10.3 FOURMILE EAST

10.3.1 Background and Summary of Impacts

10.3.1.1 General Information

The proposed Fourmile East SEZ has a total area of 3,882 acres (15.7 km^2) and is located in Alamosa County in south-central Colorado (Figure 10.3.1.1-1). In 2008, the county population was 15,783, while the four-county region surrounding the SEZ—Alamosa, Conejos, Costilla, and Rio Grande Counties—had a total population of 39,759. The largest nearby town is Alamosa, with an estimated 2008 population of 8,745, which is located about 13 mi (21 km) to the west on U.S. 160. This highway lies about 0.6 mi (1 km) south of the SEZ, while CO 150 runs north-south through the eastern portion of the SEZ; Great Sands Dunes National Park is located about 9 mi (14 km) north of the SEZ on CO 150. The SLRG Railroad serves the area. The nearest public airport is San Luis Valley Regional Airport located 12 mi (19 km) west of the SEZ in Alamosa. Santa Fe, New Mexico, lies about 120 mi (193 km) to the south, and Denver, Colorado, lies about 170 mi (31 km) to the northeast.

An existing 69-kV transmission line lies about 2 mi (3 km) to the south, and a 230-kV line lies about 8 mi (13 km) to the north of the SEZ. It is assumed that a new transmission line would be needed to provide access from the SEZ to the transmission grid (see Section 10.3.1.2). As of February 2010, there were no pending solar project applications on the SEZ.

The proposed Fourmile East SEZ lies in the eastern San Luis Valley, part of the San Luis Basin, a high-elevation (approximately 8,000 ft [2,440 m]) basin between two large mountain ranges. The San Juan Mountains to the west and the Sangre de Cristo Range to the east form the rim of the basin. The proposed SEZ lies on a flat alluvial fan formed in the basin. There are no developments on the land, which is currently used for grazing, nor is there any standing surface water. Scrubland vegetation reflects the arid climate, which produces an annual average rainfall of about 8 in (20 cm). Large groundwater reserves underlie the area in several aquifers. Little commercial or industrial activity exists in the surrounding area, while some agricultural areas lie to the southeast.

The proposed Fourmile East SEZ and other relevant information are shown in Figure 10.3.1.1-1. The criteria used to identify the SEZ as an appropriate location for solar energy development included proximity to existing transmission lines or designated corridors, proximity to existing roads, a slope of generally less than 2%, and an area of more than 2,500 acres (10 km^2). In addition, the area was identified as being relatively free of other types of conflicts, such as USFWS-designated critical habitat for threatened and endangered species, ACECs, SRMAs, and NLCS lands (see Section 2.2.2.2 for the complete list of exclusions). Although these classes of restricted lands were excluded from the proposed Fourmile East SEZ, other restrictions may be appropriate. The analyses in the following sections address the affected environment and potential impacts associated with utility-scale solar energy development in the proposed SEZ for important environmental, cultural, and socioeconomic resources.

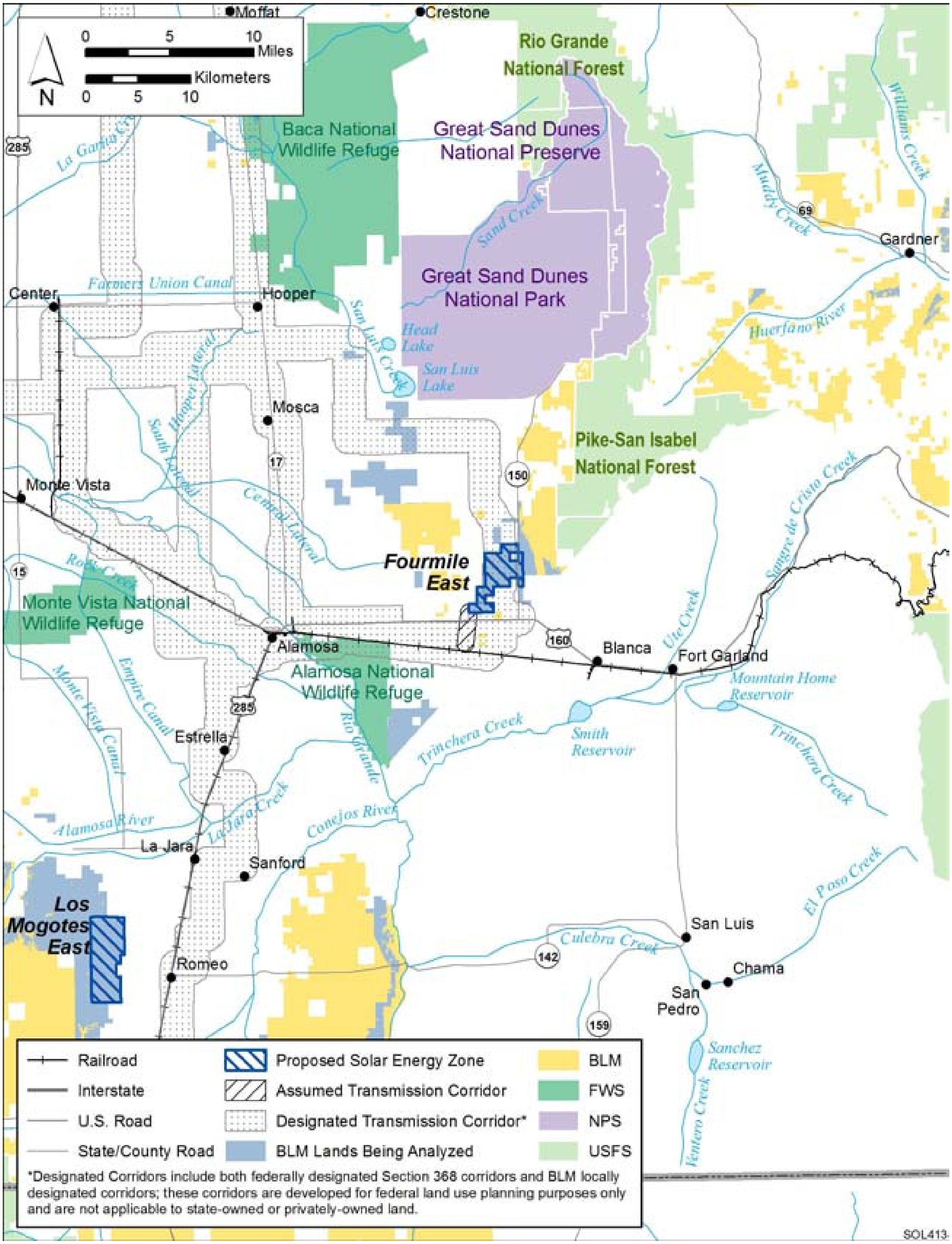

FIGURE 10.3.1.1-1 Proposed Fourmile East SEZ

10.3.1.2 Development Assumptions for the Impact Analysis

Maximum development of the proposed Fourmile East SEZ was assumed to be 80% of the total SEZ area over a period of 20 years, a maximum of 3,105 acres (12.6 km^2). These values are shown in Table 10.3.1.2-1, along with other development assumptions. Full development of the Fourmile East SEZ would allow development of facilities with an estimated total of 345 MW of electrical power capacity if power tower, dish engine, or PV technologies were used, assuming 9 acres/MW (0.04 km^2/MW) of land required, and an estimated 621 MW of power if solar trough technologies were used, assuming 5 acres/MW (0.02 km^2/MW) of land required.

Availability of electric transmission facilities from SEZs to load centers will be an important consideration for future development in SEZs. For the proposed Fourmile East SEZ, the nearest existing transmission line is a 69-kV line 2 mi (3.2 km) of the SEZ. It is possible that a new transmission line could be constructed from the SEZ to this existing line, but the 69-kV capacity of that line would be inadequate for 345 to 621 MW of new capacity (note: a 500-kV line can approximately accommodate the load of one 700-MW facility). At full build-out capacity, it is clear that substantial new transmission and/or upgrades of existing transmission lines would be required to bring electricity from the proposed Fourmile East SEZ to load centers; however, at this time the location and size of such new transmission facilities are unknown. Generic impacts of transmission and associated infrastructure construction and of line upgrades on various resources are discussed in Chapter 5. Project-specific analyses would need

TABLE 10.3.1.2-1 Proposed Fourmile East SEZ—Assumed Development Acreages, Maximum Solar MW Output, Access Roads, and Transmission Line ROWs

Total Acreage and Assumed Developed Acreage (80% of total)	Assumed Maximum SEZ Output for Various Solar Technologies	Distance to Nearest State, U.S., or Interstate Highway	Distance and Capacity of Nearest Existing Transmission Line	Assumed Area of Transmission Line ROW and Road ROW	Distance to Nearest BLM-Designated Transmission Corridor[e]
3,882 acres and 3,105 acres[a]	345 MW[b] 621 MW[c]	Adjacent (CO 150)	2 mi[d] and 69 kV	61 acres and 0 acres	Adjacent/ Through[f]

[a] To convert acres to km^2, multiply by 0.004047.

[b] Maximum power output if the SEZ were fully developed using power tower, dish engine, or PV technologies, assuming 9 acres/MW (0.04 km^2/MW) of land required.

[c] Maximum power output if the SEZ were fully developed using solar trough technologies, assuming 5 acres/MW MW (0.02 km^2/MW) of land required.

[d] To convert mi to km, multiply by 1.609.

[e] BLM-designated corridors are developed for federal land use planning purposes only and are not applicable to state-owned or privately owned land.

[f] A BLM locally designated corridor covers the entire proposed Fourmile East SEZ.

to identify the specific impacts of new transmission construction and line upgrades for any projects proposed within the SEZ.

To provide as complete an analysis of impacts of solar development in the SEZ as possible, it was assumed that, at a minimum, a transmission line segment would be constructed from the proposed Fourmile East SEZ to the nearest existing transmission line in order to connect the SEZ to the transmission grid. This assumption was made without information on whether the nearest existing transmission line would actually be available for connection of future solar facilities, and without assumptions about upgrades of the line. Establishing a connection to the line closest to the Fourmile East SEZ would involve the construction of about 2 mi (3.2 km) of new transmission line outside of the SEZ. The ROW for this transmission line would occupy approximately 61 acres (0.25 km^2) of land, assuming a 250-ft (76-m) wide ROW, a typical width for such a ROW. If a connecting transmission line were constructed to a different location in the future, site developers would need to determine the impacts from construction and operation of that line. In addition, developers would need to determine the impacts of line upgrades if they were needed.

Existing road access to the proposed Fourmile East SEZ should be adequate to support construction and operation of solar facilities, because CO 150 runs within the eastern boundary and U.S. 160 runs less than 1 mi (2 km) to the south of the SEZ. Thus, no additional road construction outside of the SEZ is assumed to be required to support solar development, as summarized in Table 10.3.1.2-1.

10.3.1.3 Summary of Major Impacts and Proposed SEZ-Specific Design Features

In this section, the impacts and proposed SEZ-specific design features assessed in Sections 10.3.2 through 10.3.21 for the proposed Fourmile East SEZ are summarized in tabular form. Table 10.3.1.3-1 is a comprehensive list of impacts discussed in these sections; the reader may reference the applicable sections for detailed support of the impact assessment. Section 10.3.22 discusses potential cumulative impacts from solar energy development in the proposed SEZ.

Only those design features that are specific to the Fourmile East SEZ are included in Sections 10.3.2 through 10.3.21 and in the summary table. The detailed programmatic design features for each resource area to be required under BLM's Solar Energy Program are presented in Appendix A, Section A.2.2. These programmatic design features would be required for development in this and other SEZs.

TABLE 10.3.1.3-1 Summary of Impacts of Solar Energy Development within the Proposed Fourmile East SEZ and Proposed SEZ-Specific Design Features[a]

Resource Area	Environmental Impacts—Proposed Fourmile East SEZ	SEZ-Specific Design Features
Lands and Realty	Full development of the SEZ could disturb up to 3,105 acres (13 km^2), utility-scale solar energy development would be a new and discordant land use to the area. There is also potential to create a more fragmented land management pattern. Solar development would exclude most traditional uses of the public lands from the SEZ. Possible non-mitigable impacts are related to induced changes to existing land uses on nearby state and private lands. Any transmission lines constructed to connect to the regional power grid would likely be constructed on private land A BLM locally designated corridor covers almost all of the SEZ. It is unlikely that solar development could occur under electric transmission lines. Thus, it appears that either the transmission corridor would have to be modified or solar development precluded in the area presently included in the transmission corridor.	None.
Specially Designated Areas and Lands with Wilderness Characteristics	The Blanca Wetlands ACEC/SRMA is within 0.5 to 6 mi (0.8 to 10 km) of the SEZ, and development within the SEZ would have a significant impact on recreation visitors in the ACEC/SRMA. Additional factors, such as noise, glare, aerial hazards, and added human presence would also disturb the use of the area by wildlife and may reduce the value of the area to wildlife. The SEZ is within view of the Sangre de Cristo Wilderness, and it is likely there would be an adverse effect on wilderness characteristics in about 1,378 acres (5.6 km^2) of the WA.	Solar technologies in the SEZ should be restricted to those with the lowest profile to minimize the visual impact on nearby specially designated areas. Additionally, lighting within the SEZ should be carefully designed to minimize visual impacts on surrounding specially designated areas.

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TABLE 10.3.1.3-1 (Cont.)

Resource Area	Environmental Impacts—Proposed Fourmile East SEZ	SEZ-Specific Design Features
Specially Designated Areas and Lands with Wilderness Characteristics *(Cont.)*	There is potential for adverse effects on the night sky viewing experience in the Great Sand Dunes National Park and other specially designated areas.	None.
	Portions of the route of the Old Spanish National Historic Trail pass within 1 mi (1.6 km) of the SEZ, and the historic setting of the trail would be adversely affected by SEZ development along at least 12 mi (19 km) of the trail. It is likely that this level of impact would affect future management of the trail.	Pending outcome of a study of the significance of potentially affected segments of the Old Spanish National Historic Trail, restrictions on solar facility development that might adversely impact trail resources should be put in place.
	The Los Caminos Antiguos Scenic Byway passes through the east side of the SEZ, and about 14 mi (22.5 km) of the highway is within the most visually sensitive zone from 1 to 5 mi (1.6 to 8 km). Solar development within the SEZ would be visible to visitors along about 50 mi (80 km) of the scenic byway. Potential impact on the use of the scenic byway is not known but may be significant.	Solar development on the east side of the scenic byway should not be approved, in order to reduce the negative visual effect on visitors from traveling on the road. This also would reduce the adverse impact on the scenic view from the highway looking to the east toward Blanca Peak and the WA. It could also reduce the potential impacts to the Old Spanish National Historic Trail.
	There may be an adverse effect on Native American religious values associated with Blanca Peak, which is within full view of the SEZ.	Consultation would be conducted to determine whether there would be adverse impacts on Native American religious values, and if so, what mitigation measures might be possible to reduce or eliminate such impacts.
	The SEZ is located within the recently (2009) designated Sangre de Cristo NHA, and it appears that solar development could be inconsistent with the designation.	Early consultation should be initiated with the entity responsible for developing the management plan for the Sangre de Cristo NHA to understand how development of the SEZ could be consistent with NHA plans/goals.

TABLE 10.3.1.3-1 (Cont.)

Resource Area	Environmental Impacts—Proposed Fourmile East SEZ	SEZ-Specific Design Features
Specially Designated Areas and Lands with Wilderness Characteristics *(Cont.)*		Adoption of visual design features described in Appendix A, Section A.2.2, would reduce visual impacts on wilderness, historic, and scenic values and should be considered as part of any solar project analysis.
Rangeland Resources: Livestock Grazing	One seasonal grazing allotment likely would be cancelled and 139 AUMs would be lost. One grazing permittee would be displaced and would incur economic and possible social impacts.	None.
Rangeland Resources: Wild Horses and Burros	None.	None.
Recreation	Recreational users would be displaced from the SEZ but impacts would be minor.	None.
	Development of the SEZ would be a dominating factor in the viewshed of the scenic byway that runs through the SEZ for about 14 mi (22.5 km) of its length and for about 5 mi (8 km) of the Rio Grande scenic railroad route. The potential impact on recreation visitors to the area is difficult to determine and would likely vary by individual and solar technology employed.	The portion of the SEZ on the east side of the scenic byway should be eliminated to reduce the negative visual effect on visitors traveling on the scenic byway and to reduce the visual impacts looking to the east toward Blanca Peak and the Sangre de Cristo Mountains.
	Because of the density of specially designated areas, scenic resources, and visually sensitive recreation resources, it is likely there would be unmitigated impacts to recreation use associated with development of the SEZ.	Solar technologies in the SEZ should be restricted to those with the lowest profile to minimize the visual impact and the accompanying adverse effect on recreational visitors.

TABLE 10.3.1.3-1 (Cont.)

Resource Area	Environmental Impacts—Proposed Fourmile East SEZ	SEZ-Specific Design Features
Military and Civilian Aviation	The SEZ is located in an area under an MTR and is identified as being a consultation area for the DoD. Development of any solar or transmission facilities that impinge into airspace used by the military would be of concern to the military and could interfere with military training activities.	None.
Geologic Setting and Soil Resources	Impacts on solar resources would occur mainly as a result of ground-disturbing activities (e.g., grading, excavating, and drilling) during the construction phase. Impacts include soil compaction, soil horizon mixing, soil erosion and deposition by wind, soil erosion by water and surface runoff, sedimentation, and soil contamination. These impacts may be impacting factors for other resources (e.g., air quality, water quality, and vegetation).	The need for a study to evaluate the potential impacts of building a solar facility in close proximity to the Great Sand Dunes should be determined.
Minerals (fluids, solids, and geothermal resources)	None.	None.
Water Resources	Ground-disturbing activities could affect surface water quality due to surface runoff, sediment erosion, and contaminant spills. Construction activities may require up to 964 ac-ft of (1.2 million m^3) of water during peak construction year. Construction activities would generate as high as 74 ac-ft (91,300 m^3) of sanitary wastewater. With full development of the SEZ, normal operations would use the following amounts of water: • For parabolic trough facilities (621-MW capacity), 444 to 941 ac-ft/yr (0.5 million to 1.2 million m^3/yr) for dry-	Wet-cooling options would not be feasible; other technologies should incorporate water conservation measures. Land disturbance activities should avoid impacts to the extent possible in the wetland areas on the western boundary of the site. During site characterization, hydrologic investigations would need to identify 100-year floodplains and potential jurisdictional water bodies subject to Clean Water Act Section 404 permitting. Siting of solar facilities and construction activities should avoid areas identified as within a 100-year floodplain.

TABLE 10.3.1.3-1 (Cont.)

Resource Area	Environmental Impacts—Proposed Fourmile East SEZ	SEZ-Specific Design Features
Water Resources *(Cont.)*	cooled systems and 3,115 to 9,325 ac-ft/yr (3.8 million to 11.5 million m^3/yr) for wet-cooled systems; • For power tower facilities (345-MW capacity), 246 to 522 ac-ft/yr (0.3 million to 0.6 million m^3/yr) for dry-cooled systems and 1,730 to 5,180 ac-ft/yr (2.1 million to 6.4 million m^3/yr) for wet-cooled systems; • For dish engine facilities (345-MW capacity), 177 ac-ft/yr (218,300 m^3/yr).; and For PV facilities (345-MW capacity), 17 ac-ft/yr (21,000 m^3/yr). With full development of the SEZ, normal operations would generate up to 9 ac-ft/yr (11,100 m^3/yr) of sanitary wastewater. With full development of the SEZ, operation of solar energy facilities using wet-cooling systems (e.g., some parabolic trough and power tower facilities) would generate 98 to 176 ac-ft/yr (0.1 million to 0.2 million m^3/yr) of cooling system blowdown wastewater.	Groundwater rights must be obtained from the Division 3 Water Court in coordination with the Colorado Division of Water Resources, existing water right holders, and applicable water conservation districts. Groundwater monitoring and production wells should be constructed in accordance with state standards. Stormwater management plans and BMPs should comply with standards developed by the Colorado Department of Public Health and Environment. Water for potable uses would have to meet or be treated to meet water quality standards according to Colorado Revised Statutes 25-8-204.
Vegetation[b]	Construction would result in the removal of all vegetation within facility footprints; re-establishment of shrub or grassland communities would be difficult. Invasive plant species could become established in disturbed areas, potentially resulting in widespread habitat degradation. Land disturbance could result in deposition of dust on nearby plant communities and adversely affect their characteristics. Grading, introduction of contaminants, groundwater withdrawal, and construction of access roads or transmission lines could result in direct	An Integrated Vegetation Management Plan addressing invasive species control, and an Ecological Resources Mitigation and Monitoring Plan addressing habitat restoration should be approved and implemented to increase the potential for successful restoration of semidesert shrub steppe and greasewood flat habitats and minimize the potential for the spread of invasive species. Invasive species control should focus on biological and mechanical methods where possible to reduce the use of herbicides.

TABLE 10.3.1.3-1 (Cont.)

Resource Area	Environmental Impacts—Proposed Fourmile East SEZ	SEZ-Specific Design Features
Vegetation[b] *(Cont.)*	impacts on wetlands both within and outside the SEZ, resulting in disruption of surface water flow, changes in groundwater discharge, and sedimentation. The results could potentially affect wetland function and degrade or eliminate wetland plant communities.	All wetland, sand dune and sand transport areas, playa, and dry wash habitats within the SEZ and assumed transmission line corridor should be avoided to the extent practicable, and any impacts minimized and mitigated. A buffer area should be maintained around wetlands and dry washes to reduce the potential for impacts on these habitats on or near the SEZ. Appropriate engineering controls should be used to minimize impacts on wetland, playa, dry wash, and riparian habitats, including downstream occurrences, resulting from surface water runoff, erosion, sedimentation, altered hydrology, accidental spills, or fugitive dust deposition to these habitats. Appropriate buffers and engineering controls would be determined through agency consultation. Transmission line towers should be sited and constructed to minimize impacts on wetlands and span them whenever practicable. Groundwater withdrawals should be limited to reduce the potential for indirect impacts on wetlands or springs on or near the SEZ associated with groundwater discharge, such as the Blanca wetlands.

TABLE 10.3.1.3-1 (Cont.)

Resource Area	Environmental Impacts—Proposed Fourmile East SEZ	SEZ-Specific Design Features
Wildlife: Amphibians and Reptiles[b]	Small impacts on amphibians and reptiles could occur from development on the SEZ. Few amphibian species are expected to occur on the SEZ.	Wetland habitats within the SEZ should be avoided to the extent practicable. Appropriate engineering controls should be used to minimize impacts on the washes that drain off of the Sangre de Cristo Mountains and on Smith Reservoir resulting from surface water runoff, erosion, sedimentation, accidental spills, or fugitive dust deposition to these habitats. Transmission line towers should be sited and constructed to minimize impacts on wetlands and riparian areas (if present within the finalized ROW location) and span them whenever practicable.
Wildlife: Birds[b]	Unmitigated direct impacts on land birds from habitat disturbance and long-term habitat reduction/fragmentation would be small. Raptors would be affected as the result of any loss of habitat used by their prey.	The requirements contained within the 2010 Memorandum of Understanding between the BLM and USFWS to promote the conservation of migratory birds will be followed. Appropriate engineering controls should be used to minimize impacts resulting from surface water runoff, erosion, sedimentation, accidental spills, or fugitive dust deposition. Take of golden eagles and other raptors should be avoided. Mitigation regarding the golden eagle should be developed in consultation with the USFWS and the CDOW. A permit may be required under the Bald and Golden Eagle Protection Act.

TABLE 10.3.1.3-1 (Cont.)

Resource Area	Environmental Impacts—Proposed Fourmile East SEZ	SEZ-Specific Design Features
Wildlife: Birds[b] *(Cont.)*		Transmission line towers should be sited and constructed to minimize impacts on wetlands and riparian areas (if present within the finalized ROW location) and span them whenever practicable. If present, prairie dog colonies (which could provide habitat or a food source for some bird species) should be avoided to the extent practicable.
Wildlife: Mammals[b]	Unmitigated direct impacts on small game, furbearers, and small mammals from habitat disturbance and long-term habitat reduction/ fragmentation would be small. Impacts on American black bear and cougar are expected to be small. No impacts are expected for bighorn sheep The SEZ occurs within the overall range and summer range of elk, overall range of mule deer, and overall range and winter range of pronghorn; however, impacts on them is expected to be small.	Prairie dog colonies should be avoided to the extent practicable to reduce impacts on species such as the desert cottontail and thirteen-lined ground squirrel. To the extent practicable, construction activities should be avoided while pronghorn are on their winter range within the immediate area of the SEZ. Development in the 213-acre (0.9 km^2) portion of the SEZ that overlaps elk summer range should be avoided.
Aquatic Biota[b]	Direct alteration of aquatic habitat would result if either construction activities or the placement of facilities occurred directly in the small emergent wetlands located primarily in the western portion of the SEZ. Removal of vegetation and disturbance of surface soils to construct solar energy facilities would likely increase the amount of sediment in wetland areas, thus negatively affecting aquatic biota. Withdrawing water from the Smith Reservoir, Rio Grande, or other perennial surface water features could affect water levels and aquatic organisms within those water bodies.	Undisturbed buffer areas and sediment and erosion controls should be maintained around wetlands on the SEZ. The use of heavy machinery and pesticides should be avoided in the immediate catchment basin for those wetlands.

TABLE 10.3.1.3-1 (Cont.)

Resource Area	Environmental Impacts—Proposed Fourmile East SEZ	SEZ-Specific Design Features
Aquatic Biota[b] *(Cont.)*	Contaminants such as fuels, lubricants, or pesticides/herbicides that directly enter the wetlands on the SEZ site or near its boundary could have a considerable impact on water quality and aquatic biota. Because of the distance to perennial streams, ponds, or reservoirs, the potential to introduce contaminants is small.	
Special Status Species[b]	Potentially suitable habitat for 59 special status species occurs in the affected area of the Fourmile East SEZ. For all special status species, less than 1% of the potentially suitable habitat in the region occurs in the area of direct effect.	Pre-disturbance surveys should be conducted within the SEZ and access road corridor to determine the presence and abundance of special status species; disturbance to occupied habitats for these species should be avoided or minimized to the extent practicable. If avoiding or minimizing impacts to occupied habitats is not possible, translocation of individuals from areas of direct effect (where appropriate); or compensatory mitigation of direct effects on occupied habitats could reduce impacts. A comprehensive mitigation strategy for special status species that used one or more of these options to offset the impacts of development should be developed in coordination with the appropriate federal and state agencies. Avoiding or minimizing impacts on grassland habitat in the transmission corridor could reduce impacts on three special status species. Coordination with the USFWS and CDOW should be conducted to address the potential for impacts on the Gunnison's prairie dog, a candidate species for listing under the ESA. Coordination would identify an appropriate survey protocol, avoidance measures,

TABLE 10.3.1.3-1 (Cont.)

Resource Area	Environmental Impacts—Proposed Fourmile East SEZ	SEZ-Specific Design Features
Special Status Species[b] *(Cont.)*		and, potentially, translocation or compensatory mitigation. Harassment or disturbance of federally listed species, candidates for federal listing, BLM-designated sensitive species, state-listed species, rare species, and their habitats in the affected area should be mitigated. This can be accomplished by identifying any additional sensitive areas and implementing necessary protection measures based upon consultation with the USFWS and CDOW.
Air Quality and Climate	*Construction:* Temporary exceedances of AAQS for PM_{10} and $PM_{2.5}$ concentration levels at the SEZ boundaries and in the immediate surrounding area during construction of solar facilities. These concentrations would decrease quickly with distance. Modeling indicates that emissions from construction activities could exceed Class I PSD PM_{10} increments at the nearest federal Class I area (the Great Sand Dunes WA, about 9 mi [14 km] north of the proposed SEZ); the potential impacts, however, would be moderate and temporary. In addition, construction emissions from the engine exhaust of heavy equipment and vehicles could affect AQRV (e.g., visibility and acid deposition) at nearby Class I areas. *Operations:* Positive impact due to avoided emission of air pollutants from combustion-related power generation: 1.3 to 2.3% of total SO_2, NO_x, Hg, and CO_2 emissions from electric power systems in Colorado (up to 1,439 tons SO_2, 1,659 tons NO_x, 0.009 tons Hg, and 1,075,000 tons CO_2).	None.

TABLE 10.3.1.3-1 (Cont.)

Resource Area	Environmental Impacts—Proposed Fourmile East SEZ	SEZ-Specific Design Features
Visual Resources	Large visual impacts on the SEZ and surrounding lands within the SEZ viewshed due to major modification of the character of the existing landscape; potential additional impacts from construction and operation of transmission lines and access roads within and/or outside the SEZ. The SEZ is located 2.8 mi (4.5 km) from Sangre de Cristo WA at the point of closest approach. Because of the short distance and elevated viewpoints, weak to strong visual contrasts could be observed by WA visitors near the point of closest approach. About 50 mi (80 km) of the Old Spanish NHT, including 25 mi (40 km) of a high-potential segment fall within the SEZ 25-mi (40-km) viewshed. Trail users would be expected to observe strong visual contrasts from solar energy development within the SEZ at some points on the trail. Strong visual contrast levels would be expected for some viewpoints in the Blanca Wetlands SRMA/ACEC, located approximately 0.5 mi (0.8 km) from the western edge of the SEZ. Moderate visual contrast levels would be expected for some viewpoints in the Zapata Falls SRMA, located approximately 4.6 mi (7.4 km) northeast of the SEZ. Almost 71 mi (114 km) of Los Caminos Antiguos Scenic Byway are within the Fourmile East SEZ viewshed. Travelers on the byway would be likely to observe strong visual contrasts from solar energy development within the SEZ at some locations on the byway.	The development of power tower facilities should be prohibited within the SEZ. Within the SEZ, in areas visible from and within 0.25 mi (0.4 km) of the Los Caminos Antiguos Scenic Byway, visual impacts associated with solar energy project operation should be consistent with VRM Class II management objectives, as experienced from key observation points on the byway. Within the SEZ, in areas visible from and within 3 mi (4.8 km) of the centerline of the high-potential segment of the Old Spanish National Historic Trail, visual impacts associated with solar energy project operation should be consistent with VRM Class II management objectives, as experienced from key observation points on the high-potential segment of the Old Spanish National Historic Trail. Within the SEZ, in areas visible from and between 3 mi (4.8 km) and 5 mi (8 km) of the centerline of the high-potential segment of the Old Spanish National Historic Trail, visual impacts associated with solar energy project operation should be consistent with VRM Class III management objectives, as experienced from key observation points on the high-potential segment of the Old Spanish National Historic Trail. Within the SEZ, in areas visible from and within 3 mi (4.8 km) of the Sangre de Cristo WA, visual impacts associated with solar energy project operation should be consistent with VRM Class II management

TABLE 10.3.1.3-1 (Cont.)

Resource Area	Environmental Impacts—Proposed Fourmile East SEZ	SEZ-Specific Design Features
Visual Resources *(Cont.)*	The SEZ is located 7 mi (11 km) from Blanca Peak (a culturally significant mountain and recreation resource) at the point of closest approach. Because of the short distance and elevated viewpoint, moderate visual contrasts could be observed by visitors. Portions of the Rio Grande Scenic Railway are within the SEZ viewshed. Railroad passengers would be likely to observe strong visual contrasts from solar energy development within the SEZ at some points on the railroad. The communities of Alamosa, Blanca, and Mosca are located within the viewshed of the SEZ, although slight variations in topography and vegetation provide some screening. Weak visual contrast levels would be expected for these communities. Residents, workers, and visitors to the area may experience visual impacts from solar energy facilities located within the SEZ (as well as any associated access roads and transmission lines) as they travel area roads, including CO 150 and U.S. 160. Strong contrast levels could potentially be observed from some locations. Minimal to weak visual contrasts would be expected for some viewpoints within other sensitive visual resource areas within the SEZ 25-mi (40-km) viewshed.	objectives, as experienced from key observation points within the WA. Within the SEZ, in areas visible from and between 3 mi (4.8 km) and 5 mi (8 km) of the Sangre de Cristo WA, visual impacts associated with solar energy project operation should be consistent with VRM Class III management objectives, as experienced from key observation points within the WA.
Acoustic Environment	*Construction:* For construction of a solar facility located near the southwestern SEZ boundary, estimated noise levels at the nearest residence located about 0.8 mi (1.3 km) from the SEZ boundary would be about 44 dBA, which is somewhat higher than the typical daytime mean rural background level of 40 dBA. However, an estimated 43 dBA L_{dn} at this residence is well below the EPA guidance of 55 dBA L_{dn} for residential areas.	Noise levels from cooling systems equipped with TES should be managed so that levels of off-site noise are within applicable guidelines. This could be accomplished in several ways, for example, through placing the power block approximately 1 to 2 mi (1.6 to 3 km) or more from the residences, limiting operations to a few hours after sunset, and/or installing fan silencers.

TABLE 10.3.1.3-1 (Cont.)

Resource Area	Environmental Impacts—Proposed Fourmile East SEZ	SEZ-Specific Design Features
Acoustic Environment *(Cont.)*	*Operations:* For operation of a parabolic trough or power tower facility located near the southwestern SEZ boundary, the predicted noise level would be about 42 dBA at the nearest residence, which is slightly higher than the typical daytime mean rural background level of 40 dBA. If the operation were limited to daytime, 12 hours only, a noise level of about 43 dBA L_{dn} would be estimated for the nearest residence, which is well below the EPA guideline of 55 dBA L_{dn} for residential areas. However, in the case of 6-hour TES, the estimated nighttime noise level at the nearest residence would be 52 dBA, which is higher than the typical nighttime mean rural background level of 30 dBA. The day-night average noise level is estimated to be about 53 dBA L_{dn}, which is a slightly lower than the EPA guideline of 55 dBA L_{dn} for residential areas. If 80% of the SEZ were developed with dish engine facilities, the estimated noise level at the nearest residence would be about 44 dBA, which is higher than the typical daytime mean rural background level of 40 dBA. On the basis of 12-hour daytime operation, the estimated 43 dBA L_{dn} at this residence would be well below the EPA guideline of 55 dBA L_{dn} for residential areas.	Dish engine facilities within the proposed Fourmile East SEZ should be located more than 1 to 2 mi (1.6 to 3 km) from the nearest residence located southwest of the SEZ (i.e., the facilities should be located in the central or northern portion of the proposed SEZ). Direct noise control measures applied to individual dish engine systems could also be used to reduce noise impacts at nearby residences.
Paleontological Resources	There could be impacts on significant paleontological resources in the proposed Fourmile East SEZ. A more detailed look at the geological deposits of the SEZ and their depth and a paleontological survey may be needed.	The depth to the Alamosa Formation within the SEZ should be determined to identify what design features might be needed in that area if solar energy development occurs.
Cultural Resources	Direct impacts on significant cultural resources (potentially including Native American burials) could occur and are likely within the SEZ and within the ROW for new transmission. However, a cultural resource survey would need to be conducted to identify archaeological sites, historic structures and features, and traditional cultural properties, and to see if any are eligible for listing in the NRHP.	A PA may need to be developed among the BLM, DOE, Colorado SHPO, ACHP, and the Trail Administration for the Old Spanish Trail to consistently address impacts on significant cultural resources from solar energy development within the San Luis Valley.

TABLE 10.3.1.3-1 (Cont.)

Resource Area	Environmental Impacts—Proposed Fourmile East SEZ	SEZ-Specific Design Features
Cultural Resources *(Cont.)*	Further evaluation is needed to determine the effects of solar energy development on a high-potential segment of the Old Spanish National Historic Trail. There will be an adverse effect on the scenic integrity of the high-potential segment. Culturally unevaluated segments of the trail should be evaluated for significance.	Because of the possibility of encountering Native American human remains in the vicinity of the proposed Fourmile East SEZ, it is recommended that, for surveys conducted in the SEZ, consideration be given to include Native American participation in the development of survey designs and historic property treatment and monitoring plans. Ongoing consultation with the Colorado SHPO and the appropriate Native American governments should be continued so that most adverse effects on significant resources in the valley could be mitigated to some degree. Some impacts may not be mitigable.
Native American Concerns	It is possible that there will be Native American concerns about culturally significant archaeological sites, the potential for Native American human remains and associated cultural items to be present within the proposed SEZ, and the potential visual and noise effects of solar energy development on culturally significant locations within the valley as consultation continues and additional analyses are undertaken. Effects on traditionally important plants and animals are also possible.	The need for and nature of SEZ-specific design features would be determined during government-to-government consultation with the affected Tribes.
Socioeconomics	Loss of grazing area could result in the loss of 20 jobs and $0.3 million in income, loss of $35 annually in grazing fees. *Transmission line construction:* 9 total jobs; $0.4 million income.	None.
	Construction: 212 to 2,804 total jobs; $11.5 million to $152.6 million income in ROI. *Operations:* 9 to 203 annual jobs; $0.3 to $6.6 million annual income in ROI.	None.

TABLE 10.3.1.3-1 (Cont.)

Resource Area	Environmental Impacts—Proposed Fourmile East SEZ	SEZ-Specific Design Features
Environmental Justice	Minority populations identified within the New Mexico portion of the 50-mi (80-km) radius around the proposed SEZ could be disproportionately affected by the construction and operation of solar facilities. Potential adverse impacts could result from noise and dust during construction; increased traffic related to construction; operations noise; visual impacts of generation and auxiliary facilities to areas of traditional or cultural significance; restricted access to animals and vegetation on developed lands; curtailed mineral, energy, and forestry development in the region; and property value impacts.	None.
Transportation	U.S. 160 provides a regional traffic corridor that could experience moderate impacts for projects that may have up to 1,000 daily workers with an additional 2,000 vehicle trips per day (maximum). Some parts of U.S. 160 could experience approximately a 50% increase in the daily traffic load. Local road improvements would be necessary in any portion of the SEZ along U.S. 160 that might be developed so as not to overwhelm the local roads near any site access point(s). The amount of traffic currently using CO 150 could increase approximately threefold. CO 150 and any other access roads connected to it would require road improvements to handle the additional traffic.	None.

Footnotes on next page.

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TABLE 10.3.1.3-1 (Cont.)

Abbreviations: AAQS = ambient air quality standards; ACHP = Advisory Council on Historic Preservation; AQRV = air quality-related value; AUM = animal unit month; BLM = Bureau of Land Management; CEQ = Council on Environmental Quality; CO = Colorado State Highway; CO_2 = carbon dioxide; CR = County Road; DOE = U.S. Department of Energy; DoD = U.S. Department of Defense; EPA= U.S. Environmental Protection Agency; ESA = Endangered Species Act; Hg = mercury; MTR = military training route; NO_x = nitrogen oxides; NRHP = *National Register of Historic Places*; PA = Programmatic Agreement; $PM_{2.5}$ = particulate matter with an aerodynamic diameter of 2.5 µm or less; PM_{10} = particulate matter with an aerodynamic diameter of 10 µm or less; PSD = Prevention of Significant Deterioration; ROI = region of influence; SEZ = solar energy zone; SHPO = State Historic Preservation Office; SO_2 = sulfur dioxide; TES = thermal energy storage; USFS = U.S. Forest Service; USFWS = U.S. Fish and Wildlife Service; WA = Wilderness Area; WSA = Wilderness Study Area.

[a] The detailed programmatic design features for each resource area to be required under BLM's Solar Energy Program are presented in Appendix A, Section A.2.2. These programmatic design features would be required for development in the proposed Fourmile East SEZ.

[b] The scientific names of all plants, wildlife, and aquatic biota are provided in Sections 10.3.10 through 10.3.12.

10.3.2 Lands and Realty

10.3.2.1 Affected Environment

The proposed Fourmile East SEZ is located within an area of mixed land ownership and is surrounded mainly by private lands, but there are also a number of BLM- and USFS-managed lands nearby. Private lands are sparsely developed, yet there are home sites scattered throughout the area. It appears that the private lands to both the east and south have been subdivided, and there are numerous roads throughout these areas. Easy access to the SEZ is available from State Highway 150 that passes through the east side of the area. Three county roads also provide good access to portions of the site. Only two existing ROWs are located in the SEZ and both are for short segments of roads. There is a transmission corridor that passes through most of the SEZ but, currently, it does not contain any transmission facilities. The overall character of the land in the SEZ and the surrounding lands is rural.

There are currently no applications for ROWs for solar facilities within the Fourmile East SEZ; however, there is one solar facility operating in the San Luis Valley on private land near Mosca, about 12 mi (19 km) northwest of the SEZ. There is ongoing interest in developing additional solar energy facilities on private lands in the valley.

10.3.2.2 Impacts

10.3.2.2.1 Construction and Operations

This analysis assumes that 3,105 acres (13 km^2), or 80%, of the proposed Fourmile East SEZ could be developed for utility-scale solar energy production over a 20-year period. This area is small when compared with many proposed SEZs; however, it would establish an industrial area that would exclude most other existing and potential uses from the site. Because the character of the area is currently rural, utility-scale solar energy development would introduce a new and discordant land use. If solar development occurred, the existing and traditional uses of the public lands in the SEZ would be foregone, perhaps in perpetuity. Additional private lands near the SEZ also could be developed, with landowner approval, in the same or a complementary manner as the public lands in the SEZ.

Current ROW authorizations on the SEZ would not be affected by solar energy development since they are prior rights. Should the proposed SEZ be identified as an SEZ in the ROD for this PEIS, the BLM would still have discretion to authorize additional ROWs in the area until solar energy development was authorized, and then future ROWs would be subject to the rights granted for solar energy development. Because the area currently has so few ROWs, it is not anticipated that approval of solar energy development would have a significant impact on ROW availability in the area.

The SEZ has an odd shape and is somewhat isolated from other public lands by the presence of State Highway 150. Depending on how the SEZ is developed, it would be possible to create a more fragmented public land pattern that would be difficult to manage.

10.3.2.2.2 Transmission Facilities and Other Off-Site Impacts

A BLM locally designated transmission corridor fully covers the SEZ; this represents a potential conflict for future solar development. Although access to transmission facilities is important for solar energy facilities, placement of transmission facilities within the SEZ would reduce the amount of land available for solar power production. Likewise, if the SEZ was fully developed with solar production facilities, future expansion of transmission facilities would be located outside of the area on private lands.

To connect solar energy production facilities in the SEZ with the regional grid, approximately 2 mi (3.2 km) of new transmission line would be required. This new transmission line and its ROW would result in about 61 acres (0.25 km^2) of surface disturbance. Because of the relative scarcity of BLM-administered land in the area, it is likely that a new transmission line would be constructed on private land. No new roads would need to be constructed outside of the SEZ to support solar development, although existing county roads might need to be upgraded to support construction of solar facilities.

10.3.2.3 SEZ-Specific Design Features and Design Feature Effectiveness

No SEZ-specific design features are required to address impacts to lands and realty. Implementing the programmatic design features described in Appendix A, Section A.2.2, as required under BLM's Solar Energy Program would reduce the potential for impacts on authorizations within the SEZ under the Lands and Realty Program.

10.3.3 Specially Designated Areas and Lands with Wilderness Characteristics

10.3.3.1 Affected Environment

There are no specially designated areas within the proposed Fourmile East SEZ. However, the SEZ is located on the floor of the San Luis Valley, and numerous specially designated areas are located within the viewshed of the site. Many of these are elevated above the SEZ, and some are in close proximity to the SEZ (see Figure 10.3.3.2-1). These areas are discussed below. No lands with wilderness characteristics have been identified within 25 mi (40 km) of the SEZ.

The BLM-administered Zapata Falls SRMA is located northeast of the SEZ, and the SEZ is visible from portions of the area. The SRMA currently is a day-use area that provides picnic and restroom facilities and an interpretive area. The area also provides overnight parking facilities for visitors to the Sangre de Cristo WA. Activities and attractions include viewing Zapata Falls and surrounding scenery, hiking, mountain biking, and horseback riding. The BLM has plans for construction of a campground within the SRMA that would include 24 single camping units, 1 group camping unit, 1 host site, and 2 accessible double vault toilets. The campground will be located along the eastern edge of the RMA (BLM 2009b).

The BLM-administered Blanca Wetlands SRMA/ACEC, which is composed of two separate units, is located within 0.5 mi (0.8 km) of the SEZ. The SRMA/ACEC was designated to protect both wildlife and recreation resources. The area that is a designated Watchable Wildlife Area contains wetland habitats that are important for waterfowl, shorebirds, and other wildlife; a day use recreation area with restroom facilities and an interpretive loop trail; and, is seasonally open to fishing and waterfowl hunting.

The Sangre de Cristo Wilderness is located on the ridgeline east of the SEZ and continues northwest for about 70 mi (113 km).

Great Sand Dunes National Park and Preserve is located north and northeast of the SEZ. Much of the park is at a higher elevation than the SEZ.

Portions of State Highways 17, 150, and 159 and Alamosa County Road 6N have been designated by the state and the BLM as part of the Los Caminos Antiguos Scenic Byway. The scenic byway provides one of the major access routes to Great Sand Dunes National Park.

The route of the Old Spanish National Historic Trail passes about 1 mi (1.6 km) east of the SEZ, and nearly 50 mi (80.5 km) of the trail is within the viewshed of the SEZ, including a 25-mi (40-km) length of a high-potential segment of the trail. The high-potential portion of the trail that is considered to be most significant (see discussion in Section 10.3.17)

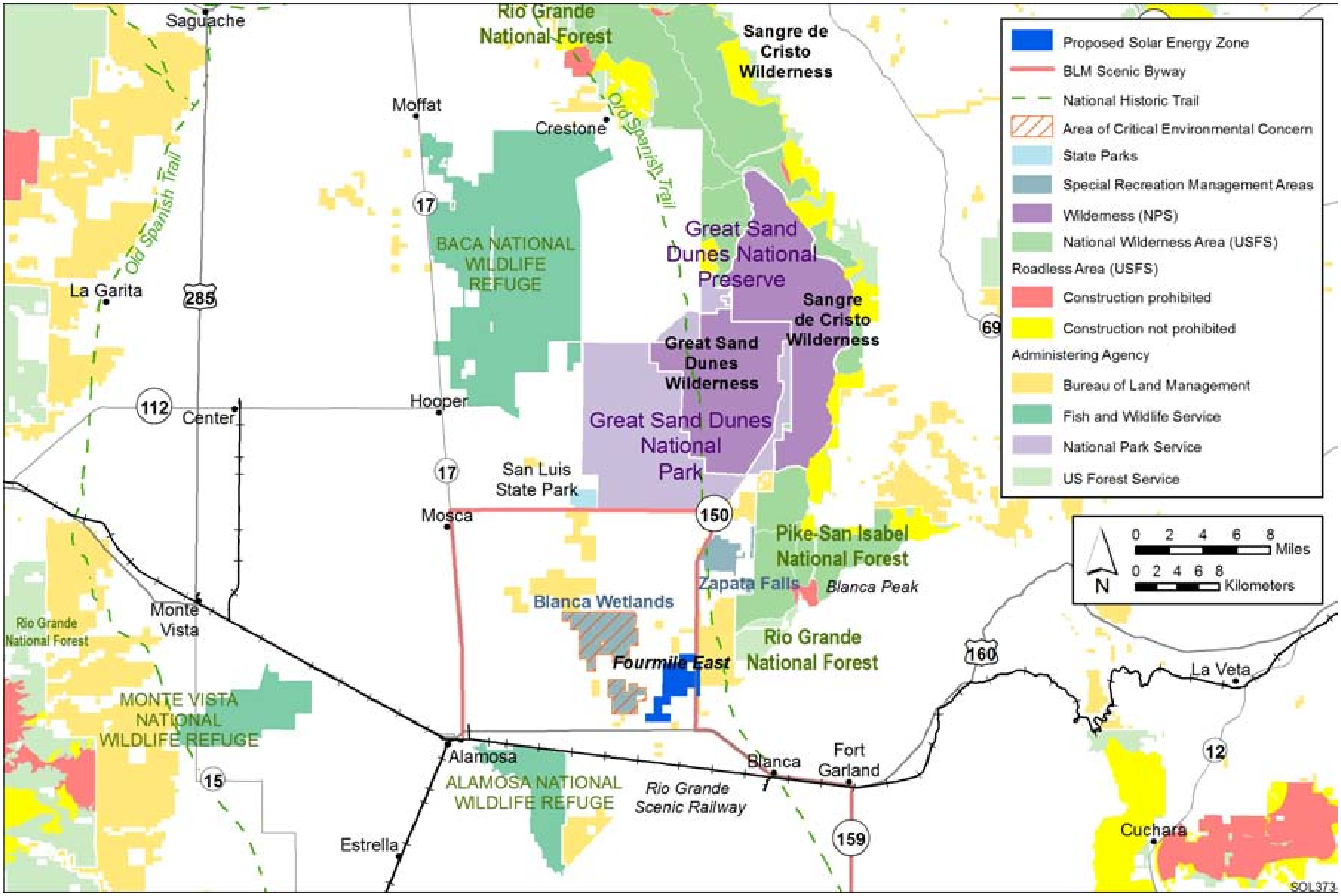

FIGURE 10.3.3.2-1 Specially Designated Areas in the Vicinity of the Proposed Fourmile East SEZ

begins about 1.5 mi (2.4 km) northeast of the corner of the SEZ (see discussion in Section 10.3.17).

San Luis Lakes State Park is located adjacent to and west of Great Sand Dunes National Park and is northwest of the SEZ.

Blanca Peak is a 14,000+-ft (4,267+-m) peak that dominates much of the San Luis Valley and is located northeast of the SEZ. The area possesses special significance to Native Americans.

The SEZ is located within the boundaries of the recently (2009) designated Sangre de Cristo NHA. The NHA includes three Colorado counties—Alamosa, Conejos, and Costilla.

10.3.3.2 Impacts

10.3.3.2.1 Construction and Operations

Potential impacts on specially designated areas from solar development within the SEZ are difficult to determine and would likely vary by solar technology employed, the specific area being impacted, and the experience of individuals. Development of the SEZ, especially full development, would be a dominating factor in the viewshed from large portions of some of these specially designated areas. Figure 10.3.3.2-1 shows the locations of the areas discussed below.

SRMAs/ACECs

- The Zapata Falls SRMA is about 5 mi (8 km) from the SEZ. On the basis of visual landscape analysis, recreational visitors traveling along portions of the access road and at the parking area in the SRMA would be able to see development in the SEZ. The SEZ would not be visible from the falls. Based on the distance to the SEZ, and the limited visibility of the SEZ, there would be minimal impact on recreational users of the SRMA due to development within the SEZ. Taller facilities within the SEZ, such as a power tower, would increase the overall visibility in the SRMA and could increase the level of impact on users.

- The Blanca Wetlands ACEC/SRMA is from 0.5 to 6 mi (0.8 to 9.7 km) from the SEZ and is at approximately the same elevation. The ACEC/SRMA is within the most visually sensitive 1- to 5-mi (0.6- to 8-km) visual zone, and development within the SEZ, especially full development, would likely have a significant impact on recreational visitors in the ACEC/SRMA. Most of this impact would be caused by the industrial nature of a solar development and its conflict with the purposes for which most visitors utilize the ACEC/SRMA. In addition, solar facilities may introduce factors such as noise, glare, aerial hazards, and added human presence that would disturb use of the area by wildlife (see Section 10.3.11 for more information on wildlife impacts). Because the function of these areas is dependent upon the presence of surface water, depending on the technology employed and the source and amount of water used, there may be potential for impact on the ACEC/SRMA (see Section 10.3.9 for more discussion of water resource issues).

Sangre de Cristo Wilderness

The USFS-administered wilderness covers the ridgeline on the east side of the San Luis Valley, and areas within the wilderness on the west side of the ridge have dominating, though relatively small views of the SEZ. Within the zone from 3 to 5 mi (5 to 8 km), about 1,378 acres (5.6 km^2) or about 0.8% of the designated wilderness would have a clear view of development in the SEZ. It is likely there would be adverse impacts on wilderness characteristics and on visitor experience in this area. In the 5- to15-mi (8- to 24-km) zone, about 2,330 additional acres would have a view of development in the SEZ bringing the total percentage of the WA potentially affected to about 2.2%. While the SEZ would be visible in this second zone, the level of visual impact on wilderness characteristics and visitor experience would be reduced but could still be significant. Views of the SEZ from farther away in the wilderness would have a much reduced impact because of the distance and additional visual distractions within the viewshed. Because of the small percentage of the wilderness that would be affected and other human structures that are also visible from the designated wilderness, the overall impact on the WA is anticipated to be small.

Great Sand Dunes National Park and Preserve

The park is a very large area (150,000 acres [604 km^2]) that stretches from about 9 to 23 mi (14 to 37 km) from the SEZ. The nearer portions of the park are at or only slightly above the elevation of the SEZ and therefore do not have a good view of the SEZ. The higher elevations within the park are about 15 mi (24 km) distant, and development within the SEZ, although visible, would be far enough away to have little effect. It is anticipated that the overall visual effect of development of the SEZ would likely be low and would have minimal impact on park visitors.

The NPS has indicated a concern for potential impact on night sky viewing in the park that could be caused by lighting installed for any solar facilities.

Los Caminos Antiguos Scenic Byway

Travelers along approximately 50 mi (80 km) of the scenic byway would have visibility of solar development within the SEZ. A portion of the byway passes through the SEZ and about 14 mi (23 km) of the highway is within the most visually sensitive zone from 0 to 5 mi (0 to 8 km). The potential impact of development of the SEZ on byway users is not known, but solar development would be a very dominant visual feature within the 0 to 5 mi (0 to 8 km) zone. From longer distances, the development in the SEZ would still be visible but, depending on the technology employed, would have less visual impact. Taller solar facilities would create more visual impacts.

A portion of the byway serves as a major access road to Great Sand Dunes National Park and Preserve, and visitors traveling to the park via this route may find the industrial look of a solar facility in stark contrast to the views anticipated within the park. Whether this would be an issue of concern for park visitors is not known.

Old Spanish National Historic Trail

The route of the Old Spanish National Historic Trail is within 1 to 2 mi (1.6 to 3.2 km) of the eastern border of the SEZ, and portions of the trail, including a high-potential segment, would have clear views of development within the SEZ. The high-potential segment would be adversely affected by solar energy development resulting from visual impacts to the historic setting of the trail. If additional portions of the trail south of the high-potential segment are also determined to be significant as a result of future survey, these portions would also be adversely affected, with possible reductions in level of impact the farther the significant portions of the trail are from the SEZ. Potential impacts on the trail from solar energy development will be both site and technology specific and will require further analysis prior to approval of solar facilities.

San Luis Lakes State Park

The State Park is about 10 mi (16 km) north of the SEZ and is at about the same elevation as the SEZ. Because of the distance to the SEZ and the low viewing angle of facilities in the SEZ, it is not likely that there would be any significant impact on recreation users at the State Park. Taller solar facilities would create more visual impacts. Night sky viewing from the park could be adversely affected by lighting installed at the SEZ.

Blanca Peak

There would be a commanding view of the SEZ from the peak. Since the distance would be about 7 mi (11.3 km), it is not within the most sensitive zone, but the SEZ would be a major component of the western viewshed from the peak. The impact on visitors to the peak would likely vary depending on the individual and the solar technology employed, but a clear determination of impact has not been made. There is potential for impact on Native American religious values associated with Blanca Peak (see Section 10.3.17 for discussion of these potential impacts).

Sangre de Cristo NHA

The SEZ is included within the NHA, and planning for the NHA is not yet complete; thus it is difficult to assess the impact that solar development in the SEZ might have. However, an NHA is described as a place where natural, cultural, historic, and scenic resources combine to form a cohesive, nationally important landscape arising from patterns of human activity shaped by geography (NPS 2008). This definition implies that visual impacts from solar energy development could be of concern.

10.3.3.2.2 Transmission Facilities and Other Off-Site Infrastructure

The nearest transmission line to the SEZ is about 2 mi (3.2 km) away, and construction of a transmission line to connect to that line would disturb about 61 acres (0.333 km^2). New transmission lines and associated construction and service roads would add to the visual impact associated with the SEZ facilities, including to the Old Spanish National Historic Trail. Because of the scarcity of BLM land in the vicinity, the transmission line would likely be built on private lands.

10.3.3.3 SEZ-Specific Design Features and Design Feature Effectiveness

Implementing the programmatic design features described in Appendix A, Section A.2.2, as required under BLM's Solar Energy Program would provide adequate mitigation for some identified impacts. However, without reducing the size of the SEZ there would be unmitigated impacts on a large portion of the Blanca Wetlands ACEC/SRMA; on the wilderness characteristics of the portion of the Sangre de Cristo WA within 5 mi (8 km) of the SEZ; on the Old Spanish National Historic Trail; and on visitors using the Los Caminos Antiguos Scenic Byway.

Proposed design features specific to the proposed Fourmile East SEZ include:

- Solar technologies in the SEZ should be restricted to those with the lowest profile to minimize the visual impact on nearby specially designated areas. Additionally, lighting within the SEZ should be carefully designed to minimize visual impacts on surrounding specially designated areas.

- Pending outcome of a study of the significance of potentially affected segments of the Old Spanish National Historic Trail, restrictions on solar facility development that might adversely impact trail resources should be put in place.

- Solar development on the east side of the scenic byway should not be approved, in order to reduce the negative visual effect on visitors from traveling on the road. This also would reduce the adverse impact on the scenic view from the highway looking to the east toward Blanca Peak and the WA. It could also reduce the potential impacts on the Old Spanish National Historic Trail.

- Consultation would be conducted to determine whether there would be adverse impacts on Native American religious values, and if so, what mitigation measures might be possible to reduce or eliminate such impacts.

- Early consultation should be initiated with the entity responsible for developing the management plan for the Sangre de Cristo NHA to understand how development of the SEZ could be consistent with NHA plans/goals.

Adoption of visual design features described in Appendix A, Section A.2.2, would reduce visual impacts on wilderness, historic, and scenic values and should be considered as part of any solar project analysis.

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10.3.4 Rangeland Resources

Rangeland resources include livestock grazing and wild horse and burros, both of which are managed by the BLM. Discussion of these resources and possible impacts of solar development within the proposed Fourmile East SEZ on these resources is presented in Sections 10.3.4.1 and 10.3.4.2.

10.3.4.1 Livestock Grazing

10.3.4.1.1 Affected Environment

The SEZ includes portions of two seasonal grazing allotments: Tobin Creek (#14117) and Foothills (#14107), which are run by separate permittees. These allotments are currently permitted to graze a total of 489 animal unit months (AUMs) per season. Table 10.3.4.1-1 summarizes key data for the allotments.

10.3.4.1.2 Impacts

Construction and Operations

Should utility-scale solar development occur in the SEZ, grazing would be excluded from the areas developed as provided for in the BLM grazing regulations (43 CFR Part 4100). This would include reimbursement of the permittee for their portion of the value for any range improvements in the area removed from the grazing allotment. The impact of this change in the grazing permits would depend on several factors, including (1) how much of an allotment the permittee might lose to development, (2) how important the specific land lost is to the permittee's overall operation, and (3) the amount of actual forage production that would be lost by the permittee.

TABLE 10.3.4.1-1 Grazing Allotments within the Proposed Fourmile East SEZ[a]

Allotment	Total Acres	% Total in SEZ[b]	Private Acres	Total Permitted AUMs	No. of Permittees
Tobin Creek	6,488	58	360	139	1
Foothills	5,340	5	640	350	1

[a] Total acres, including public and private land, are from the BLM Rangeland Administration System report (BLM 2009a).

[b] Represents the percentage of public land in the allotment within the SEZ.

If full solar development occurred in the SEZ, it is assumed that the federal grazing permit for the Tobin Creek allotment would be cancelled because all of the consolidated federal lands in that allotment would be developed. It is anticipated that all 139 AUMs currently authorized on the allotment would be lost. Because only a very small percentage of the Foothills allotment is included in the SEZ, there would be no impact on that allotment**,** although the permit would be modified to exclude the 240 acres (0.99 km^2) of the allotment in the SEZ.

The impact from modifying the Tobin Creek allotment on the permittee would depend on how much the loss would affect the permittee's overall operation. If the permittee depends solely on the Tobin Creek allotment, the loss of the use of grazing permit would be a major impact. If the allotment represents a small portion of the permittee's overall operation, the impact would be less. Section 10.3.19.2.1 provides more information on the economic impact of the loss of the 139 AUMs of grazing capacity in the allotment.

Although the impact on the Tobin Creek permittee would depend on the specific situation, there would be an adverse economic impact and possibly an adverse social impact, since for many permittees, having grazing allotments on public lands has been a longstanding tradition. It is possible that solar development proponents could purchase all or portions of the existing allotment both to facilitate solar operations and to reduce the adverse economic impact on the permittee from the loss of the grazing permit.

Transmission Facilities and Other Off-Site Infrastructure

A new transmission line and associated construction and service road would add about 61 acres (0.25 km^2) of surface disturbance to the impact associated with the SEZ facilities. This disturbance would not add a significant additional impact to grazing operations.

10.3.4.1.3 SEZ-Specific Design Features and Design Feature Effectiveness

No SEZ-specific design features would be required. Implementing the programmatic design features described in Appendix A, Section A.2.2, as required under BLM's Solar Energy Program, could minimize disruption of grazing operations; however, it may not be possible to fully mitigate the economic loss to the holders of grazing permits and the social impacts from loss of grazing rights.

10.3.4.2 Wild Horses and Burros

10.3.4.2.1 Affected Environment

Section 4.4.2 discusses wild horses (*Equus caballus*) and burros (*E. asinus*) that occur within the six-state study area. No wild or feral horses occur within the proposed Fourmile East SEZ or in proximity to it.

10.3.4.2.2 Impacts

Solar energy development of the proposed Fourmile East SEZ would not affect wild horses and burros.

10.3.4.2.3 SEZ-Specific Design Features and Design Feature Effectiveness

No SEZ-specific design features would be necessary to avoid or minimize impacts on wild horses and burros.

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10.3.5 Recreation

10.3.5.1 Affected Environment

The proposed Fourmile East SEZ is flat, and it has no unique recreation or other resource values that would attract recreation users from distant locations. Although there are no recreation data specific to the area, the area is likely used by local residents for general outdoor recreation, including horseback riding, OHV and backcountry driving, and small game hunting. Good access to the area is available via State Highway 150 and County Roads 4S, 4.4S, and 6S that go through the area. The area has been designated in the San Luis Valley Travel Management Plan as Limited, Designated Roads and Trails. There are several road/trail segments within the SEZ identified as Open Motorized Road that are available for OHV or vehicular travel. There are also several low-quality dirt roads that wind through portions of the area but that are not designated for motorized use. Recreational use of the SEZ area is likely minimal.

