.

Overall, potential environmental justice populations located in proximity to subroutes 1B2 and 1B3 are similar to those found in Subroute 1B1. Subroute 1B3 passes near the community of Bingham, while Subroute 1B2 does not pass near any communities.

Local Alternative and Crossover Links for Route Group 1

Local alternative links for 1A1 and 1B1 cross two potential environmental justice census tracts in Torrance County. Census tract 9634 is crossed by local alternative links E83 and E84, which begin at SR 14 as it parallels the Torrance-Socorro County boundary. Despite having a large Hispanic population, approximately 65 percent or 229 individuals, this portion of the tract is largely uninhabited. The population density of the entire census tract (which spans 1,727 square miles) is just 0.4 people per square mile. Census tract 9635 to the west of tract 9634 (crossed by alternative links E83, E84, and E85) contains a high percentage of low-income residents, 28.8 percent, or 392 individuals. Similar to census tract 9634, this area is characterized by a sparsely populated landscape of just 3.7 people per square mile.

3.14.3.2 Route Group 3: Midpoint Substation to Willow-500 kV Substation

Subroute 3A – North and Subroute 3A2 – BLM Preferred Alternative

In New Mexico, subroutes 3A and 3A2 cross three potential environmental justice census tracts: tract 5 in Luna County (see discussion in Subroute 1A2), tract 9648 in Grant County, and tract 9700 in Hidalgo County. The highest population densities are located far from the subroute, in the northern portions of the census tract near Silver City; estimated to be 1.9 people per square mile in 2009. Census tract 9700 in Hidalgo County comprises a high percentage of low-income individuals (28.1 percent) who are spread across the county. However, the density and total population of this tract is low; just 0.7 people per square mile, or 2,195 individuals.

In Arizona, subroutes 3A and 3A2 cross approximately 9 miles of a potential environmental justice census tract in Greenlee County (tract 9603), and approximately 26 miles of census tract 9616 in Graham County. The tracts are characterized by low population densities that range from 5.4 to 6.6 people per square mile.

Subroute 3B – South

Subroute 3B crosses potential environmental justice populations in two locations that are not crossed by Subroute 3A2. In New Mexico, Subroute 3B crosses census tract 9882 surrounding Lordsburg, which has a relatively high population density (614.7 people per square mile) and is home to a large percentage of Hispanic and low-income individuals; 77.4 percent and 36.2

percent, respectively. In Arizona, Subroute 3B crosses census tract 1 in Cochise County, which is home to a high percentage of low-income individuals, representing 22.7 percent of the population (8 percent higher than the state average).

3.14.3.3 Route Group 4: Willow-500 kV Substation to Pinal Central Substation

Subroute 4A – North of Mt. Graham

Subroute 4A crosses the southern portion of census tract 9912 in Graham County, which has a slightly higher percentage of low-income individuals than the state of Arizona (representing 15.7 percent compared to Arizona's 14.7 percent). Tract 9912 also contains the Town of Thatcher; however, the center of the town is approximately 6 miles northeast of the route.

Subroute 4A crosses or comes within proximity to three potential environmental justice census tracts in Pinal County: tracts 6.01, 12, and 20. Census tract 6.01 passes approximately 2 miles north of the unincorporated community of Mammoth, and is considered a potential environmental justice population because of a high low-income population (26.3 percent or 1,966 individuals) and a large Hispanic or Latino population (56 percent or 4,221 individuals). Population density in census tract 6.01 is low relative to other areas throughout the study corridors; 11.2 people per square mile. Near the planned Pinal Central Substation, Subroute 4A crosses census tract 12, where approximately 26.1 percent of the residents are low-income. Encompassing a portion of Toltec, census tract 20 is characterized by low-income and a high percentage of Hispanic residents; 27 and 77 percent, respectively.

Subroute 4B – Sulphur Springs Valley

Subroute 4B crosses the same potential environmental justice populations as Subroute 4A.

Subroute 4C2c – BLM Preferred Alternative

Located north of the unincorporated community of San Manuel, census tract 7 has a population of 4,375 and contains high percentages of both Hispanic (57 percent) and low-income individuals (24.3 percent). This route would affect the same environmental justice populations as subroutes 4A and 4B, including two census tracts in Pinal County.