CO 150, which passes directly through the SEZ, is a portion of the Los Caminos de Antiguos Scenic Byway, a state- and BLM-designated scenic byway. This highway is also a major access route to Great Sand Dunes National Park, located about 10 mi (16 km) north of the SEZ. Part of the scenic attraction of the highway is the view of Blanca Peak, located northeast of the SEZ, and the Sangre de Cristo Mountains and USFS-administered wilderness lands about 3 mi (5 km) northeast of the SEZ.

The Rio Grande Scenic Railroad runs scenic train tours between Alamosa and La Veta seven days a week between Memorial Day and October 31. Saturday-only trips are available from January 2 through the spring. During the main summer season, visitors have the option of leaving the train at Blanca to travel to Great Sand Dunes National Park for a brief visit (RGSR 2009). The train route passes about 2.5 mi (4 km) south of the SEZ, and most of the SEZ is within 5 mi (8 km) of the railroad. The side trip to Great Sand Dunes National Park travels along the Los Caminos de Antiguos Scenic Byway, which passes through the SEZ on the way to the park.

10.3.5.2 Impacts

10.3.5.2.1 Construction and Operations

Recreational users would be excluded from any portions of the proposed Fourmile East SEZ developed for solar energy production, and recreation opportunities within the area would be lost. Because of the low level of recreation use on the site, impacts from the loss of the area would be minimal. Users displaced from the SEZ would have similar opportunities on nearby public lands.

Should the SEZ be developed, the resulting industrial area would straddle about 2.5 mi (4 km) of the scenic byway that provides access for many recreation visitors to other important recreation attractions in the area, especially the Great Sand Dunes National Park and Preserve. Development of the portion of the SEZ on the east side of the highway also would interfere with views of Blanca Peak and the Sangre de Cristo Mountains. Development of the SEZ would be a dominating factor in the viewshed of the scenic byway for about 14 mi (23 km) of its length and for about 5 mi (8 km) of the scenic railroad route. The potential impact on recreation visitors to the area is difficult to determine and would likely vary by individual and solar technology employed. Some people could find the solar development very distracting from the primary purpose of their trip while others might find it an interesting addition.

Solar development within the SEZ would affect public access along OHV routes designated open and available for public use. If such routes were identified during project-specific analyses, they would be re-designated as closed (see Section 5.5.1 for more details on how routes coinciding with proposed solar facilities would be treated).

10.3.5.2.2 Transmission Facilities and Other Off-Site Infrastructure

The nearest transmission line to the SEZ is about 2 mi (3.2 km) away, and construction of a transmission line to connect to that line would disturb about 61 acres (0.25 km^2). New transmission lines and associated construction and service roads would add to the visual impact associated with the SEZ facilities. This, however, would contribute only a minor amount to the direct impact on recreation resources relative to that caused by development within the SEZ.

10.3.5.3 SEZ-Specific Design Features and Design Feature Effectiveness

Implementing the programmatic design features described in Appendix A, Section A.2.2, as required under BLM's Solar Energy Program, would minimize impacts on recreational use. However, because of the density of specially designated areas, scenic resources, and visually sensitive recreation resources, it is likely there would be unmitigated impacts associated with development of the SEZ.

Proposed design features specific to the proposed Fourmile East SEZ include:

- The portion of the SEZ on the east side of the scenic byway should be eliminated to reduce the negative visual effect on visitors traveling on the scenic byway and to reduce the visual impacts looking to the east toward Blanca Peak and the Sangre de Cristo Mountains.

- Solar technologies in the SEZ should be restricted to those with the lowest profile to minimize the visual impact and the effect on recreation visitors.

10.3.6 Military and Civilian Aviation

10.3.6.1 Affected Environment

The proposed Fourmile East SEZ is located under an MTR and is identified as being in a consultation area for the DoD. The San Luis Valley Regional Airport is located near Alamosa, about 12 mi (19 km) west-southwest of the SEZ.

10.3.6.2 Impacts

Development of any solar or transmission facilities that impinge into airspace used by the military would be of concern to the military and could interfere with military training activities. Preliminary input from the DoD, however, has indicated that it has no concerns about potential impacts on its activities from development

There would be no impacts on regional airport operations from solar energy development, but FAA regulations might require special marking of certain types of solar facilities.

10.3.6.3 SEZ-Specific Design Features and Design Feature Effectiveness

No SEZ-specific design features are required. The programmatic design features described in Appendix A, Section A.2.2, would require early coordination with the DoD to identify and mitigate, if possible, potential impacts on the use of MTRs.

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10.3.7 Geologic Setting and Soil Resources

10.3.7.1 Affected Environment

10.3.7.1.1 Geologic Setting

Regional Geology

The proposed Fourmile East SEZ is located in the northern part of the San Luis Valley, an alluvium-filled basin within the Southern Rocky Mountain physiographic province in south-central Colorado (Figure 10.3.7.1-1). The San Luis Valley is part of the San Luis Basin, an axial basin of the Rio Grande rift (see Section 4.7). The Rio Grande rift is a north-trending tectonic feature that extends from south-central Colorado to northern Mexico. Basins in the rift zone generally follow the course of the Rio Grande (river) and are bounded by normal faults that define the rift zone margins (Burroughs 1974, 1981; Emery 1979).

The San Luis Basin is an east-tilting half graben, flanked by the San Juan Mountains to the west and the Sangre de Cristo Range to the east. It is generally divided into five physiographic subdivisions—the Alamosa Basin, the San Luis Hills, the Taos Plateau, the Costilla Plains, and the Culebra Reentrant (Burroughs 1981; Figure 10.3.7.1-2). The proposed Fourmile East SEZ is located along the eastern edge of the Alamosa Basin near the base of the Sangre de Cristo Range. The Alamosa Basin is divided by a north-trending uplifted fault block (the Alamosa horst) that separates two down-dropped fault blocks (grabens): the Monte Vista graben to the west and the Baca graben to the east (Figure 10.3.7.1-3) (Leonard and Watts 1989).

The proposed Fourmile East SEZ sits above the Baca graben, the deepest part of the Alamosa Basin, where basin fill sediments are estimated to be up to 19,000 ft (5,800 m) deep (Figure 10.3.7.1-3) (Leonard and Watts 1989). The uppermost stratigraphic unit is the Alamosa Formation (Pliocene to Holocene), a fluviolacustrine formation consisting of a series of discontinuous blue clays interbedded with water-bearing sands that make up the unconfined and confined aquifers in the region. The Alamosa Formation is up to 2,050 ft (610 m) thick above the Baca graben. It thins to the west and is cut by channel-fill sands of various drainages in the valley. Underlying the Alamosa Formation are the interbedded buff to pink clays and silty sands of the Santa Fe Group (Miocene to Pliocene). These sediments are intertongued with the alluvial sediments of the Los Pinos Formation to the west and crop out near the eastern edge of the basin along the Northern Sangre de Cristo fault zone. The Los Pinos Formation (Oligocene to Pliocene) consists of eastward-thickening sandy gravels interbedded with volcanic rocks (tuffs and tuffaceous siltstones and conglomerates). Below the Santa Fe Formation are Tertiary and Cretaceous sedimentary rocks that predate the Vallejo Formation. These rocks overlie a basement complex of Precambrian igneous and metamorphic rocks (Brister and Gries 1994; Burroughs 1974, 1981; Leonard and Watts 1989; Molenar 1988).

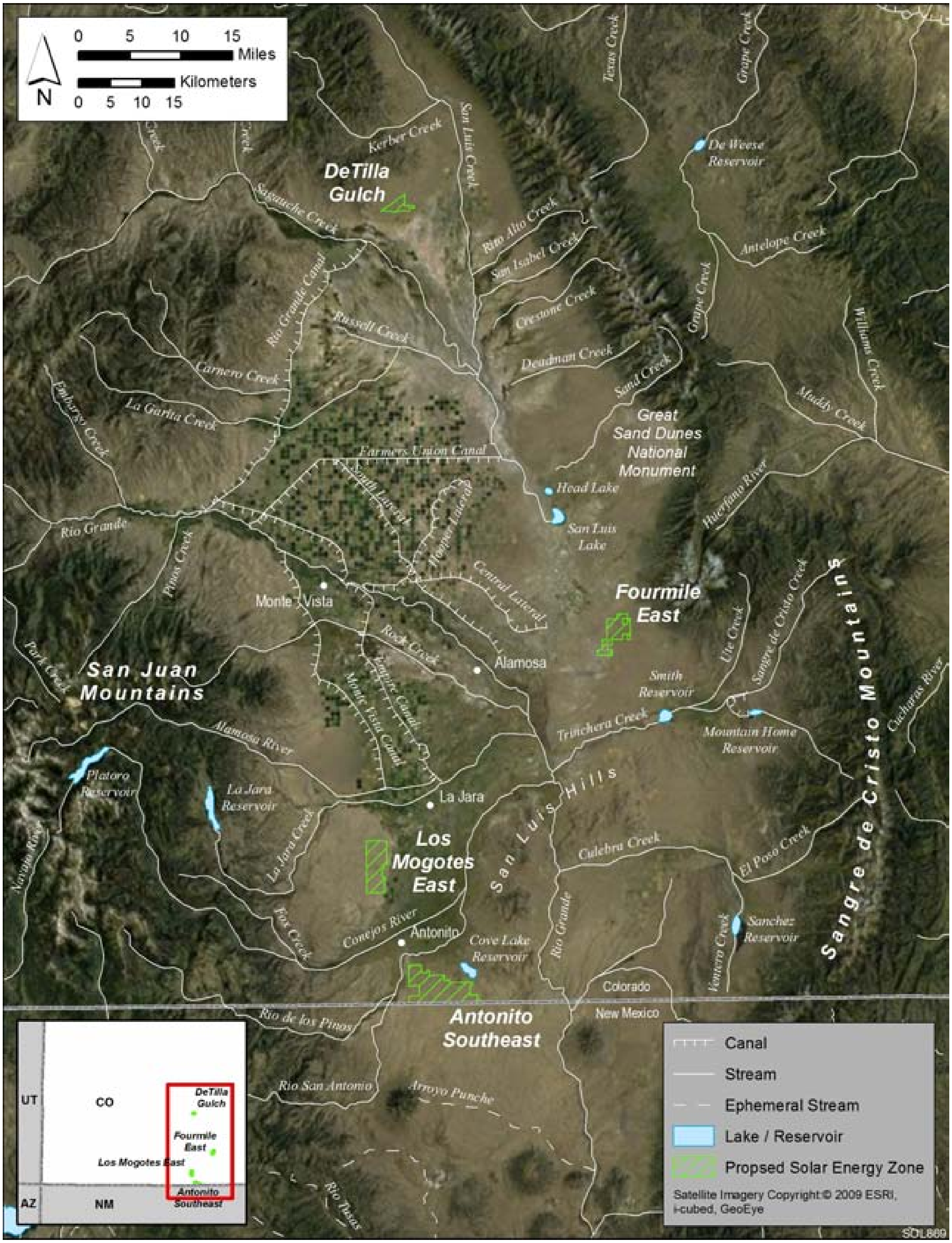

FIGURE 10.3.7.1-1 Physiographic Features of the San Luis Valley

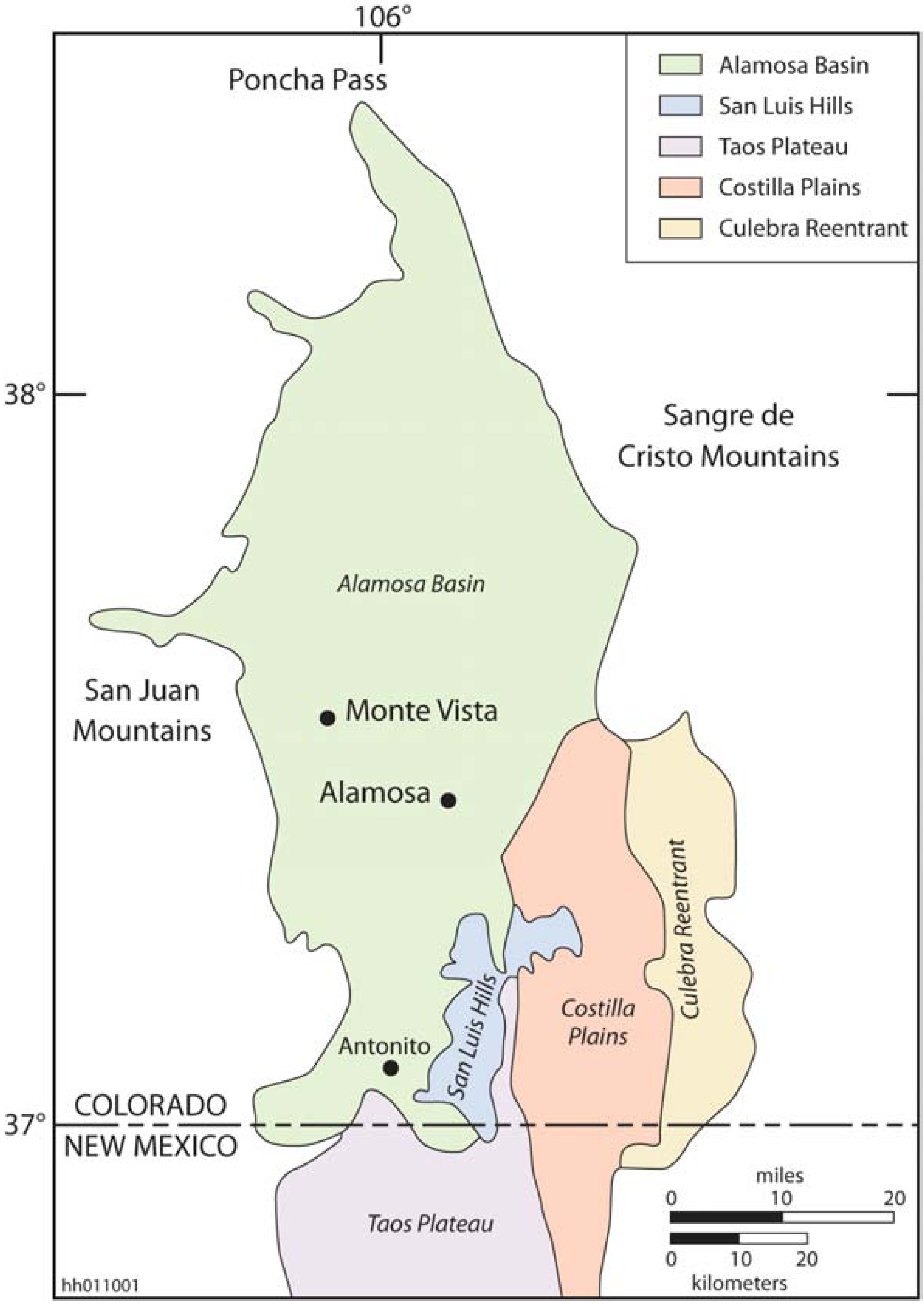

FIGURE 10.3.7.1-2 Physiographic Subdivisions within the San Luis Basin (modified from Burroughs 1981)

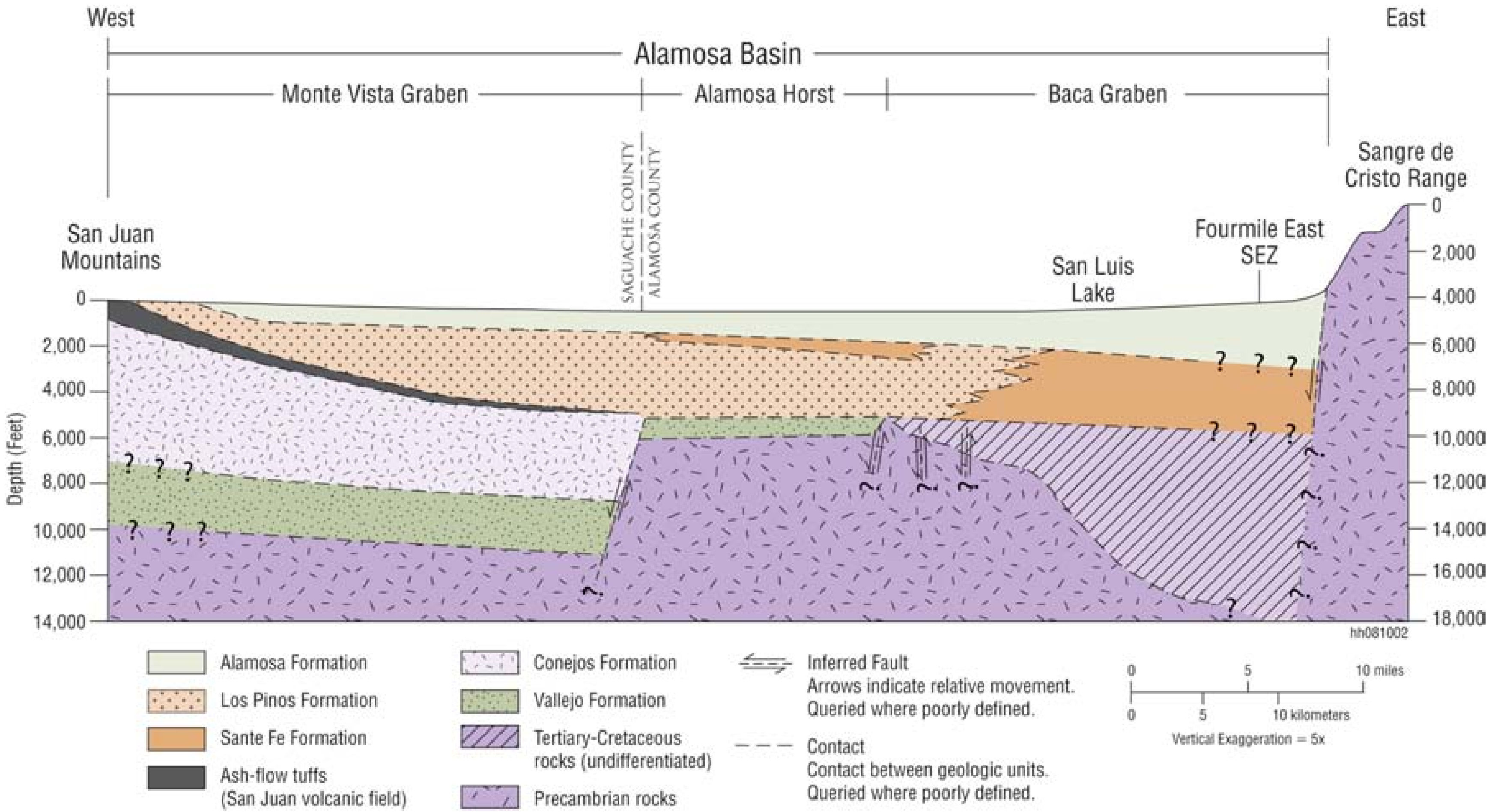

FIGURE 10.3.7.1-3 Generalized Geologic Cross Section (west to east) across the Northern Part of the Alamosa Basin (modified from Leonard and Watts 1989)

Exposed sediments in the San Luis Valley consist mainly of modern alluvial deposits and the fluviolacustrine clays and sands of the Alamosa Formation (Figure 10.3.7.1-4). Eolian deposits, such as those of the Great Sand Dunes National Monument, occur along the base of the Sangre de Cristo Mountains on the eastern side of the valley. The Rio Grande alluvial fan (at the base of the San Juan Mountains where the Rio Grande enters the valley) lies northwest of the town of Alamosa. The San Luis Hills, consisting of northeast-trending flat-topped mesas and irregular hills are a prominent feature of the southern part of the valley.

Topography

The San Luis Valley is an elongated basin with a north–south trend and an area of about 2.0 million acres (8,288 km^2). Slopes of more than 50 ft/mi (24.5 m/km) occur on the alluvial fan deposits along the valley sides; the valley floor has more gentle slopes of about 6 ft/mi (2.9 m/km). Maximum relief from the mountain peak to the valley floor is about 6,800 ft (2,073 m); relief from the heads of alluvial fans to the valley floor is about 500 ft (152 m). The valley floor is broad and flat; topographic features include the dune fields of the Great Sand Dunes and the basalt hills and mesas of the San Luis Hills. Playa lakes are present in the north part of the valley (Emery 1979; Leonard and Watts 1989).

The proposed Fourmile East SEZ is located in a topographic depression, known as the closed basin, about 10 mi (17 km) southeast of San Luis Lake in Alamosa County (Figure 10.3.7.1-1). Its terrain is relatively flat with a very gentle dip to the west and northwest (Figure 10.3.7.1-5). Elevations range from about 7,680 ft (2,341 m) near the northeastern corner of the site to less than 7,600 ft (2,316 m) along its western boundary.

Geologic Hazards

The types of geologic hazards that could potentially affect solar project sites and the potentially applicable mitigation measures to address them are discussed in Sections 5.7.3 and 5.7.4. The following sections provide a preliminary assessment of these hazards at the proposed Fourmile East SEZ. Solar project developers may need to conduct a geotechnical investigation to assess geologic hazards locally to better identify facility design criteria and site-specific design features to minimize their risk.

Seismicity. Seismic activity associated with earthquakes in Colorado is low to moderate, with a slightly higher risk in and around the Rio Grande rift zone (Kirkham and Rogers 1981). The rift zone is an extensional stress regime and consists of a series of grabens (fault-bounded basins) that extend along the northeast-oriented rift axis. It is currently dormant; however, earthquakes could potentially occur as a result of movement along existing normal faults within and along the boundaries of the San Luis Basin (Blume and Sheehan 2002).

No known Quaternary faults occur within the proposed Fourmile East SEZ. The closest Quaternary fault is the Northern Sangre de Cristo fault system that lies about 3 mi (4.8 km)

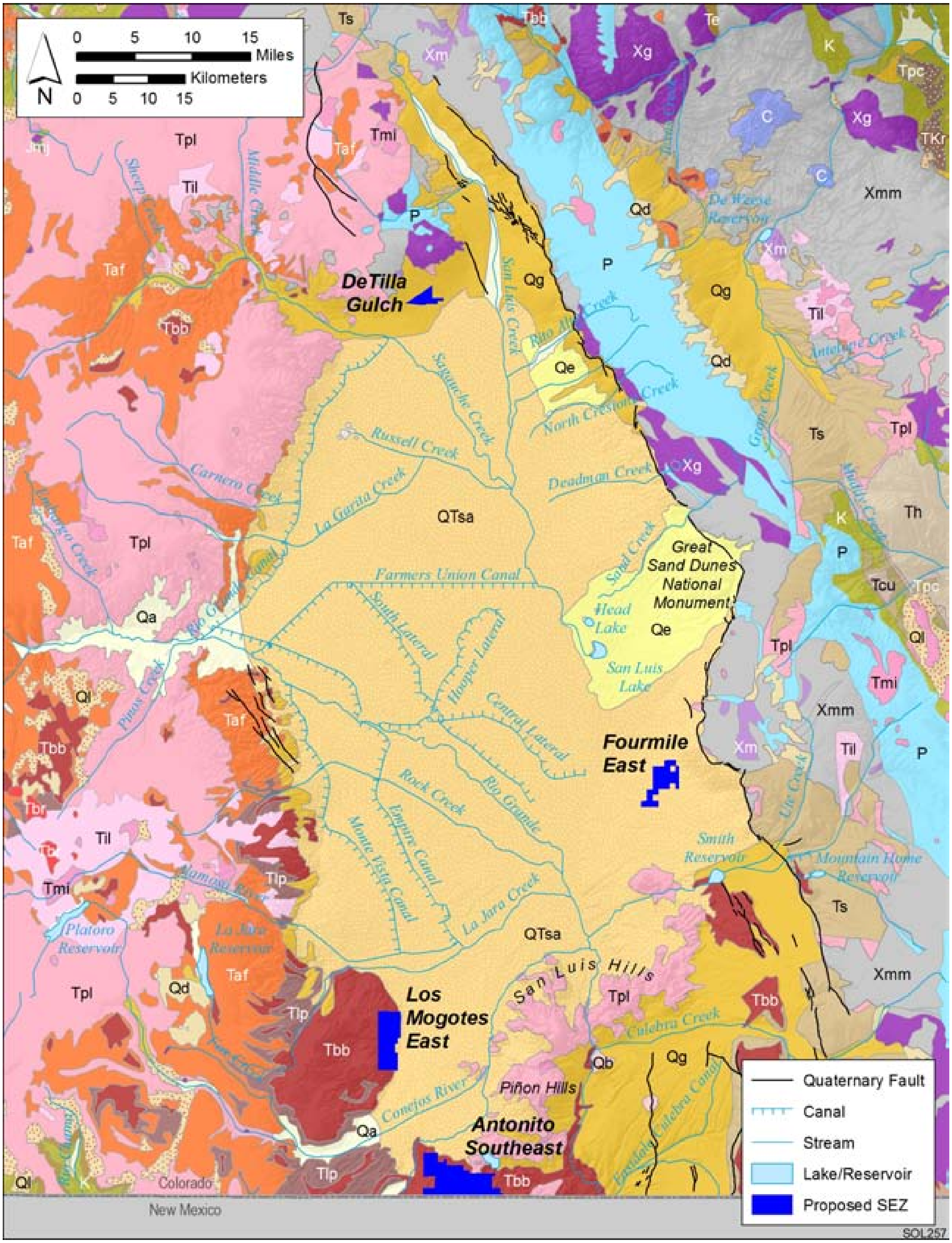

FIGURE 10.3.7.1-4 Geologic Map of the San Luis Valley and Vicinity (Stoeser et al. 2007 and Tweto 1979)

Cenozoic (Quaternary, Tertiary)

Qa	Modern alluvium (Piney Creek and younger)
Qg	Gravels and alluviums (Pinedale, Bull Lake and Pre-Bull Lake age)
Qe	Eolian deposits; includes sand dune and silt and Peoria Loess
Qd	Glacial drift (Pinedale, Bull Lake and Pre-Bull Lake glaciations)
Ql	Landslide deposits
Qb	Basalt flows (< 1.8 M.Y.)
QTsa	Alamosa Formation (gravel, sand and silt) and unclassified surficial deposits
Th	Huerfano Formation (shale, sandstone and conglomerate)
Tcu	Cuchara Formation (sandstone and shale)
Tpc	Poison Canyon Formation (arkosic conglomerate, sandstone and shale)
Ts	Santa Fe Formation (siltstone, sandstone and conglomerate)
Te	Prevolcanic sedimentary rocks (Eocene)
Tlp	Los Pinos Formation (volcaniclastic conglomerate interbedded with Hinsdale Formation)
Tbb	Basalt flows and associated tuffs, breccias, conglomerates and intrusives (3.5 - 2.6 M.Y.); includes basalts of Hinsdale Formation and Servilleta Formation
Tbr	Ash flow tuff and rhyolites (22 - 23 M.Y.)
Taf	Ash flow tuff (26 - 30 M.Y.)
Til	Andesitic and quartz latitic lavas (intra-ash flow)
Tpl	Andesitic lavas, breccias, tuffs and conglomerates (pre-ash flow)
Tmi	Middle Tertiary intrusive rocks (20 - 40 M.Y.); intermediate to felsic composition
TKr	Raton Formation (arkosic sandstone, siltstone, and shale)

Mesozoic (Cretaceous, Jurassic, Triassic)

K	Sedimentary rocks of Cretaceous age; KJdr; Kpcl; Kmv
Jmj	Morrison Formation and Junction Creek Sandstone

Paleozoic

P	Sedimentary rocks of Ordovician to Permian age
C	Diabase

Precambrian

Xmm	Metamorphic rocks (1,700 - 1,800 M.Y.); biotite gneiss, schist, migmatite, and quartzite
Xg	Granitic rocks (1,400 - 1,730 M.Y.); Yg
Xm	Mafic rocks (1,700 M.Y.)

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FIGURE 10.3.7.1-4 (Cont.)

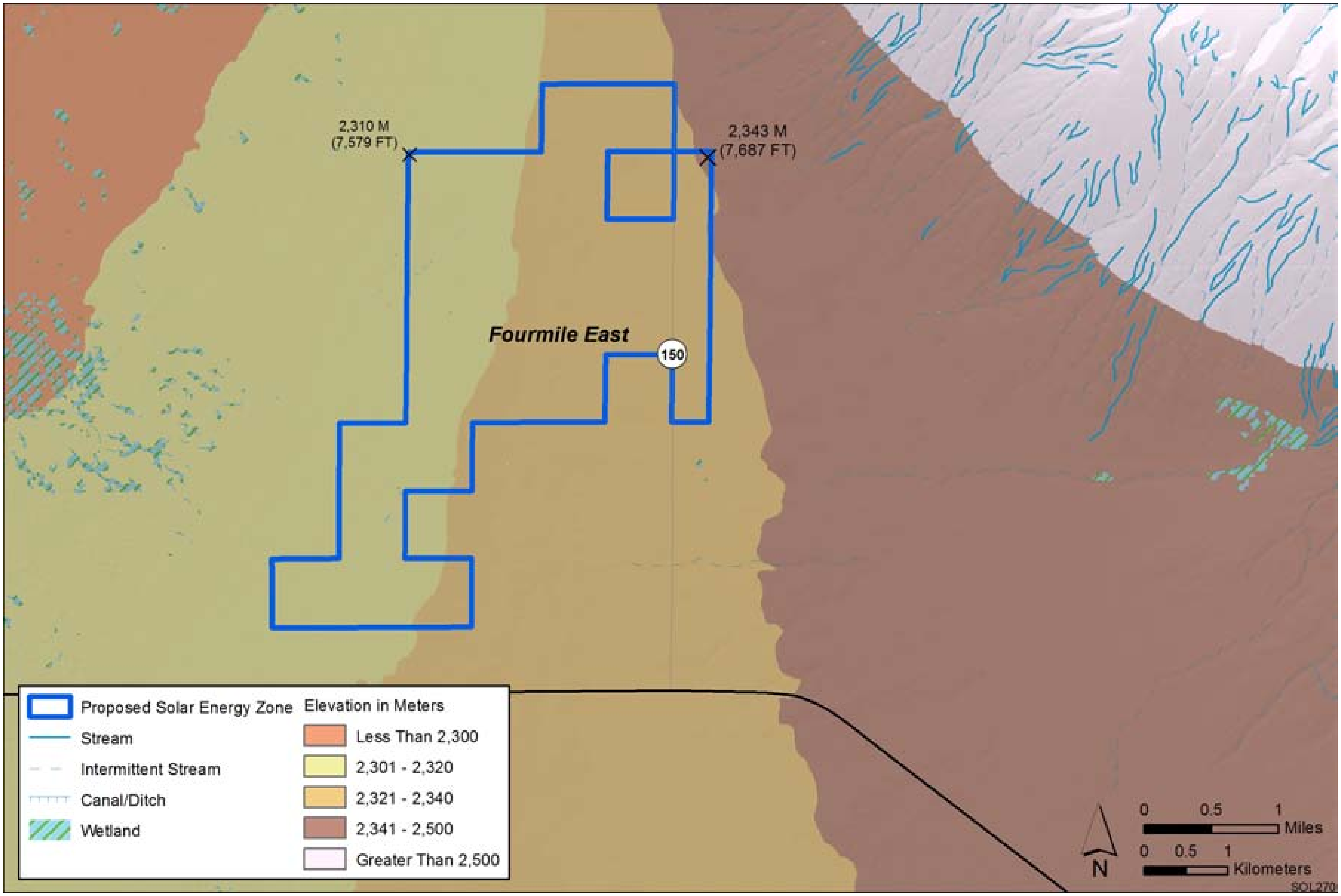

FIGURE 10.3.7.1-5 General Terrain of the Proposed Fourmile East SEZ

northeast of the SEZ (Figure 10.3.7.1-6). The Sangre de Cristo fault is a west-dipping, normal fault that forms the structural boundary between the San Luis Basin to the west and the Sangre de Cristo and Culebra Ranges to the east. The deepest part of the San Luis Basin occurs near the Northern Sangre de Cristo fault zone. Offsets of Holocene alluvial fan deposits place the most recent movement along the fault at less than 15,000 years ago; vertical displacements along the fault zone suggest past earthquakes of magnitude 6.8 to 7.1 (Ruleman and Machette 2007; Kirkham 1998).

From June 1, 2000, to May 31, 2010, 95 earthquakes were recorded within a 61-mi (100-km) radius of the proposed Fourmile East SEZ. The largest earthquake during that period occurred on August 10, 2005 (it is also the largest recorded earthquake since 1987). It was located about 60 mi (95 km) southeast of the SEZ in the Canadian River Valley (New Mexico) and registered a moment magnitude (Mw)[1] of 5.0 (Figure 10.2.7.1-6). During this period, 59 (62%) of the recorded earthquakes within a 61-mi (100-km) radius of the SEZ had magnitudes greater than 3.0 (USGS 2010a).

Liquefaction. The proposed Fourmile East SEZ lies within an area where the peak horizontal acceleration with a 10% probability of exceedance in 50 years is between 0.05 and 0.06 g. Shaking associated with this level of acceleration is generally perceived as moderate; however, the potential for damage to structures is very light (USGS 2008). Given the low intensity of ground shaking and the low incidence of historic seismicity in the San Luis Valley, the potential for liquefaction in valley sediments is also likely to be low.

Volcanic Hazards. The San Juan Mountains west of the San Luis Valley comprise the largest erosional remnant of a nearly continuous volcanic field that stretched across the Southern Rockies during the Tertiary period (Lipman et al. 1970). Extensive volcanic activity occurred in this volcanic field from about 35 to 30 million years ago, during which time lavas and breccias of intermediate composition were erupted from numerous scattered central volcanoes. About 30 million years ago, volcanic activity associated with large calderas throughout the central and western part of the San Juan Mountains changed to explosive ash-flow eruptions that deposited several miles (kilometers) of lava and ash throughout the area. Once extension began in the Rio Grande rift, about 27 million years ago, volcanic activity was predominantly basaltic. Flood basalts erupted intermittently from fissures in the rift valley from 26 to 14 million years ago. Examples include the Miocene basalts of the Hinsdale Formation, which occur along the western edge of the San Luis Valley and in the San Luis Hills, and the younger basalt flows (e.g., the Servilleta Basalt) of the Taos Plateau in the southern part of the valley (Brister and Gries 1994; Lipman 2006; Lipman and Mehnert 1979; Lipman et al. 1970; Thompson et al. 1991).

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[1] Moment magnitude (Mw) is used for earthquakes with magnitudes greater than 3.5 and is based on the moment of the earthquake, equal to the rigidity of the earth times the average amount of slip on the fault times the amount of fault area that slipped (USGS 2010b).

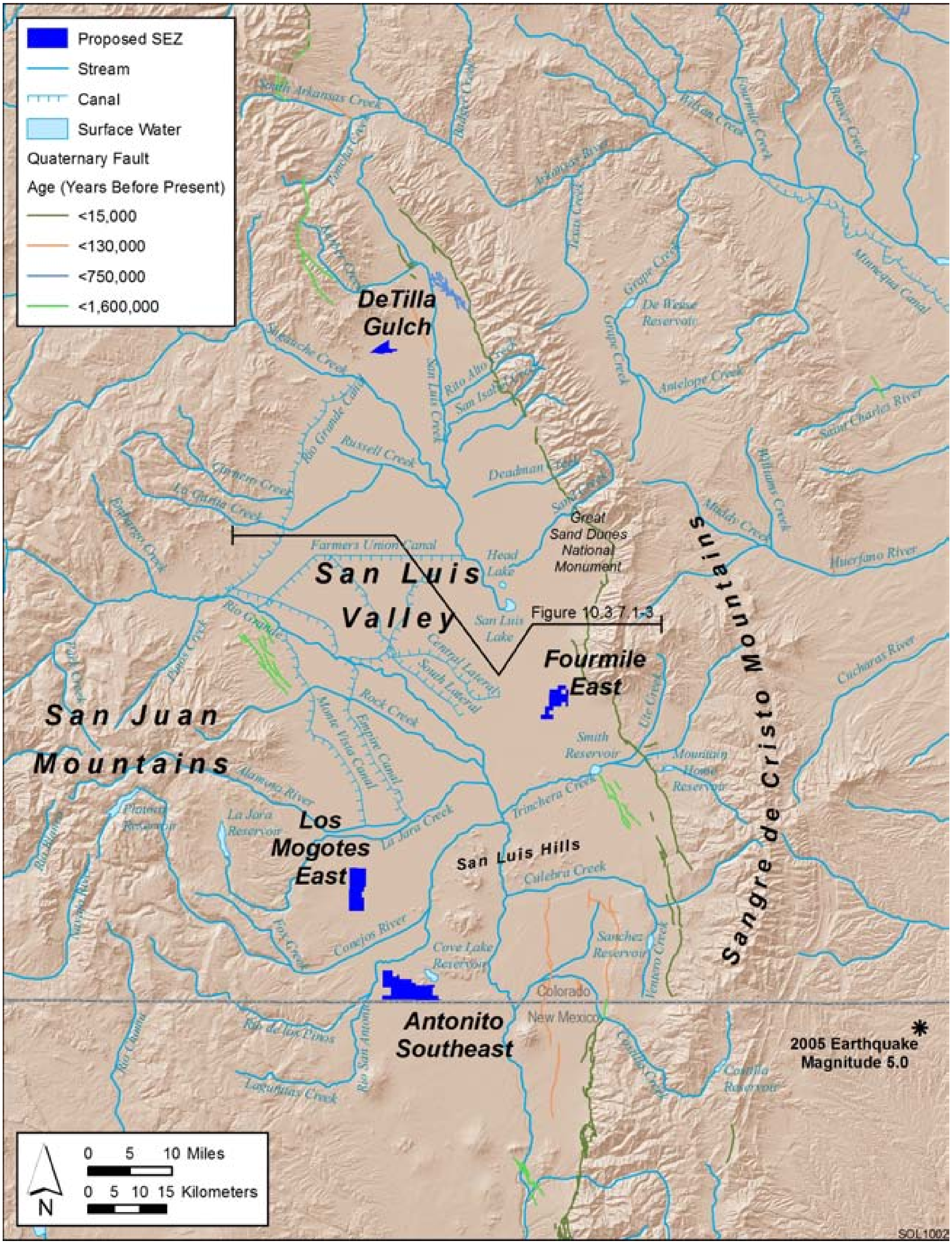

FIGURE 10.3.7.1-6 Quaternary Faults in the San Luis Valley (USGS and CGS 2009; USGS 2010a)

Although there are numerous volcanic vents and historic flows in the San Luis Valley region and volcanic activity has occurred as recently as 2 million years ago on the Taos Plateau, there is currently no evidence of volcanic eruptions or unrest in south-central Colorado.

Slope Stability and Land Subsidence. The incidence of rock falls and slope failures can be moderate to high along mountain fronts and can present a hazard to facilities on the relatively flat terrain of valley floors, such as the San Luis Valley, if they are located at the base of steep slopes. The risk of rock falls and slope failures decreases toward the flat valley center.

There has been no land subsidence monitoring within San Luis Valley to date; however, the potential for subsidence (due to compaction) does exist because groundwater levels are in decline. There is no subsidence hazard related to underground mining because there are no inactive coal mines in Conejos County. Although subsidence features (e.g., sinkholes and fissures) due to the flowage or dissolution of evaporite bedrock have been documented in Colorado, they are not known to occur in south-central Colorado (CGS 2001).

Other Hazards. Other potential hazards at the proposed Fourmile East SEZ include those associated with soil compaction (restricted infiltration and increased runoff), expanding clay soils (destabilization of structures), and hydro-compactable or collapsible soil (settlement). Disturbance of soil crusts and desert pavement on soil surfaces (if present) may increase the likelihood of soil erosion by wind.

Alluvial fan surfaces, such as those that occur along the valley margins, can be the sites of damaging high-velocity "flash" floods and debris flows during periods of intense and prolonged rainfall. The nature of the flooding and sedimentation processes (e.g., stream flow versus debris flow fans) will depend on specific morphology of the fan (National Research Council 1996). Section 10.3.9.1.1 provides further discussion of flood risks within the Fourmile East SEZ.

10.3.7.1.2 Soil Resources

Soils within the proposed Fourmile East SEZ are predominantly loamy fine sands and loamy sands of the Space City, Hooper, and Mosca Series, which together make up about 73% of the soil coverage at the site (Figure 10.3.7.1-7). Soil map units within the Fourmile East SEZ are described in Table 10.3.7.1-1. Parent material consists of alluvium and eolian sands derived from igneous rock. Soils are characterized as deep and well to somewhat excessively well drained. Most soils on the site have moderate to high surface runoff potential and slow to rapid permeability. Except for dune land soils that cover less than 1% of the site, the natural soil

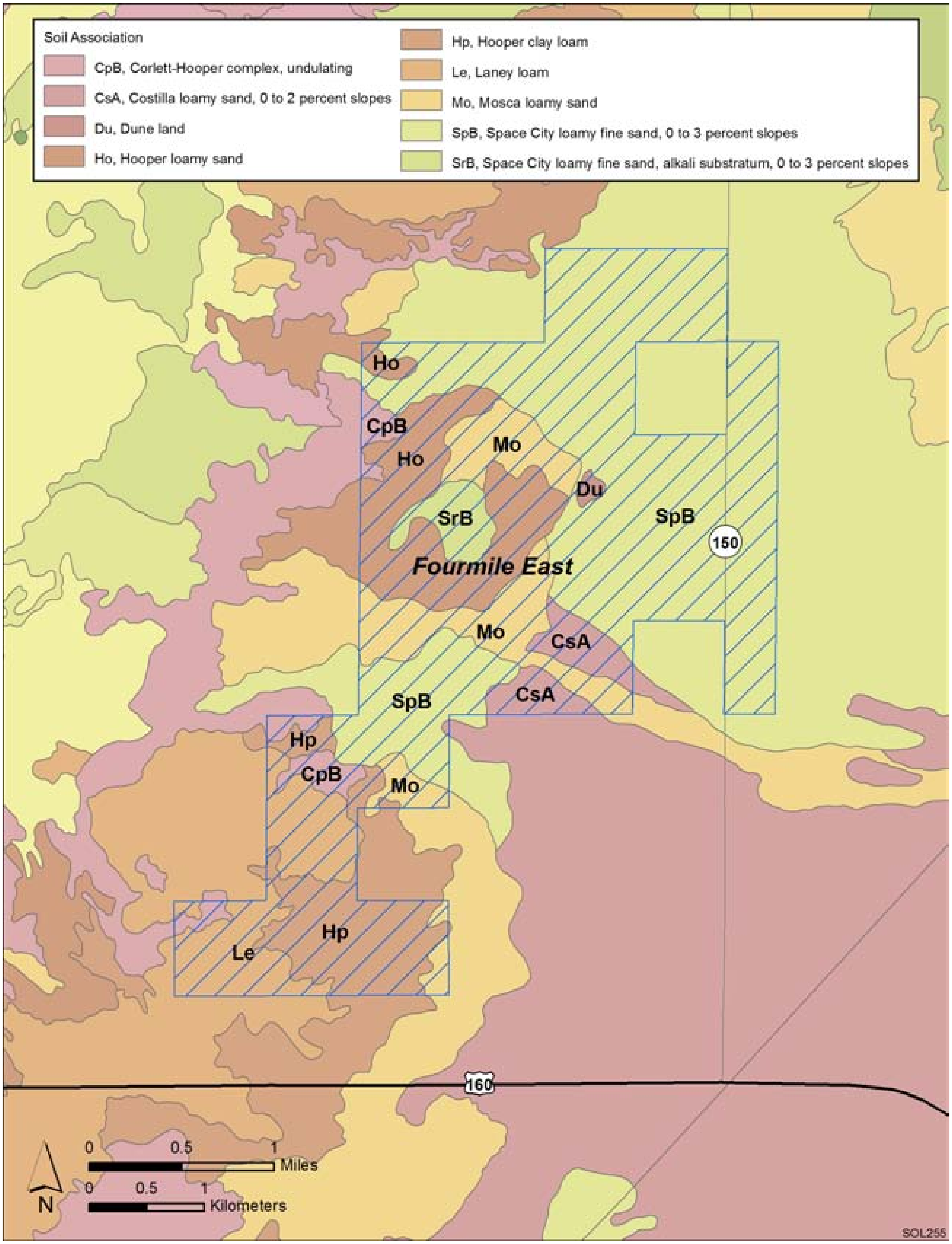

FIGURE 10.3.7.1-7 Soil Map for the Proposed Fourmile East SEZ (NRCS 2008)

TABLE 10.3.7.1-1 Summary of Soil Map Units within the Proposed Fourmile East SEZ

Map Unit Symbol	Map Unit Name	Water Erosion Potential[a]	Wind Erosion Potential	Description	Area, in Acres[b] (% of SEZ)
SpB	Space City loamy fine sand (0 to 3% slope)	Slight	High (WEG 2)[c]	Level to nearly level soils along isolated low ridges on the valley floor. Parent material consists of eolian sands derived from igneous rock. Somewhat excessively drained with high surface runoff potential (low infiltration rate) and rapid permeability. Shrink-swell potential is low. Available water capacity is low. Moderate rutting hazard. Used mainly as rangeland.	1,886 (49)
Mo	Mosca loamy sand	Slight	High (WEG 2)	Nearly level soils on floodplains. Parent material consists of alluvium derived from igneous rock. Deep and well drained with moderate surface runoff potential and moderate permeability; moderately to strongly alkaline. Shrink-swell potential is low. Available water capacity is low. Moderate rutting hazard. Used locally for irrigated crops and pastureland. Farmland of unique importance.[d]	466 (12)
Ho	Hooper loamy sand	Slight	High (WEG 2)	Level to nearly level soils on floodplains. Parent material consists of alluvium derived from igneous rock. Deep and well drained with high surface runoff potential (low infiltration rate) and slow permeability; strongly alkaline. Shrink-swell potential is low to moderate. Available water capacity is low. Moderate rutting hazard. Used mainly as rangeland.	463 (12)
Hp	Hooper clay loam	Slight	High (WEG 1)	Level to nearly level soils on floodplains. Parent material consists of alluvium derived from igneous rock. Deep and well drained with high surface runoff potential (low infiltration rate) and slow permeability; strongly alkaline. Most areas are without vegetation; provides some cover for wildlife. Shrink-swell potential is moderate to high. Available water capacity is very low. Severe rutting hazard. Used mainly as rangeland.	354 (9)

1

TABLE 10.3.7.1-1 (Cont.)

Map Unit Symbol	Map Unit Name	Water Erosion Potential[a]	Wind Erosion Potential	Description	Area, in Acres[b] (% of SEZ)
Le	Laney loam	Slight	Moderate (WEG 4) [c]	Nearly level soils on floodplains. Parent material consists of alluvium derived from igneous rock. Deep and well drained, with moderate surface runoff potential and moderate permeability. Shrink-swell potential is low to moderate. Available water capacity is moderate. Severe rutting hazard. Used mainly as rangeland.	341 (9)
CsA	Costilla loamy sand (0 to 2%)	Slight	High (WEG 1)	Level to nearly level soils on floodplains. Parent material consists of wind-worked alluvium. Deep and somewhat excessively drained with low runoff potential (high infiltration rate) and rapid permeability. Shrink-swell potential is low. Available water capacity is low. Moderate rutting hazard. Used locally for irrigated cropland.	150 (4)
CpB	Corlett-Hooper complex, undulating	Slight	High (WEG 1)	Composed of 45% Corlett sand and loamy sand, 40% Hooper loamy sand and sandy loam, and 15% minor components. Parent material consists of eolian deposits; soils occur on and between sand dunes. Undulating, deep and moderately well drained with low surface runoff potential (high infiltration rate) and rapid permeability. Shrink-swell potential is low. Available water capacity is very low. Severe rutting hazard.	115 (3)
SrB	Space City loamy fine sand, alkali substratum (0 to 3% slope)	Slight	High (WEG 2)	Level to nearly level soils along isolated low ridges on the valley floor. Parent material consists of eolian sands derived from igneous rock. Somewhat excessively drained, with low surface runoff potential (high infiltration rate) and rapid permeability. Strongly alkaline below 24 in.[e] Shrink-swell potential is low. Available water capacity is low. Moderate rutting hazard. Used mainly as rangeland.	94 (2)

TABLE 10.3.7.1-1 (Cont.)

Map Unit Symbol	Map Unit Name	Water Erosion Potential[a]	Wind Erosion Potential	Description	Area, in Acres[b] (% of SEZ)
Du	Dune land	Very severe	High (WEG 1)	Constantly shifting medium-grained sand deposited by wind blowing across the valley. Parent material consists of eolian sands. Little or no vegetation; low surface runoff potential (high infiltration rate) and very rapid permeability. Shrink-swell potential is low. Available water capacity is very low. Severe rutting hazard.	13 (<1)

[a] Water erosion potential rates the hazard of soil loss from off-road and off-trail areas after disturbance activities that expose the soil surface. The ratings are based on slope and soil erosion factor K and represent soil loss caused by sheet or rill erosion where 50 to 75% of the surface has been exposed by ground disturbance. A rating of "slight" indicates that erosion is unlikely under ordinary climatic conditions. A rating of "very severe" indicates that significant erosion is expected; loss of soil productivity and damage are likely and erosion control measures are costly and generally impractical.

[b] To convert acres to km^2, multiply by 0.004047.

[c] WEG = wind erodibility group. WEGs are based on soil texture, content of organic matter, effervescence of carbonates, content of rock fragments, and mineralogy, and also take into account soil moisture, surface cover, soil surface roughness, wind velocity and direction, and the length of unsheltered distance (USDA 2004). Groups range in value from 1 (most susceptible to wind erosion) to 8 (least susceptible to wind erosion). The NRCS provides a wind erodibility index, expressed as an erosion rate in tons per acre per year, for each of the wind erodibility groups: WEGs 1 and 2, 134 tons per acre per year; and WEG 4, 86 tons per acre per year.

[d] Farmland is of unique importance for the production of food, feed, fiber, forage, or oilseed crops.

[e] To convert from in. to cm, multiply by 2.54.

Sources: NRCS (2009); USDA (1968).

surface is suitable for roads, with a slight to moderate erosion hazard when used as roads or trails. The water erosion potential is slight for all but the dune land soils, which have a very severe risk of erosion if disturbed. Depending on the vegetative cover, the susceptibility to wind erosion is high, with as much as 134 tons (122 metric tons) of soil eroded by wind per acre each year (NRCS 2009).

The soils of the Corlett-Hooper complex occur on and between sand dunes and cover about 3% of the site. Soils in this complex as well as the Hooper clay loam, covering about 9% of the site, are rated as partially hydric.[2] Flooding of soils at the site is not likely and occurs with a frequency of less than once in 500 years (NRCS 2009).

10.3.7.2 Impacts

Impacts on soil resources would occur mainly as a result of ground-disturbing activities (e.g., grading, excavating, and drilling), especially during the construction phase of a solar project. These impacts include soil compaction, soil horizon mixing, soil erosion and deposition by wind, soil erosion by water and surface runoff, sedimentation, and soil contamination. Such impacts are common to all utility-scale solar energy developments in varying degrees and are described in more detail for the four phases of development in Section 5.7.1.

Because impacts on soil resources would result from ground-disturbing activities in the project area, soil impacts would be roughly proportional to the size of a given solar facility, with larger areas of disturbed soil having a greater potential for impacts than smaller areas (Section 5.7.2). The magnitude of impacts would also depend on the types of components built for a given facility since some components would involve greater disturbance and would take place over a longer timeframe.

It is not known whether construction within the proposed Fourmile East SEZ would affect the eolian processes that maintain the Great Sand Dunes north of the site. Because the area is a designated National Monument and Preserve, the developer may be required to conduct a study to evaluate the impacts of building a solar facility close to the landform and to develop specific mitigation measures to avoid or minimize those impacts.

10.3.7.3 SEZ-Specific Design Features and Design Feature Effectiveness

Implementing the programmatic design features described under both Soils and Air Quality in Appendix A, Section A.2.2, as required under BLM's Solar Energy Program, would reduce the potential for soil impacts during all project phases.

[2] A hydric soil is a soil that formed under conditions of saturation, flooding, or ponding (NRCS 2009).

A proposed design feature specific to the proposed Fourmile East SEZ is as follows:

- The need for a study to evaluate the potential impacts of building a solar facility in close proximity to the Great Sand Dunes should be determined.

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10.3.8 Minerals (Fluids, Solids, and Geothermal Resources)

10.3.8.1 Affected Environment

The San Luis Basin is identified as an oil and gas producing region (Burnell et al. 2008), although there is no current production. Nevertheless, the whole San Luis Basin area has been identified in the BLM's San Luis Valley RMP (BLM 1991) as an area of low potential for oil and gas development. Currently, there are no oil and gas leases in the proposed Fourmile East SEZ, although almost all of the area was leased for oil and gas at one time (BLM and USFS 2010b). No oil or gas is currently produced in Alamosa County (Burnell et al. 2008). The area is still open for discretionary mineral leasing, including leasing for oil and gas.

Currently, there are no mining claims in the SEZ (BLM and USFS 2010a). Lands in the SEZ were closed to locatable mineral entry in June 2009 pending the outcome of this PEIS (74 FR 31308–31309).

The San Luis Basin is also a region of known and potential geothermal resources. Several geothermal springs and wells have been developed in the northern part of the basin, the nearest at Alamosa, about 21 mi (34 km) west of the proposed Fourmile East SEZ (Laney and Brizzee 2005). No geothermal development has occurred within or adjacent to the SEZ (BLM and USFS 2010b).

10.3.8.2 Impacts

If the BLM identifies the proposed Fourmile East SEZ as an SEZ to be used for utility-scale solar development, it would continue to be closed to all incompatible forms of mineral development. Since the area does not contain existing mining claims, it is assumed that valuable locatable minerals are not present on the site and that there would be no impact on locatable mineral production.

Although the San Luis Basin is identified as an oil and gas production area, since there are no active oil and gas leases in the SEZ it is assumed there would be no impacts on these resources if the SEZ was developed for solar energy production. Additionally, oil and gas development utilizing directional drilling to access resources under the area (should any be found) could be allowed.

Solar energy development of the SEZ would preclude future surface use of the site to produce geothermal energy but would not preclude the possibility of accessing any geothermal resources, should any be found, through directional drilling. Because of this option and the lack of current geothermal development within the SEZ, solar development of the SEZ would have no impact on development of geothermal resources.

If the area is identified as an SEZ, some mineral uses might be allowed. For example, oil and gas development that uses directional drilling to access resources under the area (should any be found) could be allowed. Also, the production of common minerals, such as sand and gravel and mineral materials used for road construction, might take place in areas not directly developed for solar energy production.

10.3.8.3 SEZ-Specific Design Features and Design Feature Effectiveness

No SEZ-specific design features would be necessary to protect mineral resources. Implementing the programmatic design features described in Appendix A, Section A.2.2, as required under BLM's Solar Energy Program, would reduce the potential for impacts to mineral leasing.

10.3.9 Water Resources

10.3.9.1 Affected Environment

The proposed Fourmile East SEZ is located in the San Luis Valley, which is in the Rio Grande Headwaters subbasin of the Rio Grande hydrologic region (USGS 2010a). The San Luis Valley covers approximately 2 million acres (8,094 km^2) and is bounded by the San Juan Mountains to the west and the Sangre de Cristo Mountains to the east. The northern portion of the San Luis Valley is internally drained toward San Luis Lake and is referred to as the "closed basin" (see inset of Figure 10.3.9.1-1), while the southern portion of the valley drains to the Rio Grande (Mayo et al. 2007; Topper et al. 2003). The proposed Fourmile East SEZ is located in the eastern portion of the San Luis Valley and has surface elevations ranging from 7,585 to 7,675 ft (2,312 to 2,339 m) with a general east-to-west drainage pattern. The climate of the San Luis Valley is arid, with evaporation rates often exceeding precipitation amounts (Robson and Banta 1995). The average annual precipitation and snowfall amounts in the eastern San Luis Valley are on the order of 8.5 and 24 in. (22 and 61 cm), respectively (WRCC 2010a). Precipitation and snowfall amounts are much greater in the surrounding mountains and are on the order of 22 and 150 in. (56 and 381 cm), respectively, at elevations greater than 9,000 ft (2,743 m) (WRCC 2010b). Pan evaporation rates are estimated to be 54 in./yr (137 cm/yr) in the San Luis Valley (Cowherd et al. 1988; WRCC 2010c), with evapotranspiration rates potentially exceeding 40 in./yr (102 cm/yr) (Emery 1994; Leonard and Watts 1989; Mayo et al. 2007).

10.3.9.1.1 Surface Waters (Including Drainages, Floodplains, and Wetlands)

No permanent surface water bodies occur on the proposed Fourmile East SEZ. Several ephemeral washes drain off the Sangre de Cristo Mountains, but they all end about 1 mi (1.5 km) east of the SEZ. Smith Reservoir is located about 5 mi (8 km) southeast of the SEZ and is fed by Sangre de Cristo Creek and Ute Creek. The Rio Grande is about 8 mi (13 km) southeast of the proposed SEZ, flowing from northwest to southeast through the Alamosa National Wildlife Refuge (Figure 10.3.9.1-1). Additionally, two laterals that originate about 6 mi (10 km) west of the proposed SEZ deliver groundwater from the closed basin portion of the San Luis Valley to the Rio Grande as a part of the closed basin project (operated by the U.S. Bureau of Reclamation) to help support Rio Grande Compact obligations (see Section 10.3.9.1.3 for further details on the Rio Grande Compact).

Flood hazards have not been identified (Zone D) for the area surrounding the proposed Fourmile East SEZ (FEMA 2009). However, shallow ponding and runoff in ephemeral washes can occur during rain events.

The NWI identified several small palustrine wetlands with emergent vegetation along the western boundary of the proposed Fourmile East SEZ (USFWS 2009). The Alamosa National Wildlife Refuge is located 6 mi (10 km) southwest of the proposed SEZ and contains several wetlands consisting of wet meadows, oxbow lakes, and riparian floodplain regions of the Rio Grande. These wetlands are described in more detail in Section 10.3.10.1 and are

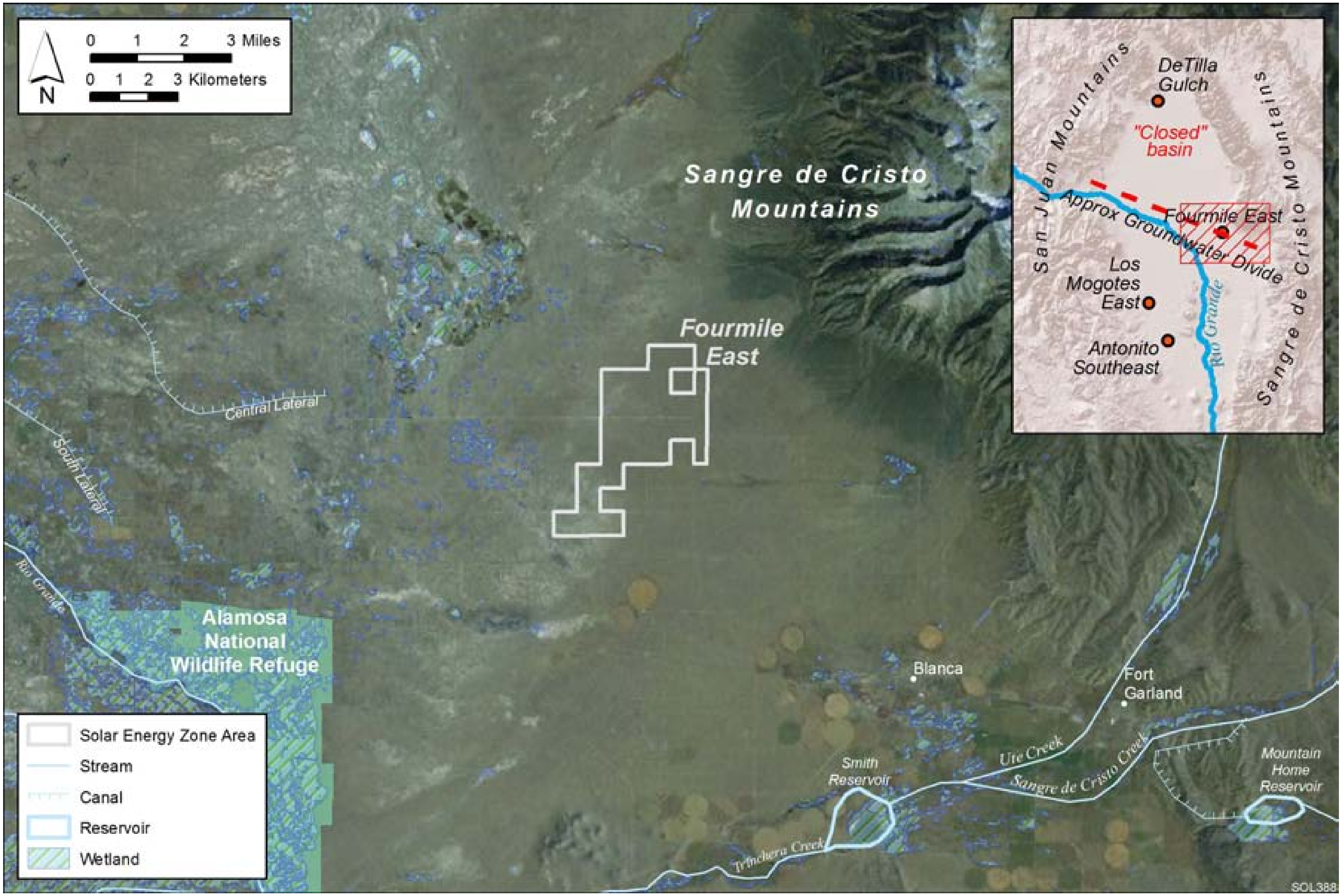

FIGURE 10.3.9.1-1 Surface Water Features near the Proposed Fourmile East SEZ

characterized as being intermittently flooded, which suggests that surface water is present for variable periods of time throughout the year.

10.3.9.1.2 Groundwater

Groundwater in the San Luis Valley is primarily in basin fill deposits ranging from 8,000 to 30,000 ft (2,438 to 9,144 m) thick and consisting of unconsolidated to moderately consolidated deposits of gravel, sands, and clays of Tertiary and Quaternary age (Robson and Banta 1995; Mayo et al. 2007). These basin fill deposits consist of two hydrogeologic units: the upper unconfined aquifer and the lower confined aquifer, which are separated by a series of confining clay layers and unfractured volcanic rocks (Brendle 2002). The unconfined aquifer covers most of the valley floor and occurs in unconsolidated valley sediments up to depths of 200 ft (61 m) (Mayo et al. 2007). The deeper confined aquifer covers about half of the valley floor and occurs in the unconsolidated sediments interlayered with basalt flows ranging in depth from 50 to 30,000 ft (15 to 9,100 m) (Emery 1994; Mayo et al. 2007). Groundwater flow in the upper unconfined aquifer follows the surface drainage divide in the San Luis Valley, with flows toward San Luis Lake in the northern portion of the valley (referred to as the closed basin) and flows toward the Rio Grande in the southern portion of the valley. Flow, however, is not separated in the lower confined aquifer, which in general flows toward the closed basin portion of the valley (Mayo et al. 2007).

Aquifers in the San Luis Valley are predominantly recharged by snowmelt runoff from higher elevations of the surrounding mountain ranges along the valley rim (Robson and Banta 1995), as well as by irrigation return flows, subsurface inflow, and seepage from streams (Emery 1994). The upper unconfined aquifer receives upward groundwater flows from the lower confined aquifer in some regions of the valley, but the conceptual model of leakage between the aquifers is not fully realized (Mayo et al. 2007). Because of the low precipitation rates and high evaporation rates in the valley, precipitation within the valley is not a significant recharge source (with only about 1% of the annual precipitation reaching the aquifers) (Robson and Banta 1995). Groundwater discharge is primarily through groundwater extractions, evapotranspiration, and surface water discharge to the Rio Grande (Emery 1994; Mayo et al. 2007). Estimates of groundwater recharge and discharge processes are variable, depending upon assumptions made in performing a water balance, but total groundwater recharge and discharge for the entire San Luis Valley are on the order of 2.8 million ac-ft/yr (3.5 billion m^3/yr) (SLV Development Resources Group 2007).

The proposed Fourmile East SEZ is situated atop the distal area of an alluvial fan above the Baca Graben where the basin fill material can be as much as 19,000 ft (5,800 m) thick (Mackelprang 1983). The unconfined aquifer in this region of the San Luis Valley is about 125 ft (38 m) thick, below which lies the confining clay layer that is on the order of 100 ft (30 m) thick separating the unconfined and confined aquifers (Colorado DWR 2010a; RGWCD 2010). The unconfined aquifer is the primary source of groundwater withdrawals in the San Louis Valley (Colorado District Court 2004). Three monitoring wells with well depths ranging from 50 to 169 ft (15 to 52 m) in the unconfined aquifer are located within the proposed SEZ. Depth to groundwater in these wells is between 32 and 52 ft (10 and 16 m) below the surface, and all wells have shown declines in groundwater surface elevations at a rate of approximately 0.4 ft/yr (0.1 m/yr) over the past couple decades (USGS 2010b; well numbers 372923105383501, 372948105385202, 373106105363401). The overall groundwater flow path in the unconfined aquifer is from east to west in this portion of the San Luis Valley (RGWCD 2010). Monitoring wells in the confined aquifer are located 4 mi (6 km) northwest and 6 mi (10 km) southwest of the proposed SEZ, and all indicate that the confined aquifer is under artesian conditions (RGWCD 2010; well numbers ALA04, ALA11, and ALA 15).

Mayo et al. (2007) summarized the TDS of groundwater in the unconfined and upper confined aquifers. The TDS in the unconfined aquifer water is estimated to be less than 250 mg/L. The upper confined aquifer water has TDS concentrations between 20 and 100 mg/L. Water collected at a depth of 5,500 ft (1,674 m) in the Baca Graben showed TDS concentrations of about 4,000 mg/L (Burroughs 1981).

10.3.9.1.3 Water Use and Water Rights Management

In 2005, water withdrawals in Alamosa County were estimated to be 305,017 ac-ft/yr (376 million m^3/yr), of which about 14% was from surface water sources (streams, springs, and irrigation canals and laterals) and 86% was from groundwater. The largest water use category was irrigation, composing 98% of the water use in that year, and groundwater withdrawals for irrigation totaled 300,130 ac-ft/yr (370 million m^3/yr). Other water use categories for groundwater were for public supply at 2,836 ac-ft/yr (3.5 million m^3/yr), aquaculture at 1,894 ac-ft/yr (2.3 million m^3/yr), livestock at 123 ac-ft/yr (152,000 m^3/yr), and mining at 11 ac-ft/yr (14,000 m^3/yr) (Kenny et al. 2009).

Colorado administers its water rights using the Doctrine of Prior Appropriation as its cornerstone, with water rights being granted by a water court system and administered by the Colorado Division of Water Resources (BLM 2001). Surface waters in much of Colorado were over-appropriated before the turn of the twentieth century. Groundwater was not actively managed until mid 1960, and the Water Rights Determination and Administration Act of 1969 (C.R.S. §§37-92-101 through §§37-92-602) required that surface waters and groundwater be managed together (Colorado DWR 2010b).

The proposed Fourmile East SEZ is located in Colorado Division of Water Resources' Division 3 management zone (Rio Grande Basin), where both surface water and groundwater rights are over-appropriated. Securing water supplies for utility-scale solar energy projects in the Rio Grande Basin requires the purchase of an augmentation certificate (where available) or existing water rights and transferring to a new point of diversion (surface diversion or new well). Any transfer of existing water rights will be carried out through the Division 3 Water Court, which includes a review process by the Colorado Division of Water Resources with respect to the location of the new diversion and its potential impacts to senior water rights, aquifer conditions, and surface water flows (Colorado District Court 2004; Colorado DWR 2008). An additional burden for new water diversions in this region is the need for a plan for augmentation[3] to protect senior water rights (typically surface water rights) with respect to any potential depletions in terms of timing, location, amount, and quality (Colorado DWR 2008).

A major element of water management in the San Luis Valley is the Rio Grande Compact of 1938, which obligates Colorado to deliver a specified quantity of water (dependent on natural supply) in the Rio Grande as it crosses the Colorado–New Mexico state line (Colorado District Court 2004). Since its inception, several U.S. Supreme Court and Colorado Supreme Court decisions (e.g., *Alamosa-La Jara Water Users Protection Association v. Gould* 1983; *Texas v. Colorado* 1968) have imposed that the Colorado Division of Water Resources develop rules and regulations regarding surface water and groundwater appropriations within the Rio Grande Basin. The process of modifying and adopting new rules and regulations regarding surface water and groundwater rights is still ongoing. In 2008, the San Luis Valley Rules Advisory Committee was established to develop new rules and regulations regarding groundwater use and water rights administration in the Rio Grande Basin (Wolfe 2008). Many issues concerning the Colorado Division of Water Resources' attempts to develop a management plan for surface waters and groundwater in the Rio Grande Basin are summarized in Case Numbers 06CV64 & 07CW52 brought before the Division 3 Water Court (Colorado District Court 2010).

The new rules and regulations governing surface water and groundwater in the Rio Grande Basin are not final; however, they will impose limits on groundwater withdrawals in order to reduce groundwater extractions to a sustainable level and help sustain treaty obligations (Colorado District Court 2010; Colorado DWR 2010c). The viability of any solar energy project will depend upon its ability to secure water rights, which would need to be done by coordinating with the Colorado Division of Water Resources, existing water right holders, and potentially some of the water conservation districts that operate in the San Luis Valley that provide augmentation water and will potentially be subdistrict groundwater managers, depending upon court decisions that are pending (Colorado District Court 2010; McDermott 2010). The transfer of water rights will most likely involve agricultural surface and groundwater rights, which have been estimated to have a consumptive water use of between 150 and 250 ac-ft/yr (185,000 and 308,400 m^3/yr) for a 125-acre (0.5-km^2) farm (SLV Development Resources Group 2007). The transfer of agricultural water rights for solar energy development will result in agricultural fields being put out of production and will significantly alter land use in the San Luis Valley.

Additional factors that solar projects will need to consider with respect to obtaining and transferring water rights include the location of the water right, whether it is a surface water or groundwater source, and the seniority of the water right. However, the biggest challenge in transferring water rights for solar energy projects will be coming up with a suitable augmentation plan, which will either be accomplished through the water courts, a groundwater management plan, or a substitute water supply plan (for temporary water uses), depending on court decisions

[3] Plan for augmentation means a detailed program, which may be either temporary or perpetual in duration, to increase the supply of water available for beneficial use in a division or portion thereof by the development of new or alternate means or points of diversion, by a pooling of water resources, by water exchange projects, by providing substitute supplies of water, by the development of new sources of water, or by any other appropriate means (*Colorado Revised Statutes* 37-92-103 (9)).

regarding groundwater management in the San Luis Valley that are expected in the near future (Colorado District Court 2010; Colorado DWR 2010c; McDermott 2010). Securing additional water supply sources for an augmentation plan reduces the amount of available water resources in the Rio Grande Basin. According to recent applications processed through the water court, it would be very difficult for any project seeking an amount of water over about 1,000 ac-ft/yr (1.2 million m^3/yr) to be successful in obtaining needed water rights (McDermott 2010).

10.3.9.2 Impacts

Potential impacts on water resources related to utility-scale solar energy development include direct and indirect impacts on surface waters and groundwater. Direct impacts occur at the place of origin and at the time of the proposed activity, while indirect impacts occur away from the place of origin or later in time. Impacts on water resources considered in this analysis are the result of land disturbance activities (construction, final developed site plan, as well as off-site activities such as road and transmission line construction) and water use requirements for solar energy technologies that take place during the four project phases: site characterization, construction, normal operations, and decommissioning/reclamation. Both land disturbance and consumptive water use activities can affect groundwater and surface water flows, cause drawdown of groundwater surface elevations, modify natural drainage pathways, obstruct natural recharge zones, and alter surface water-wetland-groundwater connectivity. Water quality can also be degraded through the generation of wastewater, chemical spills, increased erosion and sedimentation, and increased salinity (e.g., by the excessive withdrawal from aquifers).

10.3.9.2.1 Land Disturbance Impacts on Water Resources

Impacts related to land disturbance activities are common to all utility-scale solar energy facilities, which are described in more detail for the four phases of development in Section 5.9.1; these impacts would be minimized through the implementation of the programmatic design features described in Appendix A, Section A.2.2. The proposed Fourmile East SEZ contains several small palustrine wetlands along the western boundary. Siting of utility-scale solar energy facilities should not interfere with these wetland regions as they serve as local recharge zones for the unconfined aquifer. In addition, stormwater management plans need to address the potential impacts of increased runoff and sedimentation in the region of these wetlands, as well as off the proposed SEZ toward the Alamosa National Wildlife Refuge and the manmade laterals that feed into the Rio Grande (see Section 10.3.9.1.1).

10.3.9.2.2 Water Use Requirements for Solar Energy Technologies

Analysis Assumptions. A detailed description of the water use assumptions for the four utility-scale solar energy technologies (parabolic trough, power tower, dish engine, and PV systems) is presented in Appendix M. Assumptions regarding water use calculations specific to the proposed Fourmile East SEZ include the following:

- On the basis of a total area of less than 10,000 acres (40 km^2), it is assumed that only one solar project would be constructed during the peak construction year;

- Water needed for making concrete would come from an off-site source;

- The maximum land disturbance for an individual solar facility during the peak construction year is 3,000 acres (12 km^2);

- Assumptions on individual facility size and land requirements (Appendix M), along with the assumed number of projects and maximum allowable land disturbance, result in the potential to disturb up to 77% of the SEZ total area during the peak construction year; and

- Water use requirements for hybrid cooling systems are assumed to be on the same order of magnitude as those using dry cooling (see Section 5.9.2.1).

Site Characterization. During site characterization, water would be used mainly for dust suppression and the workforce potable water supply. Impacts on water resources during this phase of development are expected to be negligible because activities would be limited in area, extent, and duration. Water needs could be met by trucking water in from an off-site source.

Construction. During construction, water would be used mainly for controlling fugitive dust and for the workforce potable water supply. Because there are no significant surface water bodies on the proposed Fourmile East SEZ, the water requirements for construction activities could be met by either trucking water to the site or by using on-site groundwater resources. Water requirements for dust suppression and the potable water supply during construction are shown in Table 10.3.9.2-1 and could be as high as 964 ac-ft (1.2 million m^3). In addition, the generation of up to 74 ac-ft (91,300 m^3) of sanitary wastewater would need to be treated either on-site or sent to an off-site facility.

Groundwater wells would have to yield an estimated 425 to 597 gpm (1,609 to 2,260 L/min) to meet the estimated construction water requirements. In the San Luis Valley, current well yields for large production wells are as high as 2,000 gpm (7,571 L/min); however, the majority of well yields are under 200 gpm (757 L/min) (RGWCD 2010). The effects of groundwater withdrawal and the ability to obtain water rights needed to meet construction water needs would have to be assessed during the site characterization phase.

Normal Operations. During normal operations, water would be required for mirror/panel washing, the workforce potable water supply, and cooling (parabolic trough and power tower only) (Table 10.3.9.2-2). At full build-out capacity, water needs for mirror/panel washing are estimated to range from 17 to 311 ac-ft/yr (2,100 to 383,600 m^3/yr). As much as 9 ac-ft/yr (11,100 m^3/yr) would be needed for the potable water supply.

TABLE 10.3.9.2-1 Estimated Water Requirements during the Peak Construction Year for the Proposed Fourmile East SEZ

Activity	Parabolic Trough	Power Tower	Dish Engine	PV
Water use requirements[a]				
Fugitive dust control (ac-ft)[b,c]	612	919	919	919
Potable supply for workforce (ac-ft)	74	45	19	9
Total water use requirements (ac-ft)	686	964	938	928
Wastewater generated				
Sanitary wastewater (ac-ft)	74	45	19	9

[a] Assumptions of water use for fugitive dust control, potable supply for the workforce, and wastewater generation are presented in Appendix M.

[b] Fugitive dust control estimation assumes a local pan evaporation rate of 54 in./yr (137 cm/yr) (Cowherd et al. 1988; WRCC 2010c).

[c] To convert ac-ft to m^3, multiply by 1,234.

Cooling water is required for only the parabolic trough and power tower technologies. Water needs for cooling are a function of the type of cooling used—dry versus wet. Further refinements to water requirements for cooling would result from the percentage of time that the option was employed (30 to 60% range assumed) and the power of the system. The differences between the water requirements reported in Table 10.3.9.2-2 for the parabolic trough and power tower technologies are attributable to the assumptions of acreage per MW. As a result, the water usage for the more energy-dense parabolic trough technology is estimated to be almost twice as large as that for the power tower technology.

The maximum total water usage during one year of normal operations would be greatest for those technologies using the wet-cooling option and is estimated to be as high as 9,325 ac-ft/yr (11.5 million m^3/yr) (Table 10.3.9.2-2). Water usage for dry-cooling systems would be as high as 941 ac-ft/yr (1.2 million m^3/yr), about 10 times less than for wet cooling. Water needs for normal operations could be met by trucking in water from an off-site source for low water use technologies (e.g., dish engine or PV) or from groundwater at the site, if it is available (see Sections 10.3.9.1.2 and 10.3.9.1.3). For example, a dish engine facility would require about 177 ac-ft/yr (218,300 m^3/yr), including water needed for mirror washing and the workforce potable water supply. This quantity of water could be obtained from a groundwater well with a pump rate of about 110 gpm (420 L/min). For a parabolic trough system using wet cooling with an operational time of 60% (maximum water use scenario), a groundwater yield of approximately 5,780 gpm (21,880 L/min) would be needed This value is about a factor of two to three times larger than the largest production wells in the San Luis Valley (RGWCD 2010). Based on water use requirements, wet-cooling technologies would not be feasible given their high water needs.

TABLE 10.3.9.2-2 Estimated Water Requirements during Normal Operations at the Proposed Fourmile East SEZ

Activity	Parabolic Trough	Power Tower	Dish Engine	PV
Full build-out capacity (MW)[a,b]	621	345	345	345
Water use requirements				
Mirror/panel washing (ac-ft/yr)[c,d]	311	173	173	17
Potable supply for workforce (ac-ft/yr)	9	4	4	<1
Dry cooling (ac-ft/yr)[e]	124–621	69–345	NA[f]	NA
Wet cooling (ac-ft/yr)[e]	2,795–9,005	1,553–5,003	NA	NA
Total water use requirements				
Non-cooled technologies (ac-ft/yr)	NA	NA	177	17
Dry-cooled technologies (ac-ft/yr)	444–941	246–522	NA	NA
Wet-cooled technologies (ac-ft/yr)	3,115–9,325	1,730–5,180	NA	NA
Wastewater generated				
Blowdown (ac-ft/yr)[g]	176	98	NA	NA
Sanitary wastewater (ac-ft/yr)	9	4	4	<1

a Land area for parabolic trough was estimated at 5 acres/MW (0.02 km^2/MW); land area for the power tower, dish engine, and PV technologies was estimated at 9 acres/MW (0.04 km^2/MW).

b Water needs are linearly related to power. Water usage for any other size project can be estimated by using multipliers provided in Table M.9-2 (Appendix M).

c Value assumes a usage rate of 0.5 ac-ft/yr/MW for mirror washing for parabolic trough, power tower, and dish engine technologies and a rate of 0.05 ac-ft/yr/MW for panel washing for PV systems.

d To convert ac-ft to m^3, multiply by 1,234.

e Dry-cooling value assumes 0.2 to 1.0 ac-ft/yr/MW; wet-cooling value assumes 4.5 to 14.5 ac-ft/yr/MW (range in these values represents 30 and 60% operating times) (DOE 2009).

f NA = not applicable.

g Value scaled from 250-MW Beacon Solar project with an annual discharge of 44 gpm (167 L/min) (AECOM 2009). Blowdown estimates are relevant to wet cooling only.

The availability of water rights and the impacts associate with groundwater withdrawals would need to be assessed during the site characterization phase of a proposed solar project. Less water would be needed for any of the four solar technologies if the full build-out capacity was reduced. The analysis of water use for the various solar technologies assumed a single technology for full build-out. Water use requirements for development scenarios that assume a mixture of solar technologies can be estimated using water use factors described in Appendix M, Section M.9.

Normal operations at the proposed Fourmile East SEZ would produce up to 9 ac-ft/yr (11,100 m^3/yr) of sanitary wastewater (Table 10.3.9.2-2) that would need to be treated either on-site or sent to an off-site facility. In addition, parabolic trough or power tower projects using wet cooling would discharge cooling system blowdown water that would need to be treated either on- or off-site. The quantity of water discharged would range from 98 to 176 ac-ft/yr (12,090 to 217,090 m^3/yr) (Table 10.3.9.2-2). Any on-site treatment of wastewater would have to ensure that treatment ponds are effectively lined in order to prevent any groundwater contamination.

Decommissioning/Reclamation. During decommissioning/reclamation, all surface structures associated with a solar project would be dismantled, and the site reclaimed to its preconstruction state. Activities and water needs during this phase would be similar to those during the construction phase (e.g., dust suppression, potable supply for workers) and may also include water to establish vegetation in some areas. However, the total volume of water needed is expected to be less. Because the quantities of water needed during the decommissioning/reclamation phase would be less than those for construction; impacts on surface and groundwater resources also would be less.

10.3.9.2.3 Off-Site Impacts: Roads and Transmission Lines

The proposed Fourmile East SEZ is located adjacent to State Highway 150 and U.S. 160, and existing transmission lines are within 2 mi (3 km) of the SEZ as described in Section 10.3.1.2. Impacts associated with the construction of roads and transmission lines primarily deal with water use demands for construction, water quality concerns relating to potential chemical spills, and land disturbance effects to the natural hydrology. Water needed for road modification and transmission line construction activities (e.g., for soil compaction, dust suppression, and potable supply for workers) could be trucked to the construction area from an off-site source. As a result, water impacts due to water use would be negligible. Impacts on surface water and groundwater quality resulting from spills would be minimized by implementing the mitigation measures described in Section 5.9.3 (e.g., cleaning up spills as soon as they occur). Ground-disturbing activities that have the potential to increase sediment and dissolved solid loads in downstream waters would be conducted following the mitigation measures outlined in Section 5.9.3 to minimize impacts associated with alterations to natural drainage pathways and hydrologic processes.

10.3.9.2.4 Summary of Impacts on Water Resources

The impacts on water resources from development of solar energy at the proposed Fourmile East SEZ would be associated with land disturbance effects to the natural hydrology, water quality concerns, and water use requirements for the various solar energy technologies. Land disturbance activities can cause localized erosion and sedimentation issues, as well as alter groundwater recharge and discharge processes. The proposed SEZ contains several small wetlands along the western boundary, and surface drainage off the site could potentially affect laterals that connect to the Rio Grande and Alamosa National Wildlife Refuge. Alterations to the natural drainage pattern of the site should be avoided to the extent possible in order to minimize erosion and sedimentation impacts, as well as the disruption of wildlife habitat and clogging of groundwater recharge areas.

Water in the Rio Grande Basin is managed strictly because of its scarcity, treaty obligations, and its necessity for supporting agriculture in the San Luis Valley. Both surface water and groundwater rights are over appropriated, so water requirements for solar energy development would have to be met through the purchase of senior water rights. Water withdrawals in the basin are managed to control discharge to the Rio Grande system, in accordance with the Rio Grande Compact, so water withdrawals under purchased water rights would need to result in no net impact on the basin. In addition, applications for new points of groundwater diversion would have to demonstrate no impact on adjacent surface and groundwater rights holders. Since current water rights are used primarily for irrigation, the purchase and diversion of groundwater rights for solar energy developments would put some agricultural lands out of production. For example, assuming a 125-acre (0.5-km^2) farm has a consumptive use of 200 ac-ft/yr (246,700 m^3/yr) (see Section 10.3.9.1.3), then the water requirements for full build-out assuming dry-cooled parabolic trough technology would need to fallow 588 acres (2.4 km^2) of agricultural fields, where as PV technology would only need to fallow 11 acres (0.04 km^2). This is a hypothetical example only, and it does not take into account securing water rights needed for an augmentation plan either. However, the cost of obtaining the land-associated water rights and augmentation water could be high enough to render projects seeking large amounts of water to be unfeasible (Gibson 2010; McDermott 2010).

The scarcity and strict management of water resources in the San Luis Valley suggest that utility-scale solar energy developments that require more than 1,000 ac-ft/yr (1.2 million m^3/yr) would have a difficult time securing water rights (McDermott 2010). Considering the estimated water use requirements for the four solar energy technologies presented in Table 10.3.9.2-2, technologies using wet cooling are not feasible given that associated water requirements are from 1,730 to 9,325 ac-ft/yr (2.1 million to 11.5 million m^3/yr). Dry-cooling technologies would need to incorporate water conservation measures to reduce water needs. Impacts associated with groundwater withdrawals are primarily addressed by the thorough process involved in obtaining water rights in the Rio Grande Basin, which is primarily overseen by the Colorado Division of Water Resources and the Division 3 Water Court (see Section 10.3.9.1.3). Securing water rights in the Rio Grande Basin is a complex and expensive process, so dish engine and PV technologies are the preferable solar energy technologies for the proposed Fourmile East SEZ because of their low water use requirements.

10.3.9.3 SEZ-Specific Design Features and Design Feature Effectiveness

Implementing the programmatic design features given in Appendix A, Section A.2.2 will mitigate some impacts on water resources. Programmatic design features would focus on coordination with federal, state, and local agencies that regulate the use of water resources to meet the requirements of permits and approvals needed to obtain water for development, and on hydrological studies to characterize the aquifer from which groundwater would be obtained (including drawdown effects, if a new point of diversion is created). The greatest consideration for mitigating water impacts would be in the selection of solar technologies. The mitigation of impacts would be best achieved by selecting technologies with low water demands.

Proposed design features specific to the proposed Fourmile East SEZ include:

- Wet-cooling options would not be feasible; other technologies should incorporate water conservation measures;

- Land disturbance activities should avoid impacts to the extent possible in the wetland areas on the western boundary of the site;

- During site characterization, hydrologic investigations would need to identify 100-year floodplains and potential jurisdictional water bodies subject to Clean Water Act Section 404 permitting. Siting of solar facilities and construction activities should avoid areas identified as being within a 100-year floodplain;

- Groundwater rights must be obtained from the Division 3 Water Court in coordination with the Colorado Division of Water Resources, existing water right holders, and applicable water conservation districts;

- Groundwater monitoring and production wells should be constructed in accordance with state standards (Colorado DWR 2005);

- Stormwater management plans and BMPs should comply with standards developed by the Colorado Department of Public Health and Environment (CDPHE 2008b); and

- Water for potable uses would have to meet or be treated to meet water quality standards in according to Colorado Revised Statutes 25-8-204.

10.3.10 Vegetation

This section addresses vegetation that could occur or is known to occur within the potentially affected area of the proposed Fourmile East SEZ. The affected area considered in this assessment included the areas of direct and indirect effects. The area of direct effects was defined as the area that would be physically modified during project development (i.e., where ground-disturbing activities would occur) and included the SEZ and a 250-ft (76-m) wide portion of an assumed transmission line corridor. The area of indirect effects was defined as the area within 5 mi (8 km) of the SEZ boundary and within the 1-mi (1.6-km) wide assumed transmission line corridor where ground-disturbing activities would not occur but that could be indirectly affected by activities in the area of direct effect. No area of direct or indirect effects was assumed for new access roads because they are not expected to be needed for developments on the Fourmile East SEZ due to the proximity of an existing state highway.

Indirect effects considered in the assessment included effects from surface runoff, dust, and accidental spills from the SEZ, but do not include ground-disturbing activities. The potential degree of indirect effects would decrease with increasing distance away from the SEZ. This area of indirect effect was identified on the basis of professional judgment and was considered sufficiently large to bound the area that would potentially be subject to indirect effects. The affected area is the area bounded by the areas of direct and indirect effects. Because there is some overlap between the area of indirect effect of the SEZ and the area affected by the transmission corridor, the size of the affected area is somewhat less than the sum of the areas of direct and indirect effects. These areas are defined, and the impact assessment approach is described in Appendix M.

10.3.10.1 Affected Environment

The proposed Fourmile East SEZ is located within the Salt Flats Level IV ecoregion, which supports sparse shrubland plant communities (Chapman et al. 2006). The dominant species in this ecoregion are greasewood (*Sarcobatus vermiculatus*), fourwing saltbush (*Atriplex canescens*), shadscale (*Atriplex confertifolia*), horsebrush (*Tetradymia* sp.), spiny hopsage (*Grayia spinosa*), rubber rabbitbrush (*Ericameria nauseosa*), saltgrass (*Distichlis spicata*), and alkali sacaton (*Sporobolus airoides*). This ecoregion is located within the Arizona/New Mexico Plateau Level III ecoregion, which is described in Appendix I.

Level IV ecoregions within 5 mi (8 km) of the SEZ include the Sand Dunes and Sand Sheets ecoregion, northwest of the SEZ, which supports scrub communities on sand sheets and sparse vegetation on sand dunes, which are mostly barren. To the northeast, with increasing elevation, lie the Foothill Shrublands ecoregion, which supports shrubland and woodland habitats with interspersed grasslands; the Crystalline Subalpine Forests ecoregion, which supports mostly coniferous forest along with aspen groves and subalpine meadows; and the Alpine Zone ecoregion, which supports alpine meadows with sparse stunted trees near the tree line. To the southeast lies the San Luis Alluvial Flats and Wetlands ecoregion, which is mostly irrigated cropland with some remaining shrubland communities. The Foothill Shrublands ecoregion, Crystalline Subalpine Forests ecoregion, and the Alpine Zone ecoregion are located within the Southern Rockies Level III ecoregion, which is described in Appendix I. The Salt Flats ecoregion, Sand Dunes and Sand Sheets ecoregion, and San Luis Alluvial Flats and Wetlands ecoregion are located in the Arizona/New Mexico Plateau Level III ecoregion, which is also described in Appendix I. Annual precipitation in the vicinity of the SEZ is low, averaging 7.1 in. (18.1 cm) at Alamosa (see Section 10.3.13).

Land cover types, described and mapped under SWReGAP (USGS 2005) were used to evaluate plant communities in and near the SEZ. Each cover type encompasses a range of similar plant communities. Land cover types occurring within the potentially affected area of the proposed Fourmile East SEZ are shown in Figure 10.3.10.1-1. Table 10.3.10.1-1 provides the surface area of each cover type within the potentially affected area.

Lands within the proposed Fourmile East SEZ are classified primarily as two cover types—Inter-Mountain Basins Semi-Desert Shrub Steppe and Inter-Mountain Basins Greasewood Flat. Additional cover types within the SEZ include Inter-Mountain Basins Big Sagebrush Shrubland, Inter-Mountain Basins Active and Stabilized Dune, and Inter-Mountain Basins Playa.

Greene's rabbitbrush (*Chrysothamnus greenei*) and bottlebrush squirreltail (*Elymus elymoides*) were observed to be the dominant species in some areas of the SEZ in July 2009. Large areas of the SEZ supported a shrub steppe community with an abundance of grasses. Other areas of the SEZ support a shrub-dominated community, with few associated grasses. Prickly pear (*Opuntia* sp.) was abundant in some shrub steppe areas. Sensitive habitats on the SEZ include wetlands, sand dunes, ephemeral washes, and playas. The area has had a long history of livestock grazing, and the plant communities present within the SEZ have likely been affected by grazing.

Lands within the transmission line corridor include seven cover types. Inter-Mountain Basins Greasewood Flat is the predominant cover type in the corridor. Additional cover types include a wide variety of woodland, shrubland, and grassland types (Table 10.3.10.1-1).

The area surrounding the SEZ, within 5 mi (8 km), includes 35 cover types, which are listed in Table 10.3.10.1-1. The predominant cover types are Inter-Mountain Basins Semi-Desert Shrub Steppe and Inter-Mountain Basins Greasewood Flat.

The NWI identifies a number of small wetlands within and immediately outside of the western portion of the SEZ (Figure 10.3.10.1-2). The NWI maps are produced from high altitude imagery and are subject to uncertainties inherent in image interpretation (USFWS 2009). Most of these wetlands occur within the Inter-Mountain Basins Greasewood Flat cover type with a small number within Inter-Mountain Basins Semi-Desert Shrub Steppe.

Twelve of these wetlands, totaling 2.1 acres (0.0085 km^2), occur within the SEZ. They range in size from 0.1 to 0.6 acres (0.0004 to 0.002 km^2). These wetlands are classified as palustrine wetlands with emergent plant communities that are intermittently flooded, indicating

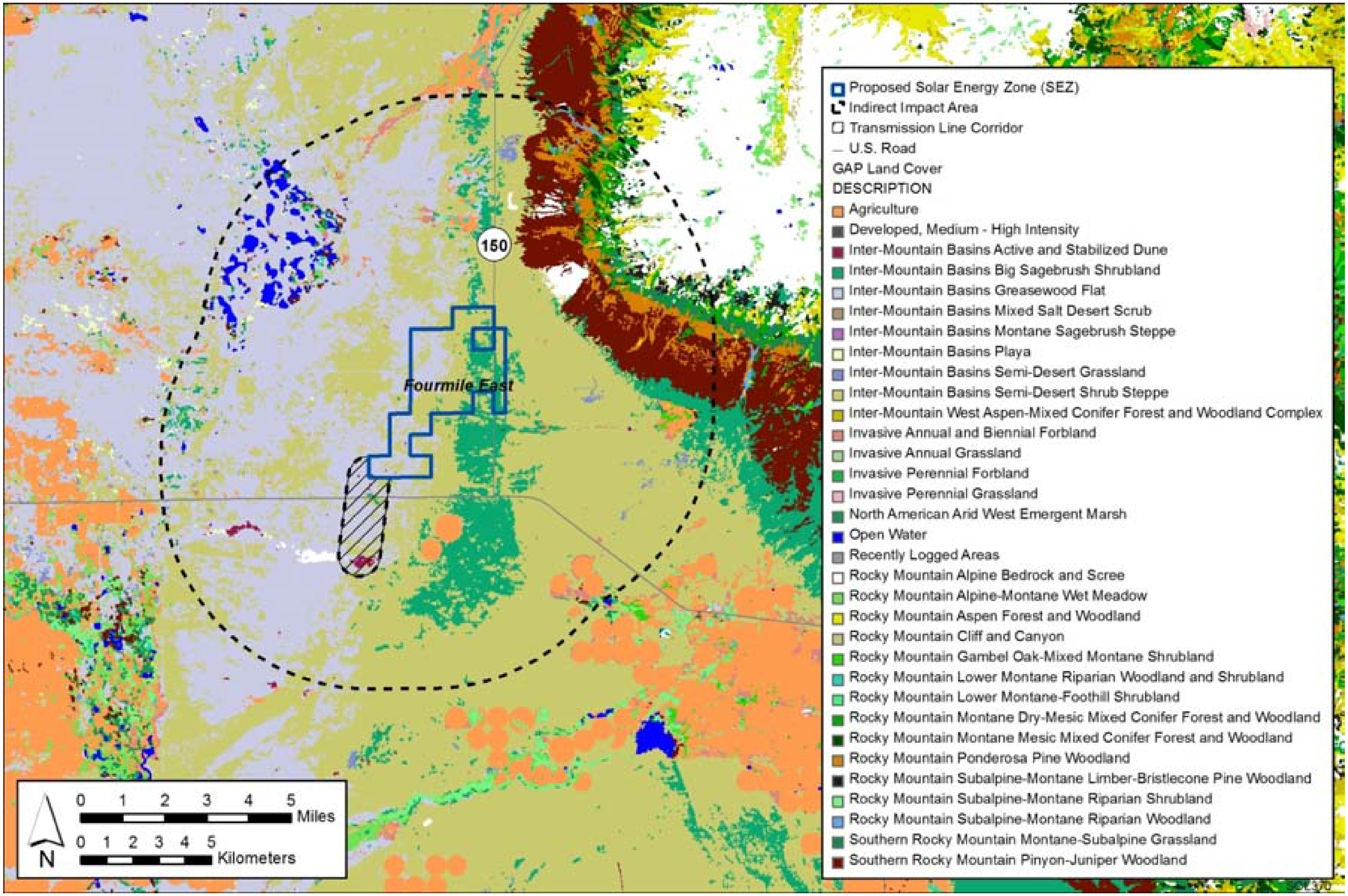

FIGURE 10.3.10.1-1 Land Cover Types within the Proposed Fourmile East SEZ (Source: USGS 2004)

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TABLE 10.3.10.1-1 Land Cover Types within the Potentially Affected Area of the Proposed Fourmile East SEZ and Potential Impacts

	Area of Cover Type Affected (acres)[b]			
Land Cover Type[a]	Within SEZ (Direct Effects)[c]	Corridor and Outside SEZ (Indirect Effects)[d]	Assumed Transmission Line (Direct Effects)[e]	Overall Impact Magnitude[f]
S079 Inter-Mountain Basins Semi-Desert Shrub Steppe: Generally consists of perennial grasses with an open shrub and dwarf shrub layer.	2,013 acres[g] (0.2%, 0.8%)	39,268 acres (4.8%)	15 acres (<0.1%)	Small
S096 Inter-Mountain Basins Greasewood Flat: Dominated or co-dominated by greasewood (*Sarcobatus vermiculatus*) and generally occurring in areas with saline soils, a shallow water table, and intermittent flooding, although remaining dry for most growing seasons. This community type generally occurs near drainages or around playas. These areas may include, or may be co-dominated by, other shrubs, and may include a graminoid herbaceous layer.	1,266 acres (0.4%, 6.1%)	28,705 acres (8.7%)	45 acres (<0.1%)	Small
S054 Inter-Mountain Basins Big Sagebrush Shrubland: Dominated by basin big sagebrush (*Artemisia tridentata tridentata*), Wyoming big sagebrush (*Artemisia tridentata wyomingensis*), or both. Other shrubs may be present. Perennial herbaceous plants are present but not abundant.	589 acres (0.2%, 1.2%)	6,828 acres (2.4%)	1 acre (<0.1%)	Small
S012 Inter-Mountain Basins Active and Stabilized Dune: Includes Dune and sandsheet areas that are unvegetated or sparsely vegetated, with up to 30% plant cover, but generally less than 10%. Plant communities consist of patchy or open grassland, shrubland, or shrub steppe, with species often adapted to the shifting sandy substrate.	7 acres (<0.1%, 2.2%)	232 acres (0.5%)	3 acres (<0.1%)	Small

TABLE 10.3.10.1-1 (Cont.)

Land Cover Type[a]	Area of Cover Type Affected (acres)[b]: Within SEZ (Direct Effects)[c]	Corridor and Outside SEZ (Indirect Effects)[d]	Assumed Transmission Line (Direct Effects)[e]	Overall Impact Magnitude[f]
S015 Inter-Mountain Basins Playa: Playa habitats are intermittently flooded and generally barren or sparsely vegetated. Depressions may contain small patches of grass and sparse shrubs may occur around playa margins.	<1 acre (<0.1%, 0.2%)	167 acres (1.5%)	<1 acre (<0.1%)	Small
D03 Recently Mined or Quarried: Includes open pit mines and quarries.	0 acres	194 acres (17%)	<1 acre (<0.1%)	Small
S090 Inter-Mountain Basins Semi-Desert Grassland: Consists of perennial bunchgrasses as dominants or co-dominants. Scattered shrubs or dwarf shrubs may also be present.	0 acres	389 acres (0.6%)	<1 acre (<0.1%)	Small
S038 Southern Rocky Mountain Pinyon-Juniper Woodland: Occurs on dry mountains and foothills. The dominant trees are twoneedle pinyon (*Pinus edulis*) or oneseed juniper (*Juniperus monosperma*), or both. Rocky Mountain juniper (*Juniperus scopulorum*) may be a dominant in higher elevation occurrences. An understory may be absent or dominated by shrubs or graminoids.	0 acres	5,476 acres (1.3%)	0 acres	Small
S036 Southern Rocky Mountain Ponderosa Pine Woodland: Occurs on dry slopes. Ponderosa pine (*Pinus ponderosa*, primarily var. *scopulorum*, and var. *brachyptera*) is the dominant species. Other tree species may be present. The understory is usually shrubby and grasses may be present.	0 acres	2,004 acres (0.6%)	0 acres	Small
N80 Agriculture: Areas where pasture/hay or cultivated crops account for more than 20% of total vegetation cover.	0 acres	1,479 acres (0.2%)	0 acres	Small

TABLE 10.3.10.1-1 (Cont.)

Land Cover Type[a]	Area of Cover Type Affected (acres)[b]: Within SEZ (Direct Effects)[c]	Corridor and Outside SEZ (Indirect Effects)[d]	Assumed Transmission Line (Direct Effects)[e]	Overall Impact Magnitude[f]
N11 Open Water: Plant or soil cover is generally less than 25%.	0 acres	1,166 acres (8.7%)	0 acres	Small
S032 Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest and Woodland: Occurs on mountain slopes, canyon sideslopes, and ridgetops. Shrub and graminoid species are generally present.	0 acres	932 acres (0.6%)	0 acres	Small
S002 Rocky Mountain Alpine Bedrock and Scree: Occurs at high elevations, usually on outcrops and scree slopes, and consists of barren and sparsely vegetated substrates. Plant communities are dominated by lichens. Plant growth is generally limited. A sparse cover of forbs, grasses, lichens, and low shrubs may be present.	0 acres	787 acres (1.7%)	0 acres	Small
S028 Rocky Mountain Subalpine Dry-Mesic Spruce-Fir Forest and Woodland: Occurs on mountain slopes. The dominant tree species is Engelmann spruce (*Picea engelmannii*), subalpine fir (*Abies lasiocarpa*), or both. Additional tree species commonly occur, and shrubs may be present.	0 acres	646 acres (0.5%)	0 acres	Small
S085 Southern Rocky Mountain Montane-Subalpine Grassland: Typically occurs as a mosaic of two or three plant associations on well-drained soils. The dominant species is usually a bunchgrass.	0 acres	642 acres (0.2%)	0 acres	Small
D09 Invasive Annual and Biennial Forbland: Areas dominated by annual and biennial non-native forb species.	0 acres	531 acres (1.0%)	0 acres	Small

TABLE 10.3.10.1-1 (Cont.)

Land Cover Type[a]	Area of Cover Type Affected (acres)[b] Within SEZ (Direct Effects)[c]	Corridor and Outside SEZ (Indirect Effects)[d]	Assumed Transmission Line (Direct Effects)[e]	Overall Impact Magnitude[f]
D11 Recently Chained Pinyon-Juniper Areas: Areas that have recently been chained to remove Pinyon-Juniper (*Pinus edulis-Juniperus* sp.).	0 acres	523 acres (17.4%)	0 acres	Small
S025 Rocky Mountain Subalpine–Montane Limber-Bristlecone Pine Woodland: Occurs on dry, rocky, exposed ridges and slopes. Dominants in the open tree canopy include limber pine (*Pinus flexilis*) or bristlecone pine (*Pinus aristata*). Additional tree species are occasionally present. In some stands an open shrub layer may be present. Sparse grasses may also be present.	0 acres	330 acres (1.1%)	0 acres	Small
S030 Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland: Occurs primarily on north- and east-facing mountain slopes and on alluvial terraces, well-drained benches, and inactive stream terraces. The dominant tree species are Engelmann spruce (*Picea engelmannii*) and subalpine fir (*Abies lasiocarpa*). Shrubs and herbaceous species are often present.	0 acres	311 acres (0.2%)	0 acres	Small
S006 Rocky Mountain Cliff and Canyon and Massive Bedrock: Occurs on steep cliffs, narrow canyons, rock outcrops, and scree and talus slopes. This cover type includes barren and sparsely vegetated areas (less than 10% cover) with scattered trees and/or shrubs, or with small dense patches. Herbaceous plant cover is limited.	0 acres	282 acres (2.3%)	0 acres	Small
S034 Rocky Mountain Mesic Montane Mixed Conifer Forest and Woodland: Occurs in lower and middle ravine slopes, along stream terraces, and on north- and east-facing slopes. The dominant trees are conifers, sometimes mixed with aspen. Shrubs and herbaceous species are generally present.	0 acres	265 acres (0.2%)	0 acres	Small

TABLE 10.3.10.1-1 (Cont.)

Land Cover Type[a]	Area of Cover Type Affected (acres)[b]: Within SEZ (Direct Effects)[c]	Corridor and Outside SEZ (Indirect Effects)[d]	Assumed Transmission Line (Direct Effects)[e]	Overall Impact Magnitude[f]
S081 Rocky Mountain Dry Tundra: Occurs in alpine areas on slopes, flat ridges, valleys, and basins with a constant water supply. The dense cover of low-growing, perennial graminoids and forbs is typically dominated by sod-forming sedges and prostrate and mat-forming forbs.	0 acres	167 acres (0.4%)	0 acres	Small
S031 Rocky Mountain Lodgepole Pine Forest: Occurs in upper montane and subalpine zones. Lodgepole pine (*Pinus contorta*) is the dominant species and may form dense even-aged stands. The understory, if present, may be composed of shrubs or grasses.	0 acres	165 acres (1.4%)	0 acres	Small
S042 Inter-Mountain Basins Aspen-Mixed Conifer Forest and Woodland Complex: Occurs on montane slopes and plateaus. The tree canopy co-dominants are quaking aspen (*Populus tremuloides*) and conifers, Quaking aspen loses dominance in older stands. Shrubs and herbaceous species are often present.	0 acres	161 acres (0.2%)	0 acres	Small
S023 Rocky Mountain Aspen Forest and Woodland: Dominated by quaking aspen (*Populus tremuloides)*, with or without a significant presence of conifers. The understory may consist of only herbaceous species or multiple shrub and herbaceous layers.	0 acres	152 acres (0.1%)	0 acres	Small
S100 North American Arid West Emergent Marsh: Occurs in natural depressions, such as ponds, or bordering lakes, or slow-moving streams or rivers. Alkalinity is highly variable. The plant community is characterized by herbaceous emergent, submergent, and floating leaved species.	0 acres	137 acres (3.1%)	0 acres	Small

TABLE 10.3.10.1-1 (Cont.)

Land Cover Type[a]	Area of Cover Type Affected (acres)[b] Within SEZ (Direct Effects)[c]	Corridor and Outside SEZ (Indirect Effects)[d]	Assumed Transmission Line (Direct Effects)[e]	Overall Impact Magnitude[f]
S102 Rocky Mountain Alpine-Montane Wet Meadow: Occurs on wet soils in very low-velocity areas along ponds, lakes, streams, and toeslope seeps. This cover type is dominated by herbaceous species and often occurs as a mosaic of several plant associations. The dominant species are often grass or grass-like plants.	0 acres	136 acres (0.2%)	0 acres	Small
S091 Rocky Mountain Subalpine-Montane Riparian Shrubland: Occurs along low-gradient streams, alluvial terraces, and floodplains; around seeps, fens, and isolated springs on hillslopes; and in above–tree-line snowmelt-fed basins. This cover type often occurs as a mosaic of shrub and herbaceous communities.	0 acres	125 acres (0.3%)	0 acres	Small
S046 Rocky Mountain Gambel Oak-Mixed Montane Shrubland: Occurs on dry foothills and lower mountain slopes. Gambel oak (*Quercus gambelii*) may be the only dominant species or share dominance with other shrubs.	0 acres	109 acres (0.1%)	0 acres	Small
S092 Rocky Mountain Subalpine-Montane Riparian Woodland: Occurs in seasonally flooded areas along river and stream floodplains or terraces, usually in narrow valleys and canyons, but may also occur in wide valley bottoms or along pond or lake margins. May include areas with a shallow water table or seeps for part of the growing season from snowmelt moisture. The dominant trees are typically conifers.	0 acres	87 acres (0.6%)	0 acres	Small
S093 Rocky Mountain Lower Montane Riparian Woodland and Shrubland: Occurs on streambanks, islands, and bars, in areas of annual or episodic flooding, and often occurs as a mosaic of tree-dominated communities with diverse shrubs.	0 acres	82 acres (0.4%)	0 acres	Small

TABLE 10.3.10.1-1 (Cont.)

Land Cover Type[a]	Area of Cover Type Affected (acres)[b] Within SEZ (Direct Effects)[c]	Corridor and Outside SEZ (Indirect Effects)[d]	Assumed Transmission Line (Direct Effects)[e]	Overall Impact Magnitude[f]
S083 Rocky Mountain Subalpine Mesic Meadow: Occurs on gentle to moderate slopes on soils that are seasonally moist to saturated in spring. Forbs typically have more cover than graminoids.	0 acres	73 acres (0.3%)	0 acres	Small
N22 Developed, Medium–High Intensity: Includes housing and commercial/industrial development. Impervious surfaces compose 50 to 100% of the total land cover.	0 acres	55 acres (1.7%)	0 acres	Small
S004 Rocky Mountain Alpine Fell-Field: Occurs on windy ridgetops and exposed saddles with shallow stony soils. Plants are typically cushioned, or matted, frequently succulent, and flat to the ground in rosettes. Plant cover is generally 15 to 50% and composed of graminoids and forbs.	0 acres	9 acres (0.1%)	0 acres	Small
D10 Recently Logged Areas: Includes clear-cut areas and areas thinned by 50% or more.	0 acres	2 acres (0.1%)	0 acres	Small

[a] Land cover descriptions are from USGS (2005). Full descriptions of land cover types, including plant species, can be found in Appendix I. Wetlands within the SEZ are not mapped as wetland cover types by SWReGAP.

[b] Area in acres, determined from USGS (2004).

[c] Includes the area of the cover type within the SEZ, the percentage that area represents of all occurrences of that cover type within the SEZ region (i.e., a 50-mi [80-km] radius from the center of the SEZ), and the percentage that area represents of all occurrences of that cover type on BLM lands within the SEZ region. Wetlands within the SEZ are not mapped as wetland cover types by SWReGAP.

Footnotes continued on next page.

TABLE 10.3.10.1-1 (Cont.)

[d] Area of indirect effects was assumed to be the area adjacent to the SEZ within 5 mi (8 km) of the SEZ boundary and within a 1-mi (1.6-km) wide assumed transmission line corridor where ground-disturbing activities would not occur. Indirect effects include effects from surface runoff, dust, and other factors from project facilities. The potential degree of indirect effects would decrease with increasing distance from the SEZ. Includes the area of the cover type within the indirect effects area and the percentage that area represents of all occurrences of that cover type within the SEZ region.

[e] For transmission, direct effects were estimated within a 2-mi (3.2-km) long, 250-ft (76-m) wide transmission ROW from the SEZ to the nearest existing line. Direct impacts within this area were determined from the proportion of the cover type within the 1-mi (1.6-km) wide transmission corridor. Impacts are for the area of the cover type within the assumed ROW, the percentage that area represents of all occurrences of that cover type within the SEZ region.

[f] Overall impact magnitude categories were based on professional judgment and are (1) *small*: a relatively small proportion of the cover type ($\leq$1%) within the SEZ region would be lost; (2) *moderate*: an intermediate proportion of a cover type (>1 but $\leq$10%) would be lost; and (3) *large*: >10% of a cover type would be lost.

[g] To convert acres to km^2, multiply by 0.004047.

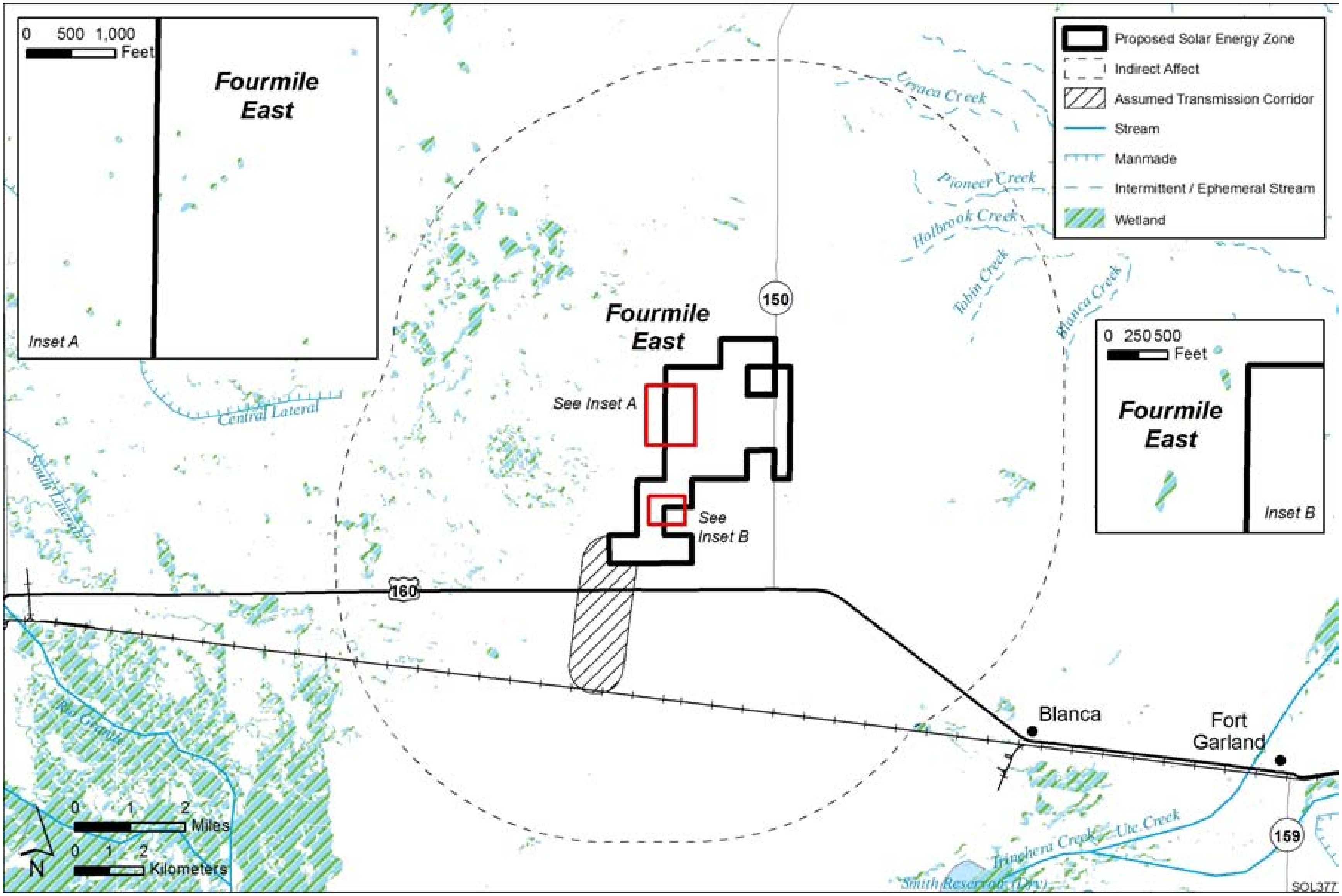

FIGURE 10.3.10.1-2 Wetlands within the Proposed Fourmile East SEZ (Source: USFWS 2009)

that surface water is usually absent but may be present for variable periods (USFWS 2009). Emergent plant communities are composed primarily of herbaceous species rooted in shallow water or saturated soil. Numerous ephemeral dry washes occur within the SEZ and transmission line corridor. These dry washes typically contain water for short periods during or following precipitation events and include temporarily flooded areas. However, these areas typically do not support wetland or riparian habitats. In addition, numerous areas in the SEZ temporarily hold surface water after storms. These areas typically have a hard, cracked sandy substrate and are often unvegetated or support sparse grasses.

Ten wetlands occur within the assumed transmission line corridor, ranging in size from 0.2 to 0.5 acres (0.0008 to 0.002 km^2) and totaling 2.6 acres (0.011 km^2). Two of these wetlands support an emergent plant community, while eight are classified as unconsolidated shore. Unconsolidated shore wetlands have a sparse vegetation cover. These wetlands occur within the Inter-Mountain Basins Greasewood Flat and Inter-Mountain Basins Active and Stabilized Dune cover types, with one located in Inter-Mountain Basins Semi-Desert Shrub Steppe.

Many palustrine emergent wetlands occur near the proposed Fourmile East SEZ to the west and range from intermittently flooded to seasonally flooded, indicating that surface water is present for extended periods, especially in the spring, but is usually absent by the end of the growing season. Many of these wetlands are included within the Blanca ACEC.

The NWI also identifies wetlands near the SEZ to the east as palustrine wetlands with emergent plant communities that are seasonally flooded (USFWS 2009). To the east and northeast, several unvegetated wetlands ranging from seasonally flooded to temporarily flooded (surface water is present for brief periods during the growing season, but the water table usually lies well below the soil surface) are identified by the NWI. Several palustrine emergent wetlands occur to the northeast that are classified as saturated, indicating that the soil is saturated to the surface for extended periods during the growing season, but surface water is seldom present (USFWS 2009).

The NWI identifies numerous lakes and palustrine wetlands, including ponds, more than 2 mi (3.2 km) to the west and northwest (USFWS 2009), which lie within the Blanca ACEC. Most of the palustrine wetlands support emergent plant communities. These are mostly classified as North American Arid West Emergent Marsh, Rocky Mountain Alpine-Montane Wet Meadow, Rocky Mountain Lower Montane Riparian Woodland and Shrubland, and Inter-Mountain Basins Playa cover types. The ponds support a variety of wetland plant community types. Other palustrine wetlands are predominantly unvegetated and seasonally flooded. Wetlands to the north of the SEZ are identified by the NWI as palustrine wetlands with emergent plant communities (USFWS 2009). Many of these are Rocky Mountain Subalpine-Montane Riparian Shrubland, Rocky Mountain Lower Montane Riparian Woodland and Shrubland, and Rocky Mountain Alpine-Montane Wet Meadow cover types.

The State of Colorado maintains an official list of weed species that are designated noxious species. Table 10.3.10.1-2 provides a summary of the noxious weed species regulated in Colorado that are known to occur in Alamosa County. No species included in Table 10.3.10.1-2 was observed on the SEZ.

TABLE 10.3.10.1-2 Colorado Noxious Weeds Occurring in Alamosa County

Common Name	Scientific Name	Status
Hoary cress	*Cardaria draba*	List B
Russian knapweed	*Acroptilon repens*	List B
Canada thistle	*Cirsium arvense*	List B
Field bindweed	*Convolvulus arvensis*	List C
Wild Caraway[a]	*Carum carvi*	Not listed

[a] Species not included on the CDA Alamosa County list but is believed to occur in the county (USDA 2010).

Source: CDA (2010).

The Colorado Department of Agriculture classifies noxious weeds into one of three lists (CDA 2010):

- "List A species in Colorado that are designated by the Commissioner for eradication."

- "List B weed species are species for which the Commissioner, in consultation with the state noxious weed advisory committee, local governments, and other interested parties, develops and implements state noxious weed management plans designed to stop the continued spread of these species."

- "List C weed species are species for which the Commissioner, in consultation with the state noxious weed advisory committee, local governments, and other interested parties, will develop and implement state noxious weed management plans designed to support the efforts of local governing bodies to facilitate more effective integrated weed management on private and public lands. The goal of such plans will not be to stop the continued spread of these species but to provide additional education, research, and biological control resources to jurisdictions that choose to require management of List C species."

Nineteen noxious weeds and invasive plant species are known or suspected to occur in the San Luis Valley Resource Area, which includes the Fourmile East SEZ (Table 10.3.10.1-3).

Those species that are known to occur near the SEZ include Russian knapweed, hoary cress, Canada thistle, Russian olive, perennial pepperweed, and salt cedar. Camelthorn (*Alhagi pseudalhagi*), a list A species, is also known to occur near the SEZ, in the Blanca Wetlands area. The only species from Table 10.3.10.1-3 on List A, Hydrilla, is an aquatic species that is also known to occur in the Blanca Wetlands area.

TABLE 10.3.10.1-3 Noxious Weeds and Invasive Plants in the San Luis Valley Resource Area

Common Name	Scientific Name	Status
Leafy spurge	*Euphorbia esula*	List B
Black henbane	*Hyoscyamus niger*	List B
Dalmatian toadflax	*Linaria dalmatica, L. genistifolia*	List B
Scotch thistle	*Onopordum acanthium, O. tauricum*	List B
Spotted knapweed	*Centaurea maculosa*	List B
Russian knapweed	*Acroptilon repens*	List B
Canada thistle	*Cirsium arvense*	List B
Field bindweed	*Convolvulus arvensis*	List C
Hoary cress	*Cardaria draba*	List B
Perennial pepperweed	*Lepidium latifolium*	List B
Yellow toadflax	*Linaria vulgaris*	List B
Houndstongue	*Cynoglossum officinale*	List B
Russian olive	*Elaeagnus angustifolia*	List B
Cheatgrass	*Bromus tectorum*	List C
Oxeye daisy	*Chrysantheum leucanthemum*	List B
Salt cedar	*Tamarix chinensis, T. parviflora, T. ramosissima*	List B
Kochia	*Bassia prostrata*	Not listed
Hydrilla	*Hydrilla verticillata*	List A
Eurasian water milfoil	*Myriophyllum spicatum*	List B

Source: BLM (2010a).

10.3.10.2 Impacts

The construction of solar energy facilities within the proposed Fourmile East SEZ would result in direct impacts on plant communities because of the removal of vegetation within the facility footprint during land-clearing and land-grading operations. Approximately 80% of the SEZ (3,105 acres [12.6 km^2]) would be expected to be cleared with full development of the SEZ. The plant communities affected would depend on facility locations and could include any of the communities occurring on the SEZ. Therefore, for this analysis, all the area of each cover type within the SEZ is considered to be directly affected by removal with full development of the SEZ.

Indirect effects (caused, for example, by surface runoff or dust from the SEZ) have the potential to degrade affected plant communities and may reduce biodiversity by promoting the decline or elimination of species sensitive to disturbance. Indirect effects can also cause an increase in disturbance-tolerant species or invasive species. High impact levels could result in the elimination of a community or the replacement of one community type for another. The proper implementation of programmatic design features, however, would reduce indirect effects to a minor/small level of impact.

Possible impacts from solar energy development on vegetation that are encountered within the SEZ or along related ROWs are described in more detail in Section 5.10.1. Any such impacts would be minimized through the implementation of required programmatic design features described in Appendix A, Section A.2.2, and through any additional mitigation applied. SEZ-specific design features are described in Section 10.3.10.3.

10.3.10.2.1 Impacts on Native Species

The impacts of construction, operation, and decommissioning were considered small if the impact affected a relatively small proportion (≤1%) of the cover type in the SEZ region (within 50 mi [80 km] of the center of the SEZ); a moderate impact (>1 but ≤10%) could affect an intermediate proportion of cover type; a large impact could affect >10% of a cover type.

Solar facility construction and operation would primarily affect communities of the Inter-Mountain Basins Semi-Desert Shrub Steppe and Inter-Mountain Basins Greasewood Flat cover types. Additional cover types within the SEZ that would be affected include Inter-Mountain Basins Big Sagebrush Shrubland, Inter-Mountain Basins Active and Stabilized Dune, and Inter-Mountain Basins Playa. The potential impacts on land cover types resulting from solar energy development in the proposed Fourmile East SEZ are summarized in Table 10.3.10.1-1. Most of these cover types are relatively common in the SEZ region, however, Inter-Mountain Basins Playa and Inter-Mountain Basins Active and Stabilized Dune are relatively uncommon, representing approximately 0.2% and 0.6% of the land area within the SEZ region, respectively. Sand dune, playa, and dry wash communities are important sensitive habitats in the region. The construction, operation, and decommissioning of solar projects within the SEZ would result in small impacts on each of the cover types in the affected area.

Disturbance of vegetation in dune communities within the SEZ, such as from heavy equipment operation, could result in the loss of substrate stabilization. Re-establishment of dune species could be difficult due to the arid conditions and unstable substrates. Because of the arid conditions, re-establishment of shrub communities in temporarily disturbed areas would likely be very difficult and may require extended periods of time. In addition, noxious weeds could become established in disturbed areas and colonize adjacent undisturbed habitats, thus reducing restoration success and potentially resulting in widespread habitat degradation.

Potential impacts on wetlands as a result of solar energy facility development are described in Section 5.10.1. Specific to the affected area of the proposed Fourmile East SEZ, approximately 2.1 acres (0.0085 km^2) of wetland habitat occurs within the SEZ and could be affected by project development. In addition, 2.6 acres (0.011 km^2) of wetlands occurs within the assumed transmission line corridor and could be affected by construction within the transmission line ROW.

Grading could result in direct impacts on the wetlands within the SEZ if fill material is placed within wetland areas. Grading near the wetlands in or near the SEZ could disrupt surface water or groundwater flow characteristics, resulting in changes in the frequency, duration, depth, or extent of inundation or soil saturation, and could potentially alter wetland plant communities and affect wetland function. Increases in surface runoff from a solar energy project site could also affect wetland hydrologic characteristics. The introduction of contaminants into wetlands in or near the SEZ could result from spills of fuels or other materials used on a project site. Soil disturbance could result in sedimentation in wetland areas, which could degrade or eliminate wetland plant communities. Sedimentation effects or hydrologic changes could also extend to wetlands outside of the SEZ. Communities associated with playa habitats, greasewood flats communities, riparian habitats, or other periodically flooded areas within or downstream from solar projects or the transmission line corridor could also be impacted by ground-disturbing activities. Grading could also affect dry washes within the SEZ, and alteration of surface drainage patterns or hydrology could adversely affect downstream dry wash communities. Vegetation within these communities could be lost by erosion or desiccation. See Section 10.3.9 for further discussion of washes.