Subroute 4C1 – East of Sand Pedro River and Subroute 4C2 – West of San Pedro River

Subroutes 4C1 and 4C2 would affect the same environmental justice populations as Subroute 4C2c.

Subroute 4C3 – Tucson

Subroute 4C3, which begins at the Willow-500 kV substation in census tract 2 of Cochise County, passes through the greatest number of potential environmental justice tracts. These are among the most densely populated areas within the Project study area and run through the Tucson metropolitan area. Due to the large number of census tracts, Subroute 4C3 environmental

justice populations are summarized as those that are located within 1 mile of Subroute 4C3, and those that are located between 1 and 3 miles of Subroute 4C3 (Table 3-72 and Table 3-73). The majority of potential environmental justice populations in these census tracts comprise low-income and Hispanic or Latino populations.

Local Alternative Links for Route Group 4

The Pantano-Rillito local alternative links (F81a and F81b) within Subroute 4C3 traverse the northern portions of Tucson. These links would affect much fewer potential environmental justice populations than the southern Tucson route. The majority of the census tracts just north of this route is characterized by higher income levels and lower numbers of minority populations. The population just south of links F81a and F81b is characterized by lower income populations similar to the southern routes. Fourteen census tracts within 1 mile south of these links have higher percentages of low-income residents as compared to the state of Arizona. Unlike the southern Tucson routes, no census tract within 1 mile of F81a and F81b has a minority population greater than 50 percent of the total tract population. Outside of 1 mile, both low-income and minority populations can be found. Some potential environmental justice populations identified within Subroute 4C3, particularly those along Link F111 in southern Tucson, are located within proximity to F81a and F81b. However, the alternative links that run through the northern portions of Tucson are in proximity to fewer potential environmental justice populations.

Table 3-72. Subroute 4C3: Potential Environmental Justice Populations by Census Tract (within 1 mile of the Proposed Route)

		Type of Environmental Justice Population		
County	**Census Tract**	**Low-Income**	**Hispanic or Latino**	**Other Minority**
Pinal	12	●		
Pima	1	●		
	2	●	●	
	3	●		
	4	●		
	9	●		
	10	●	●	●
	11	●	●	●
	12	●	●	●
	13.02	●	●	
	21	●	●	●
	22	●	●	●
	23	●	●	
	24	●	●	●
	25.01	●	●	
	25.03	●	●	

Table 3-72. Subroute 4C3: Potential Environmental Justice Populations by Census Tract (within 1 mile of the Proposed Route)				
Type of Environmental Justice Population				
County	Census Tract	Low-Income	Hispanic or Latino	Other Minority
	41.04	●	●	●
	41.10	●	●	●
	41.11	●	●	●
	41.12	●	●	●
	44.07	●	●	●
	44.12	●		
	44.14		●	
	44.15		●	
	44.18	●		
	45.04	●	●	
	45.06	●		
	45.09	●		
Source: U.S. Census 2009: 2005-2009 ACS				

Table 3-73. Subroute 4C3: Potential Environmental Justice Populations by Census Tract (between 1 and 3 miles of the Proposed Route)				
Types of Environmental Justice Population				
County	Census Tract	Low-Income	Hispanic or Latino	Other Minority
Pinal	21	●		
Pima	5	●		
	6	●		
	7	●		
	8	●	●	
	13.01	●	●	
	14	●		
	14.14		●	
	15	●		
	16	●		
	20	●	●	
	25.04	●	●	
	26.01	●	●	
	26.02	●		

Table 3-73. Subroute 4C3: Potential Environmental Justice Populations by Census Tract (between 1 and 3 miles of the Proposed Route)				
Types of Environmental Justice Population				
County	Census Tract	Low-Income	Hispanic or Latino	Other Minority
	27.01	●		
	35.01	●	●	
	37.01	●	●	
	37.02	●	●	●
	37.04	●	●	●
	38.01	●	●	
	38.02	●	●	
	39.01	●	●	
	39.02	●	●	
	41.06	●	●	
	43.10		●	●
	44.11	●		
	44.19	●		
	44.20	●		
	45.07	●		
	45.08	●		
	46.26	●		
Source: U.S. Census 2009: 2005-2009 ACS				

3.15 HEALTH AND SAFETY/HAZARDOUS MATERIALS

3.15.1 Introduction, Methods, and Regulatory Framework

3.15.1.1 Introduction

The Health and Safety/Hazardous Materials section includes documentation and discussion of EMF, and environmental contaminants occurring in the 0.2-mile-wide study corridors (0.1 mile on either side of the reference centerline).