Although the use of groundwater within the Fourmile East SEZ for technologies with high water requirements, such as wet-cooling systems, may be unlikely, groundwater withdrawals for such systems could affect groundwater resources (see Section 10.3.9). Plant communities that are supported by groundwater discharge, such as many of the lakes, ponds, and other wetlands in the vicinity of the SEZ, could become degraded or lost as a result of groundwater flow alterations.

The deposition of fugitive dust from disturbed soil areas in habitats outside a solar project area could result in reduced productivity or changes in plant community composition. Communities that would be most likely affected northeast of the SEZ, the predominant downwind direction, are those of the Inter-Mountain Basins Semi-Desert Shrub Steppe, Inter-Mountain Basins Big Sagebrush Shrubland, and Inter-Mountain Basins Greasewood Flat cover types. Inter-Mountain Basins Semi-Desert Grassland, Southern Rocky Mountain Pinyon-Juniper Woodland, Recently Chained Pinyon-Juniper Areas, and Invasive Annual and Biennial Forbland also occur to the northeast.

The construction of transmission lines in ROWs outside of the SEZ could potentially result in direct impacts on wetlands, if fill material is placed within wetland areas, or in indirect impacts as described above. Construction could also affect dry washes within or downstream of the ROW.

10.3.10.2.2 Impacts from Noxious Weeds and Invasive Plant Species

On February 8, 1999, the President signed E.O. 13112, "Invasive Species," which directs federal agencies to prevent the introduction of invasive species and provide for their control and to minimize the economic, ecological, and human health impacts of invasive species (*Federal Register*, Volume 64, page 61836, Feb. 8, 1999). Potential impacts resulting from noxious weeds and invasive plant species as a result of solar energy facility development are described in Section 5.10.1. Despite required programmatic design features to prevent the spread of noxious weeds, project disturbance could potentially increase the prevalence of noxious weeds and invasive species in and adjacent to the affected area of the proposed Fourmile East SEZ, weeds could be transported into areas that were previously relatively weed free, and this could result in reduced restoration success and possible widespread habitat degradation.

Noxious weed species that are known to occur in San Luis Valley near the SEZ include Russian knapweed, hoary cress, Canada thistle, Russian olive, perennial pepperweed, Camelthorn, and salt cedar. Additional species known to occur in Alamosa County or the San Luis Valley Resource Area are given in Table 10.3.10.1-2 and Table 10.3.10.1-3, respectively. Approximately 531 acres (2.15 km^2) of Invasive Annual and Biennial Forbland occurs within the area of indirect effects. Land disturbance from project activities and indirect effects of construction and operation could result in the expansion of these invasive species populations.

Past or present land uses may affect the susceptibility of plant communities to the establishment of noxious weeds and invasive species. Existing roads, livestock grazing, and recreational OHV use within the SEZ area of potential impact would also likely contribute to the susceptibility of plant communities to the establishment and spread of noxious weeds and invasive species. Disturbed areas, including 194 acres (0.8 km^2) of the Recently Mined or Quarried, 1,479 acres (6.0 km^2) of Agriculture, 523 acres (2.1 km^2) of Recently Chained Pinyon-Juniper Areas, 55 acres (0.2 km^2) of Developed, Medium–High Intensity, 2 acres (0.008 km^2) of Recently Logged Areas occur within the area of indirect effects and may contribute to the establishment of noxious weeds and invasive species.

10.3.10.3 SEZ-Specific Design Features and Design Feature Effectiveness

The implementation of required programmatic design features described in Appendix A, Section A.2.2, would reduce the potential for impacts on plant communities. While some SEZ-specific design features are best established when considering specific project details, design features that can be identified at this time include the following:

- An Integrated Vegetation Management Plan, addressing invasive species control, and an Ecological Resources Mitigation and Monitoring Plan, addressing habitat restoration should be approved and implemented to increase the potential for successful restoration of semidesert shrub steppe and greasewood flat habitats and minimize the potential for the spread of invasive species. Invasive species control should focus on biological and mechanical methods where possible to reduce the use of herbicides.

- All wetland, sand dune and sand transport areas, playa, and dry wash habitats within the SEZ and assumed transmission line corridor should be avoided to the extent practicable, and any impacts minimized and mitigated. A buffer area should be maintained around wetlands, and dry washes to reduce the potential for impacts on these habitats on or near the SEZ.

- Appropriate engineering controls should be used to minimize impacts on wetland, playa, dry wash, and riparian habitats, including downstream occurrences, resulting from surface water runoff, erosion, sedimentation, altered hydrology, accidental spills, or fugitive dust deposition to these habitats. Appropriate buffers and engineering controls would be determined through agency consultation.

- Transmission line towers should be sited and constructed to minimize impacts on wetlands and span them whenever practicable.

- Groundwater withdrawals should be limited to reduce the potential for indirect impacts on wetland habitats or springs that are associated with groundwater discharge, such as the Blanca wetlands.

If these SEZ-specific design features are implemented in addition to other programmatic design features, it is anticipated that a high potential for impacts from invasive species and impacts on wetlands, sand dunes, playas, springs, dry washes, and riparian habitats would be reduced to a minimal potential for impact. Residual impacts on wetlands could result from remaining groundwater withdrawal, etc.; however, it is anticipated that these impacts would be avoided in the majority of instances.

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10.3.11 Wildlife and Aquatic Biota

This section addresses wildlife (amphibians, reptiles, birds, and mammals) and aquatic biota that could occur within the potentially affected area of the proposed Fourmile East SEZ. Wildlife known to occur within 50 mi (80 km) of the SEZ (i.e., the SEZ region) were determined from the Colorado Natural Diversity Information Source Species Page (CDOW 2009) and the SWReGAP (USGS 2007). Land cover types potentially suitable for each species were determined from the SWReGAP (USGS 2004, 2005, 2007). Big game activity areas were determined from Colorado Natural Diversity Information Source Data (CDOW 2008). The amount of aquatic habitat within the SEZ region was determined by estimating the length of linear perennial stream and canal features and the area of standing water body features (i.e., ponds, lakes, and reservoirs) within 50 mi (80 km) of the SEZ using available GIS surface water datasets.

The affected area considered in this assessment included the areas of direct and indirect effects. The area of direct effects was defined as the area that would be physically modified during project development (i.e., where ground-disturbing activities would occur) and included the SEZ and a 250-ft (76-m) wide portion of an assumed 2-mi (3.2-km) long transmission line corridor. The maximum developed area within the SEZ would be 3,105 acres (12.6 km^2).

The area of indirect effects was defined as the area within 5 mi (8 km) of the SEZ boundary which includes the 1-mi (1.6-km) wide assumed transmission line corridor where ground-disturbing activities would not occur, but that could be indirectly affected by activities in the area of direct effects (e.g., surface runoff, dust, noise, lighting, and accidental spills in the SEZ or transmission line construction area). Potentially suitable habitat for a species within the SEZ greater than the maximum of 3,105 acres (12.6 km^2) of direct effect was also included as part of the area of indirect effects. The potential degree of indirect effects would decrease with increasing distance away from the SEZ. The area of indirect effect was identified on the basis of professional judgment and was considered sufficiently large to bound the area that would potentially be subject to indirect effects. These areas of direct and indirect effect are defined and the impact assessment approach is described in Appendix M. No area of direct or indirect effects was assumed for a new access road because one is not expected to be needed for the SEZ due to the proximity of an existing state highway.

The primary habitat type within the affected area is semiarid shrub-steppe (Section 10.3.10), although marsh and wetland habitats occur in the Blanca Wetlands in Alamosa County, Colorado, to the northwest of the SEZ (Figure 10.3.10.1-1). No permanent water bodies or washes occur within the SEZ (Section 10.3.9.1.1). Several small, palustrine wetlands that may contain surface water for variable periods of time throughout the year occur along the western boundary of the SEZ (Section 10.3.10.1).

10.3.11.1 Amphibians and Reptiles

10.3.11.1.1 Affected Environment

This section addresses amphibian and reptile species that are known to occur, or for which suitable habitat occurs, on or within the potentially affected area of the proposed Fourmile East SEZ. The list of amphibian and reptile species potentially present in the SEZ area was determined from the Colorado Natural Diversity Information Source (CDOW 2009) and habitat information from CDOW (2009), USGS (2007), and NatureServe (2010). Land cover types suitable for each species were determined from SWReGAP (USGS 2004, 2005, 2007). See Appendix M for additional information on the approach used.

Based on the distribution and habitat preferences of amphibian species in southern Colorado (USGS 2007; CDOW 2009), seven amphibian species could be associated with the aquatic and wetland habitats located near the SEZ: the bullfrog (*Rana catesbeiana*), Great Plains toad (*Bufo cognatus*), northern leopard frog (*Rana pipiens*), tiger salamander (*Ambystoma tigrinum*), plains spadefoot (*Spea bombifrons*), and Woodhouse's toad (*Bufo woodhousii*). Based on habitat preferences of the amphibian species, the Great Plains toad and Woodhouse's toad would be expected to occur within the SEZ (USGS 2007; Stebbins 2003). Amphibian surveys would need to be conducted to confirm which species occur within the area and whether any amphibian species occur near the wetlands within the SEZ.

Reptile species that could occur within the SEZ include the fence lizard (*Sceloporus undulatus*), gopher snake (*Pituophis catenifer*), western rattlesnake (*Crotalus viridis*), short-horned lizard (*Phrynosoma hernandesi*), and western terrestrial garter snake (*Thamnophis elegans*) (CDOW 2009; NMDGF 2009; Stebbins 2003).

Table 10.3.11.1-1 provides habitat information and the types and overall area of suitable land cover for representative amphibian and reptile species that could occur in the SEZ.

10.3.11.1.2 Impacts

The types of impacts that amphibians and reptiles could incur from construction, operation, and decommissioning of utility-scale solar energy facilities are discussed in Section 5.10.2.1. Any such impacts would be minimized through the implementation of required programmatic design features described in Appendix A, Section A.2.2, and through any additional mitigation applied. Section 10.2.11.1.3 below identifies SEZ-specific design features of particular relevance to the proposed Fourmile East SEZ.

The assessment of impacts on amphibian and reptile species is based on available information on the presence of species in the affected area as presented in Section 10.3.11.1.1 following the analysis approach described in Appendix M. Additional NEPA assessments and coordination with state natural resource agencies may be needed to address project-specific impacts more thoroughly. These assessments and consultations could result in additional

TABLE 10.3.11.1-1 Habitats, Potential Impacts, and Potential Mitigation for Representative Amphibian and Reptile Species That Could Occur on or in the Affected Area of the Proposed Fourmile East SEZ

Common Name (Scientific Name)	Habitat[a]	Maximum Area of Potential Habitat Affected[b] Within SEZ (Direct Effects)[c]	Outside SEZ (Indirect Effects)[d]	Within Transmission Line Corridor (Indirect and Direct Effects)[e]	Overall Impact Magnitude[f] and Species-Specific Mitigation[g]
Amphibians					
Great Plains toad (*Bufo cognatus*)	Sandy semidesert shrublands in the San Luis Valley. Can be relatively common in agricultural areas. About 1,532,300 acres[h] of potentially suitable habitat occurs in the SEZ region.	3,105 acres of potentially suitable habitat lost (0.1% of available potentially suitable habitat)	68,241 acres of potentially suitable habitat (4.5% of available potentially suitable habitat)	69 acres of potentially suitable habitat lost and 1,383 acres of potentially suitable habitat in area of indirect effect	Small overall impact. No species-specific mitigation of direct effects is feasible because suitable habitat is widespread in the area of direct effect.
Woodhouse's toad (*Bufo woodhousii*)	Mesic areas near streams and rivers. Often in agricultural areas and river floodplains. Prefers sandy areas. Can move several hundred meters between breeding and nonbreeding habitats. About 2,932,700 acres of potentially suitable habitat occurs in the SEZ region.	3,105 acres of potentially suitable habitat lost (0.1% of available potentially suitable habitat)	54,144 acres of potentially suitable habitat (1.8% of available potentially suitable habitat)	18 acres of potentially suitable habitat lost and 369 acres of potentially suitable habitat in area of indirect effect	Small overall impact. No species-specific mitigation of direct effects is feasible because suitable habitat is widespread in the area of direct effect.
Lizards					
Fence lizard (*Sceloporus undulatus*)	Sunny, rocky habitats of cliffs, talus, old lava flows and cones, canyons, and outcrops. Various vegetation adjacent or among rocks include montane forests, woodlands, semidesert shrubland, and various forbs and grasses. About 2,238,900 acres of potentially suitable habitat occurs in the SEZ region.	3,105 acres of potentially suitable habitat lost (0.1% of available potentially suitable habitat)	75,777 acres of potentially suitable habitat (3.4% of available potentially suitable habitat)	59 acres of potentially suitable habitat lost and 1,466 acres of potentially suitable habitat in area of indirect effect	Small overall impact. No species-specific mitigation of direct effects is feasible because suitable habitat is widespread in the area of direct effect.

TABLE 10.3.11.1-1 (Cont.)

		Maximum Area of Potential Habitat Affected[b]			
Common Name (Scientific Name)	Habitat[a]	Within SEZ (Direct Effects)[c]	Outside SEZ (Indirect Effects)[d]	Within Transmission Line Corridor (Indirect and Direct Effects)[e]	Overall Impact Magnitude[f] and Species-Specific Mitigation[g]
Lizards (Cont.)					
Short-horned lizard (*Phrynosoma hernandesi*)	Short-grass prairies, sagebrush, semidesert shrublands, shale barrens, pinyon-juniper and pine-oak woodlands, oak-grass associations, and open conifer forests in mountainous areas. About 2,767,700 acres of potentially suitable habitat occurs in the SEZ region.	589 acres of potentially suitable habitat lost (0.02% of available potentially suitable habitat)	18,630 acres of potentially suitable habitat (0.7% of available potentially suitable habitat)	1 acre of potentially suitable habitat in area of potential direct effect and 28 acres of potentially suitable habitat in area of indirect effect	Small overall impact.
Snakes					
Gophersnake (*Pituophis catenifer*)	Plains grasslands, sandhills, riparian areas, marshes, edges of ponds and lakes, rocky canyons, semidesert and mountain shrublands, montane woodlands, rural and suburban areas, and agricultural areas. Likely inhabits pocket gopher burrows in winter. About 2,079,200 acres of potentially suitable habitat occurs in the SEZ region.	589 acres of potentially suitable habitat lost (0.03% of available potentially suitable habitat)	17,188 acres of potentially suitable habitat (0.8% of available potentially suitable habitat)	1 acre of potentially suitable habitat lost and 37 acres of potentially suitable habitat in area of indirect effect	Small overall impact.
Western rattlesnake (*Crotalus viridis*)	Most terrestrial habitats. Typically inhabits plains grasslands, sandhills, semidesert and mountain shrublands, riparian areas, and montane woodlands. About 3,823,900 acres of potentially suitable habitat occurs in the SEZ region.	2,609 acres of potentially suitable habitat lost (0.07% of available potentially suitable habitat)	57,866 acres of potentially suitable habitat (1.5% of available potentially suitable habitat)	18 acres of potentially suitable habitat lost and 442 acres of potentially suitable habitat in area of indirect effect	Small overall impact. No species-specific mitigation of direct effects is feasible because suitable habitat is widespread in the area of direct effect.

TABLE 10.3.11.1-1 (Cont.)

Common Name (Scientific Name)	Habitat[a]	Maximum Area of Potential Habitat Affected[b]			Overall Impact Magnitude[f] and Species-Specific Mitigation[g]
		Within SEZ (Direct Effects)[c]	Outside SEZ (Indirect Effects)[d]	Within Transmission Line Corridor (Indirect and Direct Effects)[e]	
Snakes (Cont.)					
Western terrestrial garter snake (*Thamnophis elegans*)	Most terrestrial and wetland habitats near bodies of water, but can be found many miles from water. About 2,295,600 acres of potentially suitable habitat occurs in the SEZ region.	2,609 acres of potentially suitable habitat lost (0.1% of available potentially suitable habitat)	49,568 acres of potentially suitable habitat (2.2% of available potentially suitable habitat)	18 acres of potentially suitable habitat lost and 436 acres of potentially suitable habitat in area of indirect effect	Small overall impact. No species-specific mitigation of direct effects is feasible because suitable habitat is widespread in the area of direct effect.

[a] Potentially suitable habitat was determined by using SWReGAP habitat suitability and land cover models. Area of potentially suitable habitat for each species is presented for the SEZ region, which is defined as the area within 50 mi (80 km) of the SEZ center.

[b] Maximum area of potentially suitable habitat that could be affected relative to availability within the SEZ region. Habitat availability for each species within the region was determined by using SWReGAP habitat suitability and land cover models. This approach probably overestimates the amount of suitable habitat in the project area.

[c] Direct effects within the SEZ consist of the ground-disturbing activities associated with construction and the maintenance of an altered environment associated with operations. A maximum of 3,105 acres of direct effect within the SEZ was assumed.

[d] Area of indirect effects was assumed to be the area adjacent to the SEZ within 5 mi (8 km) of the SEZ boundary. Potentially suitable habitat within the SEZ greater than the maximum of 3,105 acres of direct effect was also added to the area of indirect effect. Indirect effects include effects from surface runoff, dust, noise, lighting, and so on from the SEZ, but do not include ground-disturbing activities. The potential degree of indirect effects would decrease with increasing distance away from the SEZ.

[e] For transmission line development, direct effects were estimated within a 2-mi (3.2-km) long, 250-ft (76-m) wide transmission line ROW from the SEZ to the nearest existing transmission line. As the transmission line corridor exists within the area of indirect effects for the SEZ, no additional area of indirect effects were determined for the transmission line.

Footnotes continued on next page.

TABLE 10.3.11.1-1 (Cont.)

[f] Overall impact magnitude categories were based on professional judgment and are as follows: (1) *small*: ≤1% of the population or its habitat would be lost and the activity would not result in a measurable change in carrying capacity or population size in the affected area; (2) *moderate*: >1 but ≤10% of the population or its habitat would be lost and the activity would result in a measurable but moderate (not destabilizing) change in carrying capacity or population size in the affected area; (3) *large*: >10% of a population or its habitat would be lost and the activity would result in a large, measurable, and destabilizing change in carrying capacity or population size in the affected area. Note that much greater weight was given to the magnitude of direct effects because those effects would be difficult to mitigate. Programmatic design features would reduce most indirect effects to negligible levels.

[g] Species-specific mitigations are suggested here, but final mitigations should be developed in consultation with state and federal agencies and should be based on pre-disturbance surveys.

[h] To convert acres to km^2, multiply by 0.004047.

Sources: CDOW (2009); NatureServe (2010); USGS (2004, 2005, 2007).

required actions to avoid or mitigate impacts on amphibians and reptiles (see Section 10.3.11.1.3).

In general, impacts on amphibians and reptiles would result from habitat disturbance (i.e., habitat reduction, fragmentation, and alteration) and from disturbance, injury, or mortality to individual amphibians and reptiles. On the basis of the impacts summarized in Table 10.3.11.1-1, direct impacts on representative amphibian and reptile species would be small, as 0.1% or less of potentially suitable habitats identified for each species in the SEZ region would be lost. Larger areas of potentially suitable habitats for reptile species occur within the area of potential indirect effects (e.g., up to 4.5% of available potentially suitable habitat for the Great Plains toad). Indirect impacts on amphibians and reptiles could result from surface water and sediment runoff from disturbed areas, fugitive dust generated by project activities, accidental spills, collection, and harassment. These indirect impacts are expected to be negligible with implementation of programmatic design features.

Decommissioning of facilities and reclamation of disturbed areas after operations cease could result in short-term negative impacts on individuals and habitats adjacent to project areas, but long-term benefits would accrue if suitable habitats were restored in previously disturbed areas. Section 5.10.2.1.4 provides an overview of the impacts of decommissioning and reclamation on wildlife. Of particular importance for amphibian and reptile species would be the restoration of original ground surface contours, soils, and native plant communities associated with semiarid shrublands.

10.3.11.1.3 SEZ-Specific Design Features and Design Feature Effectiveness

The successful implementation of programmatic design features presented in Appendix A, Section A.2.2, would reduce the potential for effects on amphibians and reptiles, especially for those species that utilize habitat types that can be avoided (e.g., small palustrine wetlands). Indirect impacts could be reduced to negligible levels by implementing programmatic design features, especially those engineering controls that would reduce runoff, sedimentation, spills, and fugitive dust. While some SEZ-specific design features are best established when considering specific project details, design features that can be identified at this time include the following:

- Wetland habitats within the SEZ should be avoided to the extent practicable.

- Appropriate engineering controls should be used to minimize impacts on the washes that drain off of the Sangre de Cristo Mountains and on Smith Reservoir resulting from surface water runoff, erosion, sedimentation, accidental spills, or fugitive dust deposition to these habitats.

- Transmission line towers should be sited and constructed to minimize impacts on wetlands and riparian areas (if present within the finalized ROW location) and span them whenever practicable.

If these SEZ-specific design features are implemented in addition to other programmatic design features, impacts on amphibian and reptile species could be reduced. Any residual impacts on amphibians and reptiles are anticipated to be small given the relative abundance of potentially suitable habitats in the SEZ region. However, as potentially suitable habitats for a number of the amphibian and reptile species occur throughout much of the SEZ, additional species-specific mitigation of direct effects for those species would be difficult or infeasible.

10.3.11.2 Birds

10.3.11.2.1 Affected Environment

This section addresses bird species that are known to occur, or for which suitable habitat occurs, on or within the potentially affected area of the proposed Fourmile East SEZ. The list of bird species potentially present in the SEZ area was determined from the Colorado Natural Diversity Information Source (CDOW 2009) and habitat information was determined from CDOW (2009), USGS (2007), and NatureServe (2010). Land cover types suitable for each species were determined from SWReGAP (USGS 2004, 2005, 2007). See Appendix M for additional information on the approach used.

Waterfowl, Wading Birds, and Shorebirds

As discussed in Section 4.10.2.2.2, waterfowl (ducks, geese, and swans), wading birds (herons and cranes), and shorebirds (avocets, gulls, plovers, rails, sandpipers, stilts, and terns) are among the most abundant groups of birds in the six-state study area. Within the proposed Fourmile East SEZ and the adjacent area of indirect effects, waterfowl, wading birds, and shorebirds are uncommon because of the lack of aquatic and wetland habitats. Smith Reservoir, located about 5 mi (8 km) southeast of the SEZ, and San Luis Lake, located 5 mi (8 km) northwest of the SEZ, provide more productive habitats for waterfowl, wading birds, and shorebirds. The mountain plover (*Charadrius montanus*) may occur on the SEZ. This special status species is discussed in Section 10.3.12.

Neotropical Migrants

As discussed in Section 4.10.2.2.3, neotropical migrants represent the most diverse category of birds within the six-state study area. Neotropical migrant species that are common or abundant within Alamosa County and that are expected to occur within the SEZ include the Brewer's blackbird (*Euphagus cyanocephalus*), Brewer's sparrow (*Spizella breweri*), common nighthawk (*Chordeiles minor*), horned lark (*Eremophila alpestris*), vesper sparrow (*Pooecetes gramineus*), and western meadowlark (*Sturnella neglecta*) (CDOW 2009; USGS 2007).

Birds of Prey

Section 4.10.2.2.4 provides an overview of the birds of prey (raptors, owls, and vultures) within the six-state study area. Species expected to occur within the SEZ include the American kestrel (*Falco sparverius*), golden eagle (*Aquila chrysaetos*), red-tailed hawk (*Buteo jamaicensis*), short-eared owl (*Asio flammeus*), and Swainson's hawk (*Buteo swainsoni*) (CDOW 2009; USGS 2007). Special status birds of prey species are discussed in Section 10.3.12.

Upland Game Birds

Section 4.10.2.2.5 provides an overview of the upland game birds (primarily pheasants, grouse, quail, and doves) that occur within the six-state study area. The mourning dove (*Zenaida macroura*) is the only upland game bird species expected to occur within the proposed Fourmile East SEZ. No activity areas mapped for upland game birds such as the wild turkey (*Meleagris gallopavo*) occur within 5 mi (8 km) of the SEZ (CDOW 2008).

Table 10.3.11.2-1 provides habitat information and the types and overall area of potentially suitable land cover for most of the bird species mentioned above.

10.3.11.2.2 Impacts

The types of impacts that birds could incur from construction, operation, and decommissioning of utility-scale solar energy facilities are discussed in Section 5.10.2.1. Any such impacts would be minimized through the implementation of required programmatic design features described in Appendix A, Section A.2.2, and through any additional mitigation measures applied. Section 10.3.11.2.3, below, identifies design features of particular relevance to the proposed Fourmile East SEZ.

The assessment of impacts on bird species is based on available information on the presence of species in the affected area, as presented in Section 10.3.11.2.1 following the analysis approach described in Appendix M. Additional NEPA assessments and coordination with federal or state natural resource agencies may be needed to address project-specific impacts more thoroughly. These assessments and consultations could result in additional required actions to avoid or mitigate impacts on birds (see Section 10.3.11.2.3).

In general, impacts on birds would result from habitat disturbance (i.e., habitat reduction, fragmentation, and alteration) and from disturbance, injury, or mortality to individual birds. Table 10.3.11.2-1 summarizes the potential impacts on birds resulting from solar energy development in the Fourmile East SEZ. Direct impacts on bird species would be small, as only 0.4% or less of potentially suitable habitats identified for each species would be lost. Larger areas of potentially suitable habitat for bird species occur within the area of potential indirect effects (e.g., up to 3.4% of available habitat for horned lark). Other impacts on birds could result

TABLE 10.3.11.2-1 Habitats, Potential Impacts, and Potential Mitigation for Representative Bird Species That Could Occur on or in the Affected Area of the Proposed Fourmile East SEZ

		Maximum Area of Potential Habitat Affected[b]			
Common Name (Scientific Name)	Habitat[a]	Within SEZ (Direct Effects)[c]	Outside SEZ (Indirect Effects)[d]	Within Transmission Line Corridor (Indirect and Direct Effects)[e]	Overall Impact Magnitude[f] and Species-Specific Mitigation[g]
Neotropical Migrants					
Brewer's blackbird (*Euphagus cyanocephalus*)	Meadows, grasslands, riparian areas, agricultural and urban areas, and occasionally in sagebrush in association with prairie dog colonies and other shrublands. Requires dense shrubs for nesting. Roosts in marshes or dense vegetation. In winter, most often near open water and farmyards with livestock. About 2,009,900 acres of potentially suitable habitat occurs in the SEZ region.[d]	1,266 acres of potentially suitable habitat lost (0.06% of available potentially suitable habitat)	31,118 acres of potentially suitable habitat (1.5% of available potentially suitable habitat)	52 acres of potentially suitable habitat in area of potential direct effect and 1,046 acres of potentially suitable habitat in area of indirect effect	Small overall impact. Avoidance of prairie dog colonies would further reduce the potential for impact. Some measure of mitigation provided by the requirements of the Migratory Bird Treaty Act.
Brewer's sparrow (*Spizella breweri*)	Breeds in sagebrush shrublands. Also occur in mountain mahogany or rabbitbrush. During migration, frequents woody, brushy, or weedy agricultural and urban areas. Inhabits sagebrush and shrubby desert habitat during winter. About 630,900 acres of potentially suitable habitat occurs in the SEZ region.	589 acres of potentially suitable habitat lost (0.09% of available potentially suitable habitat)	7,381 acres of potentially suitable habitat (1.2% of available potentially suitable habitat)	1 acre of potentially suitable habitat in area of potential direct effect and 28 acres of potentially suitable habitat in area of indirect effect	Small overall impact. Some measure of mitigation provided by the requirements of the Migratory Bird Treaty Act.
Common nighthawk (*Chordeiles minor*)	Grasslands, sagebrush, semidesert shrublands, open riparian and ponderosa pine forests, pinyon-juniper woodlands, and agricultural and urban areas. Also occurs in other habitats when foraging. About 2,913,900 acres of potentially suitable habitat occurs in the SEZ region.	2,602 acres of potentially suitable habitat lost (0.4% of available potentially suitable habitat)	54,307 acres of potentially suitable habitat (1.9% of available potentially suitable habitat)	18 acres of potentially suitable habitat in area of potential direct effect and 369 acres of potentially suitable habitat in area of indirect effect	Small overall impact.. Some measure of mitigation provided by the requirements of the Migratory Bird Treaty Act.

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TABLE 10.3.11.2-1 (Cont.)

Common Name (Scientific Name)	Habitat[a]	Maximum Area of Potential Habitat Affected[b]: Within SEZ (Direct Effects)[c]	Outside SEZ (Indirect Effects)[d]	Within Transmission Line Corridor (Indirect and Direct Effects)[e]	Overall Impact Magnitude[f] and Species-Specific Mitigation[g]
Neotropical Migrants (Cont.)					
Horned lark (*Eremophila alpestris*)	Breeds in grasslands, sagebrush, semidesert shrublands, and alpine tundra. During migration and winter, inhabits the same habitats other than tundra, and also occur in agricultural areas. They usually occur where plant density is low and there are exposed soils. About 2,214,500 acres of potentially suitable habitat occurs in the SEZ region.	3,105 acres of potentially suitable habitat lost (0.1% of available potentially suitable habitat)	76,183 acres of potentially suitable habitat (3.4% of available potentially suitable habitat)	70 acres of potentially suitable habitat in area of potential direct effect and 1,407 acres of potentially suitable habitat in area of indirect effect	Small overall impact. No species-specific mitigation of direct effects is feasible because suitable habitat is widespread in the area of direct effect. Some measure of mitigation provided by the requirements of the Migratory Bird Treaty Act.
Vesper sparrow (*Pooecetes gramineus*)	Breeds in grasslands, open shrublands mixed with grasslands, and open pinyon-juniper woodlands. Occurs in open riparian and agricultural areas during migration. About 2,607,400 acres of potentially suitable habitat occurs in the SEZ region.	2,602 acres of potentially suitable habitat lost (0.1% of available potentially suitable habitat)	48,950 acres of potentially suitable habitat (1.9% of available potentially suitable habitat)	18 acres of potentially suitable habitat in area of potential direct effect and 369 acres of potentially suitable habitat in area of indirect effect	Small overall impact. No species-specific mitigation of direct effects is feasible because suitable habitat is widespread in the area of direct effect. Some measure of mitigation provided by the requirements of the Migratory Bird Treaty Act.

TABLE 10.3.11.2-1 (Cont.)

Common Name (Scientific Name)	Habitat[a]	Maximum Area of Potential Habitat Affected[b] Within SEZ (Direct Effects)[c]	Outside SEZ (Indirect Effects)[d]	Within Transmission Line Corridor (Indirect and Direct Effects)[e]	Overall Impact Magnitude[f] and Species-Specific Mitigation[g]
Neotropical Migrants (Cont.)					
Western meadowlark (*Sturnella neglecta*)	Agricultural areas, especially in winter. Also inhabits native grasslands, croplands, weedy fields, and less commonly in semidesert and sagebrush shrublands. About 2,877,800 acres of potentially suitable habitat occurs in the SEZ region.	3,105 acres of potentially suitable habitat lost (0.1% of available potentially suitable habitat)	76,933 acres of potentially suitable habitat (2.7% of available potentially suitable habitat)	70 acres of potentially suitable habitat in area of potential direct effect and 1,405 acres of potentially suitable habitat in area of indirect effect	Small overall impact. No species-specific mitigation of direct effects is feasible because suitable habitat is widespread in the area of direct effect. Some measure of mitigation provided by the requirements of the Migratory Bird Treaty Act.
Birds of Prey					
American kestrel (*Falco sparverius*)	Wide variety of open to semi-open habitats including agricultural areas, grasslands, riparian forest edges, and urban areas. Occurs in most habitats, especially during migration. About 4,395,900 acres of potentially suitable habitat occurs in the SEZ region.	3,105 acres of potentially suitable habitat lost (0.07% of available potentially suitable habitat)	89,055 acres of potentially suitable habitat (2.0% of available potentially suitable habitat)	70 acres of potentially suitable habitat in area of potential direct effect and 1,405 acres of potentially suitable habitat in area of indirect effect	Small overall impact. No species-specific mitigation of direct effects is feasible because suitable habitat is widespread in the area of direct effect.

TABLE 10.3.11.2-1 (Cont.)

Common Name (Scientific Name)	Habitat[a]	Maximum Area of Potential Habitat Affected[b]: Within SEZ (Direct Effects)[c]	Maximum Area of Potential Habitat Affected[b]: Outside SEZ (Indirect Effects)[d]	Maximum Area of Potential Habitat Affected[b]: Within Transmission Line Corridor (Indirect and Direct Effects)[e]	Overall Impact Magnitude[f] and Species-Specific Mitigation[g]
Birds of Prey (Cont.)					
Golden eagle (*Aquila chrysaetos*)	Grasslands, shrublands, pinyon-juniper woodlands, and ponderosa pine forests. Occasionally in most other habitats, especially during migration and winter. Nests on cliffs and sometimes trees in rugged areas, with breeding birds ranging widely over surrounding areas. About 4,699,600 acres of potentially suitable habitat occurs in the SEZ region.	3,105 acres of potentially suitable habitat lost (0.07% of available potentially suitable habitat)	88,596 acres of potentially suitable habitat (1.9% of available potentially suitable habitat)	70 acres of potentially suitable habitat in area of potential direct effect and 1,405 acres of potentially suitable habitat in area of indirect effect	Small overall impact. No species-specific mitigation of direct effects is feasible because suitable habitat is widespread in the area of direct effect. Some measure of mitigation provided by the requirements of the Bald and Golden Eagle Protection Act.
Red-tailed hawk (*Buteo jamaicensis*)	Wide variety of habitats from deserts, mountains, and populated valleys. Open areas with scattered, elevated perch sites such as scrub desert, plains and montane grassland, agricultural fields, pastures urban parklands, broken coniferous forests, and deciduous woodland. Nests on cliff ledges or in tall trees. About 3,072,200 acres of potentially suitable habitat occurs in the SEZ region.	2,602 acres of potentially suitable habitat lost (0.08% of available potentially suitable habitat)	52,359 acres of potentially suitable habitat (1.7% of available potentially suitable habitat)	18 acres of potentially suitable habitat in area of potential direct effect and 369 acres of potentially suitable habitat in area of indirect effect)	Small overall impact. No species-specific mitigation of direct effects is feasible because suitable habitat is widespread in the area of direct effect.

TABLE 10.3.11.2-1 (Cont.)

Common Name (Scientific Name)	Habitat[a]	Maximum Area of Potential Habitat Affected[b]: Within SEZ (Direct Effects)[c]	Maximum Area of Potential Habitat Affected[b]: Outside SEZ (Indirect Effects)[d]	Maximum Area of Potential Habitat Affected[b]: Within Transmission Line Corridor (Indirect and Direct Effects)[e]	Overall Impact Magnitude[f] and Species-Specific Mitigation[g]
Birds of Prey (Cont.)					
Swainson's hawk (*Buteo swainsoni*)	Grasslands, agricultural areas, shrublands, and riparian forests. Nests in trees in or near open areas. Migrants occur often occur in treeless areas. Large flocks often occur in agricultural areas near locust infestations. About 2,246,600 acres of potentially suitable habitat occurs in the SEZ region.	2,013 acres of potentially suitable habitat lost (0.09% of available potentially suitable habitat)	46,632 acres of potentially suitable habitat (2.1% of available potentially suitable habitat)	17 acres of potentially suitable habitat in area of potential direct effect and 347 acres of potentially suitable habitat in area of indirect effect	Small overall impact. Avoidance of nest trees would further reduce the potential for impact.
Upland Game Birds					
Mourning dove (Zenaida macroura)	Habitat generalist, occurring in grasslands, shrublands, croplands, lowland and foothill riparian forests, ponderosa pine forests, and urban and suburban areas. Rarely in aspen and other forests, coniferous woodlands, and alpine tundra. Nests on ground or in trees. Winters mostly in lowland riparian forests adjacent to cropland. About 3,404,400 acres of potentially suitable habitat occurs in the SEZ region.	3,105 acres of potentially suitable habitat lost (0.09% of available potentially suitable habitat)	84,440 acres of potentially suitable habitat (2.5% of available potentially suitable habitat)	70 acres of potentially suitable habitat in area of potential direct effect and 1,407 acres of potentially suitable habitat in area of indirect effect	Small overall impact. No species-specific mitigation of direct effects is feasible because suitable habitat is widespread in the area of direct effect.

[a] Potentially suitable habitat was determined by using SWReGAP habitat suitability and land cover models. Area of potentially suitable habitat for each species is presented for the SEZ region, which is defined as the area within 50 mi (80 km) of the SEZ center.

[b] Maximum area of potentially suitable habitat that could be affected relative to availability within the SEZ region. Habitat availability for each species within the region was determined by using SWReGAP habitat suitability and land cover models. This approach probably overestimates the amount of suitable habitat in the project area.

[c] Direct effects within the SEZ consist of the ground-disturbing activities associated with construction and the maintenance of an altered environment associated with operations. A maximum of 3,105 acres of direct effect within the SEZ was assumed.

Footnotes continued on next page.

TABLE 10.3.11.2-1 (Cont.)

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[d] Area of indirect effects was assumed to be the area adjacent to the SEZ within 5 mi (8 km) of the SEZ boundary. Potentially suitable habitat within the SEZ greater than the maximum of 3,105 acres of direct effect was also added to the area of indirect effect. Indirect effects include effects from surface runoff, dust, noise, lighting, and so on from the SEZ, but do not include ground-disturbing activities. The potential degree of indirect effects would decrease with increasing distance away from the SEZ.

[e] For transmission line development, direct effects were estimated within a 2-mi (3.2-km) long, 250-ft (76-m) wide transmission line ROW from the SEZ to the nearest existing transmission line. As the transmission line corridor exists within the area of indirect effects for the SEZ, no additional area of indirect effects were determined for the transmission line.

[f] Overall impact magnitude categories were based on professional judgment and are as follows: (1) *small*: $\leq$1% of the population or its habitat would be lost and the activity would not result in a measurable change in carrying capacity or population size in the affected area; (2) *moderate*: >1 but $\leq$10% of the population or its habitat would be lost and the activity would result in a measurable but moderate (not destabilizing) change in carrying capacity or population size in the affected area; (3) *large*: >10% of a population or its habitat would be lost and the activity would result in a large, measurable, and destabilizing change in carrying capacity or population size in the affected area. Note that much greater weight was given to the magnitude of direct effects because those effects would be difficult to mitigate. Programmatic design features would reduce most indirect effects to negligible levels.

[g] Species-specific mitigations are suggested here, but final mitigations should be developed in consultation with state and federal agencies and should be based on pre-disturbance surveys.

[h] To convert acres to km^2, multiply by 0.004047.

Sources: CDOW (2009); NatureServe (2010); USGS (2004, 2005, 2007).

from collision with the transmission line and buildings, surface water and sediment runoff from disturbed areas, fugitive dust generated by project activities, noise, lighting, spread of invasive species, accidental spills, and harassment. Indirect impacts on areas outside the SEZ (e.g., impacts caused by dust generation, erosion, and sedimentation) are expected to be negligible with implementation of programmatic design features.

Decommissioning of facilities and reclamation of disturbed areas after operations cease could result in short-term negative impacts on individuals and habitats adjacent to project areas, but long-term benefits would accrue if suitable habitats were restored in previously disturbed areas. Section 5.10.2.1.4 provides an overview of the impacts of decommissioning and reclamation on wildlife. Of particular importance for bird species would be the restoration of original ground surface contours, soils, and native plant communities associated with semiarid shrublands.

10.3.11.2.3 SEZ-Specific Design Features and Design Feature Effectiveness

The implementation of required programmatic design features described in Appendix A, Section A.2.2, would reduce the potential for effects on birds, especially for those species that depend on habitat types that can be avoided (e.g., palustrine wetlands). Indirect impacts could be reduced to negligible levels by implementing programmatic design features, especially those engineering controls that would reduce runoff, sedimentation, spills, and fugitive dust. While some SEZ-specific design features are best established when considering specific project details, design features that can be identified at this time include the following:

- For solar energy developments that occur within the SEZ, the requirements contained within the 2010 Memorandum of Understanding between the BLM and USFWS to promote the conservation of migratory birds will be followed.

- Appropriate engineering controls should be used to minimize impacts resulting from surface water runoff, erosion, sedimentation, accidental spills, or fugitive dust deposition.

- Take of golden eagles and other raptors should be avoided. Mitigation regarding the golden eagle should be developed in consultation with the USFWS and the CDOW. A permit may be required under the Bald and Golden Eagle Protection Act.

- Transmission line towers should be sited and constructed to minimize impacts on wetlands and riparian areas (if present within the finalized ROW location) and span them whenever practicable.

- If present, prairie dog colonies (which could provide habitat or a food source for some bird species) should be avoided to the extent practicable.

If these SEZ-specific design features are implemented in addition to other programmatic design features, impacts on bird species could be reduced. Any residual impacts on birds are anticipated to be small given the relative abundance of potentially suitable habitats in the SEZ region. However, as potentially suitable habitats for a number of the bird species occur throughout much of the SEZ, additional species-specific mitigation of direct effects for those species would be difficult or infeasible.

10.3.11.3 Mammals

10.3.11.3.1 Affected Environment

This section addresses mammal species that are known to occur, or for which potentially suitable habitat occurs, on or within the potentially affected area of the proposed Fourmile East SEZ. The list of mammal species potentially present in the SEZ area was determined from the Colorado Natural Diversity Information Source (CDOW 2009) and habitat information from CDOW (2009), USGS (2007), and NatureServe (2010). Land cover types suitable for each species were determined from SWReGAP (USGS 2004, 2005, 2007). See Appendix M for additional information on the approach used. The following discussion emphasizes big game and other mammal species that (1) have key habitats within or near the SEZ, (2) are important to humans (e.g., big game, small game, and furbearer species), and/or (3) are representative of other species that share similar habitats.

Big Game

The big game species that could occur within the area of the proposed Fourmile East SEZ include American black bear (*Ursus americanus*), bighorn sheep (*Ovis canadensis*), cougar (*Puma concolor*), elk (*Cervis canadensis*), mule deer (*Odocoileus hemionus*), and pronghorn (*Antilocapra americana*) (CDOW 2009). Table 10.3.11.3-1 provides a description of the various activity areas that have been mapped for the big game species in Colorado. Table 10.3.11.3-2 (located after the discussion on other mammal species) provides habitat information for representative mammal species, including big game species that could occur within the proposed Fourmile East SEZ.

The following paragraphs present an overview of the big game species (Section 4.10.2.3 presents more detailed information on the big game species).

American Black Bear. The proposed Fourmile East SEZ is located within the American black bear's overall range but does not overlap with its mapped summer or fall concentration areas (CDOW 2008).

TABLE 10.3.11.3-1 Descriptions of Big Game Activity Areas in Colorado

Activity Area	Activity Area Description
Concentration area	That part of the overall range where densities are at least 200% greater than they are in the surrounding area during a season other than winter.
Fall concentration area	That part of the overall range occupied from August 15 until September 30 for the purpose of ingesting large quantities of mast and berries to establish fat reserves for the winter hibernation period. Applies to the American black bear.
Migration corridor	Specific mappable site through which large numbers of animals migrate and the loss of which would change migration routes.
Overall range	Area that encompasses all known seasonal activity areas for a population.
Production area	That part of the overall range occupied by females from May 15 to June 15 for calving. Applies to ungulates.
Resident population area	Area used year-round by a population (i.e., an individual could be found in any part of the area at any time of the year).
Severe winter range	That part of the winter range where 90% of the individuals are located when the annual snowpack is at its maximum and/or temperatures are at a minimum during the two worst winters out of ten. Applies to ungulates.
Summer concentration area	That portion of the overall range where individuals congregate from mid-June through mid-August.
Summer range	That portion of the overall range where 90% of the individuals are located between spring green-up and the first heavy snowfall.
Winter concentration area	That part of the winter range where densities are at least 200% greater than in surrounding winter range during an average of five winters out of ten.
Winter range	That part of the overall range where 90% of the individuals are located during an average of five winters out of ten from the first heavy snowfall to spring green-up.

Source: CDOW (2008).

The closest distances of the SEZ to the other American black bear activity areas are fall concentration area, 6 mi (10 km) and summer concentration area, 3 mi (5 km). Since the American black bear prefers montane shrublands and forests and subalpine forests at moderate elevations in Colorado (CDOW 2009), it is not expected to frequent the proposed Fourmile East SEZ.

Bighorn Sheep. The proposed Fourmile East SEZ does not occur within any mapped activity areas for the bighorn sheep (Figure 10.3.11.3-1). The SEZ does occur within 5 mi (8 km) of several bighorn sheep activity areas: overall range, 3 mi (5 km); winter range, 4 mi (7 km);

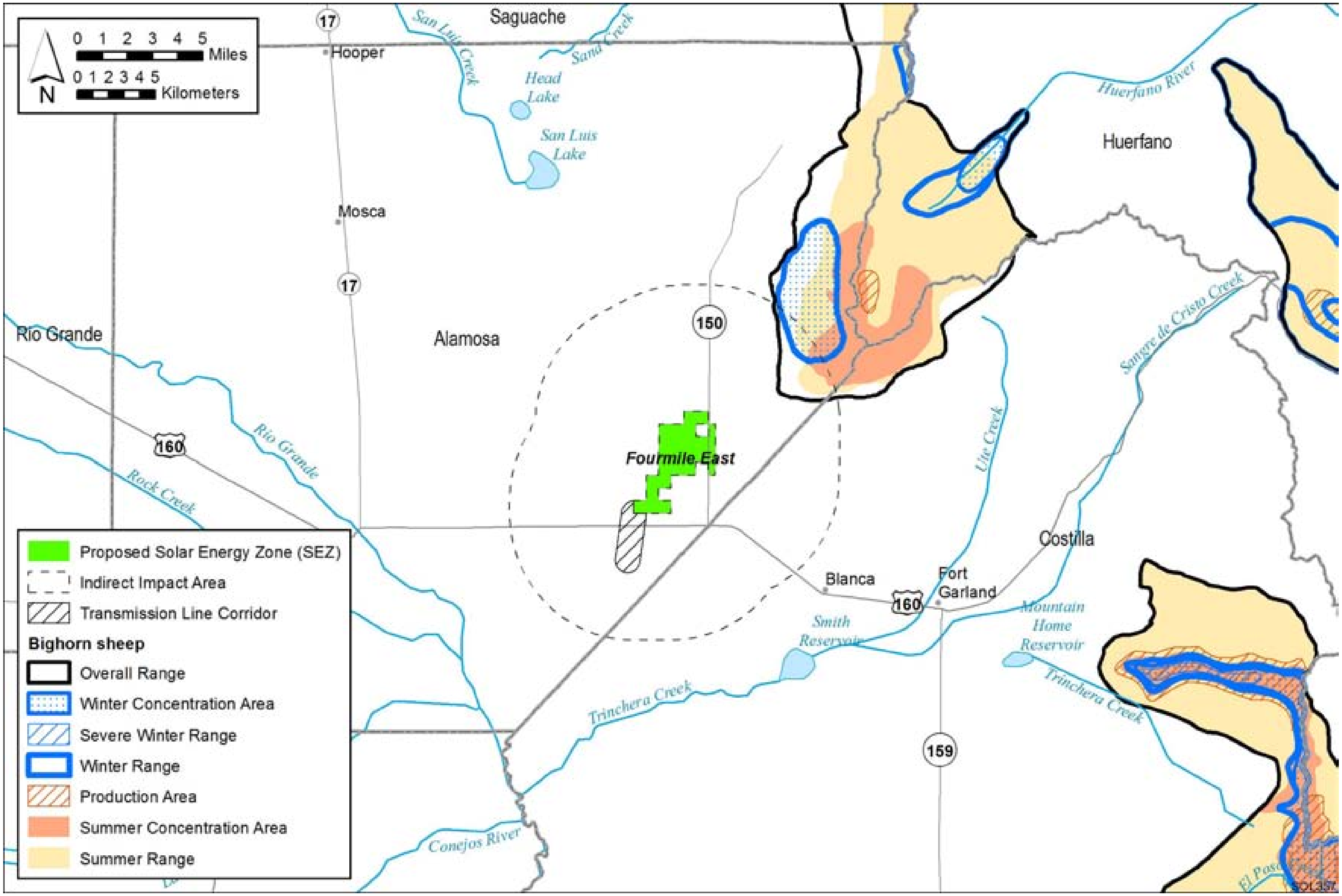

FIGURE 10.3.11.3-1 Bighorn Sheep Activity Areas within the Region That Encompasses the Proposed Fourmile East SEZ (Source: CDOW 2008)

winter concentration area, 4 mi (6.9 km); summer range, 4.0 mi (6.4 km); and summer concentration area, 5 mi (8 km). These activity areas are all located northeast of the SEZ (Figure 10.3.11.3-1). Since bighorn sheep typically inhabit mountains and foothills in Colorado (CDOW 2009), they are not expected to frequent the proposed Fourmile East SEZ.

Cougar. The proposed Fourmile East SEZ occurs within the overall range of the cougar (CDOW 2008). Within Colorado, cougars mostly occur in rough, broken foothills and canyon country, often in association with montane forests, shrublands, and pinyon-juniper woodlands (CDOW 2009). Thus, they are not expected to frequent the SEZ.

Elk. The proposed Fourmile East SEZ occurs within the overall range and summer range of the elk (Figure 10.3.11.3-2). The SEZ also occurs within 5 mi (8 km) of several other elk activity areas: winter range, 0.1 mi (0.2 km); severe winter range, 0.2 mi (0.3 km); winter concentration area, 0.5 mi (0.8 km); summer concentration area, 4 mi (7 km); production area, 4 mi (7 km); and resident population area, 5 mi (8 km). These activity areas are located from north to east of the SEZ (Figure 10.3.11.3-2).

Mule Deer. The proposed Fourmile East SEZ occurs within the mule deer's overall range but does not overlap any of its other mapped activity areas (Figure 10.3.11.3-3). The SEZ also occurs within 5 mi (8 km) of several other mule deer activity areas: winter range, 0.3 mi (0.5 km); severe winter range, 0.7 mi (1.1 km); winter concentration area, 1.2 mi (1.9 km); summer range, 0.3 mi (0.5 km); resident population area, 5 mi (8 km); and concentration area, 4 mi (7 km). The resident population area is west of the proposed Fourmile East SEZ, while the other activity areas are northeast to east of the SEZ (Figure 10.3.11.3-3).

Pronghorn. The proposed Fourmile East SEZ occurs within the overall range and winter range of the pronghorn. The SEZ also occurs 2.6 mi (4.2 km) northwest of a pronghorn winter concentration area (Figure 10.3.11.3-4). No other pronghorn activity areas occur within 5 mi (8 km) of the SEZ.

Other Mammals

A number of furbearers and small game mammal species occur within the area of the proposed Fourmile East SEZ. Those species that are fairly common to abundant within the Alamosa County and that could occur within the area of the SEZ include the American badger (*Taxidea taxus*, fairly common), coyote (*Canis latrans*, common), desert cottontail (*Sylvilagus audubonii*, abundant), red fox (*Vulpes vulpes*, common), striped skunk (*Mephitis mephitis*, common), and white-tailed jackrabbit (*Lepus townsendii*, common) (CDOW 2009). Most of these species are hunted or trapped.

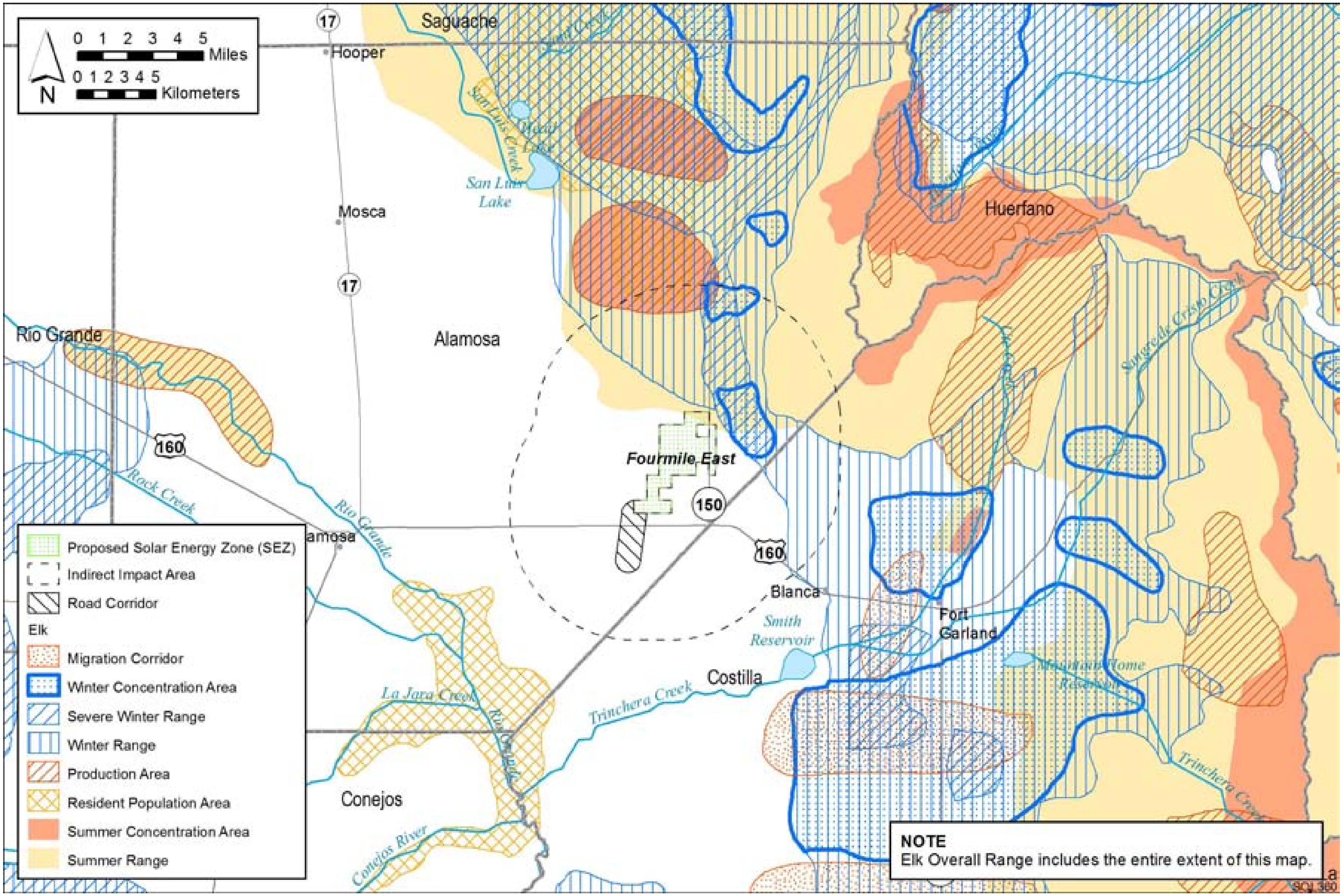

FIGURE 10.3.11.3-2 Elk Activity Areas within the Region That Encompasses the Proposed Fourmile East SEZ (Source: CDOW 2008)

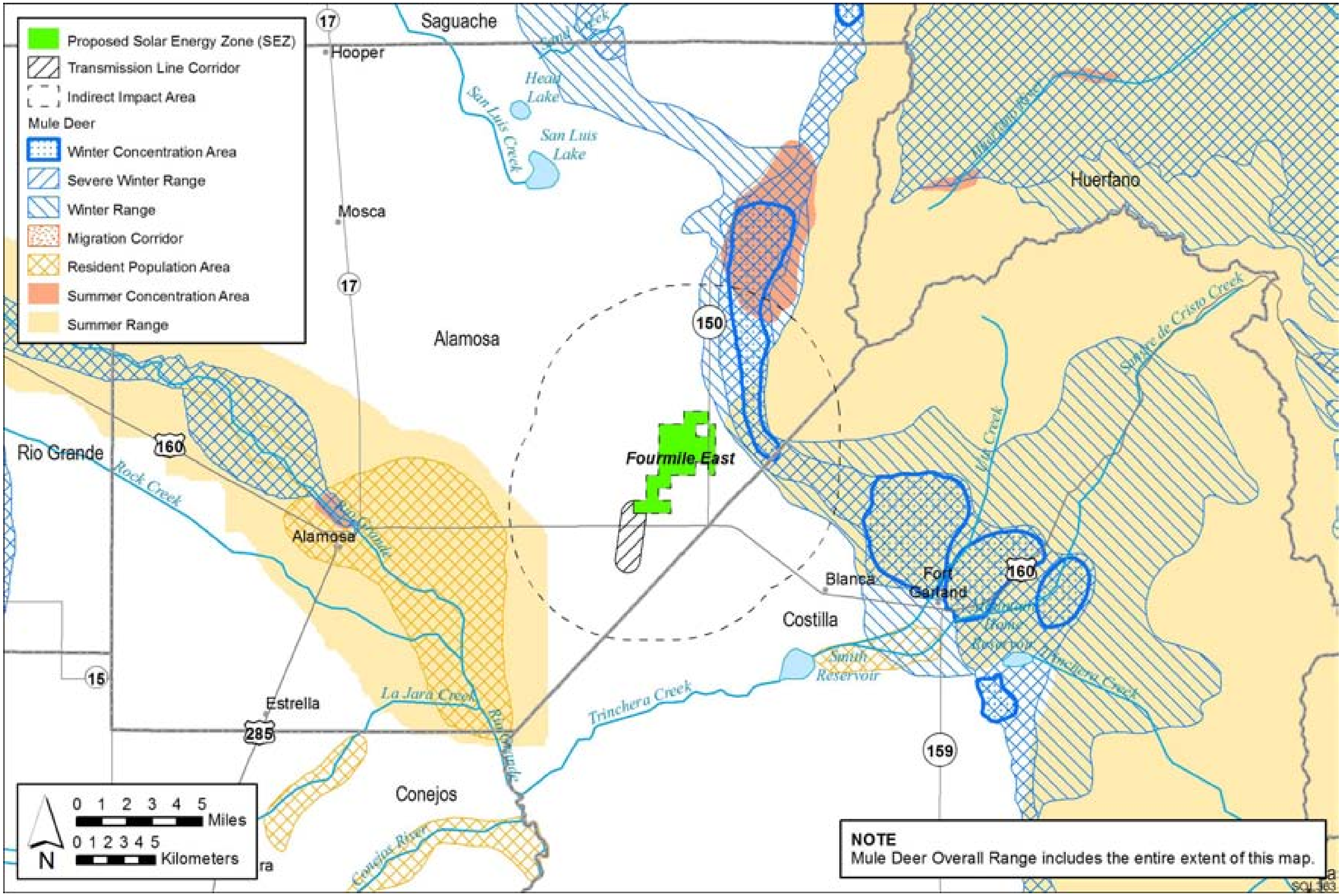

FIGURE 10.3.11.3-3 Mule Deer Activity Areas within the Region That Encompasses the Proposed Fourmile East SEZ (Source: CDOW 2008)

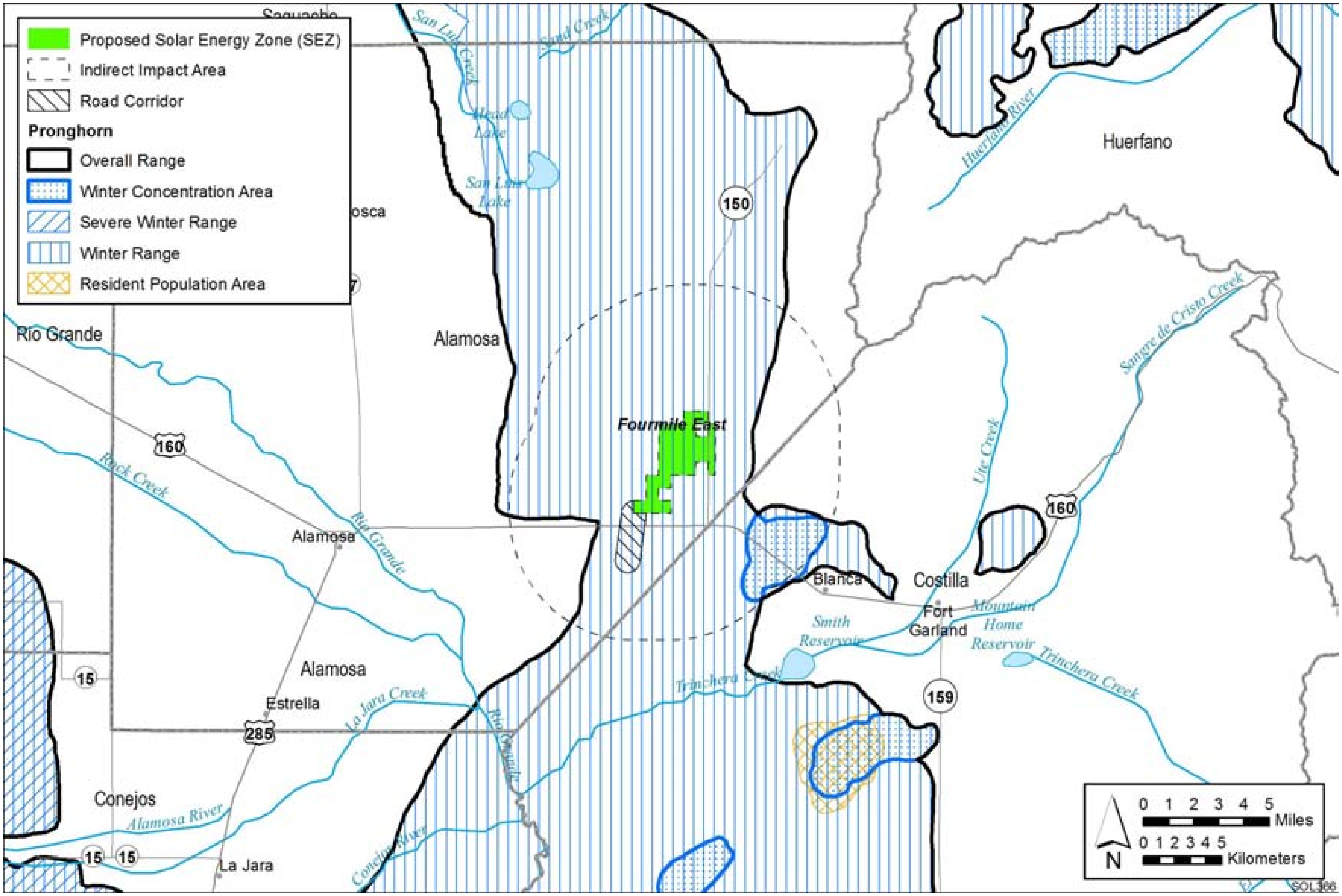

FIGURE 10.3.11 .3-4 Pronghorn Activity Areas within the Region That Encompasses the Proposed Fourmile East SEZ (Source: CDOW 2008)

The small nongame mammal species generally include bats, rodents, and shrews. Those species that are common or abundant within Alamosa County and that could occur within the area of the proposed Fourmile East SEZ include the big brown bat (*Eptesicus fuscus*, abundant), deer mouse (*Peromyscus maniculatus*, abundant), least chipmunk (*Tamias minimus*, common), little brown myotis (*Myotis lucifugus*, abundant), northern pocket gopher (*Thomomys talpoides*, common), Ord's kangaroo rat (*Dipodomys ordii*, abundant), thirteen-lined ground squirrel (*Spermophilus tridecemlineatus*, common), and western small-footed myotis (*Myotis ciliolabrum*, common). The Gunnison's prairie dog (*Cynomys gunnisoni*) is fairly common in the county and is also expected to occur within the semidesert habitat found within the SEZ (CDOW 2009). Due to its special status (candidate for listing under the ESA), the species is discussed in Section 10.3.12.