3.15.1.2 Methods

Publicly available databases were reviewed to obtain information regarding Superfund sites[1] and leaking underground storage tanks (LUST). The Comprehensive Environmental Response,

[1]A Superfund site is an uncontrolled or abandoned place where hazardous waste is located, possibly affecting local ecosystems or people.

Compensation, and Liability Information System (CERCLIS) contains data on potentially hazardous waste sites that have been reported to the EPA and on sites listed on the National Priorities List (NPL). The ADEQ, NMED, and EPA were queried regarding available data; these data were used to assess proximity and location of sites in relation to the proposed corridors.

3.15.1.3 Regulatory Framework

Federal Laws

Environmental Protection Agency

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), commonly known as Superfund, was enacted by Congress on December 11, 1980. CERCLA (USC 42 Chapter 103) provides the broad federal authority to respond directly to the release or the threatened release of hazardous substances that may endanger public health or the environment. It establishes requirements concerning closed and abandoned hazardous waste sites; provides for liability of persons responsible for the release of hazardous waste; and establishes a trust fund to provide for cleanup when no responsible party can be identified. It also enables the revision of the National Contingency Plan (Title 40 CFR Part 300), which provides the guidelines and procedures needed to respond to the release or the threatened release of hazardous substances, pollutants, and/or contaminants. The National Contingency Plan also established the NPL. CERCLA was amended by the Superfund Amendments and Reauthorization Act on October 17, 1986.

The Resource Conservation and Recovery Act of 1976 (RCRA) (USC 42 Chapter 82) established a program administered by the EPA for the regulation of the generation, treatment, storage, and disposal of hazardous waste. The RCRA was amended in 1984 by the Hazardous and Solid Waste Amendments, which affirmed and extended the "cradle to grave" system of regulating hazardous wastes. The "cradle to grave" management system ensures that hazardous waste is managed safely through its life-cycle ensuring safe transportation, treatment, storage, and disposal.

As part of the CWA, the EPA oversees and enforces the Oil Pollution Prevention regulation contained in Title 40 of the CFR, Part 112; often referred to as the "SPCC rule," because the regulations describe the requirements for facilities to prepare, amend, and implement Spill Prevention, Control, and Countermeasure Plans. A project is subject to these regulations if there is a reasonable expectation that there may be discharge of oil into or upon Navigable Waters of the United States.

Occupational Safety and Health Administration

The OSHA's mission is to ensure the safety and health of America's workers by setting and enforcing standards; providing training, outreach, and education; establishing partnerships; and encouraging continual improvement in workplace safety and health. OSHA staff establishes and enforces protective standards, and reaches out to employers and employees through technical assistance and consultation programs. OSHA standards are listed in Title 29 CFR Part 1910.

Bureau of Land Management

The BLM engages in hazardous material emergency response actions, site evaluations, and prioritization of cleanups in accordance with laws and regulations. This involves working with the EPA, state environmental quality departments, counties, and responsible parties (both public and private) to fund and expedite the cleanup of hazardous sites within their jurisdictions. Sites that are an imminent threat to public health and safety, or that are under a consent order—a voluntary agreement between a state or federal agency and a responsible party to settle a dispute—and therefore able to generate penalties and fines, are a BLM priority.

State Laws

New Mexico

Within the NMED, the Occupational Health and Safety Bureau has the responsibility of enforcing the Occupational Health and Safety Regulation within New Mexico. As applicable to the Project, New Mexico has adopted federal OSHA regulations.

The Hazardous Waste Bureau, also part of the NMED, is tasked with providing regulatory oversight and technical guidance to New Mexico hazardous waste generators and treatment, storage, and disposal facilities as required by the New Mexico Hazardous Waste Act (Chapter 74 Article 4 NMSA 1978) and regulations promulgated under the Act. Under the New Mexico Hazardous Waste Act, all underground storage tanks (UST) are required to be registered with the state. Additionally, the Hazardous Waste Bureau monitors hazardous waste and Superfund sites, coordinating the latter with the EPA.

Arizona

Within the ADEQ, the Waste Programs Division has been tasked with protecting and enhancing public health and the environment by reducing the risks associated with waste management, contaminated sites, and regulated substances. The Division ensures the proper handling, storage, treatment and disposal of wastes, and proper operation and maintenance of USTs. The division also investigates complaints and violations regarding hazardous waste and USTs. Arizona state laws regarding the standards and inspection requirements for USTs are stipulated in ARS Title 49 Chapter 6, Electric and Magnetic Fields.

3.15.2 Electric and Magnetic Fields

There are currently no laws regulating levels of EMFs; however, there is public concern regarding possible health hazards from the delivery and use of electric power. EMFs are phenomena that occur both naturally and as a result of human activity. Naturally occurring EMFs are caused by the weather and Earth's geomagnetic field. Magnetic fields associated with transmission lines are created when current flows through power lines. The strength of the fields is determined mainly by line current, line height, and distance.

Electrical transmission and distribution systems are not the only sources of magnetic fields. Local sources include homes and workplaces, and their respective electric wiring and appliances. Typical magnetic levels from common household appliances are provided in Table 3-74.

Table 3-74. Typical 60 Hz Magnetic Levels of Common Household Products

Product	Magnetic Field 6 Inches from Product (mG)	Magnetic Field 2 Feet from Product (mG)
Electric Shaver	100	–
Vacuum Cleaner	300	10
Electric Oven	9	–
Dishwasher	20	4
Microwave Oven	200	10
Hair Dryer	300	–
Computers	14	2
Fluorescent Lights	40	2
Fax Machine	6	–
Copy Machines	90	7
Garbage Disposals	80	2

Source: Western Area Power Administration 2005
mG – milliGauss
Hz – hertz

The electrical effects of transmission lines are those related to electric fields, magnetic fields, and corona. Electric fields from power lines are directly dependent on the line voltage (i.e., field strength is reduced as the distance from the source increases). EMFs can also interfere with computer monitors, cardiac pacemakers, and defibrillators. Table 3-75 lists typical EMF levels associated with 115 kV, 230 kV, and 500 kV transmission lines.

Table 3-75. Typical 60 Hz EMF Levels from Overhead Power Lines

Line Voltage	Centerline	Approximate Edge of Right-of-Way	100 feet	200 feet	300 feet
115 kV					
Electric Field (kV/m)	1.0	0.5	0.07	0.01	0.003
Magnetic Field (mG)	30	6.5	1.7	0.4	0.2
230 kV					
Electric Field (kV/m)	2.0	1.5	0.3	0.05	0.01
Magnetic Field (mG)	57.5	19.5	7.1	1.8	0.8
500 kV					
Electric Field (kV/m)	7.0	3.0	1.0	0.3	0.1
Magnetic Field (mG)	86.7	29.4	12.6	3.2	1.4

Source: Western Area Power Administration 2005
kV/m – kilovolts per meter

3.15.3 Audible Noise

At the surface of high-voltage power line conductors, the electric field may become concentrated on surface irregularities and cause an electrical breakdown of the insulating properties of the air, resulting in power loss at the site of breakdown (i.e., corona). Corona can result in audible noise, particularly when the surrounding air contains numerous water droplets or snowflakes. If there is sufficient corona activity, audible noise can be noticeable within a few hundred feet of the transmission line. The intensity is most pronounced directly beneath line conductors, and decreases with increased distance from the transmission line.

Corona activity depends on a number of factors: altitude, line voltage, conductor size, conductor geometry, and weather conditions. Corona activity is most likely to occur near transmission lines at higher altitudes and is most pronounced during foul weather. The breakdown strength of air is 30 kV per centimeter at sea level, and decreases with increasing altitude. A transmission line is designed so that at a particular altitude, conductor size, and line voltage, the electric field at the conductor surface does not exceed the breakdown potential. Nevertheless, any irregularities on the conductor surface (e.g., nicks, water droplets, or debris) will create points where the electric field is intensified sufficiently to produce corona.

When corona occurs on 500 kV transmission line conductors, it is accompanied by an audible snapping sound. If there is enough corona activity on the line, many small snaps from corona sources along a conductor may be sufficient to produce discernible audible noise (sizzling or crackle) at the edge of the right-of-way.