Table 10.3.11.3-2 provides habitat information for representative mammal species that could occur within the proposed Fourmile East SEZ.

10.3.11.3.2 Impacts

The types of impacts that mammals could incur from construction, operation, and decommissioning of utility-scale solar energy facilities are discussed in Section 5.10.2.1. Any such impacts would be minimized through the implementation of required programmatic design features described in Appendix A, Section A.2.2, and through any additional mitigation applied. Section 10.3.11.3.3 below identifies SEZ-specific design features of particular relevance to the proposed Fourmile East SEZ.

The assessment of impacts on mammal species is based on available information on the presence of species in the affected area as presented in Section 10.3.11.3.1, following the analysis approach described in Appendix M. Additional NEPA assessments and coordination with state natural resource agencies may be needed to address project-specific impacts more thoroughly. These assessments and consultations could result in additional required actions to avoid or mitigate impacts on mammals (see Section 10.3.11.3.3).

Table 10.3.11.3-2 summarizes the potential impacts on representative mammal species resulting from solar energy development (with the inclusion of programmatic design features) in the proposed Fourmile East SEZ.

American Black Bear

Based on potentially suitable land cover, up to 589 acres (2.4 km^2) of potentially suitable American black bear habitat could be lost by solar energy development within the proposed Fourmile East SEZ and another 1 acre (0.004 km^2) by transmission line construction. This represents 0.02% of potentially suitable American black bear habitat within the SEZ region. Over 17,800 acres (72 km^2) of potentially suitable American black bear habitat occurs within the area of indirect effects. As desert-like shrublands are not the preferred habitat for the American black bear, it is unlikely that impacts on the SEZ would represent an actual loss of occupied habitat.

TABLE 10.3.11.3-2 Habitats, Potential Impacts, and Potential Mitigation for Representative Mammal Species That Could Occur on or in the Affected Area of the Proposed Fourmile East SEZ

Common Name (Scientific Name)	Habitat[a]	Maximum Area of Potential Habitat Affected[b]			Overall Impact Magnitude[f] and Species-Specific Mitigation[g]
		Within SEZ (Direct Effects)[c]	Outside SEZ (Indirect Effects)[d]	Within Transmission Line Corridor (Indirect and Direct Effects)[e]	
Big Game					
American black bear (*Ursus americanus*)	Montane shrublands and forests, and subalpine forests at moderate elevations. Fairly common in Conejos County. About 2,492,300 acres of potentially suitable habitat occurs in the SEZ region.[d]	589 acres[g] of potentially suitable habitat lost (0.02% of available potentially suitable habitat)	17,850 acres of potentially suitable habitat (0.7% of available habitat)	1 acre of potentially suitable habitat in area of potential direct effect and 30 acres of potentially suitable habitat in area of indirect effect	Small overall impact.
Bighorn sheep (*Ovis canadensis*)	Prefers high-visibility habitat dominated by grass, low shrubs, and rock cover, areas near open escape terrain, and topographic relief. Due to human influence, typically occurs only on steep, precipitous terrain although some herds have habituated to areas adjacent to busy highways. Common in Conejos County. About 3,401,300 acres of potentially suitable habitat occurs in the SEZ region.	2,602 acres of potentially suitable habitat lost (0.08% of available potentially suitable habitat)	57,021 acres of potentially suitable habitat (1.7% of available habitat)	18 acres of potentially suitable habitat in area of potential direct effect and 363 acres of potentially suitable habitat in area of indirect effect	Small overall impact. No species-specific mitigation of direct effects is feasible because suitable habitat is widespread in the area of direct effect.
Cougar (*Puma concolor*)	Most common in rough, broken foothills and canyon country, often in association with montane forests, shrublands, and pinyon-juniper woodlands. Uncommon in Conejos County. About 3,714,900 acres of potentially suitable habitat occurs in the SEZ region.	2,602 acres of potentially suitable habitat lost (0.07% of available potentially suitable habitat)	58,123 acres of potentially suitable habitat (1.6% of available habitat)	18 acres of potentially suitable habitat in area of potential direct effect and 369 acres of potentially suitable habitat in area of indirect effect	Small overall impact. No species-specific mitigation of direct effects is feasible because suitable habitat is widespread in the area of direct effect.

TABLE 10.3.11.3-2 (Cont.)

Common Name (Scientific Name)	Habitat[a]	Maximum Area of Potential Habitat Affected[b]: Within SEZ (Direct Effects)[c]	Outside SEZ (Indirect Effects)[d]	Within Transmission Line Corridor (Indirect and Direct Effects)[e]	Overall Impact Magnitude[f] and Species-Specific Mitigation[g]
Big Game (Cont.)					
Elk (*Cervis canadensis*)	Semi-open forest, mountain meadows, foothills, plains, valleys, and alpine tundra. Uses open spaces such as alpine pastures, marshy meadows, river flats, brushy clean cuts, forest edges, and semidesert areas. Abundant in Conejos County. About 3,557,400 acres of potentially suitable habitat occurs in the SEZ region.	589 acres of potentially suitable habitat lost (0.02% of available potentially suitable habitat)	18,345 acres of potentially suitable habitat (0.7% of available habitat)	1 acre of potentially suitable habitat in area of potential direct effect and 22 acres of potentially suitable habitat in area of indirect effect	Small overall impact.
Mule deer (*Odocoileus hemionus*)	Most habitats including coniferous forests, desert shrub, chaparral, and grasslands with shrubs. Greatest densities in shrublands on rough, broken terrain that provides abundant browse and cover. Common in Conejos County. About 2,518,900 acres of potentially suitable habitat occurs in the SEZ region.	3,105 acres of potentially suitable habitat lost (0.1% of available potentially suitable habitat)	87,970 acres of potentially suitable habitat (3.5% of available potentially suitable habitat)	70 acres of potentially suitable habitat in area of potential direct effect and 1,405 acres of potentially suitable habitat in area of indirect effect	Small overall impact. No species-specific mitigation of direct effects is feasible because suitable habitat is widespread in the area of direct effect.
Pronghorn (*Antilocapra americana*)	Grasslands and semidesert shrublands on rolling topography that affords good visibility. Most abundant in shortgrass or midgrass prairies and least common in xeric habitats. Common in Conejos County. About 2,683,700 acres of potentially suitable habitat occurs in the SEZ region.	3,105 acres of potentially suitable habitat lost (0.1% of available potentially suitable habitat)	76,660 acres of potentially suitable habitat (2.9% of available potentially suitable habitat)	70 acres of potentially suitable habitat in area of potential direct effect and 1,405 acres of potentially suitable habitat in area of indirect effect	Small overall impact. No species-specific mitigation of direct effects is feasible because suitable habitat is widespread in the area of direct effect.

TABLE 10.3.11.3-2 (Cont.)

Common Name (Scientific Name)	Habitat[a]	Maximum Area of Potential Habitat Affected[b]: Within SEZ (Direct Effects)[c]	Maximum Area of Potential Habitat Affected[b]: Outside SEZ (Indirect Effects)[d]	Maximum Area of Potential Habitat Affected[b]: Within Transmission Line Corridor (Indirect and Direct Effects)[e]	Overall Impact Magnitude[f] and Species-Specific Mitigation[g]
Small Game and Furbearers					
American badger (*Taxidea taxus*)	Open grasslands and deserts, meadows in subalpine and montane forests, alpine tundra. Most common in areas with abundant populations of ground squirrels, prairie dogs, and pocket gophers. About 3,944,100 acres of potentially suitable habitat occurs in the SEZ region.[d]	3,105 acres of potentially suitable habitat lost (0.08% of available potentially suitable habitat)	85,820 acres of potentially suitable habitat (2.2% of available potentially suitable habitat)	708 acres of potentially suitable habitat in area of potential direct effect and 1,407 acres of potentially suitable habitat in area of indirect effect	Small overall impact. No species-specific mitigation of direct effects is feasible because suitable habitat is widespread in the area of direct effect.
Coyote (*Canis latrans*)	All habitats at all elevations. Least common in dense coniferous forest. Where human control efforts occur, they are restricted to broken, rough country with abundant shrub cover and a good supply of rabbits or rodents. About 4,956,900 acres of potentially suitable habitat occurs in the SEZ region.	3,105 acres of potentially suitable habitat lost (0.06% of available potentially suitable habitat)	89,595 acres of potentially suitable habitat (1.8% of available potentially suitable habitat)	73 acres of potentially suitable habitat in area of potential direct effect and 1,475 acres of potentially suitable habitat in area of indirect effect	Small overall impact. No species-specific mitigation of direct effects is feasible because suitable habitat is widespread in the area of direct effect.
Desert cottontail (*Sylvilagus audubonii*)	Grasslands, especially in prairie dog colonies. Also in other habitats such as montane shrublands, riparian lands, semidesert shrublands, pinyon-juniper woodlands, and various woodland-edge habitats. Can occur in areas with minimal vegetation as long as adequate cover is present. About 3,328,100 acres of potentially suitable habitat occurs in the SEZ region.	3,105 acres of potentially suitable habitat lost (0.09% of available potentially suitable habitat)	83,689 acres of potentially suitable habitat (2.5% of available potentially suitable habitat)	70 acres of potentially suitable habitat in area of potential direct effect and 1,405 acres of potentially suitable habitat in area of indirect effect)	Small overall impact.. Avoidance of prairie dog colonies would further reduce the potential for impact.

TABLE 10.3.11.3-2 (Cont.)

Common Name (Scientific Name)	Habitat[a]	Maximum Area of Potential Habitat Affected[b]: Within SEZ (Direct Effects)[c]	Outside SEZ (Indirect Effects)[d]	Within Transmission Line Corridor (Indirect and Direct Effects)[e]	Overall Impact Magnitude[f] and Species-Specific Mitigation[g]
Small Game and Furbearers (Cont.)					
Red fox (*Vulpes vulpes*)	Most common in open woodlands, pasturelands, riparian, and agricultural lands. Prefers areas with a mixture of these vegetation types occurring in small mosaics with good development of ground cover. Also is common in open space and other undeveloped areas adjacent to cities. Also occurs in mountains in montane and subalpine meadows and alpine and forest edges usually near water. About 4,131,400 acres of potentially suitable habitat occurs in the SEZ region.	2,602 acres of potentially suitable habitat lost (0.06% of available potentially suitable habitat)	58,925 acres of potentially suitable habitat (1.4% of available potentially suitable habitat)	18 acres of potentially suitable habitat in area of potential direct effect and 371 acres of potentially suitable habitat in area of indirect effect	Small overall impact. No species-specific mitigation of direct effects is feasible because suitable habitat is widespread in the area of direct effect.
Striped skunk (*Mephitis mephitis*)	Occurs in most habitats other than alpine tundra. Common at lower elevations, especially in and near cultivated fields and pastures. Generally inhabits open country in woodlands, brush areas, and grasslands, usually near water. Dens under rocks, logs, or buildings. About 4,431,100 acres of potentially suitable habitat occurs in the SEZ region.	3,105 acres of potentially suitable habitat lost (0.07% of available potentially suitable habitat)	80,565 acres of potentially suitable habitat (1.8% of available potentially suitable habitat)	72 acres of potentially suitable habitat in area of potential direct effect and 1,451 acres of potentially suitable habitat in area of indirect effect	Small overall impact. No species-specific mitigation of direct effects is feasible because suitable habitat is widespread in the area of direct effect.

TABLE 10.3.11.3-2 (Cont.)

		Maximum Area of Potential Habitat Affected[b]			
Common Name (Scientific Name)	Habitat[a]	Within SEZ (Direct Effects)[c]	Outside SEZ (Indirect Effects)[d]	Within Transmission Line Corridor (Indirect and Direct Effects)[e]	Overall Impact Magnitude[f] and Species-Specific Mitigation[g]
Small Game and Furbearers (Cont.)					
White-tailed jackrabbit (*Lepus townsendii*)	Occurs mostly in prairies, open parkland, and alpine tundra. Also occurs in semidesert shrublands and may migrate to such areas from other habitats in winter. About 2,486,400 acres of potentially suitable habitat occurs in the SEZ region.	2,602 acres of potentially suitable habitat lost (0.1 % of available potentially suitable habitat)	54,784 acres of potentially suitable habitat (2.2% of available potentially suitable habitat)	74 acres of potentially suitable habitat in area of potential direct effect and 1,479 acres of potentially suitable habitat in area of indirect effect	Small overall impact. No species-specific mitigation of direct effects is feasible because suitable habitat is widespread in the area of direct effect.
Nongame (Small) Mammals					
Deer mouse (*Peromyscus maniculatus*)	Most habitats (except well-developed wetlands) that contain cover including burrows of other animals, rock cracks and crevices, surface debris and litter, and man-made structures. About 4,422,100 acres of potentially suitable habitat occurs in the SEZ region.	3,105 acres of potentially suitable habitat lost (0.07% of available potentially suitable habitat)	81,217 acres of potentially suitable habitat (1.8% of available potentially suitable habitat)	73 acres of potentially suitable habitat in area of potential direct effect and 1,480 acres of potentially suitable habitat in area of indirect effect	Small overall impact. No species-specific mitigation of direct effects is feasible because suitable habitat is widespread in the area of direct effect.

TABLE 10.3.11.3-2 (Cont.)

Common Name (Scientific Name)	Habitat[a]	Maximum Area of Potential Habitat Affected[b]: Within SEZ (Direct Effects)[c]	Maximum Area of Potential Habitat Affected[b]: Outside SEZ (Indirect Effects)[d]	Maximum Area of Potential Habitat Affected[b]: Within Transmission Line Corridor (Indirect and Direct Effects)[e]	Overall Impact Magnitude[f] and Species-Specific Mitigation[g]
Nongame (Small) Mammals (Cont.)					
Least chipmunk (*Tamias minimus*)	Low-elevation semidesert shrublands, montane shrublands and woodlands, forest edges, and alpine tundra. About 3,478,500 acres of potentially suitable habitat occurs in the SEZ region.	3,105 acres of potentially suitable habitat lost (0.09% of available potentially suitable habitat)	86,902 acres of potentially suitable habitat (2.5% of available potentially suitable habitat)	70 acres of potentially suitable habitat in area of potential direct effect and 1,407 acres of potentially suitable habitat in area of indirect effect	Small overall impact. No species-specific mitigation of direct effects is feasible because suitable habitat is widespread in the area of direct effect.
Northern pocket gopher (*Thomomys talpoides*)	Various habitats such as agricultural and pasture lands, semidesert shrublands, and grasslands. Most common in meadows and grasslands. About 4,032,400 acres of potentially suitable habitat occurs in the SEZ region.	2,013 acres of potentially suitable habitat lost (0.05% of available potentially suitable habitat)	52,084 acres of potentially suitable habitat (1.3% of available potentially suitable habitat)	17 acres of potentially suitable habitat in area of potential direct effect and 347 acres of potentially suitable habitat in area of indirect effect	Small overall impact.
Ord's kangaroo rat (*Dipodomys ordii*)	Various habitats ranging from semidesert shrublands and pinyon-juniper woodlands to shortgrass or mixed prairie and silvery wormwood. Also occurs in dry, grazed, riparian areas if vegetation is sparse. Most common on sandy soils that allow for easy digging and construction of burrow systems. About 1,884,000 acres of potentially suitable habitat occurs in the SEZ region.	3,105 acres of potentially suitable habitat lost (0.2% of available potentially suitable habitat)	79,967 acres of potentially suitable habitat (4.2% of available potentially suitable habitat)	73 acres of potentially suitable habitat in area of potential direct effect and 1,469 acres in area of indirect effect	Small overall impact. No species-specific mitigation of direct effects is feasible because suitable habitat is widespread in the area of direct effect.

TABLE 10.3.11.3-2 (Cont.)

Common Name (Scientific Name)	Habitat[a]	Maximum Area of Potential Habitat Affected[b]: Within SEZ (Direct Effects)[c]	Outside SEZ (Indirect Effects)[d]	Within Transmission Line Corridor (Indirect and Direct Effects)[e]	Overall Impact Magnitude[f] and Species-Specific Mitigation[g]
Nongame (Small) Mammals (Cont.)					
Thirteen-lined ground squirrel (*Spermophilus tridecemlineatus*)	Short and mid-length grasslands. Also occurs in other habitats that are heavily grazed, mowed, or otherwise modified, including prairie dog colonies. About 2,399,000 acres of potentially suitable habitat occurs in the SEZ region.	2,602 acres of potentially suitable habitat lost (0.1% of available potentially suitable habitat)	47,851 acres of potentially suitable habitat (2.0% of available potentially suitable habitat)	18 acres of potentially suitable habitat in area of potential direct effect and 363 acres of potentially suitable habitat in area of indirect effect	Small overall impact.. Avoidance of prairie dog colonies would further reduce the potential for impacts.
Western small-footed myotis (*Myotis ciliolabrum*)	Broken terrain of canyons and foothills, commonly in areas with tree or shrub cover. Summer roosts include rock crevices, caves, dwellings, burrows, among rocks, under bark, and beneath rocks scattered on the ground. About 4,517,800 acres of potentially suitable habitat occurs in the SEZ region.	3,105 acres of potentially suitable habitat lost (0.07% of available potentially suitable habitat)	88,267 acres of potentially suitable habitat (2.0% of available potentially suitable habitat)	60 acres of potentially suitable habitat in area of potential direct effect and 1,548 acres of potentially suitable habitat in area of indirect effect	Small overall impact. No species-specific mitigation of direct effects is feasible because suitable habitat is widespread in the area of direct effect.

[a] Potentially suitable habitat was determined by using SWReGAP habitat suitability and land cover models. Area of potentially suitable habitat for each species is presented for the SEZ region, which is defined as the area within 50 mi (80 km) of the SEZ center.

[b] Maximum area of potentially suitable habitat that could be affected relative to availability within the SEZ region. Habitat availability for each species within the region was determined by using SWReGAP habitat suitability and land cover models. This approach probably overestimates the amount of suitable habitat in the project area.

[c] Direct effects within the SEZ consist of the ground-disturbing activities associated with construction and the maintenance of an altered environment associated with operations. A maximum of 3,105 acres of direct effect within the SEZ was assumed.

Footnotes continued on next page.

TABLE 10.3.11.3-2 (Cont.)

[d] Area of indirect effects was assumed to be the area adjacent to the SEZ within 5 mi (8 km) of the SEZ boundary. Potentially suitable habitat within the SEZ greater than the maximum of 3,105 acres of direct effect was also added to the area of indirect effect. Indirect effects include effects from surface runoff, dust, noise, lighting, and so on from the SEZ, but do not include ground-disturbing activities. The potential degree of indirect effects would decrease with increasing distance away from the SEZ.

[e] For transmission line development, direct effects were estimated within a 2-mi (3.2-km) long, 250-ft (76-m) wide transmission line ROW from the SEZ to the nearest existing transmission line. As the transmission line corridor exists within the area of indirect effects for the SEZ, no additional area of indirect effects were determined for the transmission line.

[f] Overall impact magnitude categories were based on professional judgment and are as follows: (1) small: ≤1% of the population or its habitat would be lost and the activity would not result in a measurable change in carrying capacity or population size in the affected area; (2) moderate: >1 but ≤10% of the population or its habitat would be lost and the activity would result in a measurable but moderate (not destabilizing) change in carrying capacity or population size in the affected area; (3) large: >10% of a population or its habitat would be lost and the activity would result in a large, measurable, and destabilizing change in carrying capacity or population size in the affected area. Note that much greater weight was given to the magnitude of direct effects because those effects would be difficult to mitigate. Programmatic design features would reduce most indirect effects to negligible levels.

[g] Species-specific mitigations are suggested here, but final mitigations should be developed in consultation with state and federal agencies and should be based on pre-disturbance surveys.

[h] To convert acres to km^2, multiply by 0.004047.

Sources: CDOW (2009); NatureServe (2010); USGS (2004, 2005, 2007).

Overall, impacts on the American black bear from solar energy development in the proposed Fourmile East SEZ would be small.

Bighorn Sheep

Based on potentially suitable land cover, up to 2,602 acres (10.5 km^2) of potentially suitable bighorn sheep habitat could be lost by solar energy development within the proposed Fourmile East SEZ and another 18 acres (0.07 km^2) by transmission line construction. This represents about 0.08% of potentially suitable bighorn sheep habitat within the SEZ region. Over 57,000 acres (230 km^2) of potentially suitable bighorn sheep habitat occurs within the area of indirect effects. Indirect effects could occur to bighorn sheep when occupying their mapped activity areas that occur within 5 mi (8 km) of the SEZ (Table 10.3.11.3-3). Overall, impacts on bighorn sheep from solar energy development in the SEZ would be small.

Cougar

Based on potentially suitable land cover, up to 2,602 acres (10.5 km^2) of potentially suitable cougar habitat could be lost by solar energy development within the proposed Fourmile East SEZ and another 18 acres (0.07 km^2) by transmission line construction. This represents about 0.07% of potentially suitable cougar habitat within the SEZ region. More than 58,100 acres (235 km^2) of potentially suitable cougar habitat occurs within the area of indirect effects. Overall, impacts on cougar from solar energy development in the SEZ would be small.

Elk

Based on potentially suitable land cover, 589 acres (2.4 km^2) of potentially suitable elk habitat could be lost by solar energy development within the proposed Fourmile East SEZ and only 1 acre (0.004 km^2) by transmission line construction. This represents 0.02% of potentially suitable elk habitat within the SEZ region. Nearly 18,350 acres (74.3 km^2) of potentially suitable elk habitat occurs within the area of indirect effects. Based on mapped activity areas, 3,105 acres (12.6 km^2) of elk overall range and 213 acres (0.9 km^2) of elk summer range could be directly impacted by solar energy development (Table 10.3.11.3-4). Direct loss of overall range would account for about 0.07% of the overall range occurring within Colorado portion of the SEZ region; while direct loss of summer range would account for <0.01% of the summer range within the Colorado portion of the SEZ region. No direct impacts on other mapped activity areas for the elk would occur (Table 10.3.11.3-4). Overall, impacts on elk from solar energy development in the SEZ would be small.

TABLE 10.3.11.3-3 Potential Magnitude of Impacts on Bighorn Sheep Activity Areas Resulting from Solar Energy Development within the Proposed Fourmile East SEZ

Activity Area[a]	Amount of Activity Area Affected: Within SEZ (Direct Effects)[b]	Amount of Activity Area Affected: Outside SEZ (Indirect Effects)[c]	Amount of Activity Area Affected: Transmission Line Corridor[d]	Amount of Activity Area within SEZ Region[e]	Overall Impact Magnitude[f]
Overall range	0 acres	3,501 acres[g] (0.4% of overall range)	0 acres	813,2931 acres	None
Summer range	0 acres	1,462 acres (0.2% of summer range)	0 acres	741,450 acres	None
Summer concentration area	0 acres	438 acres (0.4% of summer concentration area)	0 acres	121,225 acres	None
Winter range	0 acres	860 acres (0.3% of winter range)	0 acres	328,477 acres	None
Winter concentration area	0 acres	860 acres (0.8% of winter concentration area)	0 acres	104,808 acres	None

a Activity areas are described in Table 10.3.11.3-1.

b Direct effects within the SEZ consist of ground-disturbing activities associated with construction and the maintenance of an altered environment associated with operations.

c The area of indirect effects was assumed to be the area adjacent to the SEZ within 5 mi (8 km) of the SEZ boundary. Indirect effects include effects from surface runoff, dust, noise, lighting, etc., from the SEZ, but do not include ground-disturbing activities. The potential degree of indirect effects would decrease with increasing distance away from the SEZ boundary or transmission line ROW.

d For transmission, direct effects were estimated within a 2-mi (3.2-km) long, 250-ft (76-m) wide ROW for an assumed new transmission line connecting to the nearest existing line. Indirect effects were estimated within a 1.0-mi (1.6-km) wide transmission line corridor to the existing transmission line, less the assumed area of direct effects.

e The SEZ region is the area within a 50-mi (80-km) radius of the center of the SEZ. Activity area data available only for the Colorado portion of the SEZ region.

f Overall impact magnitude categories were based on professional judgment and include (1) *small*: ≤1% of activity area for the species would be potentially lost; (2) *moderate*: >1 but ≤10% of activity area for the species would be lost; and (3) *large*: >10% of activity area for the species would be lost. Note that much greater weight was given to the magnitude of direct effects because those effects would be difficult to mitigate. Programmatic design features would reduce most indirect effects to negligible levels.

g To convert acres to km^2, multiply by 0.004047.

Source: CDOW (2008).

TABLE 10.3.11.3-4 Potential Magnitude of Impacts on Elk Activity Areas Resulting from Solar Energy Development within the Proposed Fourmile East SEZ

	Amount of Activity Area Affected				
Activity Area[a]	Within SEZ (Direct Effects)[b]	Outside SEZ (Indirect Effects)[c]	Transmission Line Corridor[d]	Amount of Activity Area within SEZ Region[e]	Overall Impact Magnitude[f]
Overall range	3,105 acres[g] (0.07% of overall range)	89,671 acres (2.0% of overall range)	61 acres of overall range in area of potential direct effect and 1,498 acres in area of indirect effect	4,464,355 acres	Small
Summer range	213 acres (<0.01% of summer range)	29,475 acres (1.3% of summer)	0 acres	2,210,542 acres	Small
Summer concentration area	0 acres	2,098 acres (0.4% of summer concentration area)	0 acres	481,589 acres	None
Winter range	0 acres	26,662 acres (1.2% of winter range)	0 acres	2,298,301 acres	None
Winter concentration area	0 acres	3,759 acres (0.6% of winter concentration area)	0 acres	594,176 acres	None
Severe winter range	0 acres	6,942 acres (0.5% of severe winter range)	0 acres	1,264,218 acres	None
Production area	0 acres	2,098 acres (0.4% of production area)	0 acres	595,842 acres	None
Resident population area	0 acres	642 acres (0.6% of resident population area)	0 acres	113,792 acres	None

a Activity areas are described in Table 10.3.11.3-1.

b Direct effects within the SEZ consist of ground-disturbing activities associated with construction and the maintenance of an altered environment associated with operations. A maximum of 3,105 acres (12.6 km^2) would be developed in the SEZ.

Footnotes continued on next page.

TABLE 10.3.11.3-4 (Cont.)

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[c] The area of indirect effects was assumed to be the area adjacent to the SEZ within 5 mi (8 km) of the SEZ boundary. Indirect effects include effects from surface runoff, dust, noise, lighting, etc., from the SEZ, but do not include ground-disturbing activities. The potential degree of indirect effects would decrease with increasing distance away from the SEZ boundary or transmission line ROW.

[d] For transmission, direct effects were estimated within a 2-mi (3.2-km) long, 250-ft (76-m) wide ROW for an assumed new transmission line connecting to the nearest existing line. Indirect effects were estimated within a 1-mi (1.6-km) wide transmission line corridor to the existing transmission line, less the assumed area of direct effects.

[e] The SEZ region is the area within a 50-mi (80-km) radius of the center of the SEZ. Activity area data available only for the Colorado portion of the SEZ region.

[f] Overall impact magnitude categories were based on professional judgment and include (1) *small*: ≤1% of activity area for the species would be potentially lost; (2) *moderate*: >1 but ≤10% of activity area for the species would be lost; and (3) *large*: >10% of activity area for the species would be lost. Note that much greater weight was given to the magnitude of direct effects because those effects would be difficult to mitigate. Programmatic design features would reduce most indirect effects to negligible levels.

[g] To convert acres to km^2, multiply by 0.004047.

Source: CDOW (2008).

Mule Deer

Based on potentially suitable land cover, up to 3,105 acres (12.6 km^2) of potentially suitable mule deer habitat could be lost by solar energy development within the proposed Fourmile East SEZ and another 70 acres (0.3 km^2) by transmission line construction. This represents about 0.1% of potentially suitable mule deer habitat within the SEZ region. Nearly 88,000 acres (356 km^2) of potentially suitable mule deer habitat occurs within the area of indirect effects. Based on mapped activity areas, 3,105 acres (12.6 km^2) of mule deer overall range could be directly impacted by SEZ development (Table 10.3.11.3-5). Direct loss of overall range would account for about 0.2% of the overall range occurring within Colorado portion of the SEZ region. No direct impacts on other mapped activity areas for the mule deer would occur (Table 10.3.11.3-5). Overall, impacts on mule deer from solar energy development in the SEZ would be small.

Pronghorn

Based on potentially suitable land cover, up to 3,105 acres (12.6 km^2) of potentially suitable pronghorn habitat could be lost by solar energy development within the proposed Fourmile East SEZ and another 70 acres (0.3 km^2) by transmission line construction. This represents about 0.1% of potentially suitable pronghorn habitat within the SEZ region. Less than 76,700 acres (310 km^2) of potentially suitable pronghorn habitat occurs within the area of indirect effects. Based on mapped pronghorn activity areas (Table 10.3.11.3-6), solar development in the proposed Fourmile East SEZ would directly impact 3,105 acres (12.6 km^2)

TABLE 10.3.11.3-5 Potential Magnitude of Impacts on Mule Deer Activity Areas Resulting from Solar Energy Development within the Proposed Fourmile East SEZ

Activity Area[a]	Amount of Activity Area Affected: Within SEZ (Direct Effects)[b]	Amount of Activity Area Affected: Outside SEZ (Indirect Effects)[c]	Amount of Activity Area Affected: Transmission Line Corridor[d]	Amount of Activity Area within SEZ Region[e]	Overall Impact Magnitude[f]
Overall range	3,105 acres[g] (0.07% of overall range)	89,671 acres (2.0% of overall range)	61 acres of overall range in area of potential direct effect and 1,498 acres in area of indirect effect	4,581,733 acres	Small
Summer range	0 acres	16,820 acres (0.7% of summer range)	0 acres	2,555,171 acres	None
Summer concentration area	0 acres	916 acres (0.3% of summer concentration area)	0 acres	307,721 acres	None
Winter range	0 acres	14,910 acres (0.8% of winter range)	0 acres	1,938,078 acres	None
Winter concentration area	0 acres	3,886 acres (2.3% of winter concentration area)	0 acres	172,264 acres	None
Severe winter range	0 acres	9,736 acres (1.0% of severe winter range)	0 acres	932,751 acres	None

[a] Activity areas are described in Table 10.3.11.3-1.

[b] Direct effects within the SEZ consist of ground-disturbing activities associated with construction and the maintenance of an altered environment associated with operations. A maximum of 3,105 acres (12.6 km^2) would be developed in the SEZ.

[c] The area of indirect effects was assumed to be the area adjacent to the SEZ within 5 mi (8 km) of the SEZ boundary. Indirect effects include effects from surface runoff, dust, noise, lighting, etc., from the SEZ, but do not include ground-disturbing activities. The potential degree of indirect effects would decrease with increasing distance away from the SEZ boundary or transmission line ROW.

Footnotes continued on next page.

[d] For transmission, direct effects were estimated within a 2-mi (3.2-km) long, 250-ft (76-m) wide ROW for an assumed new transmission line connecting to the nearest existing line. Indirect effects were estimated within a 1.0-mi (1.6-km) wide transmission line corridor to the existing transmission line, less the assumed area of direct effects.

[e] The SEZ region is the area within a 50-mi (80-km) radius of the center of the SEZ. Activity area data available only for the Colorado portion of the SEZ region.

[f] Overall impact magnitude categories were based on professional judgment and include (1) *small*: ≤1% of activity area for the species would be potentially lost; (2) *moderate*: >1 but ≤10% of activity area for the species would be lost; and (3) *large*: >10% of activity area for the species would be lost. Note that much greater weight was given to the magnitude of direct effects because those effects would be difficult to mitigate. Programmatic design features would reduce most indirect effects to negligible levels.

[g] To convert acres to km^2, multiply by 0.004047.

Source: CDOW (2008).

of both pronghorn overall range and winter range (about 0.2% of each range occurring within the Colorado portion of the SEZ region). No direct impacts would occur on other activity areas (Table 10.3.11.3-6). Overall, impacts on pronghorn from solar energy development in the SEZ would be small.

Other Mammals

Direct impacts on small game, furbearers, and nongame (small) mammal species would be small, as only 0.2% or less of habitats identified for each species would be lost (Table 10.3.11.3-2). Larger areas of suitable habitat for these mammal species occur within the area of potential indirect effects (e.g., up to 4.2% of available habitat for the Ord's kangaroo rat).

Summary

Overall, direct impacts on mammal species would be small for all species, as only 0.2% or less of potentially suitable habitats for the representative mammal species would be lost (Table 10.3.11.3-2). Larger areas of potentially suitable habitat for mammal species occur within the area of potential indirect effects (e.g., up to 4.2% for the Ord's kangaroo rat). Other impacts on mammals could result from collision with fences and vehicles, surface water and sediment runoff from disturbed areas, fugitive dust generated by project activities, noise, lighting, spread of invasive species, accidental spills, and harassment. These indirect impacts are expected to be negligible with implementation of programmatic design features.

Decommissioning of facilities and reclamation of disturbed areas after operations cease could result in short-term negative impacts on individuals and habitats adjacent to project areas, but long-term benefits would accrue if suitable habitats were restored in previously disturbed

TABLE 10.3.11.3-6 Potential Magnitude of Impacts on Pronghorn Activity Areas Resulting from Solar Energy Development within the Proposed Fourmile East SEZ

	Amount of Activity Area				
Activity Area[a]	Within SEZ (Direct Effects)[b]	Outside SEZ (Indirect Effects)[c]	Transmission Line Corridor[d]	Amount of Activity Area within SEZ Region[e]	Overall Impact Magnitude[f]
Overall range	3,105 acres[g] (0.2% of overall range)	69,765 acres (3.5% of overall range)	61 acres of overall range in area of potential direct effect and 1,498 acres in area of indirect effect	1,989,307 acres	Small
Winter range	3,105 acres (0.2% of winter range)	69,765 acres (4.4% of winter range)	61 acres of winter range in area of potential direct effect and 1,498 acres in area of indirect effect	1,576,770 acres	Small
Winter concentration area	0 acres	4,608 acres (2.3% of winter concentration area)	0 acres	201,510 acres	None

[a] Activity areas are described in Table 10.3.11.3-1.

[b] Direct effects within the SEZ consist of ground-disturbing activities associated with construction and the maintenance of an altered environment associated with operations. A maximum of 3,105 acres (12.6 km^2) would be developed in the SEZ.

[c] The area of indirect effects was assumed to be the area adjacent to the SEZ within 5 mi (8 km) of the SEZ boundary. Indirect effects include effects from surface runoff, dust, noise, lighting, etc. from the SEZ, but do not include ground-disturbing activities. The potential degree of indirect effects would decrease with increasing distance away from the SEZ boundary or transmission line ROW.

[d] For transmission, direct effects were estimated within a 2-mi (3.25-km) long, 250-ft (76-m) wide ROW for an assumed new transmission line connecting to the nearest existing line. Indirect effects were estimated within a 1.0-mi (1.6-km) wide transmission line corridor to the existing transmission line, less the assumed area of direct effects.

[e] The SEZ region is the area within a 50-mi (80-km) radius of the center of the SEZ. Activity area data available only for the Colorado portion of the SEZ region.

[f] Overall impact magnitude categories were based on professional judgment and include (1) *small*: ≤1% of activity area for the species would be potentially lost; (2) *moderate*: >1 but ≤10% of activity area for the species would be lost; and (3) *large*: >10% of activity area for the species would be lost. Note that much greater weight was given to the magnitude of direct effects because those effects would be difficult to mitigate. Programmatic design features would reduce most indirect effects to negligible levels.

[g] To convert acres to km^2, multiply by 0.004047.

Source: CDOW (2008).

areas. Section 5.10.2.1.4 provides an overview of the impacts of decommissioning and reclamation on wildlife. Of particular importance for mammal species would be the restoration of original ground surface contours, soils, and native plant communities associated with semiarid shrublands.

10.3.11.3.3 SEZ-Specific Design Features and Design Feature Effectiveness

The implementation of programmatic design features presented in Appendix A, Section A.2.2, could greatly reduce the potential for effects on mammals. While some SEZ-specific design features are best established when considering specific project details, design features that can be identified at this time include the following:

- Prairie dog colonies should be avoided to the extent practicable to reduce impacts on species such as desert cottontail and thirteen-lined ground squirrel.

- To the extent practicable, construction activities should be avoided while pronghorn are on their winter range within the immediate area of the proposed Fourmile East SEZ.

- Development in the 213-acre (0.9-km^2) portion of the SEZ that overlaps elk summer range should be avoided.

If these SEZ-specific design features are implemented in addition to programmatic design features, impacts on mammals could be reduced. Any residual impacts are anticipated to be small, given the relative abundance of suitable habitats in the SEZ region.

10.3.11.4 Aquatic Biota

10.3.11.4.1 Affected Environment

There are no permanent water bodies or perennial streams within the boundaries of the Fourmile East SEZ, within the presumed transmission line corridor, or within the area of indirect effects. The NWI does identify a small number of palustrine wetlands with emergent plant communities at or just outside the western boundary of the SEZ (Sections 10.3.9.1.1 and 10.2.10.1). These wetlands are classified as intermittently flooded, indicating that surface water is usually absent but may be present for variable periods during the year. Many palustrine emergent wetlands also occur 1.2 mi (2.0 km) or more to the northwest within the Blanca ACEC; these wetlands are intermittently flooded to seasonally flooded, indicating that surface water is present for extended periods, especially in spring (Section 10.3.9.1.1).

Outside of the indirect effects area, but within 50 mi of the SEZ, there are approximately 960 mi (1,545 km) of perennial streams, 50 mi (80 km) of intermittent streams, and 190 mi (306 km) of canals. The nearest stream and canal features include the Central Lateral Canal, Trinchera Creek, and the Rio Grande, all located 6 mi (10 km) or more from the boundaries of the Fourmile East SEZ and outside the area of potential indirect effects analyzed here.

There are approximately 6,400 acres (25.9 km^2) of lake and reservoir habitat within 50 mi (80 km) of the SEZ, although there are no lakes or reservoirs within the area considered for analysis of direct or indirect effects. The nearest such habitat is the 800-acre (3.2-km^2) Smith Reservoir, located approximately 7 mi (11 km) to the southeast of the SEZ.

10.3.11.4.2 Impacts

Because surface water habitats are a unique feature in the arid landscape of this area, the maintenance and protection of such habitats may be particularly important. Invertebrates supported by such habitats serve as food sources for various species of vertebrates. In addition, surface water features can serve as drinking water sources, migratory stopovers, and feeding stations for shorebirds.

The types of impacts that could occur on aquatic habitats and biota from development of utility-scale solar energy facilities are discussed in Section 5.10.3. Aquatic habitats, including wetland areas, present on or near the Fourmile East SEZ could be affected by solar energy development in a number of ways, including (1) direct disturbance, (2) deposition of sediments, (3) changes in water quantity, and (4) degradation of water quality.

There are no permanent water bodies or perennial streams within the boundaries of the Fourmile East SEZ or within the presumed transmission line corridor. Consequently, there would be no direct impacts on these aquatic habitats from construction and operation of utility-scale solar energy facilities within the SEZ. In addition, there are no permanent water bodies or perennial streams located within the identified indirect effects area that extends 5 mi (8 km) from the boundaries of the SEZ.

Direct alteration of aquatic habitat associated with the small emergent wetlands located along the western edge of the SEZ would occur with construction activities or placement of facilities directly in the wetlands. The amount of aquatic habitat provided by the wetlands within the Fourmile East SEZ is <1% of total wetland surface area in the 50-mi (80.5-km) SEZ region. Consequently, the potential impacts on populations of aquatic biota from direct alteration would be small. Prohibiting construction activities and placing facilities within the historical boundaries or in the immediate vicinity of wetlands would eliminate direct impacts.

Disturbance of land areas at the SEZ could increase the amount of sediment in nearby wetland areas because of deposition of waterborne and airborne soils from disturbed areas. Because prevailing winds are primarily toward the east, it is likely that only a small portion of the airborne dust associated with SEZ activities would settle in the wetlands near the western border of the SEZ or in the wetlands within the Blanca ACEC located further to the northwest. Sedimentation could be controlled with commonly used structures and practices, such as settling basins and silt fences, or by directing water draining from the developed areas away from surface water features. Maintaining undisturbed areas around the perimeter of on-site or nearby wetlands would further reduce the potential for waterborne sediments to become deposited in those wetlands.

In arid environments, reductions in the quantity of water in aquatic habitats are of particular concern. Reductions in water quantity could occur if the topography within the catchment basins is altered. Water quantity could also be affected if significant amounts of surface water or groundwater are utilized for power plant cooling water, for washing mirrors, or for other needs. The greatest need for water would occur if technologies employing wet cooling, such as parabolic trough or power tower, were developed at the site; the associated impacts would ultimately depend on the water source used (including groundwater from aquifers at various depths). Withdrawing water from Smith Reservoir, the Rio Grande, or other perennial surface water features in the vicinity could affect water levels and, as a consequence, aquatic organisms in those water bodies. Additional details regarding the volume of water required and the types of organisms present in potentially affected water bodies would be required in order to further evaluate the potential for impacts from water withdrawals.

As described in Section 5.10.3, water quality in aquatic habitats could be affected by the introduction of contaminants such as fuels, lubricants, or pesticides/herbicides during site characterization, construction, operation, or decommissioning for a solar energy facility. Restricting the use of heavy machinery and pesticides within the immediate catchment basin for those wetlands would mitigate potential impacts from contaminants. Because perennial streams, ponds, or reservoirs are more than 5 mi (8 km) distant from the Fourmile East SEZ, the potential for solar energy development activities within the SEZ to introduce contaminants into those water bodies would be negligible.

10.3.11.4.3 SEZ-Specific Design Features and Design Feature Effectiveness

The implementation of required programmatic design features described in Appendix A would greatly reduce or eliminate the potential for effects on aquatic biota and aquatic habitats from development and operation of solar energy facilities. While some SEZ-specific design features are best established when specific project details are being considered, design features that can be identified at this time include the following:

- Undisturbed buffer areas and sediment and erosion controls should be maintained around wetlands on the SEZ.

- The use of heavy machinery and pesticides should be avoided within the immediate catchment basins for wetlands on the SEZ.

If these SEZ-specific design features are implemented in addition to other programmatic design features and if the utilization of water from groundwater or surface water sources is adequately controlled to maintain sufficient water levels in nearby aquatic habitats, the potential impacts on aquatic biota and habitats from solar energy development at the Fourmile East SEZ would be small.

10.3.12 Special Status Species (Threatened, Endangered, Sensitive, and Rare Species)

This section addresses special status species that are known to occur, or for which suitable habitat occurs, on or within the potentially affected area of the proposed Fourmile East SEZ. Special status species include the following types of species[4]:

- Species listed as threatened or endangered under the ESA;
- Species that are proposed for listing, are under review, or are candidates for listing under the ESA;
- Species that are listed by the State of Colorado[5];
- Species that are listed by the BLM as sensitive; and
- Species that have been ranked by the State of Colorado as S1 or S2, or species of concern by the State of Colorado or the USFWS; hereafter referred to as "rare" species.

Special status species known to occur within 50 mi (80 km) of the Fourmile East SEZ center (i.e., the SEZ region) were determined from natural heritage records available through NatureServe Explorer (NatureServe 2010), information provided by the Colorado Natural Heritage Program (CNHP 2009), Colorado Division of Wildlife (CDOW 2009), the Southwest Regional Gap Analysis Project (SWReGAP) (USGS 2004, 2005, 2007), and the USFWS Environmental Conservation Online System (ECOS) (USFWS 2010). Information reviewed consisted of county-level and USGS 7.5-minute quad-level occurrences of the species provided by the CDOW, CNHP, and NatureServe, as well as modeled land cover types and predicted suitable habitats for the species within the 50 mi (80 km) region as determined from SWReGAP. The 50 mi (80 km) SEZ region intersects Alamosa, Conejos, Costilla, Custer, Huerfano, Las Animas, Pueblo, Rio Grande, and Saguache Counties, Colorado, as well as Colfax, Rio Arriba, and Taos Counties, New Mexico. However, the SEZ and affected area occur only in Alamosa and Costilla Counties, Colorado. See Appendix M for additional information on the approach used to identify species that could be affected by development within the SEZ.

10.3.12.1 Affected Environment

The affected area considered in this assessment included the areas of direct and indirect effects. The area of direct effects was defined as the area that would be physically modified during project development (i.e., where ground-disturbing activities would occur). For the Fourmile East SEZ, the area of direct effect included the SEZ and the area within the

[4] See Section 4.6.4 for definitions of these species categories. Note that some of the categories of species included here do not fit BLM's definition of special status species as defined in BLM Manual 6840 (BLM 2008). These species are included here to ensure broad consideration of species that may be most vulnerable to impacts.

[5] State-listed species for Colorado are those species protected under *Colorado Revised Statutes* 33-2-101.

transmission corridor where ground-disturbing activities are assumed to occur. No new access road developments are expected to be needed to serve development on the SEZ due to the proximity of existing roads (refer to Section 10.3.1.2 for development assumptions). The area of indirect effects was defined as the area within 5 mi (8 km) of the SEZ boundary and the portion of the transmission corridor where ground-disturbing activities would not occur but that could be indirectly affected by activities in the area of direct effect. Indirect effects considered in the assessment included effects from surface runoff, dust, noise, lighting, and accidental spills from the SEZ and transmission line ROW, but do not include ground-disturbing activities. The potential magnitude of indirect effects would decrease with increasing distance away from the SEZ. This area of indirect effect was identified on the basis of professional judgment and was considered sufficiently large to bound the area that would potentially be subject to indirect effects. The affected area includes both the direct and indirect effects areas.

The primary habitat type within the affected area is semi-arid shrub steppe (see Section 10.3.10). Potentially unique habitats in the affected area in which special status species may reside include rocky cliffs and outcrops, sand dunes, woodlands, and wetlands (including playas, streams, and mesic grasslands and meadows). As discussed in Section 10.3.11.4.1, there are no permanent water bodies or perennial streams within the Fourmile East SEZ or within the area of indirect effects; however, small seasonally or intermittently inundated palustrine emergent wetlands may occur within and immediately adjacent to the western boundary of the SEZ. The size and abundance of these wetlands increases west and northwest of the SEZ towards the Blanca Wetlands, about 3 mi (5 km) northwest of the SEZ (Figure 10.3.12.1-1).

All special status species that are known to occur within the Fourmile East SEZ region (i.e., within 50 mi [80 km] of the center of the SEZ) are listed, with their status, nearest location, and habitats, in Appendix J. Of these species, there are 59 that could occur on or in the affected area, based on recorded occurrences or the presence of potentially suitable habitat in the area. These species, their status, and their habitats are presented in Table 10.3.12.1-1. For many of the species listed in the table, their predicted potential occurrence in the affected area is based only on a general correspondence between mapped SWReGAP land cover types and descriptions of species habitat preferences. This overall approach to identifying species in the affected area probably overestimates the number of species that actually occur in the affected area. For many of the species identified as having potentially suitable habitat in the affected area, the nearest known occurrence is over 20 mi (32 km) away from the SEZ.

Quad-level occurrences for the following seven special status species intersect the affected area of the Fourmile East SEZ: Altai chickweed, blue-eyed grass, Gray's Peak whitlow-grass, Smith's whitlow-grass, many-stemmed spider flower, American white pelican, and western snowy plover. There are no groundwater-dependent species in the vicinity of the SEZ based upon CNHP records, comments provided by the USFWS (Stout 2009), and the evaluation of groundwater resources in the Fourmile East SEZ region (Section 10.3.9).

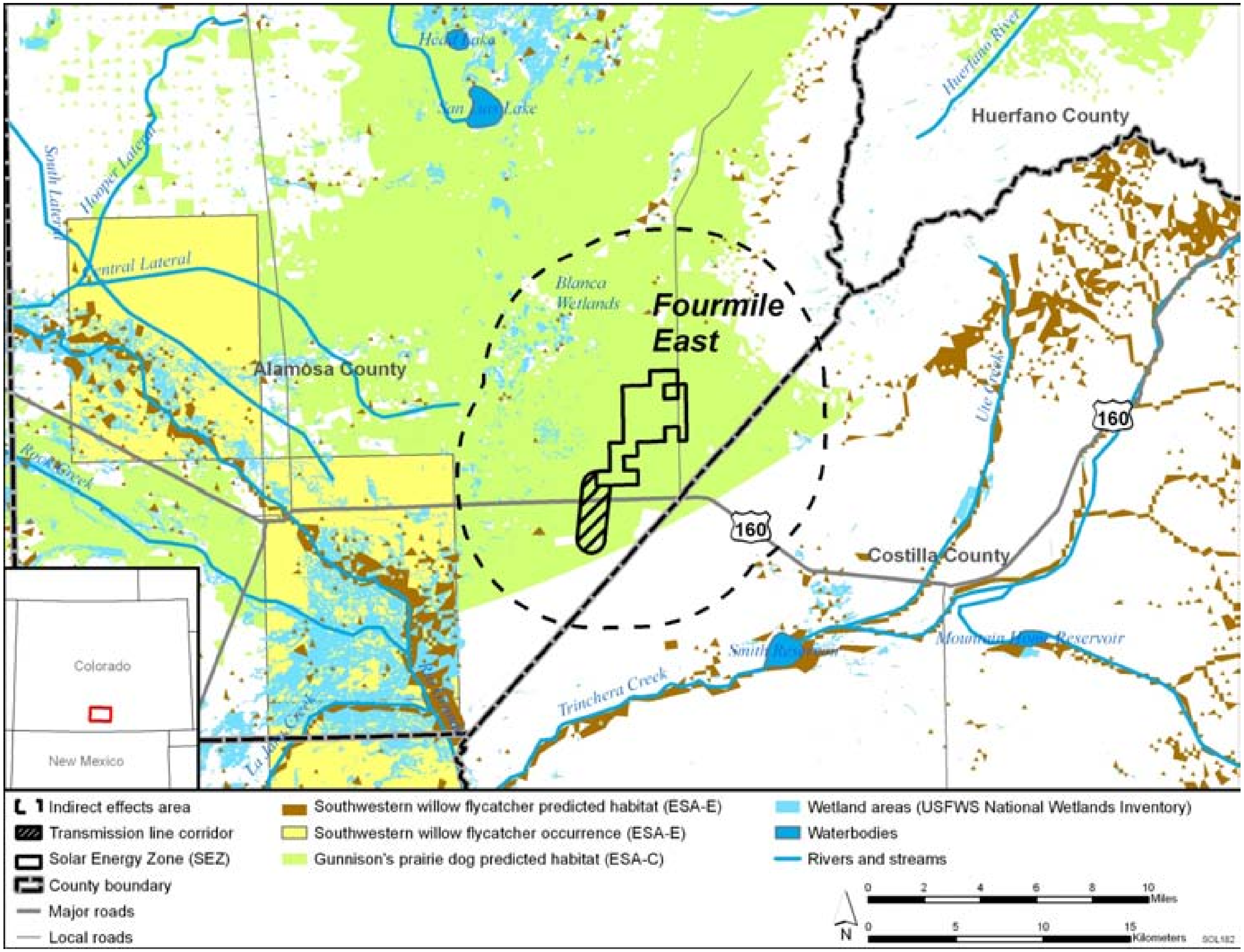

FIGURE 10.3.12.1-1 Locations of Species Listed as Endangered, Threatened, Candidates for Listing, or Species under Review for Listing under the ESA That May Occur in the Proposed Fourmile East SEZ Affected Area (Sources: CNHP 2009; NatureServe 2010; USGS 2007)

TABLE 10.3.12.1-1 Habitats, Potential Impacts, and Potential Mitigation for Special Status Species That Could Be Affected by Solar Energy Development on the Proposed Fourmile East SEZ

Common Name	Scientific Name	Listing Status[a]	Habitat[b]	Maximum Area of Potential Habitat Affected[c]: Within SEZ (Direct Effects)[d]	Transmission Line ROW (Direct Effects)[e]	Indirect Effects (Outside SEZ)[f]	Overall Impact Magnitude[g] and Species-Specific Mitigation[h]
Plants							
Altai chickweed[l]	***Stellaria irrigua***	CO-S2	Mountain rills and scree above 8,200 ft. This species has a remarkably disjunct distribution where it is known only to occur in Colorado and Siberia. Nearest occurrence intersects the affected area from the Sangre de Cristo Mountains, as near as 5 mi northeast of the SEZ. About 46,156 acres of potentially suitable habitat occurs within the SEZ region.	0 acres	0 acres	787 acres (1.7% of available potentially suitable habitat)	Small overall impact; no direct impact. No species-specific mitigation is warranted.
American yellow lady's-slipper	*Cypripedium calceolus. parviflorum*	CO-S2	Aspen groves, ponderosa, and Douglas fir forests with rich humus and decaying leaf litter. Soil substrates are sandy to loam. Prefers rocky north or east facing hillsides at elevations between 7,400 and 8,500 ft. Nearest known occurrences are about 40 mi from the SEZ. About 609,418 acres of potentially suitable habitat occurs within the SEZ region.	0 acres	0 acres	2,317 acres (0.4% of available potentially suitable habitat)	Small overall impact; no direct impact. No species-specific mitigation is warranted.
Autumn willow	*Salix serissima*	CO-S1	Marshes or fens associated with other *Salix* and *Carex* species. Elevation ranges between 7,800 and 9,300 ft. Nearest occurrence is about 38 mi from the SEZ. About 26,722 acres of potentially suitable habitat occurs within the SEZ region.	0 acres	0 acres	73 acres (0.3% of available potentially suitable habitat)	Small overall impact; no direct impact. No species-specific mitigation is warranted.

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TABLE 10.3.12.1-1 (Cont.)

Common Name	Scientific Name	Listing Status[a]	Habitat[b]	Maximum Area of Potential Habitat Affected[c]: Within SEZ (Direct Effects)[d]	Maximum Area of Potential Habitat Affected[c]: Transmission Line ROW (Direct Effects)[e]	Maximum Area of Potential Habitat Affected[c]: Indirect Effects (Outside SEZ)[f]	Overall Impact Magnitude[g] and Species-Specific Mitigation[h]
Plants (Cont.)							
Aztec milkvetch	*Astragalus proximus*	CO-S2	Rocky Mountain ponderosa pine woodland, Colorado Plateau pinyon-juniper woodland, Intermountain-basins, semi-desert shrub-steppe, and Rocky Mountain Gambel oak-mixed montane shrublands at elevations between 5,400 and 7,300 ft. Nearest known occurrences are 45 mi from the SEZ. About 1,697,670 acres of potentially suitable shrubland habitat occurs within the SEZ region.	2,013 acres of potentially suitable habitat lost (0.1% of available potentially suitable habitat)	14 acres of potentially suitable habitat lost (<0.1% of available potentially suitable habitat)	46,513 acres (2.7% of available potentially suitable habitat)	Small overall impact. Pre-disturbance surveys and avoiding or minimizing disturbance of occupied habitats in the areas of direct effect; translocation of individuals from areas of direct effect; or compensatory mitigation of direct effects on occupied habitats could reduce impacts. Note that these same potential mitigations apply to all special status plants.
Blue-eyed grass	***Sisyrinchium demissum***	CO-S2	Moist areas, springs, stream banks, meadows, and forest seeps at elevations between 1,600 and 9,500 ft. Nearest occurrence intersects the affected area from the Blanca Wetlands about 5 mi from the SEZ. About 49,227 acres of potentially suitable habitat occurs within the SEZ region.	0 acres	0 acres	156 acres (0.3% of available potentially suitable habitat)	Small overall impact; no direct impact. No species-specific mitigation is warranted.

TABLE 10.3.12.1-1 (Cont.)

Common Name	Scientific Name	Listing Status[a]	Habitat[b]	Maximum Area of Potential Habitat Affected[c]: Within SEZ (Direct Effects)[d]	Transmission Line ROW (Direct Effects)[e]	Indirect Effects (Outside SEZ)[f]	Overall Impact Magnitude[g] and Species-Specific Mitigation[h]
Plants (Cont.)							
Bodin milkvetch	*Astragalus bodinii*	CO-S2	Open forest clearings in association with aspen, pinyon-juniper, and ponderosa pine woodlands. Nearest known occurrences are 13 mi north of the SEZ. Occurrences within the region are known from elevations between 7,500 and 7,875 ft. About 815,203 acres of potentially suitable habitat occurs within the SEZ region.	0 acres	0 acres	7,642 acres (1.0% of available potentially suitable habitat)	Small overall impact; no direct impact. No species-specific mitigation is warranted.
Brandegee's milkvetch	*Astragalus brandegeei*	BLM-S; CO-S1	Sandy or gravelly banks, flats, and stony meadows within pinyon-juniper woodlands. Substrates are usually sandstone with granite or basalt. Elevation ranges between 5,400 and 8,800. Nearest occurrences are located 40 mi southwest of the SEZ. About 733,938 acres of potentially suitable habitat occurs within the SEZ region.	0 acres	0 acres	7,480 acres (1.0% of available potentially suitable habitat)	Small overall impact; no direct impact. No species-specific mitigation is warranted.
Broad-leaved twayblade	*Listera convallarioides*	CO-S2	Rich humus in open woods to boggy meadows with cool, circumneutral soils at elevations below 8,500 ft. Nearest known occurrences are about 45 mi from the SEZ. About 1,371,320 acres of potentially suitable habitat occurs within the SEZ region.	0 acres	0 acres	7,782 acres (0.6% of available potentially suitable habitat)	Small overall impact; no direct impact. No species-specific mitigation is warranted.

TABLE 10.3.12.1-1 (Cont.)

Common Name	Scientific Name	Listing Status[a]	Habitat[b]	Maximum Area of Potential Habitat Affected[c]: Within SEZ (Direct Effects)[d]	Transmission Line ROW (Direct Effects)[e]	Indirect Effects (Outside SEZ)[f]	Overall Impact Magnitude[g] and Species-Specific Mitigation[h]
Plants (Cont.)							
Colorado larkspur	*Delphinium ramosum* var. *alpestre*	CO-S2	Meadows, aspen woodlands, and sagebrush scrub communities at elevations between 6,900 and 10,500 ft. Nearest known occurrences are about 28 mi from the SEZ. About 466,055 acres of potentially suitable habitat occurs within the SEZ region.	589 acres of potentially suitable habitat lost (0.1% of available potentially suitable habitat)	<1 acres of potentially suitable habitat lost (<0.1% of available potentially suitable habitat)	7,176 acres (1.5% of available potentially suitable habitat)	Small overall impact. See Aztec milkvetch for a list of potential mitigations applicable to all special status plant species.
Dwarf hawksbeard	*Askellia nana*	CO-S2	Steep alpine scree and talus slopes at elevations between 10,000 and 14,000 ft. Nearest known occurrences are about 38 mi from the SEZ. About 46,156 acres of potentially suitable habitat occurs within the SEZ region.	0 acres	0 acres	787 acres (1.7% of available potentially suitable habitat)	Small overall impact; no direct impact. No species-specific mitigation is warranted.
Fragile rockbrake	*Cryptogramma stelleri*	BLM-S; CO-S2	Moist soils on shaded limestone cliffs at elevations greater than 7,000 ft, and often in association with mosses. The nearest known occurrences are located in the San Juan Mountains, about 50 mi to the west of the SEZ. About 12,297 acres of potentially suitable habitat occurs within the SEZ region.	0 acres	0 acres	282 acres (2.3% of available potentially suitable habitat)	Small overall impact; no direct impact. No species-specific mitigation is warranted.

TABLE 10.3.12.1-1 (Cont.)

Common Name	Scientific Name	Listing Status[a]	Habitat[b]	Maximum Area of Potential Habitat Affected[c]: Within SEZ (Direct Effects)[d]	Transmission Line ROW (Direct Effects)[e]	Indirect Effects (Outside SEZ)[f]	Overall Impact Magnitude[g] and Species-Specific Mitigation[h]
Plants (Cont.)							
Grassy slope sedge	*Carex oreocharis*	CO-S1	Granitic soils on dry slopes at elevations between 7,200 and 10,800 ft. Endemic to the southern Rocky Mountains. Nearest known occurrences are about 45 mi from the SEZ. About 368,086 acres of potentially suitable habitat occurs within the SEZ region.	0 acres	0 acres	642 acres (0.2% of available potentially suitable habitat)	Small overall impact; no direct impact. No species-specific mitigation is warranted.
Gray's Peak whitlow-grass	***Draba grayana***	CO-S2	Gravelly alpine slopes and fellfields at elevations between 11,500 and 14,000 ft. Endemic to Colorado. Nearest known occurrences intersect the affected area from the western escarpment of the Sangre de Cristo Mountains, about 5 mi northeast of the SEZ. About 54,717 acres of potentially suitable habitat occurs within the SEZ region.	0 acres	0 acres	796 acres (1.5% of available potentially suitable habitat)	Small overall impact; no direct impact. No species-specific mitigation is warranted.
Halfmoon milkvetch	*Astragalus allochrous* var. *playanus*	CO-S1	Gravelly washes and sandbars of summer-dry streams at elevations between 3,000 and 4,000 ft. Nearest known occurrences are about 40 mi from the SEZ. About 87,052 acres of potentially suitable habitat occurs within the SEZ region.	0 acres	0 acres	295 acres (0.3% of available potentially suitable habitat)	Small overall impact; no direct impact. No species-specific mitigation is warranted.