Sound level is measured in decibels (dB) referenced to 20 micropascals, which is approximately the pressure threshold of human hearing at 1 kilohertz (kHz). The range of audible frequencies for the human ear is approximately 20 Hz to 20 kHz, with peak sensitivity near 1 kHz. Sound at 20 Hz or 20 kHz, where the ear is less sensitive, is given much less weight than at frequencies near 1 kHz, where the ear is most sensitive. The weighting of sound over the frequency spectrum to account for the sensitivity of the human ear is called the A-weighted sound level.

When the A-weighting scale is applied to a sound-pressure measurement, the level is often reported as dBA (A-weighted decibel), referenced to the audible pressure threshold. The sound level of typical human speech is approximately 60 dBA, and background levels of noise in rural and urban environments are approximately 30 to 40 dBA. Specific identifiable noises such as birdcalls, neighborhood activity, and traffic can produce audible noise levels of 50 to 60 dBA. Table 3-76 lists the sound intensities of common acoustic sources.

Table 3-76. Commonly Encountered Acoustic and Audible Noise Levels

Source	A-Weighted Sound Level (dBA)
Automobile horn	110
Inside subway	95
Traffic	75
Conversation	65
Office	55
Living Room	45

Table 3-76. Commonly Encountered Acoustic and Audible Noise Levels	
Source	**A-Weighted Sound Level (dBA)**
Library	35
Bedroom	24

Corona-generated audible noise varies at different times to account for fluctuating sound levels; statistical descriptors are used to describe environmental noise. Exceedance levels (L levels) refer to the A-weighted sound level that is exceeded for a specified percentage of the time. Thus, L_5 refers to a noise level that is exceeded only 5 percent of the time, L_{50} refers to a sound level exceeded 50 percent of the time, etc. Sound-level measurements are expressed in the L_{50} level (median level) in fair and foul (steady rain) conditions.

3.15.4 Summary of Inventory Results

Existing and past land uses are indicators of hazardous materials storage or use. A limited review of environmental databases was conducted to identify known hazardous waste sites within the study corridors.

3.15.4.1 CERCLIS Sites

A search of publicly available databases was used to determine if there were any NPL sites or Superfund sites within the study corridors. No sites were located within the study corridors in New Mexico (NMED 2011; EPA 2011g). A total of three sites were identified in Arizona within the study corridor in the Tucson metropolitan area, using the CERCLIS database and data provided by the ADEQ (Table 3-77). None of the sites identified is on the NPL.

Table 3-77. CERCLIS Sites within the Study Corridors in Arizona			
Route	**CERCLIS ID**	**Site Name**	**Location**
Pantano-Rillito Subroute (Link F81a)	AZD983471418	Broadway Landfill – South	South of intersection of E Broadway Blvd and S Prudence Rd.
Pantano-Rillito Subroute (Link F81a and F81b)	AZD983471426	Broadway Landfill – North	North of intersection of E Broadway Blvd and S Prudence Rd.
Pantano-Rillito Subroute (Link F81b)	AZD980813216	El Camino del Cerro Landfill	0.25 mile west of I-10 and El Camino Blvd.
Source: ADEQ 2009; EPA 2011g			

3.15.4.2 Underground Storage Tanks

According to the NMED, there are currently 16 USTs located within 1 mile of the proposed routes within New Mexico (NMED 2011). All are located underneath gas stations that may or may not still be operational, and none of these is located within 600 feet of the Project centerline.

According to the ADEQ, there are currently 886 USTs located within 1 mile of the proposed routes within Arizona. Of these, 35 are located within 600 feet of the Project centerline; 30 along Subroute 4C3, on links F111 and F112 (Table 3-78); and 5 within 600 feet of the Pantano-Rillito Local Alternative Subroute centerline along Link F81b (ADEQ 2009).

Table 3-78. Underground Storage Tanks within 600 Feet of the Project Centerline				
Route	**Non-Leaking**	**Leaking**	**Priority-Leaking**	**Total**
Pantano-Rillito Subroute (Link F81b)	1	4	0	**5**
Subroute 4C3 – Willow-500 kV Substation to Pinal Central Substation (Link F111)	6	12	0	**18**
Subroute 4C3 – Willow-500 kV Substation to Pinal Central Substation (Link F112)	1	6	5	**12**
Source: ADEQ 2009				

Five USTs are designated priority leaking sites. All five are located at a single gas station at the intersection of West St. Mary's Road and I-10, on the west side of Tucson.