TABLE 10.3.12.1-1 (Cont.)

				Maximum Area of Potential Habitat Affected[c]			
Common Name	Scientific Name	Listing Status[a]	Habitat[b]	Within SEZ (Direct Effects)[d]	Transmission Line ROW (Direct Effects)[e]	Indirect Effects (Outside SEZ)[f]	Overall Impact Magnitude[g] and Species-Specific Mitigation[h]
Plants (Cont.)							
Hall fescue	*Festuca hallii*	CO-S1	Alpine tundra and dry subalpine grasslands at elevations between 11,000 and 12,000 ft. Nearest known occurrences are from the Sangre de Cristo Mountains, about 35 mi from the SEZ. About 368,086 acres of potentially suitable habitat occurs within the SEZ region.	0 acres	0 acres	642 acres (0.2% of available potentially suitable habitat)	Small overall impact; no direct impact. No species-specific mitigation is warranted.
Helleborine	*Epipactis gigantea*	CO-S2	Wet gravelly and sandy stream shores and bars, seeps on sandstone cliffs, and to a lesser extent chaparral, marshes, hot springs, or riparian willow, box elder, and river birch woodlands. Elevation ranges between 4,800 and 8,000 ft. Nearest known occurrences are about 50 mi from the SEZ. About 102,599 acres of potentially suitable habitat occurs within the SEZ region.	0 acres	0 acres	356 acres (0.3% of available potentially suitable habitat)	Small overall impact; no direct impact. No species-specific mitigation is warranted.
James' cat's-eye	*Oreocarya cinerea* var. *pustulosa*	CO-S1	Gypsum and sandy substrates within sagebrush, pinyon-juniper, oak mountain brush, and ponderosa pine communities at elevations between 5,400 and 8,500 ft. Nearest known occurrences are about 12 mi from the SEZ. About 1,178,982 acres of potentially suitable habitat occurs within the SEZ region.	589 acres of potentially suitable habitat lost (<0.1% of available potentially suitable habitat)	1 acre of potentially suitable habitat lost (<0.1% of available potentially suitable habitat)	14,394 acres (1.2% of available potentially suitable habitat)	Small overall impact. See Aztec milkvetch for a list of potential mitigations applicable to all special status plant species.

TABLE 10.3.12.1-1 (Cont.)

Common Name	Scientific Name	Listing Status[a]	Habitat[b]	Maximum Area of Potential Habitat Affected[c]: Within SEZ (Direct Effects)[d]	Transmission Line ROW (Direct Effects)[e]	Indirect Effects (Outside SEZ)[f]	Overall Impact Magnitude[g] and Species-Specific Mitigation[h]
Plants (Cont.)							
King's campion	*Gastrolychnis kingii*	CO-S1	Spruce-fir, sedge, and alpine tundra communities at elevations between 10,800 and 11,300 ft. Endemic to Wyoming, western Colorado, and Utah. Nearest known occurrences are about 20 mi from the SEZ. About 256,575 acres of potentially suitable habitat occurs within the SEZ region.	0 acres	0 acres	957 acres (0.4% of available potentially suitable habitat)	Small overall impact; no direct impact. No species-specific mitigation is warranted.
Livermore fiddleleaf	*Nama dichotomum*	CO-S1	Plains and prairies at elevations between 7,000 and 10,200 ft. Nearest known occurrences are about 30 mi from the SEZ. About 60,516 acres of potentially suitable habitat occurs within the SEZ region.	0 acres	<1 acre of potentially suitable habitat lost (<0.1% of available potentially suitable habitat)	384 acres (0.6% of available potentially suitable habitat)	Small overall impact. Avoiding or minimizing disturbance of grassland habitat in the area of direct effects could reduce impacts. See Aztec milkvetch for a list of potential mitigations applicable to all special status plant species.

TABLE 10.3.12.1-1 (Cont.)

Common Name	Scientific Name	Listing Status[a]	Habitat[b]	Maximum Area of Potential Habitat Affected[c]: Within SEZ (Direct Effects)[d]	Maximum Area of Potential Habitat Affected[c]: Transmission Line ROW (Direct Effects)[e]	Maximum Area of Potential Habitat Affected[c]: Indirect Effects (Outside SEZ)[f]	Overall Impact Magnitude[g] and Species-Specific Mitigation[h]
Plants (Cont.)							
Many-flowered gilia	*Ipomopsis multiflora*	CO-S1	Open sites, desert shrublands, and woodlands. Nearest known occurrences are about 45 mi from the SEZ. About 1,419,012 acres of potentially suitable habitat occurs within the SEZ region.	3,868 acres of potentially suitable habitat lost (0.3% of available potentially suitable habitat)	58 acres of potentially suitable habitat lost (<0.1% of available potentially suitable habitat)	73,393 acres (5.2% of available potentially suitable habitat)	Small overall impact. See Aztec milkvetch for a list of potential mitigations applicable to all special status plant species.
Many-stemmed spider-flower	***Cleome multicaulis***	BLM-S; CO-S2; FWS-SC	San Luis Valley on saturated soils created by waterfowl management on public lands. Nearest occurrences intersect the affected area from the Blanca Wetlands, about 3 mi west and northwest of the SEZ. About 4,439 acres of potentially suitable habitat occurs within the SEZ region in the Blanca Wetlands.	0 acres	0 acres	137 acres (3.1% of available potentially suitable habitat)	Small overall impact; no direct impact. No species-specific mitigation is warranted.
Marsh-meadow indian-paintbrush	*Castilleja lineata*	CO-S1	Montane woodlands and meadows at elevations between 8,500 and 12,000 ft. Nearest known occurrences are about 40 mi from the SEZ. About 1,898,264 acres of potentially suitable habitat occurs within the SEZ region.	0 acres	0 acres	10,761 acres (0.6% of available potentially suitable habitat)	Small overall impact; no direct impact. No species-specific mitigation is warranted.

TABLE 10.3.12.1-1 (Cont.)

Common Name	Scientific Name	Listing Status[a]	Habitat[b]	Maximum Area of Potential Habitat Affected[c]: Within SEZ (Direct Effects)[d]	Transmission Line ROW (Direct Effects)[e]	Indirect Effects (Outside SEZ)[f]	Overall Impact Magnitude[g] and Species-Specific Mitigation[h]
Plants (Cont.)							
Mingan's moonwort	*Botrychium minganense*	CO-S1	Dense forest to open meadow and from summer-dry meadows to permanently saturated fens and seeps but most common in moist meadows and woodlands in association with riparian corridors. Recorded sites are often associated with old (>10 year) disturbances. Nearest known occurrences are about 42 mi from the SEZ. About 1,978,082 acres of potentially suitable habitat occurs within the SEZ region.	0 acres	0 acres	11,055 acres (0.6% of available potentially suitable habitat)	Small overall impact; no direct impact. No species-specific mitigation is warranted.
Mountain bladder fern	*Cystopteris montana*	CO-S1	Moist, rich soil in closed-canopied spruce-fir forests at elevations between 9,000 and 11,000 ft. Nearest known occurrences are about 50 mi from the SEZ. About 265,575 acres of potentially suitable habitat occurs within the SEZ region.	0 acres	0 acres	957 acres (0.4% of available potentially suitable habitat)	Small overall impact; no direct impact. No species-specific mitigation is warranted.
Mountain whitlow-grass	*Draba rectifructa*	CO-S2	Openings in sagebrush ponderosa pine, aspen, spruce-fir, lodgepole pine, and moderately moist alpine meadow communities at elevations between 6,400 and 9,600 ft. Nearest known occurrences are about 30 mi from the SEZ. About 946,322 acres of potentially suitable habitat occurs within the SEZ region.	0 acres	0 acres	3,575 acres (0.4% of available potentially suitable habitat)	Small overall impact; no direct impact. No species-specific mitigation is warranted.

TABLE 10.3.12.1-1 (Cont.)

Common Name	Scientific Name	Listing Status[a]	Habitat[b]	Maximum Area of Potential Habitat Affected[c]: Within SEZ (Direct Effects)[d]	Transmission Line ROW (Direct Effects)[e]	Indirect Effects (Outside SEZ)[f]	Overall Impact Magnitude[g] and Species-Specific Mitigation[h]
Plants (Cont.)							
New Mexico cliff fern	*Woodsia neomexicana*	CO-S2	Cliffs and rocky slopes usually on sandstone or igneous substrates. Elevations range between 7,875 and 11,500 ft. Nearest occurrences are from the Sangre de Cristo Mountains, about 12 mi from the SEZ. About 12,297 acres of potentially suitable habitat occurs within the SEZ region.	0 acres	0 acres	282 acres (2.3% of available potentially suitable habitat)	Small overall impact; no direct impact. No species-specific mitigation is warranted.
Pale moonwort	*Botrychium pallidum*	CO-S2	Open exposed hillsides, burned or cleared areas, or old mining situations at elevations between 9,800 and 10,600 ft. Nearest known occurrences are about 28 mi from the SEZ. About 47,267 acres of potentially suitable habitat occurs within the SEZ region.	0 acres	0 acres	970 acres (2.1% of available potentially suitable habitat)	Small overall impact; no direct impact. No species-specific mitigation is warranted.
Parry's crazy-weed	*Oxytropis parryi*	CO-S1	Gravelly, calcareous soil on exposed ridgetops in the alpine zone. Occurs within the SEZ region at elevations between 8,200 and 10,200 ft. Nearest known occurrences are from the Sangre de Cristo Mountains, about 25 mi east of the SEZ. About 94,561 acres of potentially suitable habitat occurs within the SEZ region.	0 acres	0 acres	962 acres (1.0% of available potentially suitable habitat)	Small overall impact; no direct impact. No species-specific mitigation is warranted.

TABLE 10.3.12.1-1 (Cont.)

Common Name	Scientific Name	Listing Status[a]	Habitat[b]	Maximum Area of Potential Habitat Affected[c]: Within SEZ (Direct Effects)[d]	Transmission Line ROW (Direct Effects)[e]	Indirect Effects (Outside SEZ)[f]	Overall Impact Magnitude[g] and Species-Specific Mitigation[h]
Plants (Cont.)							
Peck sedge	*Carex peckii*	CO-S1	Calcareous soils on dry to mesic slopes in partial shade within rich, deciduous or mixed deciduous-coniferous woodlands; open woods; bases of slopes; or full sun on exposed outcrops. Occurs as elevations below 6,600 ft. Nearest known occurrences are about 50 mi from the SEZ. About 818,045 acres of potentially suitable habitat occurs within the SEZ region.	0 acres	0 acres	2,400 acres (0.3% of available potentially suitable habitat)	Small overall impact; no direct impact. No species-specific mitigation is warranted.
Philadelphia fleabane	*Erigeron philadelphicus*	CO-S1	Woodland openings and margins, marshes edges, creek sides, roadsides, ditch banks, lawns, low prairies, and other open, disturbed sites at elevations below 9,500 ft. Nearest known occurrences are about 12 mi from the SEZ. About 261,409 acres of potentially suitable habitat occurs within the SEZ region.	0 acres	0 acres	800 acres (0.3% of available potentially suitable habitat)	Small overall impact; no direct impact. No species-specific mitigation is warranted.
Porsild's whitlow-grass	*Draba porsildii*	CO-S1	Scree and grassy meadows, along ridges, slopes, and in summits within the alpine zone at elevations between 9,600 and 13,000 ft. Nearest known occurrences are from the Sangre de Cristo Mountains, about 10 mi east of the SEZ. About 54,717 acres of potentially suitable habitat occurs within the SEZ region.	0 acres	0 acres	800 acres (1.5% of available potentially suitable habitat)	Small overall impact; no direct impact. No species-specific mitigation is warranted.

TABLE 10.3.12.1-1 (Cont.)

Common Name	Scientific Name	Listing Status[a]	Habitat[b]	Maximum Area of Potential Habitat Affected[c]: Within SEZ (Direct Effects)[d]	Transmission Line ROW (Direct Effects)[e]	Indirect Effects (Outside SEZ)[f]	Overall Impact Magnitude[g] and Species-Specific Mitigation[h]
Plants (Cont.)							
Prairie violet	*Viola pedatifida*	CO-S2	Rocky sites within prairies, open woodlands, and forest openings at elevations between 5,800 and 8,800 ft. Nearest known occurrences are about 30 mi from the SEZ. About 1,518,000 acres of potentially suitable habitat occurs within the SEZ region.	0 acres	0 acres	9,250 acres (0.6% of available potentially suitable habitat)	Small overall impact; no direct impact. No species-specific mitigation is warranted.
Ripley's milkvetch	*Astragalus ripleyi*	BLM-S; CO-S2; FWS-SC	Mixed conifer and shrubland habitats on rocky substrates at elevations above 8,000 ft. The nearest known occurrences are located 30 mi to the west of the SEZ. About 394,308 acres of potentially suitable habitat occurs within the SEZ region.	0 acres	0 acres	1,350 acres (0.3% of available potentially suitable habitat)	Small overall impact; no direct impact. No species-specific mitigation is warranted.
Rock sandwort	*Minuartia stricta*	CO-S1	Moist, granitic gravel sedge meadows, heath, alpine or arctic tundra at elevations between 300 and 12,500 ft. Nearest occurrences are within the Sangre de Cristo Mountains about 11 mi east of the SEZ. About 139,426 acres of potentially suitable habitat occurs within the SEZ region.	0 acres	0 acres	510 acres (0.4% of available potentially suitable habitat)	Small overall impact; no direct impact. No species-specific mitigation is warranted.

TABLE 10.3.12.1-1 (Cont.)

Common Name	Scientific Name	Listing Status[a]	Habitat[b]	Maximum Area of Potential Habitat Affected[c]: Within SEZ (Direct Effects)[d]	Transmission Line ROW (Direct Effects)[e]	Indirect Effects (Outside SEZ)[f]	Overall Impact Magnitude[g] and Species-Specific Mitigation[h]
Plants (Cont.)							
Rock-loving aletes	*Neoparrya lithophila*	BLM-S; CO-S2	Igneous rock outcrops on north-facing cliffs and ledges within pinyon-juniper woodlands at elevations greater than 7,000 ft. Endemic to south-central Colorado. Found as near as 15 mi southwest of the SEZ. About 434,485 acres of potentially suitable habitat occurs within the SEZ region.	0 acres	0 acres	5,750 acres (1.3% of available potentially suitable habitat)	Small overall impact; no direct impact. No species-specific mitigation is warranted.
Rocky Mountain bladderpod	*Lesquerella calcicola*	CO-S2	Shale bluffs, limy hillsides, gypseous knolls and ravines, and various calcareous substrates at elevations between 5,000 and 7,500 ft. Nearest known occurrences are about 40 mi from the SEZ. About 12,297 acres of potentially suitable habitat occurs within the SEZ region.	0 acres	0 acres	282 acres (2.3% of available potentially suitable habitat)	Small overall impact; no direct impact. No species-specific mitigation is warranted.

TABLE 10.3.12.1-1 (Cont.)

Common Name	Scientific Name	Listing Status[a]	Habitat[b]	Maximum Area of Potential Habitat Affected[c]: Within SEZ (Direct Effects)[d]	Maximum Area of Potential Habitat Affected[c]: Transmission Line ROW (Direct Effects)[e]	Maximum Area of Potential Habitat Affected[c]: Indirect Effects (Outside SEZ)[f]	Overall Impact Magnitude[g] and Species-Specific Mitigation[h]
Plants (Cont.)							
Rocky Mountain blazing-star	*Liatris ligulistylis*	CO-S1	Dry, rocky slopes, rocky woodlands, gravelly ground in valleys, pine barrens, aspen clearings, granite depressions, stream sides, prairies, and open moist sites at elevations below 7,900 ft. Nearest known occurrences are about 12 mi from the SEZ. About 1,393,825 acres of potentially suitable habitat occurs within the SEZ region.	0 acres	<1 acre of potentially suitable habitat lost (<0.1% of available potentially suitable habitat)	7,850 acres (0.6% of available potentially suitable habitat)	Small overall impact. Avoiding or minimizing disturbance of grassland habitat in the area of direct effects could reduce impacts. See Aztec milkvetch for a list of potential mitigations applicable to all special status plant species.
Slender cottongrass	*Eriophorum gracile*	CO-S2	Fens and subalpine wetlands that are supported by groundwater discharge or snowmelt at elevations between 7,100 and 12,000 ft. Nearest known occurrences are about 40 mi from the SEZ. About 95,143 acres of potentially suitable habitat occurs within the SEZ region.	0 acres	0 acres	210 acres (0.2% of available potentially suitable habitat)	Small overall impact; no direct impact. No species-specific mitigation is warranted.

TABLE 10.3.12.1-1 (Cont.)

Common Name	Scientific Name	Listing Status[a]	Habitat[b]	Maximum Area of Potential Habitat Affected[c]: Within SEZ (Direct Effects)[d]	Transmission Line ROW (Direct Effects)[e]	Indirect Effects (Outside SEZ)[f]	Overall Impact Magnitude[g] and Species-Specific Mitigation[h]
Plants (Cont.)							
Slender sedge	*Carex lasiocarpa*	CO-S1	Very wet boreal wetlands including sedge meadows, fens, bogs, lakeshores, and stream banks. Nearest known occurrences are about 12 mi from the SEZ. About 152,679 acres of potentially suitable habitat occurs within the SEZ region.	0 acres	0 acres	550 acres (0.4% of available potentially suitable habitat)	Small overall impact; no direct impact. No species-specific mitigation is warranted.
Small-winged sedge	*Carex stenoptila*	CO-S1	Open, rocky sites within coniferous woodlands at elevations between 7,900 and 9,500 ft. Nearest known occurrences are about 30 mi from the SEZ. About 1,402,150 acres of potentially suitable habitat occurs within the SEZ region.	0 acres	0 acres	10,900 acres (0.8% of available potentially suitable habitat)	Small overall impact; no direct impact. No species-specific mitigation is warranted.
Smith's whitlow-grass	***Draba smithii***	CO-S2	Talus slopes providing shaded and protected crevices at elevations between 8,000 and 11,000 ft. Endemic to the mountains of southern Colorado. Nearest known occurrences intersect the affected area from the Sangre de Cristo Mountains, about 5 mi northeast of the SEZ. About 58,453 acres of potentially suitable habitat occurs within the SEZ region.	0 acres	0 acres	1,069 acres (1.8% of available potentially suitable habitat)	Small overall impact; no direct impact. No species-specific mitigation is warranted.

TABLE 10.3.12.1-1 (Cont.)

Common Name	Scientific Name	Listing Status[a]	Habitat[b]	Maximum Area of Potential Habitat Affected[c]: Within SEZ (Direct Effects)[d]	Transmission Line ROW (Direct Effects)[e]	Indirect Effects (Outside SEZ)[f]	Overall Impact Magnitude[g] and Species-Specific Mitigation[h]
Plants (Cont.)							
Tundra saxifrage	*Muscaria monticola*	CO-S1	Rock outcrops, crevices, talus, scree slopes, rocky tundra, fellfields, nunataks, and stream banks at elevations below 14,700 ft. Nearest known occurrences are about 28 mi from the SEZ. About 67,015 acres of potentially suitable habitat occurs within the SEZ region.	0 acres	0 acres	1,078 acres (1.6% of available potentially suitable habitat)	Small overall impact; no direct impact. No species-specific mitigation is warranted.
Wahatoya Creek larkspur	*Delphinium robustum*	CO-S2	Broad canyon bottoms, aspen groves, subalpine meadows, riparian woodlands, and lower and upper montane coniferous forest at elevations between 7,200 and 11,200 ft. Nearest known occurrences are about 30 mi from the SEZ. About 641,197 acres of potentially suitable habitat occurs within the SEZ region.	0 acres	0 acres	2,200 acres (0.3% of available potentially suitable habitat)	Small overall impact; no direct impact. No species-specific mitigation is warranted.
Western moonwort	*Botrychium hesperium*	CO-S2	Early successional habitats with coarse gravelly soil which undergo periodic disturbance, including grassy mountain slopes, snow fields, road ditches, and gneiss outcrops and cliffs, as well as old fields at elevations between 650 and 11,300 ft. Nearest known occurrences are 27 mi from the SEZ. About 137,044 acres of potentially suitable habitat occurs within the SEZ region.	0 acres	0 acres	2,990 acres (2.2% of available potentially suitable habitat)	Small overall impact; no direct impact. No species-specific mitigation is warranted.

TABLE 10.3.12.1-1 (Cont.)

Common Name	Scientific Name	Listing Status[a]	Habitat[b]	Maximum Area of Potential Habitat Affected[c]: Within SEZ (Direct Effects)[d]	Transmission Line ROW (Direct Effects)[e]	Indirect Effects (Outside SEZ)[f]	Overall Impact Magnitude[g] and Species-Specific Mitigation[h]
Arthropods							
Sphinx moth	*Sphinx dollii*	CO-S2	Madrean oak woodland, arid brushlands, and desert foothills with woody broad-leafed shrubs. Nearest occurrence is from the Great Sand Dunes National Park, about 12 mi north of the SEZ. About 1,250,756 acres of potentially suitable habitat occurs within the SEZ region.	2,603 acres of potentially suitable habitat lost (0.2% of available potentially suitable habitat)	15 acres of potentially suitable habitat lost (<0.1% of available potentially suitable habitat)	45,839 acres (3.7% of available potentially suitable habitat)	Small overall impact. Pre-disturbance surveys and avoiding or minimizing disturbance of occupied habitats in the areas of direct effect; or compensatory mitigation of direct effects on occupied habitats could reduce impacts.
Birds							
American peregrine falcon	*Falco peregrinus anatum*	BLM-S; FWS-SC; CO-SC; CO-S2	Year-round resident in the SEZ region. Open spaces associated with high, near vertical cliffs and bluffs above 200 ft in height overlooking rivers. Nearest occurrences are from the Rio Grande National Forest about 40 mi northwest of the SEZ. About 3,277,511 acres of potentially suitable habitat occurs within the SEZ region.	2,000 acres of potentially suitable foraging habitat lost (<0.1% of available potentially suitable habitat)	48 acres of potentially suitable foraging habitat lost (<0.1% of available potentially suitable habitat)	48,240 acres (1.5% of potentially suitable available habitat)	Small overall impact; direct impact on foraging habitat only. Avoidance of direct impacts on foraging habitat is not feasible because suitable foraging habitat is widespread in the area of direct effect.

TABLE 10.3.12.1-1 (Cont.)

Common Name	Scientific Name	Listing Status[a]	Habitat[b]	Maximum Area of Potential Habitat Affected[c]: Within SEZ (Direct Effects)[d]	Transmission Line ROW (Direct Effects)[e]	Indirect Effects (Outside SEZ)[f]	Overall Impact Magnitude[g] and Species-Specific Mitigation[h]
Birds (Cont.)							
American white pelican	***Pelecanus erythrorhynchos***	BLM-S; CO-SC; CO-S1; FWS-SC	Large reservoirs in summer. May be observed in the Blanca Wetlands, about 5 mi northwest of the SEZ. About 205,596 acres of potentially suitable habitat occurs within the SEZ region associated with the Blanca Wetlands.	0 acres	0 acres	1,290 acres (0.6% of available potentially suitable habitat)	Small overall impact; no direct impact. No species-specific mitigation is warranted.
Bald eagle	*Haliaeetus leucocephalus*	CO-T; CO-S1	Year-round resident in the SEZ region. Seldom seen far from water, especially larger rivers, lakes, and reservoirs. Occurs locally in semiarid shrubland habitats where there is an abundance of small mammal prey. Known to occur in riparian habitats along the Rio Grande about 10 mi west of the SEZ. About 2,072,279 acres of potentially suitable habitat occurs within the SEZ region.	1,800 acres of potentially suitable foraging habitat lost (0.1% of available habitat)	14 acres of potentially suitable foraging habitat lost (<0.1% of available potentially suitable habitat)	43,930 acres (2.1% of available potentially suitable habitat)	Small overall impact; direct impact on foraging habitat only. Avoidance of direct impacts on foraging habitat is not feasible because suitable foraging habitat is widespread in the area of direct effect.
Barrow's goldeneye	*Bucephala islandica*	BLM-S; CO-S2	Winter resident in the SEZ region on larger lakes and rivers. Known to occur in the San Luis Valley. About 163,900 acres of potentially suitable habitat occurs in the affected area.	0 acres	0 acres	1,420 acres (1.0% of available potentially suitable habitat)	Small overall impact; no direct impact. No species-specific mitigation is warranted.

TABLE 10.3.12.1-1 (Cont.)

Common Name	Scientific Name	Listing Status[a]	Habitat[b]	Maximum Area of Potential Habitat Affected[c]: Within SEZ (Direct Effects)[d]	Maximum Area of Potential Habitat Affected[c]: Transmission Line ROW (Direct Effects)[e]	Maximum Area of Potential Habitat Affected[c]: Indirect Effects (Outside SEZ)[f]	Overall Impact Magnitude[g] and Species-Specific Mitigation[h]
Birds (Cont.)							
Ferruginous hawk	*Buteo regalis*	BLM-S; CO-SC	Summer resident in the affected area, but year-round resident in portions of the SEZ region. Grasslands, sagebrush, and saltbrush habitats, as well as the periphery of pinyon-juniper woodlands. Known to occur in San Luis State Park and Wildlife Area, about 10 mi northwest of the SEZ. About 1,360,614 acres of potentially suitable habitat occurs within the SEZ region.	2,000 acres of potentially suitable foraging habitat lost (0.2% of available potentially suitable habitat)	50 acres of potentially suitable foraging habitat lost (<0.1% of available potentially suitable habitat)	36,287 acres (2.7% of available potentially suitable habitat)	Small overall impact; direct impact on foraging habitat only. Avoidance of direct impacts on foraging habitat is not feasible because suitable foraging habitat is widespread in the area of direct effect.
Mountain plover	*Charadrius montanus*	BLM-S; CO-SC; CO-S2	Summer resident in the SEZ region. Prairie grasslands and arid plains and fields. Nests in shortgrass prairies associated with prairie dogs, bison, and cattle. Known to occur within 25 mi southeast of the SEZ. About 1,709,413 acres of potentially suitable habitat occurs within the SEZ region.	1,800 acres of potentially suitable habitat lost (0.1% of available potentially suitable habitat)	14 acres of potentially suitable habitat lost (<0.1% of available potentially suitable habitat)	40,385 acres (2.4% of available potentially suitable habitat)	Small overall impact on foraging and nesting habitat. Pre-disturbance surveys and avoiding or minimizing disturbance of occupied nests and habitats in the area of direct effect or compensatory mitigation of direct effects on occupied habitats could reduce impacts.

TABLE 10.3.12.1-1 (Cont.)

Common Name	Scientific Name	Listing Status[a]	Habitat[b]	Maximum Area of Potential Habitat Affected[c]: Within SEZ (Direct Effects)[d]	Maximum Area of Potential Habitat Affected[c]: Transmission Line ROW (Direct Effects)[e]	Maximum Area of Potential Habitat Affected[c]: Indirect Effects (Outside SEZ)[f]	Overall Impact Magnitude[g] and Species-Specific Mitigation[h]
Birds (Cont.)							
Short-eared owl	*Asio flammeus*	CO-S2	Year-round resident in the SEZ region. Nesting habitat includes grasslands, sagebrush, marshes, and tundra. Wintering habitat include grasslands and marshes. Nearest occurrences are about 12 mi from the SEZ. About 2,426,482 acres of potentially suitable habitat occurs within the SEZ region.	2,382 acres of potentially suitable habitat lost (0.1% of available potentially suitable habitat)	15 acres of potentially suitable habitat lost (<0.1% of available potentially suitable habitat)	49,715 acres (2.0% of available potentially suitable habitat)	Small overall impact on foraging and nesting habitat. Pre-disturbance surveys and avoiding or minimizing disturbance of occupied nests and habitats in the area of direct effect or compensatory mitigation of direct effects on occupied habitats could reduce impacts.
Southwestern willow flycatcher	*Empidonax traillii extimus*	ESA-E; CO-E	Nests in thickets, scrubby and brushy areas, open second growth, swamps, and open woodlands in the Alamosa National Wildlife Refuge along the Rio Grande, about 7.5 mi southwest of the SEZ. Suitable habitats may occur in the Blanca Wetlands about 3 mi west of the SEZ. About 210,962 acres of potentially suitable habitat occurs within the SEZ region.	0 acres	0 acres	390 acres (0.2% of available potentially suitable habitat)	Small overall impact; no direct impact. No species-specific mitigation is warranted.

TABLE 10.3.12.1-1 (Cont.)

Common Name	Scientific Name	Listing Status[a]	Habitat[b]	Maximum Area of Potential Habitat Affected[c]: Within SEZ (Direct Effects)[d]	Transmission Line ROW (Direct Effects)[e]	Indirect Effects (Outside SEZ)[f]	Overall Impact Magnitude[g] and Species-Specific Mitigation[h]
Birds (Cont.)							
Western burrowing owl	*Athene cunicularia hypugaea*	BLM-S; CO-T; FWS-SC	Open grasslands and prairies, as well as disturbed sites such as golf courses, cemeteries, and airports throughout the SEZ region. Nests in burrows constructed by mammals (prairie dog, badger, etc.). Known to occur in the San Luis Valley. About 2,209,000 acres of potentially suitable habitat occurs in the SEZ region.	2,425 acres of potentially suitable habitat lost (0.1% of available potentially suitable habitat)	19 acres of potentially suitable habitat lost (<0.1% of available potentially suitable habitat)	48,000 acres (2.2% of available potentially suitable habitat)	Small overall impact on foraging and nesting habitat. Pre-disturbance surveys and avoiding or minimizing disturbance of occupied burrows and habitats in the area of direct effect or compensatory mitigation of direct effects on occupied habitats could reduce impacts.
Western Snowy plover	***Charadrius alexandrinus nivosus***	BLM-S; CO-S1; CO-SC	Breeds in Colorado on alkali flats around reservoirs and sandy shorelines. May be observed as a summer breeder and fall migrant in the Blanca Wetlands, about 3 mi northwest of the SEZ. About 29,290 acres of potentially suitable habitat occurs within the SEZ region.	0 acres	0 acres	1,466 acres (5.0% of available potentially suitable habitat)	Small overall impact; no direct impact. No species-specific mitigation is warranted.

TABLE 10.3.12.1-1 (Cont.)

				Maximum Area of Potential Habitat Affected[c]			
Common Name	Scientific Name	Listing Status[a]	Habitat[b]	Within SEZ (Direct Effects)[d]	Transmission Line ROW (Direct Effects)[e]	Indirect Effects (Outside SEZ)[f]	Overall Impact Magnitude[g] and Species-Specific Mitigation[h]
Mammals							
Big free-tailed bat	*Nyctinomops macrotis*	BLM-S; CO-S1; FWS-SC	Year-round resident in the SEZ region. Roosts in rock crevices on cliff faces or in buildings. Forages primarily in coniferous forests and arid shrublands to feed on moths. May occur in the San Luis Valley. About 2,745,262 acres of potentially suitable habitat occurs within the SEZ region.	3,800 acres of potentially suitable foraging habitat lost (0.1% of available potentially suitable habitat)	63 acres of potentially suitable foraging habitat lost (<0.1% of available potentially suitable habitat)	80,840 acres (2.9% of available potentially suitable habitat)	Small overall impact; direct impact on foraging habitat only. Avoidance of direct impacts on foraging habitat is not feasible because suitable foraging habitat is widespread in the area of direct effect.
Dwarf shrew	*Sorex nanus*	CO-S2	Rocky sites within alpine, bare rock/talus/scree, coniferous forests, herbaceous grasslands, shrubland/chaparral, and woodland-conifer forests. Other habitats include sedge marsh, subalpine meadow, dry brushy slopes, arid shortgrass prairie, dry stubble fields, and pinyon-juniper woodlands. Nearest occurrences are about 40 mi from the SEZ. About 1,191,389 acres of potentially suitable habitat occurs within the SEZ region.	0 acres	0 acres	5,516 acres (0.5% of available potentially suitable habitat)	Small overall impact; no direct impact. No species-specific mitigation is warranted.

TABLE 10.3.12.1-1 (Cont.)

Common Name	Scientific Name	Listing Status[a]	Habitat[b]	Maximum Area of Potential Habitat Affected[c]: Within SEZ (Direct Effects)[d]	Maximum Area of Potential Habitat Affected[c]: Transmission Line ROW (Direct Effects)[e]	Maximum Area of Potential Habitat Affected[c]: Indirect Effects (Outside SEZ)[f]	Overall Impact Magnitude[g] and Species-Specific Mitigation[h]
Mammals (Cont.)							
Gunnison's prairie dog	*Cynomys gunnisoni*	ESA-C	Mountain valleys, plateaus, and open brush habitats in the project area at elevations between 6,000 and 12,000 ft. Known to occur as near as 20 mi south of the SEZ. About 1,938,641 acres of potentially suitable habitat occurs within the SEZ region.	3,882 acres of potentially suitable habitat lost (0.2% of available potentially suitable habitat)	62 acres of potentially suitable habitat lost (<0.1% of available potentially suitable habitat)	80,178 acres (4.1% of available potentially suitable habitat)	Small overall impact. Pre-disturbance surveys and avoiding or minimizing disturbance of active colonies in the area of direct effect; translocation of individuals from areas of direct effect; or compensatory mitigation of direct effects on occupied habitats could reduce impacts. Mitigation should be developed in coordination with the USFWS and CDOW.

TABLE 10.3.12.1-1 (Cont.)

Common Name	Scientific Name	Listing Status[a]	Habitat[b]	Maximum Area of Potential Habitat Affected[c]: Within SEZ (Direct Effects)[d]	Maximum Area of Potential Habitat Affected[c]: Transmission Line ROW (Direct Effects)[e]	Maximum Area of Potential Habitat Affected[c]: Indirect Effects (Outside SEZ)[f]	Overall Impact Magnitude[g] and Species-Specific Mitigation[h]
Mammals (Cont.)							
Pale Townsend's big-eared bat	*Corynorhinus townsendii pallescens*	BLM-S; CO-SC; CO-S2; FWS-SC	Year-round resident in the SEZ region. Semiarid shrublands, pinyon-juniper woodlands, and montane forests to elevations of 9,500 ft. Roosts in caves, mines, rock crevices, under bridges, or within buildings. Known to occur in the San Luis Valley about 25 mi southwest of the SEZ. About 3,075,160 acres of potentially suitable habitat occurs within the SEZ region.	1,800 acres of potentially suitable foraging habitat lost (0.1% of available potentially suitable habitat)	16 acres of potentially suitable foraging habitat lost (<0.1% of available potentially suitable habitat)	51,488 acres (1.7% of available potentially suitable habitat)	Small overall impact; direct impact on foraging habitat only. Avoidance of direct impacts on foraging habitat is not feasible because suitable foraging habitat is widespread in the area of direct effect.

[a] BLM-S = listed as a sensitive species by the BLM; CO-E = listed as endangered by the State of Colorado; CO-S1 = ranked as S1 in the State of Colorado; CO-S2 = ranked as S2 in the State of Colorado; CO-SC = species of special concern in the State of Colorado; CO-T = listed as threatened by the State of Colorado; ESA-C = candidate for listing under the ESA; ESA-E = listed as endangered under the ESA; FWS-SC = USFWS species of concern.

[b] For plant and invertebrate species, potentially suitable habitat was determined using SWReGAP land cover types. For bird and mammal species, potentially suitable habitat was determined using SWReGAP habitat suitability models. Area of potentially suitable habitat for each species is presented for the SEZ region, which is defined as the area within 50 mi (80 km) of the SEZ center.

[c] Maximum area of potential habitat that could be affected relative to availability within the SEZ region. Habitat availability for each species within the SEZ region was determined using SWReGAP habitat suitability and land cover models. This approach probably overestimates the amount of suitable habitat in the project area. No new access roads are assumed to be needed due to the proximity of existing roads to the SEZ.

[d] Direct effects within the SEZ consist of the ground-disturbing activities associated with construction and the maintenance of an altered environment associated with operations.

[e] For transmission line development, direct effects were estimated within a 2-mi (3-km) , 250-ft (76-m) wide ROW from the SEZ to the nearest transmission line. Direct impacts within this area were determined from the proportion of potentially suitable habitat within the 1-mi (1.6-km) wide transmission corridor.

Footnotes continued on next page.

TABLE 10.3.12.1-1 (Cont.)

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f Area of indirect effects was assumed to be the area adjacent to the SEZ within 5 mi (8 km) of the SEZ boundary and the portion of the transmission corridor where ground-disturbing activities would not occur. Indirect effects include effects from surface runoff, dust, noise, lighting, and so on from project developments. The potential degree of indirect effects would decrease with increasing distance away from the SEZ.

g Overall impact magnitude categories were based on professional judgment and include (1) *small*: ≤1% of the population or its habitat would be lost, and the activity would not result in a measurable change in carrying capacity or population size in the affected area; (2) *moderate*: >1 but ≤10% of the population or its habitat, would be lost and the activity would result in a measurable but moderate (not destabilizing) change in carrying capacity or population size in the affected area; *large*: >10% of a population or its habitat would be lost and the activity would result in a large, measurable, and destabilizing change in carrying capacity or population size in the affected area. Note that much greater weight was given to the magnitude of direct effects because those effects would be difficult to mitigate. Programmatic design features would reduce most indirect effects to negligible levels.

h Species-specific mitigation is presented for those species that could occur in the area of direct effects and have particular habitat features that could be readily avoided.

i To convert ft to m, multiply by 0.3048.

j To convert mi to km, multiply by 1.609.

k To convert acres to km^2, multiply by 0.004047.

l Species in bold text have been recorded or have designated critical habitat in the affected area.

10.3.12.1.1 Species Listed under the ESA That Could Occur in the Affected Area

In scoping comments on the proposed Fourmile East SEZ, the USFWS did not identify any ESA-listed species that may occur within the affected area of the SEZ (Stout 2009). However, one species listed under the ESA, the southwestern willow flycatcher, has the potential to occur within the affected area of the SEZ on the basis of observed occurrences near the affected area and the presence of apparently suitable habitat in the affected area (Table 10.3.12.1-1, Figure 10.3.12.1-1). In Appendix J, basic information is provided on life history, habitat needs, and threats to populations of this species.

The southwestern willow flycatcher is known to occur and breed in riparian habitats along the Rio Grande in the Alamos National Wildlife Refuge, about 7.5 mi (12 km) southwest of the Fourmile East SEZ. This area is considered to be outside of the areas of direct and indirect effects. The species has not been recorded on the SEZ or within the affected area. According to the SWReGAP habitat suitability model, potentially suitable habitat for the southwestern willow flycatcher does not occur on the SEZ or within the transmission corridor. However, potentially suitable habitat may occur outside of the SEZ in the area of indirect effects, particularly among habitats associated with the Blanca Wetlands (Table 10.3.12.1-1, Figure 10.3.12.1-1). Designated critical habitat for this species does not occur in the SEZ region.

10.3.12.1.2 Species That Are Candidates for Listing under the ESA

In scoping comments on the proposed Fourmile East SEZ, the USFWS did not identify any candidate species for listing under the ESA that may occur in the affected area of the SEZ (Stout 2009). However, one candidate species, the Gunnison's prairie dog, may occur near the proposed Fourmile East SEZ (Table 10.3.12.1-1). The known distribution of this species relative to the Fourmile East SEZ is shown in Figure 10.3.12.1-1. In Appendix J, basic information is provided on life history, habitat needs, and threats to populations of this species.

Gunnison's prairie dog occurs in the San Luis Valley and has been recorded about 20 mi (32 km) south of the Fourmile East SEZ (Figure 10.3.12.1-1). According to the SWReGAP habitat suitability model, potentially suitable habitat for the species exists on the SEZ, and Gunnison's prairie dog burrows were observed on the SEZ during a site visit in July 2009. Potentially suitable habitat may also occur throughout the affected area, including the transmission corridor and the area of indirect effects (Figure 10.3.12.1-1, Table 10.3.12.1-1).

10.3.12.1.3 BLM-Designated Sensitive Species

Fourteen BLM-designated sensitive species may occur in the affected area of the Fourmile East SEZ (Table 10.3.12.1-1). These BLM-designated sensitive species include the following (1) plants: Brandegee's milkvetch, fragile rockbrake, many-stemmed spider-flower, Ripley's milkvetch, and rock-loving aletes; (2) birds: American peregrine falcon, American white pelican, Barrow's goldeneye, ferruginous hawk, mountain plover, western burrowing owl, and western snowy plover; and (3) mammals: big free-tailed bat and pale Townsend's big-eared bat. Habitats in which these species are found, the amount of potentially suitable habitat in the affected area, and known locations of the species relative to the SEZ are presented in Table 10.3.12.1-1. These species are discussed below and additional life history information for these species is provided in Appendix J. Of these BLM-designated sensitive species with potentially suitable habitat in the affected area, occurrences of the many-stemmed spider-flower, American white pelican, and western snowy plover intersect the affected area of the Fourmile East SEZ.

Brandegee's Milkvetch

The Brandegee's milkvetch is a perennial forb that is known from disjunct locations in Arizona, Colorado, New Mexico, and Utah. The species inhabits sandy or gravelly banks, flats, and rocky meadows within pinyon-juniper woodlands at elevations between 5,400 and 8,800 ft (1,645 and 2,680 m). Nearest quad-level occurrences of this species are about 40 mi (64 km) southwest of the Fourmile East SEZ. According to the SWReGAP land cover model, potentially suitable habitat for this species does not occur on the SEZ or within the transmission corridor; however, potentially suitable pinyon-juniper woodland and mesic meadow habitats may occur in the area of indirect effects (Table 10.3.12.1-1).

Fragile Rockbrake

The fragile rockbrake is a perennial forb that is widespread across North America, Europe, and Asia. The species inhabits moist soils on shaded limestone cliffs at elevations greater than 7,000 ft (2,130 m). Nearest quad-level occurrences of this species are from the San Juan Mountains, about 50 mi (80 km) west of the Fourmile East SEZ. According to the SWReGAP land cover model, potentially suitable habitat for this species does not occur on the SEZ or transmission corridor. However, potentially suitable rocky cliffs and outcrops may occur within the area of indirect effects (Table 10.3.12.1-1).

Many-Stemmed Spider-Flower

The many-stemmed spider-flower is an annual forb that is known from disjunct locations from central Wyoming, south-central Colorado, southeast Arizona, and southwest Texas. The species inhabits saturated soils of saline depressions, such as alkali sinks, alkaline meadows, and playa margins. Within the San Luis Valley of south-central Colorado, the species is known from saturated soils created by waterfowl management on public lands. Nearest quad-level occurrences of this species are from the Blanca Wetlands, within 5 mi (8 km) west and northwest of the Fourmile East SEZ. According to the SWReGAP land cover model, potentially suitable habitat for this species does not occur on the SEZ or transmission corridor. However, potentially suitable playa or mesic meadow habitats may occur within the area of indirect effects (Table 10.3.12.1-1).

Ripley's Milkvetch

The Ripley's milkvetch is a perennial forb that is restricted to a range of less than 1,000 mi^2 (2,590 km^2) in Conejos County, Colorado and Taos and Rio Arriba Counties, New Mexico. The species inhabits mixed conifer woodlands on rocky volcanic substrates at elevations above 8,000 ft (2,440 m). Nearest quad-level occurrences of this species are about 30 mi (48 km) west of the Fourmile East SEZ. According to the SWReGAP land cover model, potentially suitable habitat for this species does not occur on the SEZ or transmission corridor. However, potentially suitable rocky cliff and outcrops or pinyon-juniper woodland habitats may occur within the area of indirect effects (Table 10.3.12.1-1).

Rock-Loving Aletes

The rock-loving aletes is a perennial forb that is endemic to south-central Colorado. The species occurs on volcanic rock substrates such as outcrops, cracks, or ledges. It is associated with pinyon-juniper woodlands on these substrates at elevations greater than 7,000 ft (2,130 m). Nearest quad-level occurrences of this species are about 15 mi (24 km) southwest of the Fourmile East SEZ. According to the SWReGAP land cover model, potentially suitable habitat for this species does not occur on the SEZ or transmission corridor. However, potentially suitable rocky cliff and outcrops or pinyon-juniper woodland habitats may occur within the area of indirect effects (Table 10.3.12.1-1).

American Peregrine Falcon

The American peregrine falcon occurs throughout the western United States in areas with high vertical cliffs and bluffs that overlook large open areas such as deserts, shrublands, and woodlands. Nests are usually constructed on rock outcrops and cliff faces. Foraging habitat varies from shrublands and wetlands to farmland and urban areas. Nearest quad-level occurrences of this species are from the Rio Grande National Forest, about 40 mi (64 km) northwest of the Fourmile East SEZ (Table 10.3.12.1-1). According to the SWReGAP habitat suitability model, potentially suitable year-round foraging nesting habitat for the American peregrine falcon may occur on the SEZ, the transmission corridor, and throughout portions of the area of indirect effects. On the basis of an evaluation of SWReGAP land cover types, however, potentially suitable nesting habitat (cliffs or outcrops) does not occur within the area of direct effects but about 280 acres (1 km^2) of cliff and rock outcrop habitat that may be potentially suitable nesting habitat occurs in the area of indirect effects.

American White Pelican

The American white pelican occurs in Colorado on larger lakes and reservoirs. The species is known to occur in the San Luis Valley, and, according to the SWReGAP habitat suitability model, potentially suitable summer nesting and migratory habitat for the species is predicted to occur within the affected area of the Fourmile East SEZ. Quad-level occurrences for this species intersect the SEZ affected area in association with the Blanca Wetlands. According to the SWReGAP habitat suitability model, suitable habitat for this species does not occur on the SEZ or within the transmission corridor; however, potentially suitable summer nesting habitat may occur in the area of indirect effects (Table 10.3.12.1-1). The potentially suitable habitat within the area of indirect effects is primarily associated with the Blanca Wetlands, about 3 mi (5 km) northwest of the SEZ.

Barrow's Goldeneye

The Barrow's goldeneye is a diving duck that occurs in Colorado on larger lakes and rivers. The species is known to occur in the San Luis Valley, and, according to the SWReGAP habitat suitability model, only potentially suitable wintering habitat for the Barrow's goldeneye is predicted to occur within the affected area of the Fourmile East SEZ. According to the SWReGAP habitat suitability model, suitable habitat for this species does not occur on the SEZ or within the transmission corridor; however, potentially suitable habitat may occur in the area of indirect effects (Table 10.3.12.1-1). The potentially suitable habitat within the area of indirect effects is primarily associated with the Blanca Wetlands, about 3 mi (5 km) northwest of the SEZ.

Ferruginous Hawk

The ferruginous hawk is a summer resident in the Fourmile East SEZ affected area and a year-round resident in portions of the SEZ region. The species inhabits open grasslands, sagebrush flats, desert scrub, and the edges of pinyon-juniper woodlands. The ferruginous hawk is known to occur in the San Luis Valley about 10 mi (16 km) northwest of the Fourmile East SEZ. According to the SWReGAP habitat suitability model, suitable habitat for this species may occur on the SEZ, transmission corridor, and within the area of indirect effects (Table 10.3.12.1-1). Most of this suitable habitat is represented by foraging habitat (shrublands). On the basis of an evaluation of SWReGAP land cover types, there is no suitable nesting habitat (rock outcrops or trees) on the SEZ or within the transmission corridor. However, about 10,300 acres (42 km^2) of forested habitat and 280 acres (1 km^2) of cliffs and rock outcrops within the area of indirect effects may be potentially suitable nesting habitat for the ferruginous hawk.

Mountain Plover

The mountain plover inhabits prairie grasslands and arid plains and fields, and nests in shortgrass prairie habitats associated with prairie dogs, bison, and cattle. The species occurs within the San Luis Valley, and the nearest quad-level occurrences are about 25 mi (40 km) southeast of the Fourmile East SEZ. According to the SWReGAP habitat suitability model, potentially suitable summer habitat for this species may occur on the SEZ, transmission corridor, and within the area of indirect effects (Table 10.3.12.1-1). The availability of suitable nesting habitat on the SEZ and in other portions of the affected area has not been determined.

Western Burrowing Owl

The western burrowing owl occurs in open areas with sparse vegetation where it forages in grasslands, shrublands, and open disturbed areas, and nests in burrows typically constructed by mammals. The species is known to occur in the San Luis Valley. According to the SWReGAP habitat suitability model, potentially suitable summer habitat for this species occurs on the SEZ, transmission corridor, and in portions of the area of indirect effects (Table 10.3.12.1-1). The availability of nest sites (burrows) within the affected area has not been determined, but Gunnison's prairie dog burrows were observed on the SEZ during a site visit in July 2009, and shrubland habitat that may be suitable for either foraging or nesting occurs throughout the affected area.

Western Snowy Plover

The western snowy plover nests on alkaline flats around reservoirs and sandy shorelines. It is known to occur as a summer breeder and fall migrant in the Blanca Wetlands, about 3 mi (5 km) northwest of the Fourmile East SEZ. According to the SWReGAP habitat suitability model, suitable habitat for this species does not occur in the SEZ affected area. On the basis of SWReGAP land cover types, however, potentially suitable habitat may occur in the area of indirect effects (Table 10.3.12.1-1). No potentially suitable land cover types occur in the area of direct effects. The potentially suitable habitat within the area of indirect effects is primarily associated with the Blanca Wetlands, about 3 mi (5 km) northwest of the SEZ.

Big Free-Tailed Bat

The big free-tailed bat is a year-round resident in the Fourmile East SEZ region where it forages in a variety of habitats including coniferous forests and desert shrublands. The species roosts in rock crevices or in buildings. The species is known to occur in the San Luis Valley of southern Colorado. According to the SWReGAP habitat suitability model, potentially suitable foraging habitat for the big free-tailed bat occurs on the SEZ, transmission corridor, and in portions of the area of indirect effects (Table 10.3.12.1-1). On the basis of an evaluation of SWReGAP land cover types, there is no potentially suitable roosting habitat (rocky cliffs and outcrops) in the area of direct effects.

Pale Townsend's Big-Eared Bat

The pale Townsend's big-eared bat is widely distributed throughout the western United States. The species forages year-round in a wide variety of desert and non-desert habitats in the Fourmile East SEZ region. The species roosts in caves, mines, tunnels, buildings, and other manmade structures. Nearest recorded quad-level occurrences of this species are about 25 mi (40 km) southwest of the Fourmile East SEZ. According to the SWReGAP habitat suitability model, potentially suitable foraging habitat for the pale Townsend's big-eared bat occurs on the SEZ, transmission corridor, and in portions of the area of indirect effects (Table 10.3.12.1-1). On the basis of an evaluation of SWReGAP land cover types, there is no potentially suitable roosting habitat (rocky cliffs and outcrops) in the affected area.

10.3.12.1.4 State-Listed Species

Three bird species listed by the State of Colorado may occur in the Fourmile East SEZ affected area (Table 10.3.12.1-1). Two species (southwestern willow flycatcher and western burrowing owl) were discussed in Section 10.3.12.1.1 and Section 10.3.12.1.3 because of their status under the ESA and BLM. The other state-listed species that may occur in the Fourmile East SEZ affected area is the bald eagle. This species as related to the SEZ is described in this section and presented in Table 10.3.12.1-1. Additional life history information for this species is provided in Appendix J.

The bald eagle is a year-round resident in the San Luis Valley, where it is associated with riparian habitats of larger permanent water bodies such as lakes, rivers, and reservoirs. This species also occasionally forages in arid shrubland habitats. Nearest quad-level occurrences of this species are from the Rio Grande, about 10 mi (16 km) west of the Fourmile East SEZ. According to the SWReGAP habitat suitability model, potentially suitable habitat for the species could occur on the SEZ, transmission corridor, and within the area of indirect effects. On the basis of an evaluation of SWReGAP land cover types, potentially suitable nesting habitat for the bald eagle does not occur on the SEZ or within the transmission corridor (Table 10.3.12.1-1); however, about 80 acres (0.3 km^2) of riparian woodlands that may be potentially suitable nesting habitat occur in the area of indirect effects.

10.3.12.1.5 Rare Species

Fifty-seven species that have a state status of S1 or S2 in Colorado or New Mexico or are species of concern by the USFWS or Colorado that may occur in the affected area of the Fourmile East SEZ (Table 10.3.12.1-1). Of these species, 42 have not been discussed as ESA-listed (Section 10.3.12.1.1), candidates for listing under the ESA (Section 10.3.12.1.2), BLM-designated sensitive (Section 10.3.12.1.3), or state-listed (Section 10.3.12.1.4).

10.3.12.2 Impacts

The potential for impacts on special status species from utility-scale solar energy development within the proposed Fourmile East SEZ is discussed in this section. The types of impacts that special status species could incur from construction and operation of utility-scale solar energy facilities are discussed in Section 5.10.4.

The assessment of impacts on special status species is based on available information on the presence of species in the affected area as presented in Section 10.3.12.1 following the analysis approach described in Appendix M. It is assumed that, prior to development, surveys would be conducted to determine the presence of special status species and their habitats in and near areas where ground-disturbing activities would occur. Additional NEPA assessments, ESA consultations, and coordination with state natural resource agencies may be needed to address project-specific impacts more thoroughly. These assessments and consultations could result in additional required actions to avoid, minimize, or mitigate impacts on special status species (see Section 10.3.12.3).

Solar energy development within the Fourmile East SEZ could affect a variety of habitats (see Section 10.3.10). Based on CNHP records, occurrences for the following seven special status species intersect the Fourmile East SEZ affected area: Altai chickweed, blue-eyed grass, Gray's Peak whitlow-grass, many-stemmed spider flower, Smith's whitlow-grass, American white pelican, and western snowy plover. Suitable habitat for each of these species may occur in the affected area. Other special status species may occur on the SEZ or within the affected area based on the presence of potentially suitable habitat. As discussed in Section 10.3.12.1, this approach to identifying the species that could occur in the affected area probably overestimates the number of species that actually occur in the affected area, and may therefore overestimate impacts to some special status species.

Potential direct and indirect impacts on special status species within the SEZ and in the area of indirect effects outside the SEZ are presented in Table 10.3.12.1-1. In addition, the overall potential magnitude of impacts on each species (assuming programmatic design features are in place) is presented along with any potential species-specific mitigation measures that could further reduce impacts.

Impacts on special status species could occur during all phases of development (construction, operation, and decommissioning and reclamation) of a utility-scale solar energy project within the SEZ. Construction and operation activities could result in short- or long-term impacts on individuals and their habitats, especially if these activities are sited in areas where special status species are known to or could occur. As presented in Section 10.3.1.2, a 2-mi (3-km) long transmission line from the SEZ is assumed to be needed to serve development in this SEZ. No new access road developments are assumed to be needed due to the proximity of U.S. Highway 160 adjacent to the southern boundary of the SEZ.

Direct impacts would result from habitat destruction or modification. It is assumed that direct impacts would occur only within the SEZ and within the assumed transmission line ROW where ground-disturbing activities are expected to occur. Indirect impacts could result from surface water and sediment runoff from disturbed areas, fugitive dust generated by project activities, accidental spills, harassment, and lighting. No ground-disturbing activities associated with project development are anticipated to occur within the area of indirect effects. Decommissioning of facilities and reclamation of disturbed areas after operations cease could result in short-term negative impacts on individuals and habitats adjacent to project areas, but long-term benefits would accrue if original land contours and native plant communities were restored in previously disturbed areas.

The successful implementation of programmatic design features (discussed in Appendix A) would reduce direct impacts on some special status species, especially those that depend on habitat types that can be easily avoided. Indirect impacts on special status species could be reduced to negligible levels by implementing programmatic design features especially those engineering controls that would reduce runoff, sedimentation, spills, and fugitive dust.

10.3.12.2.1 Impacts on Species Listed under the ESA

In their scoping comments on the proposed Fourmile East SEZ, the USFWS did not express concern for impacts of project development within the SEZ to any ESA-listed species (Stout 2009). However, on the basis of CNHP recorded occurrences and the presence of potentially suitable habitat, the southwestern willow flycatcher has the potential to occur in the affected area. The species has not been recorded on the SEZ or in the area of indirect effects, and, according to the SWReGAP habitat suitability model, suitable habitat does not occur on the SEZ or within the transmission corridor. However, about 390 acres (1.5 km^2) of potentially suitable habitat occurs in the area of indirect effects; this area represents about 0.2% of the available potentially suitable habitat in the SEZ region (Table 10.3.12.1-1).

The overall impact on the southwestern willow flycatcher from construction, operation, and decommissioning of utility-scale solar energy facilities within the Fourmile East SEZ is considered small because no potentially suitable habitat for this species occurs in the area of direct effects, and only indirect effects are possible. The implementation of programmatic design features is expected to be sufficient to reduce indirect impacts to negligible levels.

10.3.12.2.2 Impacts on Species That Are Candidates for Listing under the ESA

In their scoping comments on the proposed Fourmile East SEZ, the USFWS did not express concern for impacts of project development within the SEZ to any species that are candidates for listing under the ESA (Stout 2009). However, on the basis of CNHP recorded occurrences and the presence of potentially suitable habitat, the Gunnison's prairie dog could occur in the affected area. Quad-level occurrences of this species are known to occur as near as 20 mi (32 km) south of the SEZ, and Gunnison's prairie dog burrows were observed on the SEZ during a site visit in July 2009. According to the SWReGAP habitat suitability model, approximately 3,882 acres (15.5 km^2) of potentially suitable shrubland habitat on the SEZ and about 62 acres (0.3 km^2) of potentially suitable habitat in the transmission corridor could be directly affected by construction and operations (Table 10.3.12.1-1). This direct impact area represents about 0.2% of available suitable habitat in the SEZ region. About 80,178 acres (324 km^2) of suitable habitat occurs in the area of potential indirect impacts; this area represents about 4.1% of the available suitable habitat in the SEZ region (Table 10.3.12.1-1).

The overall impact on the Gunnison's prairie dog from construction, operation, and decommissioning of utility-scale solar energy facilities within the Fourmile East SEZ is considered small because the amount of potentially suitable habitat for this species in the area of direct effects represents less than 1% of potentially suitable habitat in the region. The implementation of programmatic design features may be sufficient to reduce indirect impacts on the Gunnison's prairie dog to negligible levels.

Avoidance of all potentially suitable habitats for the Gunnison's prairie dog is not a feasible means of mitigating impacts because these habitats (shrublands) are widespread throughout the area of direct effect. However, direct impacts could be reduced by avoiding or minimizing disturbance to occupied habitats in the area of direct effects. If avoidance or minimization is not a feasible option, individuals could be translocated from the area of direct effects to protected areas that would not be affected directly or indirectly by future development. Alternatively, or in combination with translocation, a compensatory mitigation plan could be developed and implemented to mitigate direct effects on occupied habitats. Compensation could involve the protection and enhancement of existing occupied or suitable habitats to compensate for habitats lost to development. A comprehensive mitigation strategy that used one or more of these options could be designed to completely offset the impacts of development. The need for mitigation, other than programmatic design features, should be determined by conducting pre-disturbance surveys for the species and its habitat on the SEZ.

Development of mitigation for the Gunnison's prairie dog, including development of a survey protocol, avoidance and minimization measures, and, potentially, translocation or compensatory mitigation, should be developed in coordination with the USFWS per Section 7 of the ESA. Consultation with the CDOW should also occur to determine any state mitigation requirements.

10.3.12.2.3 Impacts on BLM-Designated Sensitive Species

There are 14 BLM-designated sensitive species that could occur in the affected area of the Fourmile East SEZ Impacts on these BLM-designated sensitive species are discussed below.

Brandegee's Milkvetch

The Brandegee's milkvetch is known to occur about 40 mi (64 km) southwest of the SEZ and potentially suitable habitat may occur in the affected area of the Fourmile East SEZ. According to the SWReGAP land cover model, potentially suitable pinyon-juniper woodland and mesic meadow habitats do not occur on the SEZ or within the transmission corridor. However, about 7,480 acres (30 km^2) of potentially suitable habitat occurs in the area of indirect effects; this area represents 1.0% of the available suitable habitat in the SEZ region (Table 10.3.12.1-1).

The overall impact on the Brandegee's milkvetch from construction, operation, and decommissioning of utility-scale solar energy facilities within the Fourmile East SEZ is considered small because no potentially suitable habitat for this species occurs in the area of direct effects, and only indirect effects are possible. The implementation of programmatic design features is expected to be sufficient to reduce indirect impacts to negligible levels.

Fragile Rockbrake

The fragile rockbrake is known to occur about 50 mi (80 km) west of the Fourmile East SEZ, and potentially suitable habitat may occur in the affected area. According to the SWReGAP land cover model, potentially suitable rocky cliffs and outcrops do not occur on the SEZ or within the transmission corridor. However, about 282 acres (1 km^2) of potentially suitable habitat occurs in the area of indirect effects; this area represents 2.3% of the available suitable habitat in the SEZ region (Table 10.3.12.1-1).

The overall impact on the fragile rockbrake from construction, operation, and decommissioning of utility-scale solar energy facilities within the Fourmile East SEZ is considered small because no potentially suitable habitat for this species occurs in the area of direct effects, and only indirect effects are possible. The implementation of programmatic design features is expected to be sufficient to reduce indirect impacts to negligible levels.

Many-Stemmed Spider-Flower

The many-stemmed spider-flower is known from the Blanca Wetlands, about 3 mi (5 km) northwest of the Fourmile East SEZ, and potentially suitable habitat occurs in the affected area. According to the SWReGAP land cover model, potentially suitable habitat for this species does not occur on the SEZ or within the transmission corridor. However, about 137 acres (0.5 km^2) of potentially suitable playa or mesic meadow habitats may occur in the area of indirect effects; this area represents 3.1% of the available suitable habitat in the SEZ region (Table 10.3.12.1-1).

The overall impact on the many-stemmed spider-flower from construction, operation, and decommissioning of utility-scale solar energy facilities within the Fourmile East SEZ is considered small because no potentially suitable habitat for this species occurs in the area of direct effects, and only indirect effects are possible. The implementation of programmatic design features is expected to be sufficient to reduce indirect impacts to negligible levels.

Ripley's Milkvetch

The Ripley's milkvetch is known to occur about 30 mi (48 km) west of the Fourmile East SEZ, and potentially suitable habitat occurs in the affected area. According to the SWReGAP land cover model, potentially suitable habitat does not occur on the SEZ or within the transmission corridor. However, about 1,350 acres (5.5 km^2) of potentially suitable woodland habitat may occur in the area of indirect effects; this area represents 0.3% of the available suitable habitat in the SEZ region (Table 10.3.12.1-1).

The overall impact on the Ripley's milkvetch from construction, operation, and decommissioning of utility-scale solar energy facilities within the Fourmile East SEZ is considered small because no potentially suitable habitat for this species occurs in the area of direct effects, and only indirect effects are possible. The implementation of programmatic design features is expected to be sufficient to reduce indirect impacts to negligible levels.

Rock-Loving Aletes

The rock-loving aletes is known to occur about 15 mi (24 km) southwest of the Fourmile East SEZ, and potentially suitable habitat occurs in the affected area. According to the SWReGAP land cover model, potentially suitable habitat does not occur on the SEZ or within the transmission corridor. However, about 5,750 acres (23 km^2) of potentially suitable rocky cliffs and outcrops or pinyon-juniper woodland habitats may occur in the area of indirect effects; this area represents 1.3% of the available suitable habitat in the SEZ region (Table 10.3.12.1-1).

The overall impact on the rock-loving aletes from construction, operation, and decommissioning of utility-scale solar energy facilities within the Fourmile East SEZ is considered small because no potentially suitable habitat for this species occurs in the area of direct effects, and only indirect effects are possible. The implementation of programmatic design features is expected to be sufficient to reduce indirect impacts to negligible levels.

American Peregrine Falcon

The American peregrine falcon is a year-round resident in the Fourmile East SEZ region and is known to occur about 40 mi (64 km) northwest of the SEZ. According to the SWReGAP habitat suitability model, about 2,000 acres (8 km^2) of potentially suitable habitat on the SEZ and 48 acres (0.2 km^2) of potentially suitable habitat in the transmission corridor could be directly affected by construction and operations (Table 10.3.12.1-1). This direct impact area represents less than 0.1% of potentially suitable habitat in the SEZ region. About 48,240 acres (195 km^2) of potentially suitable habitat occurs in the area of indirect effects; this area represents about 1.5% of the potentially suitable habitat in the SEZ region (Table 10.3.12.1-1). Most of this area could serve as foraging habitat (open shrublands). On the basis of an evaluation of SWReGAP land cover data, potentially suitable nest sites for this species (rocky cliffs and outcrops) do not occur on the SEZ or the transmission corridor, but about 280 acres (1 km^2) of this habitat may occur in the area of indirect effects.

The overall impact on the American peregrine falcon from construction, operation, and decommissioning of utility-scale solar energy facilities within the Fourmile East SEZ is considered small because direct effects would only occur on potentially suitable foraging habitat, and the amount of this habitat in the area of direct effects represents less than 1% of potentially suitable foraging habitat in the SEZ region. The implementation of programmatic design features is expected to be sufficient to reduce indirect impacts on this species to negligible levels. Avoidance of impacts on suitable foraging habitat is not a feasible way to mitigate impacts on the American peregrine falcon because potentially suitable shrubland is widespread throughout the area of direct effects and readily available in other portions of the affected area.

American White Pelican

The American white pelican is a summer resident and fall migrant within the San Luis Valley. According to CNHP records, this species has been observed in the Blanca Wetlands about 5 mi (8 km) northwest of the Fourmile East SEZ. According to the SWReGAP habitat suitability model, suitable habitat for this species does not occur on the SEZ or within the transmission corridor; however, about 1,290 acres (5 km^2) of potentially suitable habitat occurs in the area of potential indirect effects; this area represents about 0.6% of the available suitable habitat in the SEZ region (Table 10.3.12.1-1).

The overall impact on the American white pelican from construction, operation, and decommissioning of utility-scale solar energy facilities within the Fourmile East SEZ is considered small because no potentially suitable habitat for this species occurs in the area of direct effects, and only indirect effects are possible. The implementation of programmatic design features is expected to be sufficient to reduce indirect impacts to negligible levels.

Barrow's Goldeneye

The Barrow's goldeneye is a winter resident within the San Luis Valley. According to CNHP records, the species has not been recorded on the Fourmile East SEZ or in the affected area. According to the SWReGAP habitat suitability model, suitable habitat for this species does not occur on the SEZ or within the transmission corridor; however, about 1,420 acres (6 km^2) of potentially suitable habitat occurs in the area of potential indirect effects; this area represents about 1.0% of the available suitable habitat in the SEZ region (Table 10.3.12.1-1).

The overall impact on the Barrow's goldeneye from construction, operation, and decommissioning of utility-scale solar energy facilities within the Fourmile East SEZ is considered small because no potentially suitable habitat for this species occurs in the area of direct effects, and only indirect effects are possible. The implementation of programmatic design features is expected to be sufficient to reduce indirect impacts to negligible levels.

Ferruginous Hawk

The ferruginous hawk is a summer breeding resident in the Fourmile East SEZ region and is known to occur about 10 mi (16 km) northwest of the Fourmile East SEZ. According to the SWReGAP habitat suitability model, about 2,000 acres (8 km^2) of potentially suitable habitat on the SEZ and 50 acres (<0.5 km^2) of potentially suitable habitat within the assumed transmission corridor could be directly affected by construction and operations (Table 10.3.12.1-1). This direct impact area represents 0.2% of available suitable habitat in the SEZ region. About 36,287 acres (147 km^2) of potentially suitable habitat occurs in the area of potential indirect effects; this area represents about 2.7% of the available suitable habitat in the SEZ region (Table 10.3.12.1-1). Most of this area could serve as foraging habitat (open shrublands). On the basis of an evaluation of SWReGAP land cover data, potentially suitable nest sites for this species (trees and rocky cliffs and outcrops) do not occur on the SEZ. However, about 10,300 acres (42 km^2) of forested habitat and 280 acres (1 km^2) of cliffs and rock outcrops that may be potentially suitable nesting habitat occur in the area of indirect effects.

The overall impact on the ferruginous hawk from construction, operation, and decommissioning of utility-scale solar energy facilities within the Fourmile East SEZ is considered small because direct effects would only occur on potentially suitable foraging habitat, and the amount of this habitat in the area of direct effects represents less than 1% of potentially suitable foraging habitat in the SEZ region. The implementation of programmatic design features is expected to be sufficient to reduce indirect impacts on this species to negligible levels. Avoidance of impacts on suitable foraging habitat is not a feasible way to mitigate impacts on the ferruginous hawk because potentially suitable shrubland is widespread throughout the area of direct effects and readily available in other portions of the affected area.

Mountain Plover

The mountain plover is a summer breeding resident in the Fourmile East SEZ region and is known to occur about 25 mi (40 km) southeast of the SEZ. According to the SWReGAP habitat suitability model, about 1,800 acres (7.5 km^2) of potentially suitable habitat on the SEZ and 14 acres (<0.5 km^2) of potentially suitable habitat within the assumed transmission corridor could be directly affected by construction and operations (Table 10.3.12.1-1). This direct impact area represents 0.1% of available suitable habitat in the SEZ region. About 40,375 acres (163 km^2) of potentially suitable habitat occurs in the area of indirect effects; this area represents about 2.4% of the available suitable habitat in the SEZ region (Table 10.3.12.1-1). Most of this area could serve as foraging and nesting habitat.

The overall impact on the mountain plover from construction, operation, and decommissioning of utility-scale solar energy facilities within the Fourmile East SEZ is considered small because the amount of potentially suitable habitat for this species in the area of direct effects represents less than 1% of potentially suitable foraging habitat in the SEZ region. The implementation of programmatic design features is expected to be sufficient to reduce indirect impacts on this species to negligible levels.

Avoidance of all potentially suitable foraging and nesting habitats is not feasible to mitigate impacts on the mountain plover because potentially suitable habitats are widespread throughout the area of direct effect and may be readily available in other portions of the SEZ region. Direct impacts on the mountain plover could be reduced by avoiding or minimizing disturbance to occupied nests and suitable habitat in the area of direct effects. If avoiding or minimizing disturbance to all occupied habitat is not a feasible option, a compensatory mitigation plan could be developed and implemented to mitigate direct effects. Compensation could involve the protection and enhancement of existing occupied or suitable habitats to compensate for habitats lost to development. A comprehensive mitigation strategy that used one or both of these options could be designed to completely offset the impacts of development. The need for mitigation, other than programmatic design features, should be determined by conducting preconstruction surveys for the species and its habitat within the area of direct effects.

Western Burrowing Owl

The western burrowing owl is a summer breeding resident in the San Luis Valley. According to the SWReGAP habitat suitability model, about 2,425 acres (10 km^2) of potentially suitable habitat on the SEZ and 19 acres (<0.1 km^2) of potentially suitable habitat in the transmission corridor could be directly affected by construction and operations (Table 10.3.12.1-1). This direct impact area represents about 0.1% of potentially suitable habitat in the SEZ region. About 48,000 acres (194 km^2) of potentially suitable habitat occurs in the area of indirect effects; this area represents about 2.2% of the potentially suitable habitat in the SEZ region (Table 10.3.12.1-1). Most of this area could serve as foraging and nesting habitat. The abundance of burrows suitable for nesting on the SEZ, transmission corridor, and in the area of indirect effects has not been determined.

The overall impact on the western burrowing owl from construction, operation, and decommissioning of utility-scale solar energy facilities within the Fourmile East SEZ is considered small because the amount of potentially suitable foraging and nesting habitat for this species in the area of direct effects represents less than 1% of potentially suitable foraging and nesting habitat in the region. The implementation of programmatic design features is expected to be sufficient to reduce indirect impacts on this species to negligible levels.

Avoidance of all potentially suitable habitats is not feasible to mitigate impacts on the western burrowing owl because potentially suitable shrubland habitats are widespread throughout the area of direct effect and readily available in other portions of the SEZ region. However, impacts on the western burrowing owl could be reduced by avoiding or minimizing disturbance to occupied burrows and habitat in the area of direct effects. If avoiding or minimizing disturbance to all occupied habitat is not a feasible option, a compensatory mitigation plan could be developed and implemented to mitigate direct effects. Compensation could involve the protection and enhancement of existing occupied or suitable habitats to compensate for habitats lost to development. A comprehensive mitigation strategy that used one or both of these options could be designed to completely offset the impacts of development. The need for mitigation, other than programmatic design features, should be determined by conducting preconstruction surveys for the species and its habitat within the area of direct effects.

Western Snowy Plover

The western snowy plover is a summer resident and fall migrant within the San Luis Valley. According to CNHP records, the species has been observed in the Blanca Wetlands about 5 mi (8 km) northwest of the Fourmile East SEZ. According to the SWReGAP habitat suitability model, suitable habitat for this species does not occur in the affected area; however, on the basis of SWReGAP land cover types, about 1,466 acres (6 km^2) of potentially suitable habitat occurs in the area of potential indirect effects; this area represents about 5.0% of the available suitable habitat in the SEZ region (Table 10.3.12.1-1). No potentially suitable land cover types occur in the area of direct effects. The potentially suitable habitat within the area of indirect effects is primarily associated with the Blanca Wetlands, about 3 mi (5 km) northwest of the SEZ.

The overall impact on the western snowy plover from construction, operation, and decommissioning of utility-scale solar energy facilities within the Fourmile East SEZ is considered small because no potentially suitable habitat for this species occurs in the area of direct effects, and only indirect effects are possible. The implementation of programmatic design features is expected to be sufficient to reduce indirect impacts to negligible levels.

Big Free-Tailed Bat

The big free-tailed bat is a year-round resident within the Fourmile East SEZ region and is known to occur in the San Luis Valley. According to the SWReGAP habitat suitability model, about 3,800 acres (15.5 km^2) of potentially suitable habitat on the SEZ and 63 acres (<0.5 km^2) of potentially suitable habitat within the assumed transmission corridor could be directly affected by construction and operations (Table 10.3.12.1-1). This direct impact area represents about 0.2% of available suitable habitat in the SEZ region. About 80,840 acres (327 km^2) of potentially suitable habitat occurs in the area of potential indirect impacts; this area represents about 2.9% of the available suitable habitat in the SEZ region (Table 10.3.12.1-1). Most of the potentially suitable habitat in the affected area is foraging habitat represented by desert shrubland. On the basis of an evaluation of SWReGAP land cover types, there is no potentially suitable roosting habitat (rocky cliffs and outcrops) in the area of direct effects; about 280 acres (1 km^2) of cliffs and rock outcrops that might be potentially suitable roost habitat occurs in the area of indirect effects.

The overall impact on the big free-tailed bat from construction, operation, and decommissioning of utility-scale solar energy facilities within the Fourmile East SEZ is considered small because the amount of potentially suitable foraging habitat for this species in the area of direct effects represents less than 1% of potentially suitable foraging habitat in the SEZ region. The implementation of programmatic design features is expected to be sufficient to reduce indirect impacts on this species to negligible levels. Avoidance of all potentially suitable foraging habitats is not feasible because potentially suitable habitat is widespread throughout the area of direct effect and readily available in other portions of the SEZ region.

Pale Townsend's Big-Eared Bat

The pale Townsend's big-eared bat is a year-round resident within the Fourmile East SEZ region and is known to occur about 25 mi (40 km) southwest of the SEZ. According to the SWReGAP habitat suitability model, about 1,800 acres (7.5 km^2) of potentially suitable habitat on the SEZ and 16 acres (<0.5 km^2) of potentially suitable habitat within the assumed transmission corridor could be directly affected by construction and operations (Table 10.3.12.1-1). This direct impact area represents about 0.1% of available suitable habitat in the SEZ region. About 51,488 acres (208 km^2) of potentially suitable habitat occurs in the area of potential indirect impacts; this area represents about 1.7% of the available potentially suitable habitat in the SEZ region (Table 10.3.12.1-1). Most of the potentially suitable habitat in the affected area is foraging habitat represented by desert shrubland. On the basis of an evaluation of SWReGAP land cover types, there is no potentially suitable roosting habitat (rocky cliffs and outcrops) in the area of direct effects; about 280 acres (1 km^2) of cliffs and rock outcrops that might be potentially suitable roost habitat occurs in the area of indirect effects.

The overall impact on the pale Townsend's big-eared bat from construction, operation, and decommissioning of utility-scale solar energy facilities within the Fourmile East SEZ is considered small because the amount of potentially suitable foraging habitat for this species in the area of direct effects represents less than 1% of potentially suitable foraging habitat in the SEZ region. The implementation of programmatic design features is expected to be sufficient to reduce indirect impacts on this species to negligible levels. Avoidance of all potentially suitable foraging habitats is not feasible because potentially suitable habitat is widespread throughout the area of direct effect and readily available in other portions of the SEZ region.

10.3.12.2.4 Impacts on State-Listed Species

Three state-listed species could occur in the affected area of the Fourmile East SEZ: bald eagle, southwestern willow flycatcher, and western burrowing owl. Two of these species (southwestern willow flycatcher and western burrowing owl) were discussed in Section 10.3.12.2.1 and Section 10.3.12.2.3 because of their status under the ESA and BLM. For the remaining state listed species, the bald eagle, impacts from solar development within the Fourmile East SEZ are discussed below.

The bald eagle is a year-round resident within the Fourmile East SEZ region and is known to occur about 10 mi (16 km) west of the SEZ. According to the SWReGAP habitat suitability model, about 1,800 acres (7.5 km^2) of potentially suitable habitat on the SEZ and 14 acres (<1 km^2) of potentially suitable habitat within the assumed transmission corridor could be directly affected by construction and operations (Table 10.3.12.1-1). This direct impact area represents less than 0.1% of available suitable habitat in the SEZ region. About 43,930 acres (178 km^2) of suitable habitat occurs in the area of potential indirect effect; this area represents about 2.1% of the available suitable habitat in the SEZ region (Table 10.3.12.1-1). Most of the potentially suitable habitat in the affected area is foraging habitat represented by desert shrubland. On the basis of an evaluation of SWReGAP land cover types, potentially suitable nesting habitat for the bald eagle (riparian woodlands) does not occur on the SEZ or within the transmission corridor. However, about 80 acres (0.3 km^2) of riparian woodlands that may be potentially suitable nesting habitat occur in the area of indirect effects.

The overall impact on the bald eagle from construction, operation, and decommissioning of utility-scale solar energy facilities within the Fourmile East SEZ is considered small because direct effects would only occur on potentially suitable foraging habitat, and the amount of this habitat in the area of direct effects represents less than 1% of potentially suitable foraging habitat in the SEZ region. The implementation of programmatic design features is expected to be sufficient to reduce indirect impacts on this species to negligible levels. Avoidance of impacts on suitable foraging habitat is not a feasible way to mitigate impacts on the bald eagle because potentially suitable foraging habitat (shrubland) is widespread throughout the area of direct effects and readily available in other portions of the SEZ region.

10.3.12.2.5 Impacts on Rare Species

Fifty-seven species with a state status of S1 or S2 in Colorado or that are listed as species of concern by the USFWS or Colorado may occur in the affected area of the Fourmile East SEZ. Impacts have been previously discussed for 15 of these species that are also listed under the ESA (Section 10.3.12.2.1), are candidates for listing under the ESA (10.3.12.2.2), are BLM-designated sensitive (10.3.12.2.3), or are state-listed species (10.3.12.2.4). Impacts on the remaining 42 rare species that do not have any other special status designation are presented in Table 10.3.12.1-1.

10.3.12.3 SEZ-Specific Design Features and Design Feature Effectiveness

The implementation of required programmatic design features described in Appendix A, Section A.2.2, would greatly reduce or eliminate the potential for effects on special status species. While some SEZ-specific design features are best established when specific project details are being considered, some design features can be identified at this time, including the following:

- Pre-disturbance surveys should be conducted within the SEZ and transmission corridor to determine the presence and abundance of special status species, including those identified in Table 10.3.12.1-1; disturbance to occupied habitats for these species should be avoided or minimized to the extent practicable. If avoiding or minimizing impacts to occupied habitats is not possible, translocation of individuals from areas of direct effect, or compensatory mitigation of direct effects on occupied habitats could reduce impacts. A comprehensive mitigation strategy for special status species that uses one or more of these options to offset the impacts of development should be developed in coordination with the appropriate federal and state agencies.

- Avoiding or minimizing impacts on grassland habitat in the transmission corridor could reduce impacts on the Livermore fiddleleaf, Rocky Mountain blazing-star, and short-eared owl.

- Coordination with the USFWS and CDOW should be conducted to address the potential for impacts on the Gunnison's prairie dog, a candidate species for listing under the ESA. Coordination would identify an appropriate survey protocol, avoidance measures, and, potentially, translocation or compensatory mitigation.

- Harassment or disturbance of federally listed species, candidates for federal listing, BLM-designated sensitive species, state-listed species, rare species, and their habitats in the affected area should be mitigated. This can be accomplished by identifying any additional sensitive areas and implementing necessary protection measures based upon consultation with the USFWS and CDOW.

If these SEZ-specific design features are implemented in addition to required programmatic design features, impacts on special status species would be reduced.

10.3.13 Air Quality and Climate

10.3.13.1 Affected Environment

10.3.13.1.1 Climate

The proposed Fourmile East SEZ is located in southeastern portion of Alamosa County in south-central Colorado. The SEZ, with an average elevation of about 7,620 ft (2,323 m), is located in the central part of the San Luis Valley. The valley lies in a broad depression between the Sangre de Cristo Mountain Range to the east and the San Juan and La Garita Mountain Ranges to the west; they converge to the north. As a result of these barriers, the valley experiences an arid climate, which is marked by cold winters and moderate summers, light precipitation, a high rate of evaporation, and abundant sunshine due to the thin atmosphere caused by its high elevation (NCDC 2009a). Meteorological data collected at the San Luis Valley Regional Airport and Blanca, which are about 12 mi (19 km) west-southwest and 7 mi (11 km) southeast of the Fourmile East SEZ, respectively, are summarized below.

A wind rose from the San Luis Valley Regional Airport in Alamosa, Colorado, for the 5-year period 2004 to 2008 taken at a level of 33 ft (10 m) is presented in Figure 10.3.13.1-1 (NCDC 2009b). During this period, the annual average wind speed at the airport was about 7.4 mph (3.3 m/s), with a relatively weak prevailing wind direction from the southwest (about 7.9% of the time). Winds that ranged from the south to west-southwest occurred for about 30.5% of the time and prevailed throughout the year, except in July and August when east-southeast winds prevailed. Wind speeds categorized as calm (less than 1.1 mph [0.5 m/s]) occurred frequently (about one-fifth of the time) because of the stable conditions caused by strong radiative cooling that lasted from late night to sunrise. Average wind speeds were the highest in spring at 9.6 mph (4.3 m/s); lower in summer and fall at 7.4 mph (3.3 m/s) and 6.7 mph (3.0 m/s), respectively; and lowest in winter at 6.1 mph (2.7 m/s).

In Colorado, topography plays a large role in determining the temperature of any specific location (NCDC 2009c). The San Luis Valley is at a relatively high elevation; thus temperatures are relatively lower than at lesser elevations of comparable latitude. For the 1909 to 2009 period, the annual average temperature at Blanca was 42.2°F (5.7°C) (WRCC 2009). January was the coldest month, with an average minimum temperature of 2.0°F (–16.7°C), and July was the warmest month, with an average maximum temperature of 81.6°F (27.6°C). In summer, daytime maximum temperatures over 90°F (32.2°C) were infrequent, and minimum temperatures were in the low 40s. On most days of the colder months (November through March), the minimum temperatures recorded were below freezing (≤32°F [0°C]), and subzero temperatures were common in January and December. For the 1909 to 2009 period, the highest temperature, 97°F (36.1°C), was reached in June 1961, and the lowest, –38°F (–38.9°C), was reached in January 1963. Each year, about 1.7 days had a maximum temperature that was 90°F (32.2°C) or greater, while about 220 days had a minimum temperature at or below freezing.

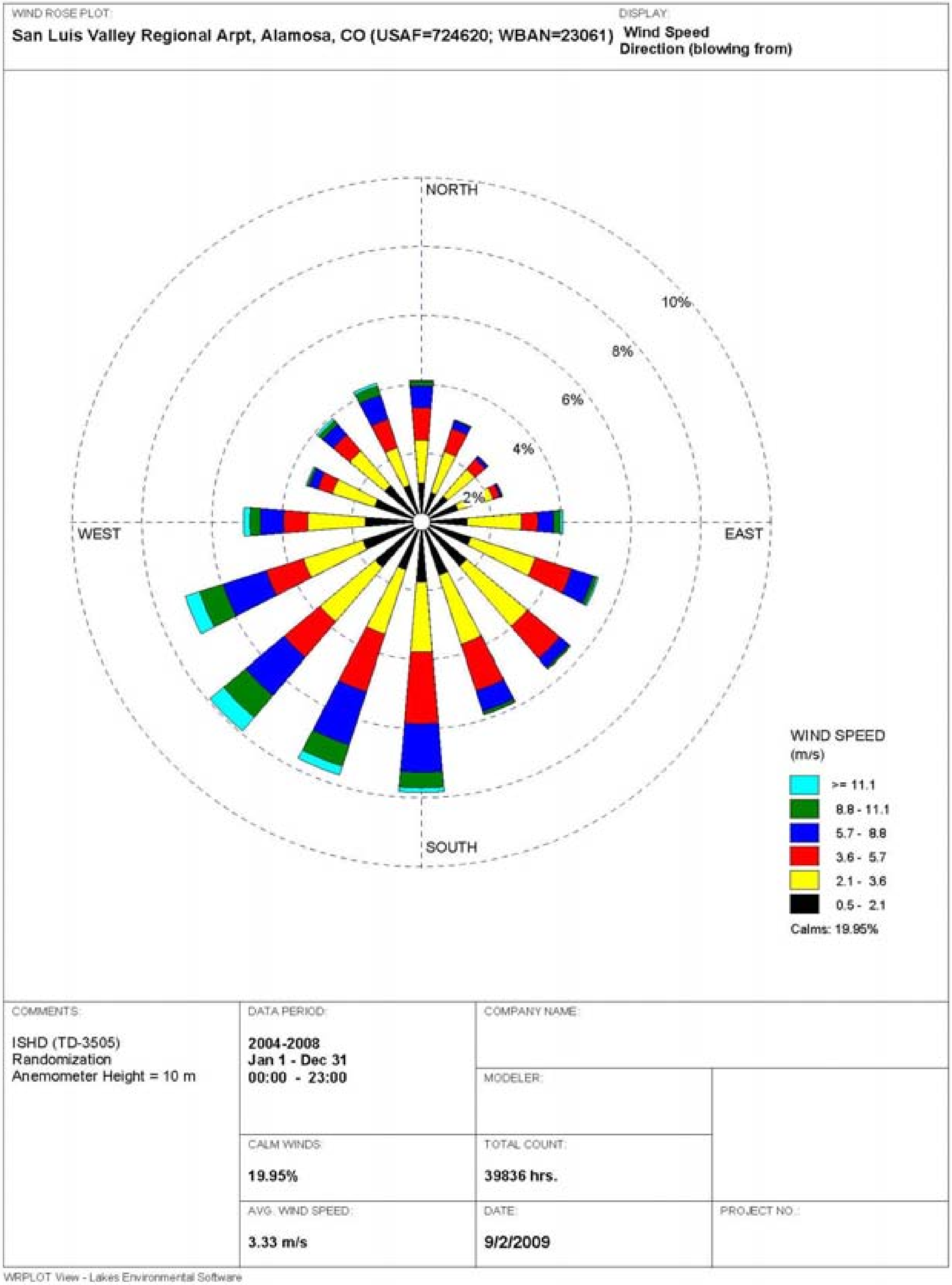

FIGURE 10.3.13.1-1 Wind Rose at 33-ft (10-m) Height at San Luis Valley Regional Airport, Alamosa, Colorado, 2004–2008 (Source: NCDC 2009b)

In Colorado, precipitation patterns are largely controlled by mountain ranges and elevation (NCDC 2009c). Because the San Luis Valley is so far from major sources of moisture and is surrounded by mountain ranges, precipitation is relatively light there. The valley is among the driest areas in Colorado. In the 1909 to 2009 period, annual precipitation at Blanca averaged about 8.59 in. (21.8 cm) (WRCC 2009). On average, 56 days a year have measurable precipitation (0.01 in. [0.025 cm] or higher). Nearly half of the annual precipitation occurs during summer months, when the Southwest Monsoon is most active (NCDC 2009c). Most of it is in the form of scattered, light showers and thunderstorms that develop over the mountains and move into the valley from the southwest. Scattered afternoon thunderstorms can accompany locally heavy rain and occasional hail. Snow occurs mainly in light falls that start as early as October and continue as late as May; most of the snow falls from November through April. The annual average snowfall at Blanca is about 24.4 in. (62.0 cm).

Because the San Luis Valley is so far from major water bodies and because surrounding mountain ranges block air masses from penetrating into the area, severe weather events, such as tornadoes, are a rarity there (NCDC 2010).

In 1999, two floods were reported in Alamosa County (NCDC 2010). These floods caused considerable property and crop damage.

In Alamosa County, 13 hail events have been reported since 1961, one of which caused some property and crop damage. Hail measuring 2.50 in. (6.4 cm) in diameter was reported in 2008. In Alamosa County, 22 high wind and 10 thunderstorm wind events have been reported since 1995 and 1962, respectively. Such events, with up to a maximum wind speed of 104 mph (46 m/s), have occurred any time of the year. Nine injuries and some property damage have been reported (NCDC 2010).

No dust storm events have been reported in Alamosa County (NCDC 2010). Nevertheless, the ground surface of the SEZ is covered predominantly with loamy fine sands and loamy sands, which have relatively high dust storm potential. High winds can trigger large amounts of blowing dust in areas of Alamosa County that have dry and loose soils with sparse vegetation. Dust storms can reduce air quality and visibility and may cause adverse health effects, particularly for people with asthma or other respiratory problems.

Infrequently, remnants from a decayed Pacific hurricane may dump widespread heavy rains in Colorado (NCDC 2009c). Tornadoes in Alamosa County, which encompasses the proposed Fourmile East SEZ, occur infrequently. In the period 1950 to June 2010, a total of 15 tornadoes (0.3 per year) were reported in Alamosa County (NCDC 2010). However, most of those tornadoes were relatively weak (i.e., nine were F0, five were F1, and one was F2 on the Fujita tornado scale), three of these caused minor property damage. Two of these tornadoes occurred about 3 to 4 mi (5 to 6 km) from the SEZ.

10.3.13.1.2 Existing Air Emissions

In Alamosa County, there are only a few industrial emission sources, and their emissions are relatively low. Because of the sparse population, only a few major roads, such as U.S. 160 and U.S. 285, and several state routes exist in Alamosa County. Thus, onroad mobile source emissions are not substantial. Data on annual emissions of criteria pollutants and VOCs in Alamosa County, which encompasses the proposed Fourmile East SEZ, are presented in Table 10.3.13.1-1 for 2002 (WRAP 2009). Emission data are classified into six source categories: point, area, onroad mobile, nonroad mobile, biogenic, and fire (wildfires, prescribed fires, agricultural fires, structural fires). In 2002, onroad and area sources were major contributors to SO_2 emissions, accounting for about 29% and 28%, respectively, of the county total SO_2 emissions. Onroad sources accounted for about 48% of the NO_x emissions and 68% of the CO emissions. Biogenic sources (e.g., vegetation, including trees, plants, and crops, and soils) accounted for about 88% of the VOC emissions. Area sources accounted for most of the county emissions of PM_{10} and $PM_{2.5}$, about 94% and 84%, respectively. Nonroad sources were secondary contributors to SO_2 (about 22%), NO_x (about 29%), and CO emissions (about 15%). In Alamosa County, point and fire sources were minor contributors to most of criteria pollutants and VOCs, except that point sources were secondary contributors to SO_2 emissions (about 21%).

TABLE 10.3.13.1-1 Annual Emissions of Criteria Pollutants and VOCs in Alamosa County, Colorado, Encompassing the Proposed Fourmile East SEZ, 2002[a]

Pollutant[b]	Emissions (tons/yr)
SO_2	49
NO_x	1,219
CO	9,604
VOCs	9,165
PM_{10}	1,223
$PM_{2.5}$	327

[a] Includes point, area, onroad and nonroad mobile, biogenic, and fire emissions.

[b] Notation: CO = carbon monoxide; NO_x = nitrogen oxides; $PM_{2.5}$ = particulate matter with a diameter of ≤2.5 μm; PM_{10} = particulate matter with a diameter of ≤10 μm; SO_2 = sulfur dioxide; and VOCs = volatile organic compounds.

Source: WRAP (2009).

In 2005, Colorado produced about 118 million metric tons (MMt) of *gross*[6] carbon dioxide equivalent (CO_2e)[7] emissions (Strait et al. 2007). Gross GHG emissions in Colorado increased by about 35% from 1990 to 2005, which was twice as fast as the national rate (about 16%). In 2005, electricity use (36.4%) and transportation (23.8%) were the primary contributors to gross GHG emission sources in Colorado. Fossil fuel use (in the residential, commercial, and nonfossil industrial sectors) and fossil fuel production accounted for about 18% and 8.6%, respectively, of total state emissions. Colorado's *net* emissions were about 83.9 MMt CO_2e, considering carbon sinks from forestry activities and agricultural soils throughout the state. The EPA (2009a) also estimated that in 2005, CO_2 emissions from fossil fuel combustion were 94.34 MMt, which was comparable to the state's estimate. The electric power generation (43%) and transportation (31%) sectors accounted

[6] Excluding GHG emissions removed as a result of forestry and other land uses and excluding GHG emissions associated with exported electricity.

[7] A measure used to compare the emissions from various GHGs on the basis of their global warming potential, defined as the cumulative radiative forcing effects of a gas over a specified time horizon resulting from the emission of a unit mass of gas relative to a reference gas, CO_2. The CO_2e for a gas is derived by multiplying the mass of the gas by the associated global warming potential.

for about three-fourths of the CO_2 total, and the residential, commercial, and industrial sectors accounted for the remainder.

10.3.13.1.3 Air Quality

Colorado State Ambient Air Quality Standards (SAAQS) include six criteria pollutants: SO_2, NO_2, CO, 1-hour O_3, PM_{10}, and Pb (5 *Code of Colorado Regulations* 1001-14; CDPHE 2008a). The Colorado SAAQS are identical to the National Ambient Air Quality Standards (NAAQS) for annual NO_2, CO, 1-hour O_3, and 24-hour PM_{10} (EPA 2010), but Colorado has no standards for 1-hour, 24-hour, and annual SO_2; 1-hour NO_2; 8-hour O_3; $PM_{2.5}$; and calendar quarter and rolling 3-month Pb. Colorado has more stringent standards than the NAAQS for 3-hour SO_2 and 1-month Pb, and it still maintains an annual average PM_{10} standard, for which the national standard was revoked by the EPA on December 18, 2006. The NAAQS/SAAQS for criteria pollutants are presented in Table 10.3.13.1-2.

Alamosa County, which encompasses the Fourmile East SEZ, is located administratively within the San Luis Intrastate Air Quality Control Region (AQCR) (Title 40, Part 81, Section 176 of the *Code of Federal Regulations* [40 CFR 81.176]), along with other counties in and around the San Luis Valley, such as Conejos, Costilla, Mineral, Rio Grande, and Saguache Counties, which is the same as Colorado State AQCR 8. Currently, Colorado State AQCR 8 is designated as being in unclassifiable/attainment for all criteria pollutants (40 CFR 81.306).

Because of low population density, low level of industrial activities (except for agriculture-related activities), and low traffic volume, the quantity of anthropogenic emissions in the San Luis Valley is small, and ambient air quality is thus relatively good. The only air quality concern in the valley is particulates (primarily related to woodstoves, unpaved roads, and street sanding). Controlled and uncontrolled burns are a significant source of air pollution in the valley as well. Seasonal high winds and dry soil conditions in the valley result in blowing dust storms. In Alamosa, high PM_{10} concentrations have been monitored during these unusual natural events since 1988; they peaked at 494 and 473 $\mu g/m^3$ in 2007, 424 $\mu g/m^3$ in 2006, and 412 $\mu g/m^3$ in 1991 (CDPHE 2008a).

Except for data on PM_{10} and $PM_{2.5}$, there are no recent measurement data for air pollutants in the San Luis Valley. Background concentrations representative of the San Luis Valley presented in Table 10.3.13.1-2 are based on intermittent monitoring studies and routine monitoring data (Chick 2009; EPA 2009b). Except for Pb,[8] these values are conservative indicators of ambient concentrations that were developed for the CDPHE's internal use in initial screening models for permit applications.

[8] As a direct result of the phaseout of leaded gasoline in automobiles in the 1970s, average Pb concentrations throughout the country have decreased dramatically. Accordingly, Pb is not an air quality concern except at certain locations, such as lead smelters, waste incinerators, and lead-acid battery facilities, where the highest levels of lead in air are found.

TABLE 10.3.13.1-2 Applicable Ambient Air Quality Standards and Background Concentration Levels Representative of the Proposed Fourmile East SEZ in Alamosa County, Colorado

			Background Concentration Level	
Pollutant[a]	Averaging Time	NAAQS/ SAAQS[b]	Concentration[c,d]	Measurement Location, Year
SO_2	1-hour	75 ppb[e]	NA[f]	NA
	3-hour	0.5 ppm[g,h]	0.009 ppm (1.8%)	Golden Energy at Portland, 2005–2006
	24-hour	0.14 ppm[g]	0.002 ppm (1.4%)	
	Annual	0.030 ppm[g]	0.001 ppm (3.3%)	
NO_2	1-hour	100 ppb[i]	NA	NA
	Annual	0.053 ppm	0.006 ppm (11%)	Southern Ute Site, 7571 Highway 550, 2003–2006
CO	1-hour	35 ppm	1 ppm (2.9%)	Southern Ute Site, 1 mi (1.6 km) northeast of Ignacio on County Road 517, 2005–2006
	8-hour	9 ppm	1 ppm (11%)	
O_3	1-hour	0.12 ppm[j]	NA	NA
	8-hour	0.075 ppm	0.063 ppm (84%)	Southern Ute Site, 7571 Highway 550, 2004–2006
PM_{10}	24-hour	150 $\mu g/m^3$	27 $\mu g/m^3$ (18%)	Battle Mountain Gold Mine, San Luis, West Site, 1991
	Annual	50 $\mu g/m^3$ [k]	13 $\mu g/m^3$ (26%)	
$PM_{2.5}$	24-hour	35 $\mu g/m^3$	16 $\mu g/m^3$ (46%)	Great Sand Dunes, 1998–2002
	Annual	15.0 $\mu g/m^3$	4 $\mu g/m^3$ (27%)	
Pb[l]	Calendar quarter	1.5 $\mu g/m^3$	0.02 $\mu g/m^3$ (1.3%)	Pueblo, 2002
	Rolling 3-month	0.15 $\mu g/m^3$ [m]	NA	NA

a Notation: CO = carbon monoxide; NO_2 = nitrogen dioxide; O_3 = ozone; Pb = lead; $PM_{2.5}$ = particulate matter with a diameter of ≤ 2.5 μm; PM_{10} = particulate matter with a diameter of ≤ 10 μm; and SO_2 = sulfur dioxide.

b NAAQS/SAAQS for annual NO_2, CO, 1-hour O_3, and 24-hour PM_{10}; NAAQS for SO_2, 1-hour NO_2, 8-hour O_3, $PM_{2.5}$, and Pb; and SAAQS for annual PM_{10}.

c Monitored concentrations are the highest for calendar-quarter Pb; second-highest for all averaging times less than or equal to 24-hour averages, except fourth-highest daily maximum for 8-hour O_3; and arithmetic mean for annual SO_2, NO_2, PM_{10}, and $PM_{2.5}$. These values, except for Pb, are conservative indicators of ambient concentrations developed for internal use by CDPHE in initial screening models for permit application.

Footnotes continued on next page.

TABLE 10.3.13.1-2 (Cont.)

[d] Values in parentheses are background concentration levels as a percentage of NAAQS/SAAQS. Calculation of 1-hour SO_2, 1-hour NO_2, and rolling 3-month Pb to NAAQS was not made, because no measurement data based on new NAAQS are available.

[e] Effective August 23, 2010.

[f] NA = not applicable or not available.

[g] Colorado has also established increments limiting the allowable increase ambient concentrations over an established baseline.

[h] Colorado state standard for 3-hour SO_2 is 700 $\mu g/m^3$ (0.267 ppm).

[i] Effective April 12, 2010.

[j] The EPA revoked the 1-hour O_3 standard in all areas, although some areas have continuing obligations under that standard (“anti-backsliding”).

[k] Effective December 18, 2006, the EPA revoked the annual PM_{10} standard of 50 $\mu g/m^3$.

[l] The Colorado Pb standard is 1-month average of 1.5 $\mu g/m^3$.

[m] Effective January 12, 2009.

Sources: CDPHE (2008a); Chick (2009); EPA (2009b, 2010); 5 *Code of Colorado Regulations* 1001-14.

The PSD regulations (40 CFR 52.21), which are designed to limit the growth of air pollution in clean areas, apply to a major new or modification of an existing major source within an attainment or unclassified area (see Section 4.11.2.3). As a matter of policy, the EPA recommends that the permitting authority notify the Federal Land Managers when a proposed PSD source would locate within 62 mi (100 km) of a Class I area. There are several Class I areas around the Fourmile East SEZ, four of which are situated within the 62-mi (100-km) range. The nearest Class I area is the Great Sand Dunes WA (40 CFR 81.406), about 9 mi (14 km) north of the Fourmile East SEZ. This Class I area is located downwind of prevailing winds at the Fourmile East SEZ (see Figure 10.3.13.1-1). Two other Class I areas in this range—Weminuche and La Garita WAs—in Colorado are located about 62 mi (100 km) west and west-northwest of the Fourmile East SEZ, respectively. The fourth Class I area is the Wheeler Peak WA in New Mexico (40 CFR 81.421), which is located about 60 mi (97 km) south of the Fourmile East SEZ. The latter three Class I areas are not located downwind of the prevailing winds at the Fourmile East SEZ.

10.3.13.2 Impacts

Potential impacts on ambient air quality associated with a solar project would be of most concern during the construction phase. Assuming application of extensive fugitive dust control measures and soil conservation mitigations, including adherence to vegetation management plans, impacts on ambient air quality from fugitive dust emissions from soil disturbances are anticipated, but they would be of short duration. During the operation phase, only a few sources with generally low-level emissions would exist for any of the four types of solar technologies evaluated. A solar facility would either not burn fossil fuels or burn only small amounts during operation. (For facilities using HTFs, fuel could be used to maintain the temperature of the HTFs for more efficient daily start-up.) Conversely, solar facilities would displace air emissions that would otherwise be released from fossil-fuel power plants.

Air quality impacts shared by all solar technologies are discussed in detail in Section 5.11.1, and technology-specific impacts are discussed in Section 5.11.2. Impacts specific to the Fourmile East SEZ are presented in the following sections. Any such impacts would be minimized through the implementation of required programmatic design features described in Appendix A, Section A.2.2, and through any additional mitigation applied. Section 10.3.13.3 below identifies SEZ-specific design features of particular relevance to the Fourmile East SEZ.

10.3.13.2.1 Construction

The Fourmile East SEZ has a relatively flat terrain; thus only a minimum number of site preparation activities, perhaps with no large-scale earthmoving operations, would be required. However, fugitive dust emissions from soil disturbances during the entire construction phase would be a major concern because of the large areas that would be disturbed in a region that experiences wind-blown dust problems. Fugitive dusts, which are released near ground level, typically have more localized impacts than do similar emissions from an elevated stack with additional plume rise induced by buoyancy and momentum effects.

Methods and Assumptions

Air quality modeling for PM_{10} and $PM_{2.5}$ emissions associated with construction activities was performed using the EPA-recommended AERMOD model (EPA 2009c). Details for emissions estimation, the description of AERMOD, input data processing procedures, and modeling assumption are described in Section M.13 of Appendix M. Estimated air concentrations were compared with the applicable NAAQS/SAAQS levels at the site boundaries and nearby communities and with Prevention of Significant Deterioration (PSD) increment levels at nearby Class I areas.[9] For the Fourmile East SEZ, the modeling was conducted on the basis of the following assumptions and input:

- Uniformly distributed emissions over the 3,000 acres (12.1 km^2) in the southern and central portions of the SEZ, close to the nearest residence and the towns of Alamosa and Blanca;

9 To provide a quantitative assessment, the modeled air impacts of construction were compared to the NAAQS/SAAQS levels and the PSD Class I increment levels. Although the Clean Air Act exempts construction activities from PSD requirements, a comparison with the Class I increment levels was used to quantify potential impacts. Only monitored data can be used to determine the attainment status. Modeled data are used to assess potential problems and as a consideration in the permitting process.

- Surface hourly meteorological data from the San Luis Valley Regional Airport in Alamosa and upper air sounding data from Denver for the 2004 to 2008 period;

- A regularly spaced receptor grid over a modeling domain of 62 mi × 62 mi (100 km × 100 km) centered on the proposed SEZ; and

- Additional discrete receptors at the SEZ boundaries and at the nearest Class I area—Great Sand Dunes WA—about 9 mi (14 km) north of the SEZ.

Results

The modeling results for both PM_{10} and $PM_{2.5}$ concentration increments and total concentrations (modeled plus background concentrations) that would result from construction-related fugitive emissions are summarized in Table 10.3.13.2-1. Maximum 24-hour PM_{10} concentration increments modeled at the site boundaries would be about 569 $\mu g/m^3$, which far exceeds the relevant standard level of 150 $\mu g/m^3$. Total 24-hour PM_{10} concentrations of 596 $\mu g/m^3$ would also exceed the standard level, by about a factor of 4, at the SEZ boundary. However, high PM_{10} concentrations would be limited to the immediate area surrounding the SEZ boundary and would decrease quickly with distance. Predicted maximum 24-hour PM_{10} concentration increments would be about 130 $\mu g/m^3$ at the nearest residence about 0.8 mi (1.3 km) southwest of the SEZ, about 20 $\mu g/m^3$ at Alamosa and Blanca, about 13 $\mu g/m^3$ at Estrella and Mosca, and about 8 $\mu g/m^3$ at Fort Garland, La Jara, and Sanford. Annual modeled and total PM_{10} concentration increments at the SEZ boundary would be about 101 $\mu g/m^3$ and 114 $\mu g/m^3$, respectively, which are higher than the standard level of 50 $\mu g/m^3$. Annual PM_{10} increments would be much lower for the mentioned locations, about 3 $\mu g/m^3$ at the nearest residence, about 0.7 $\mu g/m^3$ at Blanca and about 0.3 $\mu g/m^3$ at Alamosa and Mosca. Total 24-hour $PM_{2.5}$ concentrations would be 57 $\mu g/m^3$ at the SEZ boundary, which is about 162% of the standard level; modeled concentrations are more than twice background concentrations. The total annual average $PM_{2.5}$ concentration would be 14.1 $\mu g/m^3$, which is just below the standard level of 15.0 $\mu g/m^3$. At the nearest residence, predicted maximum 24-hour and annual $PM_{2.5}$ concentration increments would be about 4 and 0.3 $\mu g/m^3$, respectively.

Predicted 24-hour and annual PM_{10} concentration increments at the nearest Class I area, the Great Sand Dunes WA, would be about 34.2 and 1.1 $\mu g/m^3$, or 427% and 28%, respectively, of the allowable PSD increment levels for Class I areas. When distance, prevailing winds, and topography are considered, concentration increments at the other three Class I areas (La Garita WA and Weminuche WA, and Wheeler Peak WA, New Mexico) would be much lower than those at the Great Sand Dunes WA.

In conclusion, predicted 24-hour and annual PM_{10} and 24-hour $PM_{2.5}$ concentration levels could exceed air quality standard levels at the SEZ boundaries and immediately surrounding areas during the construction phase of a solar development. To reduce potential impacts on ambient air quality and in compliance with BLM design features, aggressive dust control measures would be used. Additionally, potential air quality impacts on neighboring

TABLE 10.3.13.2-1 Maximum Air Quality Impacts from Emissions Associated with Construction Activities for the Proposed Fourmile East SEZ

			Concentration ($\mu g/m^3$)				Percentage of NAAQS/SAAQS	
Pollutant[a]	Averaging Time	Rank[b]	Maximum Increment[b]	Background	Total	NAAQS/ SAAQS	Increment	Total
PM_{10}	24 hours	H6H	569	27	596	150	379	397
	Annual	–	101	13	114	50	202	228
$PM_{2.5}$	24 hours	H8H	40.8	16	56.8	35	117	162
	Annual	–	10.1	4	14.1	15	67	94

[a] $PM_{2.5}$ = particulate matter with a diameter of ≤2.5 µm; PM_{10} = particulate matter with a diameter of ≤10 µm.

[b] Concentrations for attainment demonstration are presented. H6H = highest of the sixth-highest concentrations at each receptor over the five-year period. H8H = highest of the multiyear average of the eighth-highest concentrations at each receptor over the 5-year period. For the annual average, multiyear averages of annual means over the five-year period are presented. Maximum concentrations are predicted to occur at the site boundaries.

Source: Chick (2009) for background concentration data.

communities would be much lower. Predicted total concentrations for annual $PM_{2.5}$ would be below the standard level. Modeling indicates that construction activities could result in concentrations above Class I PSD PM_{10} increment levels at the nearest federal Class I area, Great Sand Dunes WA. However, construction activities are not subject to the PSD program; the comparison is made as an indicator of possible dust levels in the WA during the limited construction period and as a screen to gage the size of the potential impact. Therefore, it is anticipated that the potential impacts of construction activities on ambient air quality would be moderate and temporary.

Construction emissions from engine exhaust of heavy equipment and vehicles could cause potential impacts on AQRVs (e.g., visibility and acid deposition) at the nearby federal Class I areas. SO_x emissions from engine exhaust would be very low because BLM design features would require that ultra-low–sulfur fuel with a sulfur content of 15 ppm would be used. NO_x emissions from engine exhaust would be primary contributors to potential impacts on AQRVs. Construction-related emissions are temporary in nature and thus would cause some unavoidable but short-term impacts.

It is assumed that a transmission line would need to be constructed to connect to the nearest existing line located about 2 mi (3 km) south of the Fourmile East SEZ. As discussed in Section 5.11.1.5, this activity would result in fugitive dust emissions from soil disturbance and engine exhaust emissions from heavy equipment and vehicles (commuter, visitor, support, and delivery vehicles), as at other construction sites. Because of the short distance to the regional grid, transmission line construction from the Fourmile East SEZ could be performed in a relatively short time (likely a few months). The construction site along the transmission line ROW would move continuously; thus no particular area would be exposed to air emissions for a prolonged period, and potential air quality impacts on nearby residences along the transmission lines ROW, if any, would be minor and temporary.

10.3.13.2.2 Operations

Emission sources associated with the operation of a solar facility include auxiliary boilers; vehicle traffic (commuter, visitor, support, and delivery); maintenance (e.g., mirror cleaning and repair or replacement of damaged mirrors); and drift from cooling towers for the parabolic trough or power tower technology if wet cooling was implemented (drift constitutes low-level PM emissions).

The types of emission sources caused by and offset by operation of a solar facility are discussed in Section M.13.4 of Appendix M.

Estimates of potential air emissions displaced by solar project development at the Fourmile East SEZ are presented in Table 10.3.13.2-2. Total power generation capacity ranging from 345 to 621 MW was estimated for the Fourmile East SEZ for various solar technologies (see Section 10.3.1.2). The estimated amount of emissions avoided for the solar technologies evaluated depends only on the megawatts of conventional fossil-fuel–generated power displaced, because a composite emission factor per megawatt-hour of power by conventional technologies is assumed (EPA 2009d). If the Fourmile East SEZ was fully developed, it is expected that the emissions avoided would be somewhat substantial. Development of 345 to 621 MW of solar power in the SEZ would result in avoided air emissions ranging from 1.3 to 2.3% of total emissions of SO_2, NO_x, Hg, and CO_2 from electric power systems in the state of Colorado (EPA 2009d). Avoided emissions would be up to 0.6% of total emissions from electric power systems in the six-state study area. When compared with emissions from all source categories, power production from the same solar facilities would displace up to 1.2% of SO_2, 0.4% of NO_x, and 1.0% of CO_2 emissions in the state of Colorado (EPA 2009a; WRAP 2009). These emissions would be up to 0.3% of total emissions from all source categories in the six-state study area. Power generated from fossil-fuel–fired power plants accounts for more than 96% of the total electric power generated in Colorado. The contribution of coal combustion is about 72%, followed by that of natural gas combustion at about 24%. Thus solar facilities to be built in the Fourmile East SEZ could displace relatively more fossil fuel emissions than those built in other states that rely less on fossil fuel–generated power.

As discussed in Section 5.11.1.5, the operation of associated transmission lines would generate some air pollutants from activities such as periodic site inspection and maintenance. However, these activities would occur infrequently, and emissions would be small. In addition, transmission lines could produce minute amounts of O_3 and its precursor NO_x associated with corona discharge (i.e., the breakdown of air near high-voltage conductors), which is most noticeable for higher voltage lines during rain or very humid conditions. Since the Fourmile East SEZ is located in an arid desert environment, these emissions would be small, and the potential

TABLE 10.3.13.2-2 Annual Emissions from Combustion-Related Power Generation Displaced by Full Solar Development of the Proposed Fourmile East SEZ

Area Size (acres)	Capacity (MW)[a]	Power Generation (GWh/yr)[b]	Emissions Displaced (tons/yr; 10^3 tons/yr for CO_2)[c]			
			SO_2	NO_x	Hg	CO_2
3,882	345–621	604–1,088	799–1,439	922–1,659	0.005–0.009	597–1,075
Percentage of total emissions from electric power systems in the state of Colorado[d]			1.3–2.3%	1.3–2.3%	1.3–2.3%	1.3–2.3%
Percentage of total emissions from all source categories in the state of Colorado[e]			0.68–1.2%	0.23–0.40%	–[f]	0.57–1.0%
Percentage of total emissions from electric power systems in the six-state study area[d]			0.32–0.57%	0.25–0.45%	0.18–0.32%	0.23–0.41%
Percentage of total emissions from all source categories in the six-state study area[e]			0.17–0.31%	0.03–0.06%	–	0.07–0.13%

[a] It is assumed that the SEZ would eventually have development on 80% of the lands and that a range of 5 acres (0.020 km^2) per MW (parabolic trough technology) to 9 acres (0.036 km^2) per MW (power tower, dish engine, and PV technologies) would be required.

[b] A capacity factor of 20% is assumed.

[c] Composite combustion-related emission factors for SO_2, NO_x, Hg, and CO_2 of 2.64, 3.05, 1.71×10^{-5}, and 1,976 lb/MWh, respectively, were used for the state of Colorado.

[d] Emission data for all air pollutants are for 2005.

[e] Emission data for SO_2 and NO_x are for 2002, while those for CO_2 are for 2005.

[f] A dash indicates not estimated.

Source: EPA (2009a,d); WRAP (2009).

impacts on ambient air quality would be negligible, taking into consideration infrequent occurrences of and small amount of emissions from corona discharges.

10.3.13.2.3 Decommissioning/Reclamation

As discussed in Section 5.11.1.4, decommissioning/reclamation activities are similar to construction activities but occur on a more limited scale and of shorter duration. Potential impacts on ambient air quality would be correspondingly less than those from construction activities. Decommissioning activities would last for a short period, and their potential impacts would be moderate and temporary in nature. The same mitigation measures adopted during the construction phase would also be implemented during the decommissioning phase (Section 5.11.3).

10.3.13.3 SEZ-Specific Design Features and Design Feature Effectiveness

No SEZ-specific design features are required. Limiting dust generation during construction and operations at the Fourmile East SEZ (for example by increased watering frequency, or road paving or treatment) is a required design feature under BLM's Solar Energy Program. These extensive fugitive dust control measures would keep off-site PM levels (particularly at Great Sand Dunes WA) as low as possible during construction.

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10.3.14 Visual Resources

10.3.14.1 Affected Environment

10.3.14.1.1 Regional Setting

The proposed Fourmile East SEZ is located approximately 33.5 mi (53.9 km) north of the Colorado–New Mexico border on the eastern side of the San Luis Valley in Alamosa County in southern Colorado. Section 10.1.7.1.1 discusses the regional setting (San Luis Valley) for Fourmile East and the other Colorado SEZs.

10.3.14.1.2 Fourmile East SEZ

The proposed Fourmile East SEZ (3,882 acres [15.7 km^2]) occupies an area approximately 4.0 mi (6.4 km) north to south (at greatest extent) and 3.3 mi (5.3 km) east to west and is located approximately 11.8 mi (18.9 km) (at closest approach) east–northeast of the town of Alamosa, Colorado, and 6.4 mi (10.3 km) northwest of the community of Blanca. CO 150 (Los Caminos Antiguos Scenic Byway) passes through the far eastern side of the SEZ, and U.S. 160 parallels the far southern boundary of the SEZ at a distance of 0.5 mi (0.8 km). The elevation of the proposed Fourmile East SEZ ranges from 7,589 ft (2,313 m) along the western portion of the SEZ to 7,678 ft (2,339 m) in the northeastern portion, along State Route 150.

The SEZ is a flat treeless plain; the strong horizon line is the dominant visual feature except for views to the northeast, which are dominated by Blanca Peak and the surrounding mountains a short distance from the northeast corner of the SEZ.

Vegetation varies somewhat in different parts of the SEZ. Some areas contain primarily low shrubs (generally less than 4 ft [1.2 m] in height), mixed with prickly pear cacti, and many large areas of bare, generally tan soil, presenting varied colors and generally coarse foreground textures. In other areas, grasses predominate, and vegetative cover is thicker, with more consistent color and finer visual texture. During a July 2009 site visit, the vegetation presented a range of gray-blues, greens, and grays, with banding and other variation sufficient to add visual interest. Some or all the vegetation might be snow-covered in winter, and the snow cover might significantly affect the visual qualities of the area by changing the color contrasts associated with the vegetation and could in turn change the contrasts associated with the introduction of solar facilities into the landscape.

No permanent water features are present on the SEZ. This landscape type is common within the region.

Although the SEZ itself is generally natural appearing, cultural modifications within the SEZ detract somewhat from the SEZ's scenic quality. In addition to State 150, several gravel and dirt roads of various sizes cross the SEZ. Traffic on U.S. 160 is visible from much of the SEZ. Panoramic views of the SEZ are shown in Figures 10.3.14.1-1, 10.3.14.1-2, and 10.3.14.1-3.

Off-site views are dominated by Blanca Peak and the surrounding mountains, which rise abruptly from the valley floor just northeast of the SEZ. The spatial relationship of the SEZ and the nearby mountains makes the Blanca Peak area seem somewhat isolated from the rest of the Sangre de Cristo Range and adds to Blanca Peak's visual prominence. The slopes of the nearby mountains are forested, with snow at the higher elevations, adding variety in color and texture. While evidence of past timber harvesting on the mountain slopes detracts slightly from the visual integrity of the view of Blanca Peak, the dramatic visual presence of the adjacent mountains adds significantly to the scenic value of the SEZ.

Immediately north of the visual mass of Blanca Peak and the surrounding mountains, the low form of light-colored sand dunes within the western portions of Great Sand Dunes National Park (approximately 8.6 mi [13.8 km] distant at the point of closest approach) is visible against the darker backdrop of the Sangre de Cristo Range, which recedes northward almost as far as the eye can see. To the northwest, west, and southwest, the low forms of the distant San Juan Mountains are visible across the valley floor, and the Sangre de Cristo Range is visible to the southeast.

While the land to the east and northeast of the SEZ is undeveloped, the lands to the north, west, and south of the SEZ are rural in character, and off-site views from the SEZ in these directions include a number of cultural modifications that detract slightly from the scenic quality of the area. Isolated ranches and homes and associated structures are visible in private lands adjacent to the SEZ, as are roads and local traffic. Scattered tanks and other structures associated with ranching and farming are visible, primarily west of the SEZ. Some of these cultural modifications are visible in Figure 10.3.14.1-1.

The BLM conducted a VRI for the SEZ and surrounding lands in 2009 (BLM 2010c). The VRI evaluates BLM-administered lands based on scenic quality; sensitivity level, in terms of public concern for preservation of scenic values in the evaluated lands; and distance from travel routes or KOPs. Based on these three factors, BLM-administered lands are placed into one of four VRI Classes, which represent the relative value of the visual resources. Classes I and II are the most valued; Class III represents a moderate value; and Class IV represents the least value. Class I is reserved for specially designated areas, such as national wildernesses and other congressionally and administratively designated areas where decisions have been made to preserve a natural landscape. Class II is the highest rating for lands without special designation. More information about VRI methodology is available in Section 5.12 and in Visual Resource Inventory, BLM Manual Handbook 8410-1 (BLM 1986a).

The VRI values for the SEZ and immediate surroundings are VRI Class III, indicating moderate relative visual values. The inventory indicates low scenic quality for the SEZ and its immediate surroundings, based in part on the lack of topographic relief and water features, and the relative commonness of the landscape type within the region. Positive scenic quality attributes included some variety in vegetation types and color and attractive off-site views; however, these positive attributes were insufficient to raise the scenic quality to the "Moderate"

FIGURE 10.3.14.1-1 Approximately 180° Panoramic View from the Southern Portion of the Proposed Fourmile East SEZ Facing North, Including Blanca Peak and Great Sand Dunes National Park at Far Right

FIGURE 10.3.14.1-2 Approximately 120° Panoramic View from the South-Central Portion of the Proposed Fourmile East SEZ Facing Northwest, Including San Juan Mountains in Background

FIGURE 10.3.14.1-3 Approximately 120° Panoramic View from the Central Portion of the Proposed Fourmile East SEZ Facing Northeast, Including Blanca Peak at Right Center and Great Sand Dunes National Park and Sangre de Cristo Range at Left

level. The inventory indicates high sensitivity for the SEZ and its immediate surroundings. The inventory indicates relatively low levels of use; however, the overall sensitivity rating is “High” because the Los Caminos Antiguos Byway passes through the SEZ. The byway is noted as a major route to access Great Sand Dunes National Park, in addition to its historic and scenic values.

Other factors contributing to the sensitivity rating include the following:

- Changes here would attract public attention.

- The SEZ is visible from the Sangre de Cristo Wilderness.

- The SEZ is within the Sangre de Cristo NHA.

- The Blanca Wetlands ACEC is nearby.

Lands within the 25-mi (40-km), 650-ft (198-m) viewshed of the SEZ contain 139,836 acres (566 km^2) of VRI Class II areas, primarily northwest of the SEZ in the Lake Mead area; 402,069 acres (1,627 km^2) of Class III areas surrounding the SEZ, primarily north of the SEZ; and 41,928 acres (170 km^2) of VRI Class IV areas, surrounding the SEZ.

The VRI map for the SEZ and surrounding lands is shown in Figure 10.3.14.1-4. More information about VRI methodology is available in Section 5.7 and in *Visual Resource Inventory*, BLM Manual Handbook 8410-1 (BLM 1986a).

The San Luis Resource Management Plan (RMP) (BLM 1991) indicates that the entire SEZ is managed as VRM Class III. VRM Class III objectives include partially retaining the existing character of the SEZ and allowing a moderate level of changes to the characteristic landscape. Management activities may attract attention but should not dominate the views of casual observers. The VRM map for the SEZ and surrounding lands is shown in Figure 10.3.14.1-5. More information about BLM’s VRM program is available in Section 5.7 and in *Visual Resource Management*, BLM Manual Handbook 8400 (BLM 1984).

10.3.14.2 Impacts

The potential for impacts from utility-scale solar energy development on visual resources within the proposed Fourmile East SEZ and surrounding lands, as well as the impacts of related developments (e.g., access roads and transmission lines) outside of the SEZ, is presented in this section, as are SEZ-specific design features.

Site-specific impact assessment is needed to systematically and thoroughly assess visual impact levels for a particular project. Without precise information about the location of a project and a relatively complete and accurate description of its major components and their layout, it is not possible to assess precisely the visual impacts associated with the facility. However, if the general nature and location of a facility are known, a more generalized assessment of potential

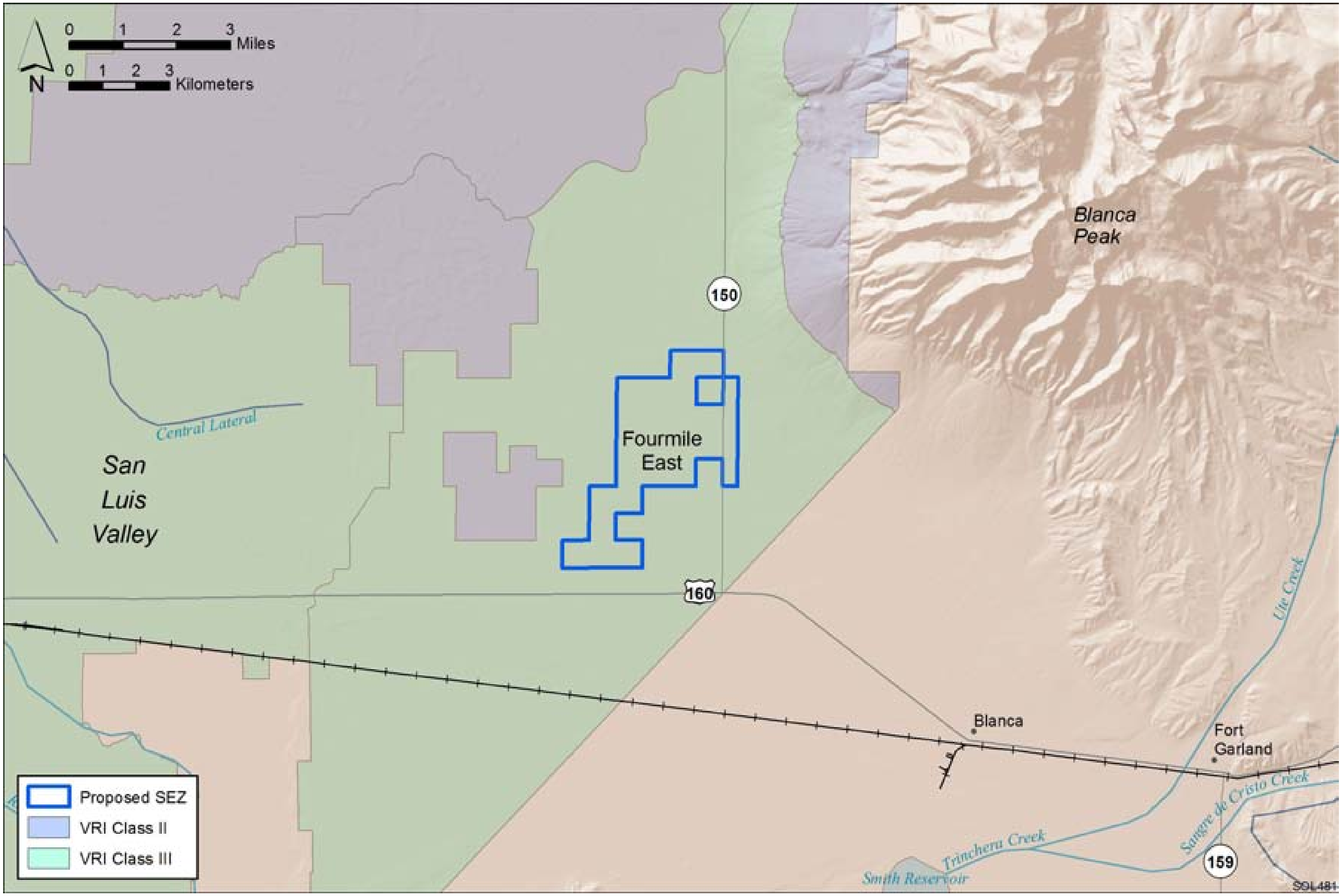

FIGURE 10.3.14.1-4 Visual Resource Inventory Values for the Proposed Fourmile East SEZ and Surrounding Lands

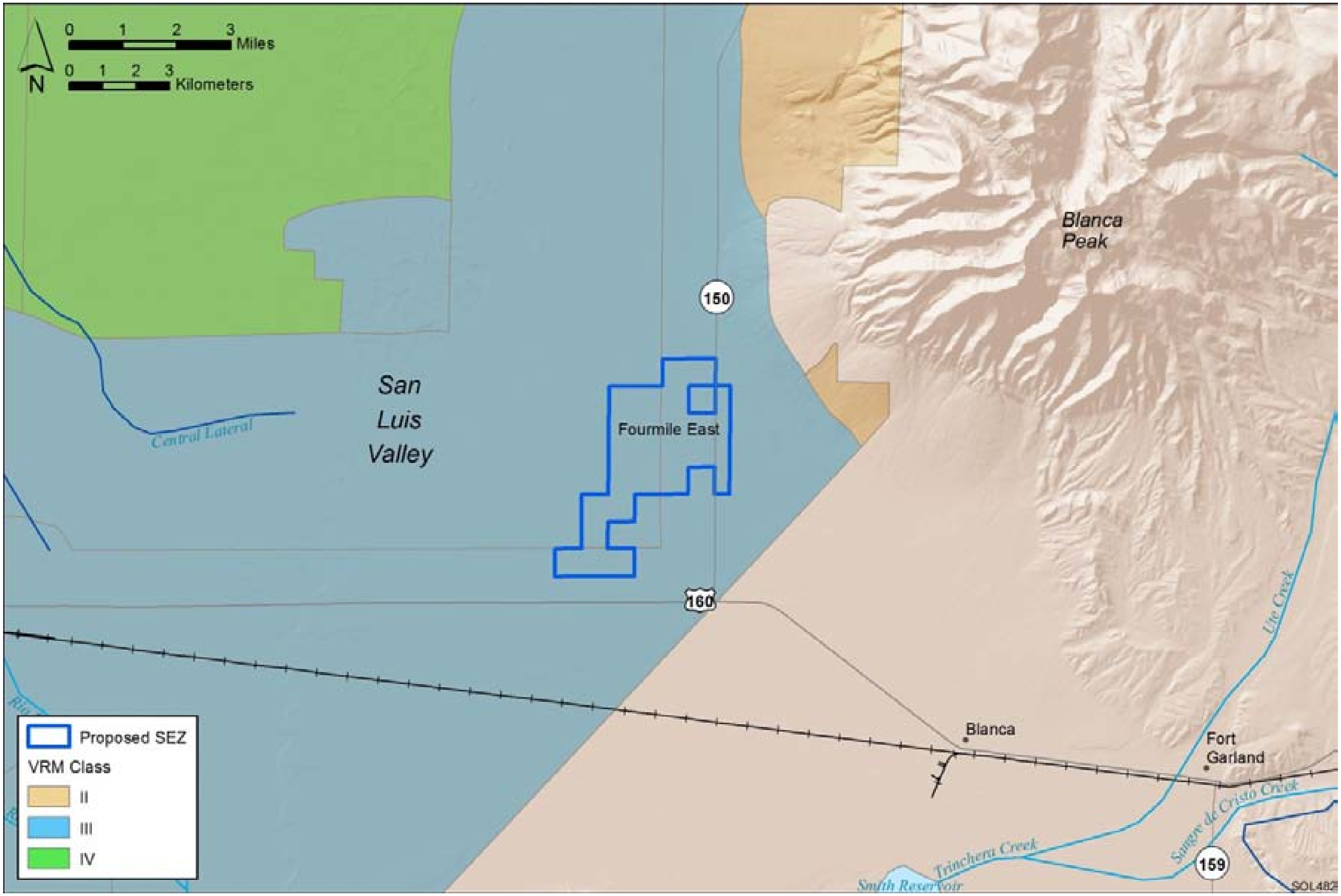

FIGURE 10.3.14.1-5 Visual Resource Management Classes for the Proposed Fourmile East SEZ and Surrounding Lands

visual impacts can be made by describing the range of expected visual changes and discussing contrasts typically associated with these changes. In addition, a general analysis can be used to identify sensitive resources that may be at risk if a future project is sited in a particular area. Detailed information on the methodology employed for the visual impact assessment for this Solar Energy PEIS, including assumptions and limitations, is presented in Appendix M.

Potential glint and glare impacts. Similarly, the nature and magnitude of potential glint- and glare-related visual impacts for a given solar facility are highly dependent on viewer position, sun angle, the nature of the reflective surface and its orientation relative to the sun and the viewer, atmospheric conditions, and other variables. The determination of potential impacts from glint and glare from solar facilities within a given proposed SEZ would require precise knowledge of these variables, and thus is not possible given the scope of the PEIS. Therefore, the following analysis does not describe or suggest potential contrast levels arising from glint and glare for facilities that might be developed within the SEZ; however, it should be assumed that glint and glare are possible visual impacts from any utility-scale solar facility, regardless of size, landscape setting, or technology type. The occurrence of glint and glare at solar facilities could potentially cause large, though temporary, increases in brightness and visibility of the facilities. The visual contrast levels projected for sensitive visual resource areas discussed in the following analysis do not account for potential glint and glare effects; however, these effects would be incorporated into a future site-and project-specific assessment that would be conducted for specific proposed utility-scale solar energy projects. For more information about potential glint and glare impacts associated with utility-scale solar energy facilities, see Section 5.12 of this PEIS.

10.3.14.2.1 Impacts on the Proposed Fourmile East SEZ

Some or all of the SEZ could be developed for one or more utility-scale solar energy projects, utilizing one or more of the solar energy technologies described in Appendix F. Because of the industrial nature and large size of utility-scale solar energy facilities, large visual impacts on the SEZ would occur as a result of the construction, operation, and decommissioning of solar energy projects. In addition, large impacts could occur at solar facilities utilizing highly reflective surfaces or major light-emitting facility components (solar dish, parabolic trough, and power tower technologies), with lesser impacts associated with reflective surfaces expected from PV facilities. These impacts would be expected to involve major modification of the existing character of the landscape and would likely dominate the views from nearby locations. Additional, and potentially large, impacts would occur as a result of the construction, operation, and decommissioning of related facilities, such as access roads and electric transmission lines. While the primary visual impacts associated with solar energy development within the SEZ would occur during daylight hours, lighting required for utility-scale solar energy facilities would be a potential source of visual impacts at night, both within the SEZ and in surrounding lands. Common and technology-specific visual impacts from utility-scale solar energy development, as well as impacts associated with electric transmission lines, are discussed in Section 5.12 of this PEIS. Impacts would last throughout construction, operation, and decommissioning, and some impacts could continue after project decommissioning. Visual impacts resulting from solar energy development in the SEZ would be in addition to impacts from solar energy development or other development that may occur on other public or private lands within the SEZ viewshed and are subject to cumulative effects. For discussion of cumulative impacts, see Section 10.3.22.4.13 of this PEIS.

The changes described above would be expected to be consistent with BLM visual resource management objectives for VRM Class IV, as seen from nearby KOPs. VRPM Class IV management objectives include major modification of the existing character of the landscape. As shown in Figure 10.3.14.1-5, the SEZ is currently designated as VRM Class III. VRM Class III objectives allow only a moderate level of change to the characteristic landscape; therefore, impacts associated with utility-scale solar energy development at the Fourmile East SEZ could exceed those consistent with the current VRM Class III management objectives for the area. More information about impact determination using BLM's VRM program is available in Section 5.7 and in *Visual Resource Contrast Rating*, BLM Manual Handbook 8431-1 (BLM 1986b).

10.3.14.2.2 Impacts on Lands Surrounding the Proposed Fourmile East SEZ

Impacts on Selected Sensitive Visual Resource Areas

Because of the large size of utility-scale solar energy facilities and the generally flat, open nature of the proposed SEZ, lands outside the SEZ would be subjected to visual impacts related to construction, operation, and decommissioning of utility-scale solar energy facilities. The affected areas and extent of impacts would depend on a number of visibility factors and viewer distance (for a detailed discussion of visibility and related factors, see Section 5.12). A key component in determining impact levels is the intervisibility between the project and potentially affected lands; if topography, vegetation, or structures screen the project from viewer locations, there is no impact.

Preliminary viewshed analyses were conducted to identify which lands surrounding the proposed SEZ could have views of solar facilities in at least some portion of the SEZ (see Appendix M for important information on assumptions and limitations of the methods used). Four viewshed analyses were conducted, assuming four different heights representative of project elements associated with potential solar energy technologies: PV and parabolic trough arrays, 24.6 ft (7.5 m); solar dishes and power blocks for CSP technologies, 38 ft (11.6 m); transmission towers and short solar power towers, 150 ft (45.7 m); and tall solar power towers, 650 ft (198.1 m). Viewshed maps for the SEZ for all four solar technology heights are presented in Appendix N.

Figure 10.3.14.2-1 shows the combined results of the viewshed analyses for all four solar technologies. The colored portions indicate areas with clear lines of sight to one or more areas within the SEZ and from which solar facilities within these areas of the SEZ would be expected to be visible, assuming the absence of screening vegetation or structures and adequate lighting and other atmospheric conditions. The light brown areas are locations from which PV and

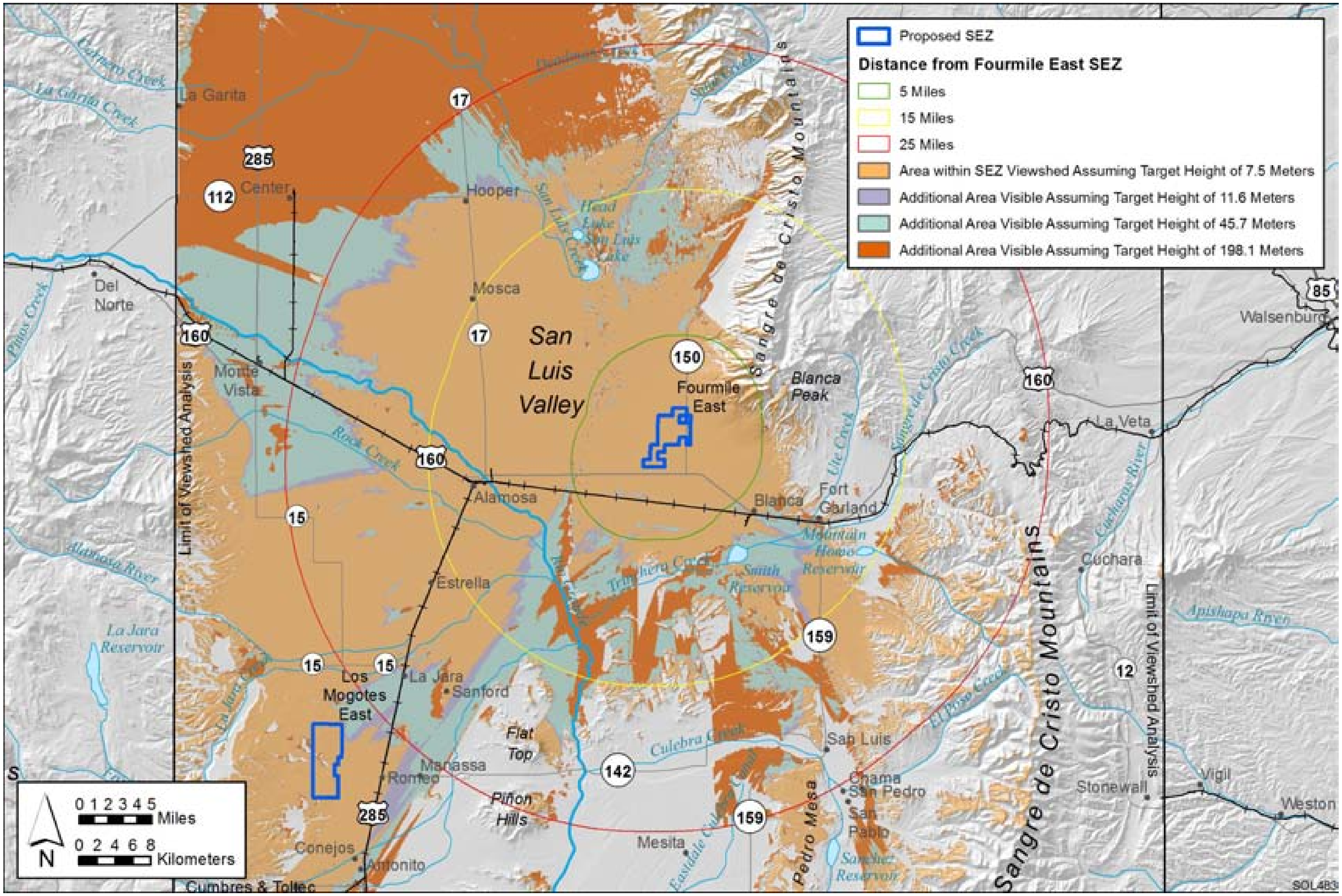

FIGURE 10.3.14.2-1 Viewshed Analyses for the Proposed Fourmile East SEZ and Surrounding Lands, Assuming Solar Technology Heights of 24.6 ft (7.5 m), 38 ft (11.6 m), 150 ft (45.7 m), and 650 ft (198.1 m) (shaded areas indicate lands from which solar development within the SEZ could be visible)

parabolic trough arrays located in the SEZ could be visible. Solar dishes and power blocks for CSP technologies would be visible from the areas shaded light brown and the additional areas shaded light purple. Transmission towers and short solar power towers would be visible from the areas shaded light brown and light purple and the additional areas shaded dark purple. Power tower facilities located in the SEZ could be visible from areas shaded light brown, light purple, and dark purple and at least the upper portions of power tower receivers could be visible from the additional areas shaded medium brown.

For the following visual impact discussion, the tall solar power tower (650 ft [198.1 m]) and PV and parabolic trough array (24.6 ft [7.5 m]) viewsheds are shown in the figures and discussed in the text. These heights represent the maximum and minimum landscape visibility, respectively, for solar energy technologies analyzed in this PEIS. Viewsheds for solar dish and CSP technology power blocks (38 ft [11.6 m]) and for transmission towers and short solar power towers (150 ft [45.7 m]) are presented in Appendix N. The visibility of these facilities would fall between that for tall power towers and PV and parabolic trough arrays.

Impacts on Selected Federal-, State-, and BLM-Designated Sensitive Visual Resource Areas

Figure 10.3.14.2-2 shows the results of a GIS analysis that overlays selected federal-, state-, and BLM-designated sensitive visual resource areas onto the combined tall solar power tower (650 ft [198.1 m]) and PV and parabolic trough array (24.6 ft [7.5 m]) viewsheds, in order to illustrate which of these sensitive visual resource areas could have views of solar facilities within the SEZ and therefore potentially would be subject to visual impacts from those facilities. Distance zones that correspond with BLM's VRM system-specified foreground-middleground distance (5 mi [8 km]), background distance (15 mi [24.1 km]), and a 25-mi (40.2-km) distance zone are shown as well, in order to indicate the effect of distance from the SEZ on impact levels, which are highly dependent on distance.

The scenic resources included in the analysis were as follows:

- National Parks, National Monuments, National Recreation Areas, National Preserves, National Wildlife Refuges, National Reserves, National Conservation Areas, National Historic Sites;

- Congressionally authorized Wilderness Areas;

- Wilderness Study Areas;

- National Wild and Scenic Rivers;

- Congressionally authorized Wild and Scenic Study Rivers;

- National Scenic Trails and National Historic Trails;

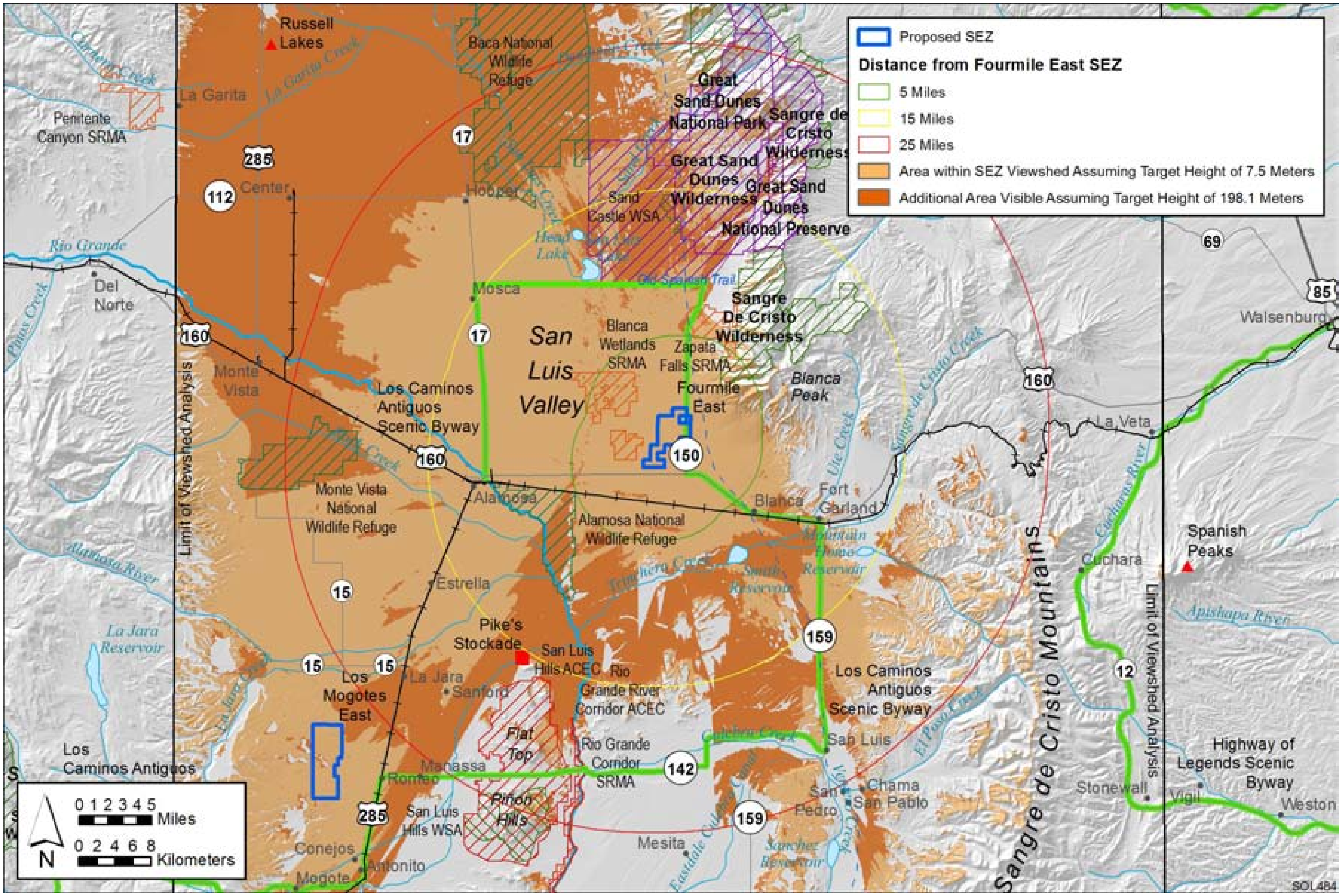

FIGURE 10.3.14.2-2 Overlay of Selected Sensitive Visual Resource Areas onto Combined 650-ft (198.1-m) and 24.6-ft (7.5-m) Viewsheds

- National Historic Landmarks and National Natural Landmarks;
- All-American Roads, National Scenic Byways, State Scenic Highways, and BLM- and USFS-designated scenic highways/byways;
- BLM-designated Special Recreation Management Areas; and
- ACECs designated because of outstanding scenic qualities.

Potential impacts on specific sensitive resource areas visible from and within 25 mi (40 km) of the proposed Fourmile East SEZ are discussed below. The results of this analysis are also summarized in Table 10.3.14.2-1. Further discussion of impacts on these areas is available in Sections 10.3.3 (Specially Designated Areas and Lands with Wilderness Character) and 10.3.17 (Cultural Resources) of this PEIS.

The following visual impact analysis describes *visual contrast levels* rather than *visual impact levels*. *Visual contrasts* are changes in the landscape as seen by viewers, including changes in the forms, lines, colors, and textures of objects seen in the landscape. A measure of *visual impact* includes potential human reactions to the visual contrasts arising from a development activity, based on viewer characteristics, including attitudes and values, expectations, and other characteristics that that are viewer- and situation-specific. Accurate assessment of visual impacts requires knowledge of the potential types and numbers of viewers for a given development and their characteristics and expectations; specific locations where the project might be viewed from; and other variables that were not available or not feasible to incorporate into the PEIS analysis. These variables would be incorporated into a future site-and project-specific assessment that would be conducted for specific proposed utility-scale solar energy projects. For more discussion of visual contrasts and impacts, see Section 5.12 of the PEIS.

GOOGLE EARTH™ VISUALIZATIONS

The visual impact analysis discussion in this section uses three-dimensional Google Earth™ perspective visualizations of hypothetical solar facilities placed within the SEZ. The visualizations include simplified wireframe models of a hypothetical solar power tower facility. The models were placed at various locations within the SEZ as visual aids for assessing the approximate size and viewing angle of utility-scale solar facilities. The visualizations are intended to show the apparent size, distance, and configuration of the SEZ, as well as the apparent size of a typical utility-scale solar power tower project and its relationship to the surrounding landscape, as viewed from potentially sensitive visual resource areas within the viewshed of the SEZ.

The visualizations are not intended to be realistic simulations of the actual appearance of the landscape or of proposed utility-scale solar energy projects. The placement of models within the SEZ did not reflect any actual planned or proposed projects within the SEZ, and did not take into account engineering or other constraints that would affect the siting or choice of facilities for this particular SEZ. The number of facility models placed in the SEZ does not reflect the 80% development scenario analyzed in the PEIS, but it should be noted that the discussion of expected visual contrast levels does account for the 80% development scenario. A solar power tower was chosen for the models because the unique height characteristics of power tower facilities make their visual impact potential extend beyond other solar technology types.

TABLE 10.3.14.2-1 Selected Potentially Affected Sensitive Visual Resources within a 25-mi (40-km) Viewshed of the Proposed Fourmile East SEZ, Assuming a Viewshed Analysis Target Height of 650 ft (198.1 m)

		Feature Area or Linear Distance[a]		
			Visible between	
Feature Type	Feature Name (Total Acreage/Linear Distance)	Visible within 5 mi	5 and 15 mi	15 and 25 mi
National Park	Great Sand Dunes (80,913 acres)	0 acres	35,693 acres (44%)[b]	22,701 acres (28%)
National Preserve	Great Sand Dunes (41,670 acres)	0 acres	48 acres (0.1%)	6,056 acres (15%)
National Historic Trail	Old Spanish	12 mi	20 mi	23 mi (37 km)
NHL	Pike's Stockade (4 acres)	0 acres	0 acres	4 acres (100%)
WAs	Great Sand Dunes (32,841 acres)	0 acres	9,047 acres (28%)	9,056 acres (28%)
	Sangre de Cristo (217,702 acres)[c]	1,317 (0.6%)	2,223 acres (1%)	8,256 acres (4%)
WSA	San Luis Hills (10,896 acres)	0 acres	0 acres	1,175 acres (11%)
	Sand Castle (1,097 acres)	0 acres	885 acres (81%)	69 acres (6%)
NWRs	Alamosa (12,098 acres)	0 acres	11,219 acres (93%)	0 acres
	Monte Vista (14,761 acres)	0 acres	0 acres	9,736 acres (66%)
	Baca (92,596 acres)	0 acres	1,081 acres (1%)	7,037 acres (51%)
ACECs designated for outstanding scenic values	San Luis Hills (39,421 acres)	0 acres	0 acres	5,956 acres (15%)
	Rio Grande River Corridor (4,644 acres)	0 acres	0 acres	133 acres (3%)
Scenic Highways/Byway	Los Caminos Antiguos	13.6 mi	44.5 mi	12.9 mi

TABLE 10.3.14.2-1 (Cont.)

Feature Type	Feature Name (Total Acreage/Linear Distance)	Feature Area or Linear Distance[a] Visible within 5 mi	Visible between 5 and 15 mi	Visible between 15 and 25 mi
SRMAs	Blanca Wetlands (8,599 acres)	7,450 acres (87%)	1,131 acres (13%)	0 acres
	Rio Grande River Corridor (4,368 acres)	0 acres	0 acres	324 acres (7%)
	Zapata Falls (3,702 acres)	103 acres (3%)	2,235 acres (60%)	0 acres

[a] To convert acres to km^2, multiply by 0.004047. To convert mi to km, multiply by 1.609.

[b] Percentage of total feature acreage or road length viewable.

[c] Includes both BLM and NPS WA acreage.

National Parks

- *Great Sand Dunes*—The Great Sand Dunes National Park and Preserve contains the tallest sand dunes in North America within its 80,913 acres (327 km^2) designated as national park. It is located 8.5 mi (13.7 km) due north of the SEZ at the point of closest approach. As shown in Figure 10.3.14.2-2, the area of the national park within the 650-ft (198.1-m) viewshed of the SEZ includes 58,394 acres (236.31 km^2), or 72% of the total park acreage. The area within the 24.6-ft (7.5-m) viewshed of the SEZ includes 22,594 acres (91.435 km^2), or 28% of the total park acreage. The visible area of the national park extends approximately 20 mi (33 km) from the northern boundary of the SEZ.

  The foothills of Blanca Peak and the surrounding mountains screen views of the SEZ from the park's visitor facility and much of the eastern portions of the park. Intervening dunes screen views of the SEZ from many locations within the dune field; however, the SEZ would be visible from the crests of many dunes within the park, provided the dunes were far enough west to avoid the topographic screening. The park's dune field is higher in elevation than the SEZ, but the distance to the SEZ is great enough (at least 8.5 mi [13.7 km]) that the collector/reflector arrays of solar facilities within the SEZ would be seen at low viewing angles, and would occupy a small part of the total horizontal field of view.

Figure 10.3.14.2-3 is a three-dimensional perspective visualization created with Google Earth™ depicting the SEZ as it would be seen from the crest of a high dune in the eastern portion of the national park, approximately 15 mi (24 km) north of the SEZ. The viewpoint is about 900 ft (270 m) higher in elevation than the SEZ.

The visualization includes a simplified wireframe model of a hypothetical solar power tower facility. The model was placed within the SEZ as a visual aid for assessing the approximate size and viewing angle of utility-scale solar facilities for this and other visualizations shown in this section of the PEIS. The receiver tower depicted in the visualization is a properly scaled model of a 459-ft (140-m) power tower with an 867-acre (3.5-km^2) field of 12-ft (3.7-m) heliostats, and the tower/heliostat system represents about 100 MW of electric generating capacity.

This visualization suggests that the far eastern portion of the SEZ would be screened by the lower slopes of the Sangre de Cristo Mountains. Despite the elevated viewpoint, the distance to the SEZ is great enough that the vertical angle of view from the viewpoint to the SEZ would be very low. At this low viewing angle, solar collector/reflector arrays in the SEZ would be seen edge-on, which would make their large areal extent and regular geometry much less apparent and would cause them to appear to repeat the strong horizontal line of the horizon, thus tending to decrease visual contrast. Because of the distance (15 mi [24 km]) and because of the partial screening, the SEZ would occupy a very small portion of the field of view.

Any operating power towers within the SEZ would likely appear as points of light against the backdrop of the Sangre de Cristo Range. The tower structures could be visible. Other taller solar facility components, such as transmission towers, could also be visible, depending on lighting, but might not be noticed by casual observers.

At night, if sufficiently tall, power towers in the SEZ could have red or white flashing hazard navigation lighting that would likely be visible from this location in the national park; however, lighting from other sources in the San Luis Valley as well as other lighting associated with solar facilities in the SEZ could be visible as well.

Visual contrasts from solar facilities in the SEZ would vary depending on the number, layout, and types of facilities within the SEZ, as well as other visibility factors. Under the 80% development scenario analyzed in the PEIS, solar energy development within the SEZ would be expected to create weak visual contrasts for viewers at this location.

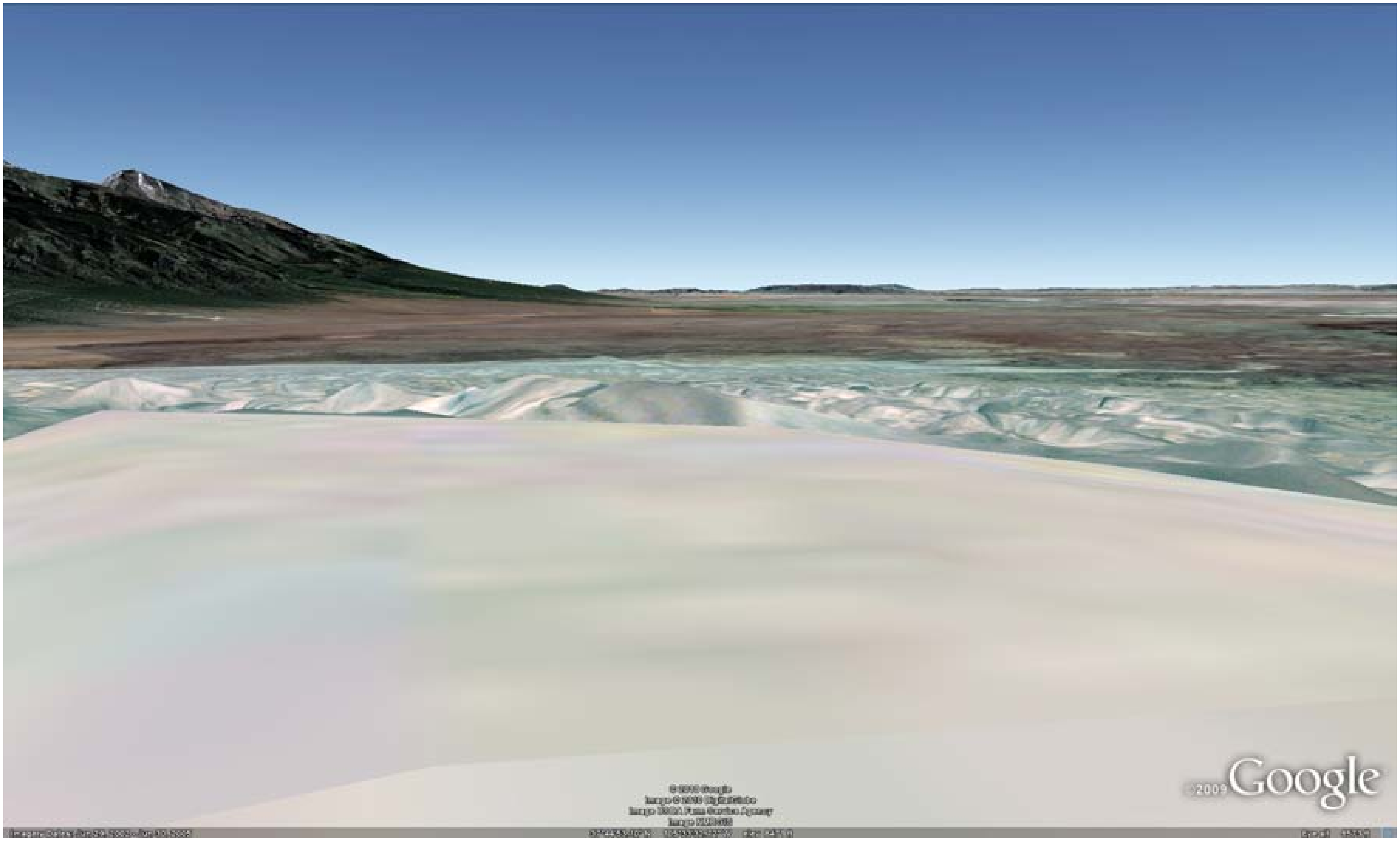

FIGURE 10.3.14.2-3 Google Earth Visualization of the Proposed Fourmile East SEZ (shown in orange tint) and Surrounding Lands, with Power Tower Wireframe Model, as Seen from Great Sand Dunes National Park, Eastern Section

Figure 10.3.14.2-4 is a Google Earth visualization depicting the SEZ as it would be seen from a low ridge in the far western portion of the national park, approximately 10.5 mi (16.9 km) north–northwest of the SEZ. The SEZ area is depicted in orange; the heliostat fields in blue. The viewpoint is about 50 ft (15 m) lower in elevation than the SEZ, so the vertical angle of view is extremely low. At this low viewing angle, solar collector/reflector arrays would be seen edge-on, which would make their large areal extent and regular geometry much less apparent and would cause them to appear to repeat the strong horizontal line of the horizon, thus tending to decrease visual contrast. The SEZ would occupy a small portion of the field of view. Operating power towers within the SEZ would likely appear as bright point light sources against the backdrop of the Sangre de Cristo Range. Other taller solar facility components, such as transmission towers, could be visible as well.

At night, if sufficiently tall, power towers in the SEZ could have red or white flashing hazard navigation lighting that would likely be visible from this location in the national park; however, lighting from other sources in the San Luis Valley and lighting associated with solar facilities in the SEZ could be visible as well.

Under the 80% development scenario analyzed in this PEIS, solar energy development within the SEZ would be expected to create weak visual contrasts for viewers within the national park.

In general, because of the relatively long distance to the SEZ from the park, and because of a low vertical angle of view, only weak levels of visual contrast would be expected for viewpoints in Great Sand Dunes National Park. Contrast levels would generally be higher at higher elevation viewpoints and at viewpoints in the western portion of the national park.

National Preserves

- *Great Sand Dunes*—The Great Sand Dunes National Park and Preserve contains 41,670 acres (168.63 km^2) designated as preserve. It is located 11.9 mi (19.2 km) northeast of the SEZ at the point of closest approach. The area of the preserve within the viewshed is 14 mi (23 km) from the northeast corner of the SEZ, and portions stretch to the extent of the 25-mi (40-km) distance zone and beyond. The area of the national preserve within the 650-ft (198.1-m) viewshed of the SEZ includes 6,104 acres (24.70 km^2), or 15% of the total preserve acreage. The area within the 24.6-ft (7.5-m) viewshed of the SEZ includes 5,157 acres (20.87 km^2), or 12% of the total preserve acreage.

  The Great Sand Dunes National Preserve is part of the Great Sand Dunes National Park and Preserve and is located immediately east of Great Sand

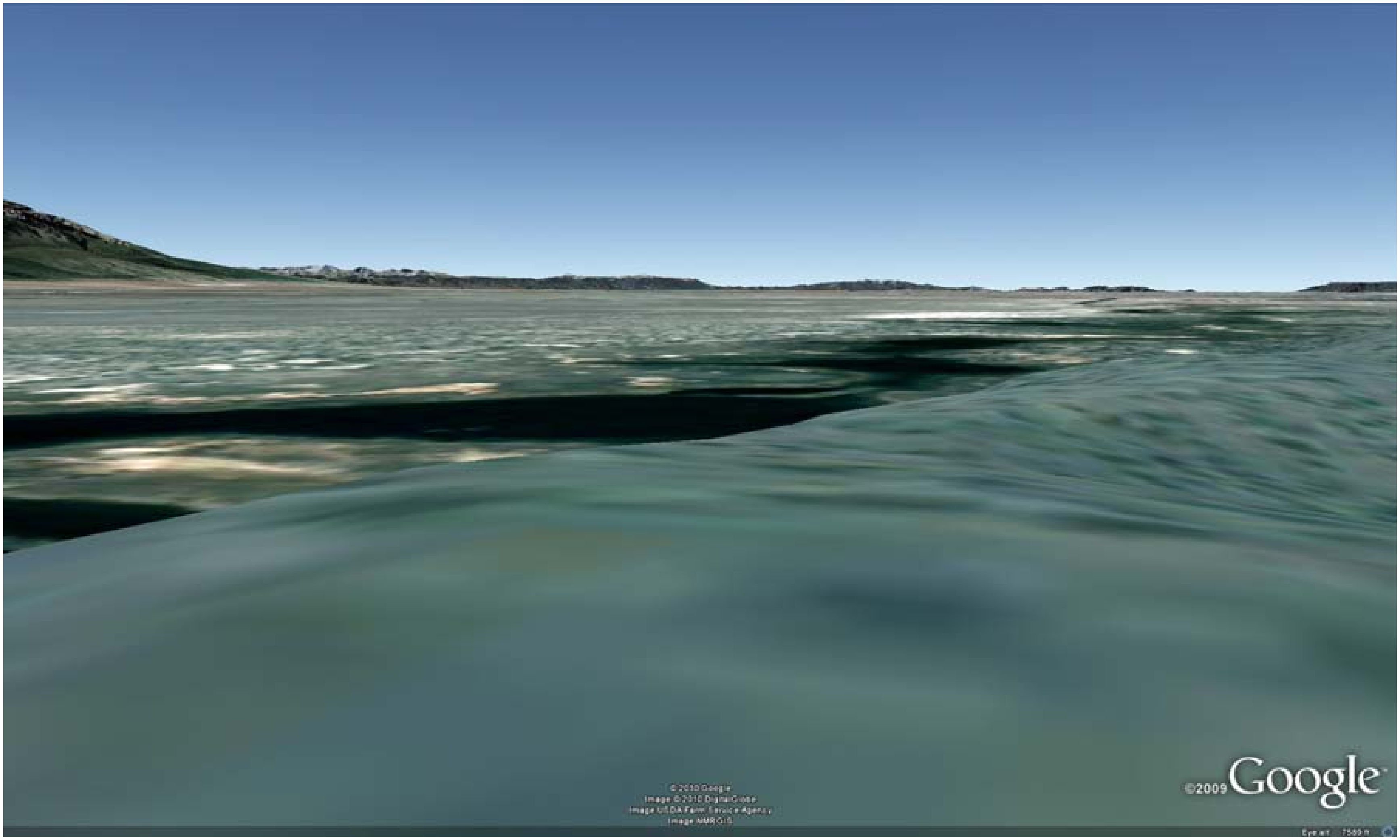

FIGURE 10.3.14.2-4 Google Earth Visualization of the Proposed Fourmile East SEZ (shown in orange tint) and Surrounding Lands, with Power Tower Wireframe Model, as Seen from Great Sand Dunes National Park, Western Section

Dunes National Park. Lands within the preserve are generally at much higher elevations than those within the park; much of the preserve is within the Sangre de Cristo mountain range.

The viewshed analysis suggests that the SEZ is not visible from lower elevations within the preserve because of topographic screening from intervening mountain ridges. In addition, much of the national preserve is forested, so views from many areas would be screened by trees. However, on some of the high mountain ridges within the preserve, vegetation is absent and a clear line of sight to the SEZ exists. In these areas, the angle of view is high enough that the tops of solar arrays within the SEZ would be visible and the arrays would therefore not repeat the line of the horizon, but because the SEZ is at least 14 mi (23 km) distant, it would occupy a very small portion of the field of view. Power towers within the SEZ would be visible as point light sources with the valley floor as a backdrop. Under the 80% development scenario analyzed in this PEIS, solar energy development within the SEZ would be expected to create minimal to weak visual contrasts for viewers within the preserve.

Wilderness Areas

- *Great Sand Dunes*—The 32,841-acre (132.90-km^2) Great Sand Dunes Wilderness is a congressionally designated WA located 11 mi (17 km) northeast of the SEZ at the point of closest approach. Portions of the WA within the 650-ft (198.1-m) viewshed (approximately 18,103 acres [73.260 km^2], or 55% of the total WA acreage) extend from the point of closest approach at the northeast corner of the SEZ to approximately 19.3 mi (31.1 km) from the SEZ. Portions of the WA within the 24.6-ft (7.5-m) viewshed encompass approximately 7,788 acres (31.52 km^2), or 24% of the total WA acreage.

  The Great Sand Dunes WA is entirely contained within Great Sand Dunes National Park and constitutes much of the eastern portion of the national park, including the dune field. Potential impacts on the WA from solar energy development within the SEZ are the same as those described for the eastern portion of the national park (discussed above).

- *Sangre de Cristo*—The 217,702-acre (881.009-km^2) Sangre de Cristo WA (including both NPS- and BLM-managed units) is located approximately 2.8 mi (4.5 km) northeast of the SEZ at the point of closest approach. As shown in Figure 10.3.14.2-2, a small portion of the WA (approximately 10,479 acres [42.407 km^2]) is within the 650-ft (198.1-m) viewshed of the SEZ, generally limited to the southern tip of the range and including 1,320 acres (5.341 km^2) within the BLM foreground-middleground distance of 5 mi (8 km). Visible portions extend up to 4.5 mi (7.2 km) from the northern boundary of the SEZ. Approximately 9,045 acres (36.60 km^2) of the WA is within the 24.6-ft (7.5-m) SEZ viewshed.

Views of the SEZ from most of the WA are fully screened by landform, and much of the area not screened by landform is screened by vegetation, as much of the WA is forested. Vegetative screening is absent or insufficient in some areas that are above timberline or otherwise unable to support vegetation tall enough or dense enough to screen views. At these locations, the elevated viewpoint and relatively close proximity of the SEZ result in a high viewing angle, so that the tops of solar collectors could be visible. A larger portion of the solar facilities would be visible relative to low-angle views, increasing potential visual contrasts from the facilities, and the high viewing angle would also make the regular geometry of visible solar facilities more apparent. The strong, regular geometry of the solar collector arrays would generally be inconsistent with the natural background in terms of form, line, and texture, and possibly color, depending on mitigation employed.

Views from the WA toward the SEZ would also encompass a variety of cultural disturbances, such as towns, railroads, center-pivot irrigation circles, transmission lines, and other disturbances common to rural settings; however, because of the close proximity of the SEZ to the southern portion of the WA, the addition of utility-scale solar energy development within the SEZ would represent a major new source of visual contrast.

At locations within the WA nearest to the SEZ, facilities in the northeastern portions of the SEZ could be close enough that they would occupy a large portion of the field of view and could potentially create strong visual contrasts. This is shown in Figure 10.3.14.2-5, a Google Earth visualization depicting the SEZ as it would be seen from an unpaved road within the WA, approximately 3.2 mi (5.1 km) northeast of the SEZ. The viewpoint is near the point in the WA closest to the SEZ. The viewpoint is about 2,400 ft (730 m) higher in elevation than the SEZ. The SEZ area is depicted in orange; the heliostat field in blue.

The visualization suggests that the SEZ is close enough, and the angle of view high enough, that under the development scenario analyzed in the PEIS, solar energy developments within the SEZ could strongly attract visual attention and could dominate the view from this location. The tops of collector/reflector arrays for solar facilities within the SEZ would be visible, revealing their large areal extent and their strong regular geometry, which would likely contrast strongly with the more natural appearing background. Taller ancillary facilities, such as buildings, transmission structures, cooling towers, and plumes (if present) would likely be visible projecting above the collector/reflector arrays, and their structural details could be evident, at least for nearby facilities. The ancillary facilities would likely create form and line contrasts with the strongly horizontal, regular, and repeating forms and lines

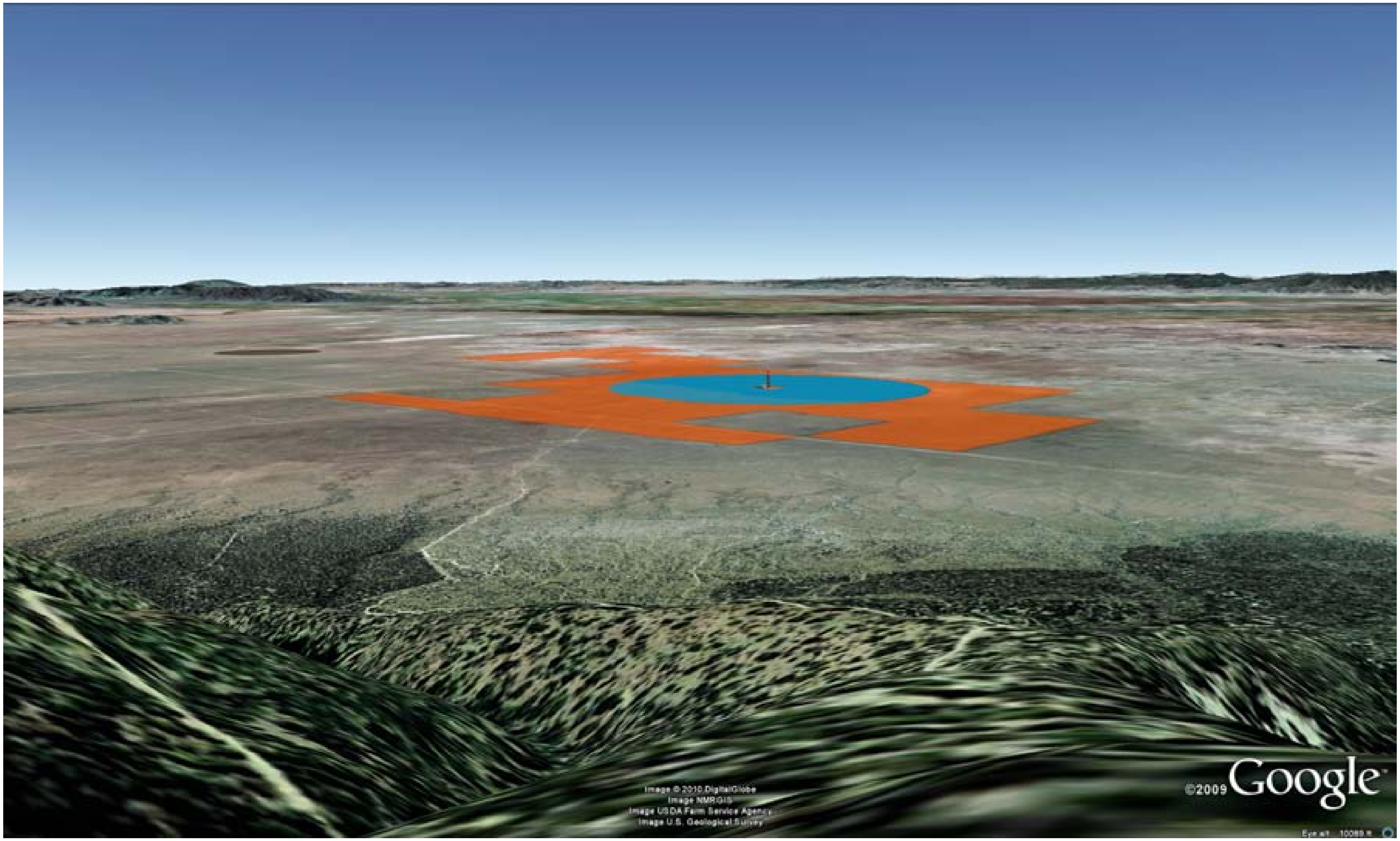

FIGURE 10.3.14.2-5 Google Earth Visualization of the Proposed Fourmile East SEZ (shown in orange tint) and Surrounding Lands, with Power Tower Wireframe Model, as Seen from a Road in the Sangre de Cristo WA

of the collector/reflector arrays. Color and texture contrasts would also be likely, but their extent would depend on the materials and surface treatments utilized in the facilities.

Operating power towers within the SEZ would likely appear as very bright white non-point (i.e., with a visible cylindrical or rectangular shape) light sources atop clearly discernable tower structures. Also, during certain times of the day from certain angles, sunlight on dust particles in the air might result in the appearance of light streaming down from the towers. When operating, the power towers would likely strongly attract visual attention, as seen from this viewpoint.

At night, if sufficiently tall, power towers in the SEZ could have red or white flashing hazard navigation lighting that would likely be visible from this location in the National Park; however, lighting from other sources in the San Luis Valley and lighting associated with solar facilities in the SEZ could be visible as well.

Under the 80% development scenario analyzed in this PEIS, solar energy development within the SEZ would be expected to create strong visual contrasts for viewers within the national park.

Figure 10.3.14.2-6 is a Google Earth visualization depicting the SEZ (highlighted in orange) as it would be seen from Ellingwood Point, a mountain peak within the WA connected to Blanca Peak and a popular destination for climbers, about 6.6 mi (10.7 km) northeast of the SEZ. The viewpoint is about 6,300 ft (1,900 m) higher in elevation than the SEZ. The heliostat field is highlighted in blue.

In terms of distance, this visualization shows the appearance of the SEZ from a high-elevation viewpoint within the WA. At this distance and with partial screening by an intervening mountain ridge, the apparent size of the SEZ is much reduced; however, it would still be likely to attract attention, though it would not be expected to dominate the view. The visualization also shows that in addition to the Fourmile East SEZ, both the Antonito Southeast SEZ (visible as orange-tinted area at the far left of the image) and the Los Mogotes East SEZ (visible to the left of center of the image) would be visible from Ellingwood Point and nearby locations, although the much greater distance to these SEZs and the resultant lower viewing angle suggest much smaller visual impacts from solar energy development in these SEZs.

Observed visual contrasts from solar energy development within the proposed SEZ would be highly dependent on viewer location within the WA, as well as on project characteristics and location within the SEZ and other visibility parameters. Under the 80% development scenario analyzed in this PEIS, solar

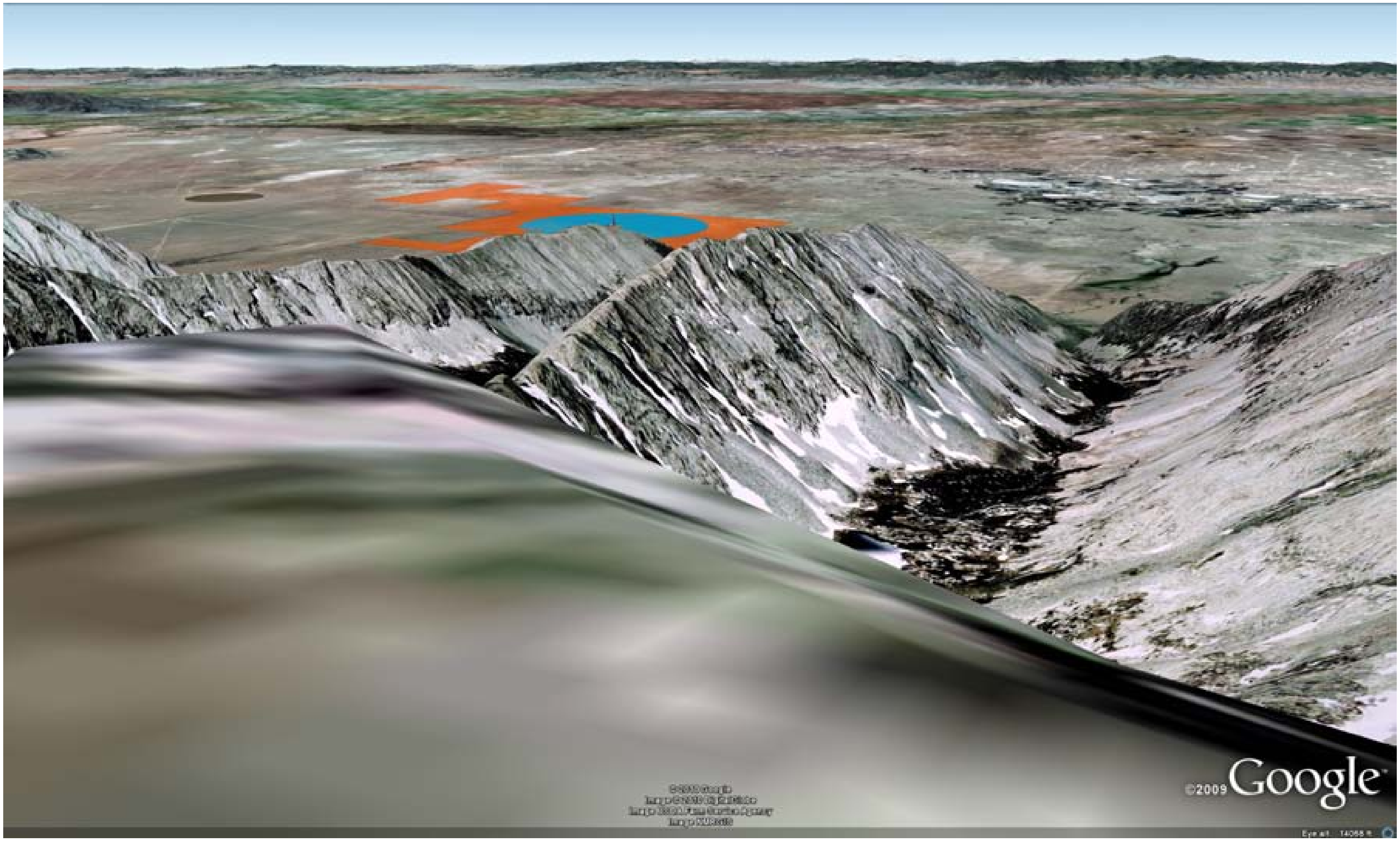

FIGURE 10.3.14.2-6 Google Earth Visualization of the Proposed Fourmile East SEZ (shown in orange tint) and Surrounding Lands, with Power Tower Wireframe Model, as Seen from Ellingwood Point in the Sangre de Cristo WA

energy development within the SEZ would be expected to create weak to strong visual contrasts, as seen from the WA.

Wilderness Study Areas

- *San Luis Hills*—The San Luis Hills WSA is located approximately 23.3 mi (37.5 km) southwest of the SEZ at the point of closest approach and encompasses 10,896 acres (44.09 km^2). As shown in Figure 10.3.14.2-2, the area of the WSA within the 650-ft (198.1-m) viewshed of the SEZ includes 1,175 acres (4.755 km^2), or 11% of the total WSA acreage. The area within the 24.6-ft (7.5-m) viewshed of the SEZ includes 954 acres (3.86 km^2), or 9% of the total WSA acreage. The visible area extends from approximately 24 mi (39 km) from the southwest corner of the SEZ to approximately 26 mi (42 km) from the SEZ.

  The WSA encompasses most of the Pinyon Hills. The San Luis Hills WSA is located entirely within the San Luis Hills ACEC, and both the ACEC and the WSA were designated in part for their scenic values and opportunities for solitude. The WSA provides panoramic views of the San Luis Valley and the surrounding mountain ranges. The SEZ viewshed includes the northeast-facing slopes of the Pinyon Hills and some lower elevation areas east of the Pinyon Hills; however, in the lower areas, intervening landforms would screen views of low-height solar technologies within the SEZ.

  The upper slopes and peaks of the Pinyon Hills are sparsely vegetated, and where intervening landforms do not screen the view, these areas have relatively open views of the distant Fourmile East proposed SEZ. Even at the higher elevations, the angle of view is low enough that the tops of solar collector arrays would likely not be visible and the arrays would repeat the line of the plain in which the SEZ is located. Operating power towers within the SEZ would likely be visible as distant starlike points of light at the base of the Great Sands Dunes dune field or the lower slopes of the Sangre de Cristo Mountains. At night, if sufficiently tall, power towers in the SEZ could have red or white flashing hazard navigation lights that could be visible from some points in the WSA. Under the development scenario analyzed in this PEIS, solar facilities within the SEZ would be expected to be minimal to weak visual contrasts as viewed from the WSA, depending on viewer location and other visibility factors.

- *Sand Castle*—The Sand Castle WSA is located approximately 12 mi (19 km) north of the SEZ at the point of closest approach and encompasses 1,097 acres (4.439 km^2). The area of the WSA within the 650-ft (198.1-m) viewshed of the SEZ includes 954 acres (3.86 km^2), or 87% of the total WSA acreage. The area within the 24.6-ft (7.5-m) viewshed of the SEZ includes 123 acres (0.498 km^2), or 11% of the total WSA acreage. The visible area extends from the point of closest approach on the northern boundary of the SEZ to approximately 15 mi (24 km) from the SEZ.

The elevation of the WSA is about the same or slightly higher than that of the SEZ, and at about 12 mi (19 km) from the SEZ, the vertical angle of view from the WSA to the SEZ would be very low. At this very low viewing angle, solar collector/reflector arrays in the SEZ would be seen edge-on, which would make their large areal extent and regular geometry much less apparent and would cause them to appear to repeat the strong horizontal line of the horizon, thus tending to decrease visual contrast. Because of the distance (12 mi [19 km] or more), the SEZ would occupy a very small portion of the field of view.

Any operating power towers within the SEZ would likely appear as points of light projecting above the southern horizon. The tower structures could be visible. Other taller solar facility components, such as transmission towers, could also be visible, depending on lighting, but might not be noticed by casual observers.

At night, if sufficiently tall, power towers in the SEZ could have red or white flashing hazard navigation lighting that would likely be visible from the WSA; however, lighting from other sources in the San Luis Valley would be visible as well.

Visual contrasts from solar facilities in the SEZ would be highly dependent on viewer location within the WSA, but would also vary depending on the number, layout, and types of facilities within the SEZ, as well as other visibility factors. Under the 80% development scenario analyzed in this PEIS, solar energy development within the SEZ would be expected to create weak visual contrasts for viewers in the WSA.

National Historic Trail

- *Old Spanish National Historic Trail*—The Old Spanish National Historic Trail is a congressionally designated multistate historic trail that passes within 0.86 mi (1.4 km) of the SEZ at the point of closest approach on the east side of the SEZ. A high potential segment of the trail begins 1.25 mi (2.0 km) northeast of the northeast corner of the SEZ. Nearly 50 mi (80.5 km) of the trail is within the viewshed of the SEZ, including 25 mi (40.2 km) of the high-potential segment.

Within 25 mi (40 km) of the SEZ, the trail runs generally north–south on the east side of the San Luis Valley and generally along the base of the Sangre de Cristo Range. The SEZ is within view of the trail for much of the area. Within the viewshed, the trail runs through alluvial flats and wetlands and through salt flats and sand dunes.

For northbound/westbound trail users, the trail enters the 25-mi (40-km) SEZ viewshed approximately 4 mi (6 km) north of the community of San Luis, approximately 19 mi (31 km) south–southeast of the SEZ. At this point, in the absence of screening by vegetation, the upper portions of sufficiently tall power towers would come into view, likely appearing as distant starlike points of light on the north–northwest horizon. In this area, the trail passes through agricultural lands, with roads and other cultural disturbances typical of a rural setting.

At a distance of about 14 mi (23 km) from the SEZ, low-height solar facilities within the SEZ could become visible, in the absence of vegetative screening. At about this same distance, the trail turns slightly west directly toward the SEZ. As trail users travel northwest toward the SEZ, solar facilities would slowly increase in apparent size and would be visible in the direction of travel, resulting in more and longer views. At these distances and viewing angles, under the 80% development scenario analyzed in this PEIS, solar energy development within the SEZ would be expected to create minimal to weak contrasts as viewed from the trail.

At approximately 10 mi (16 km) southeast of the SEZ, the trail passes through a low area (approximately 2.5 mi [4 km] of the trail) near Blanca, Colorado, where only the upper parts of sufficiently tall power towers would likely be visible. After trail users leave this area (approximately 8 mi [13 km] from the SEZ), low-height solar facilities would again come into view, but at a very low viewing angle, such that they would appear as a thin horizontal band that would repeat the strong horizon line of the valley floor, tending to reduce visual contrast. Expected contrast levels would be weak.

At about 3 mi (5 km) southeast of the SEZ, the trail turns back to the north, and the SEZ would gradually shift out of the center of the field of view (looking down the trail) to the left of center. As it passes the SEZ, the trail is nearly parallel to the eastern boundary of the SEZ, and at a distance of approximately 1 mi (1.6 km), under the development scenario analyzed in this PEIS, solar facilities within the SEZ would fill the view to the west looking out over the San Luis Valley.

Figure 10.3.14.2-7 is a Google Earth visualization depicting a view of the SEZ as seen from a point on the Old Spanish National Historic Trail route approximately 0.9 mi (1.5 km) from the SEZ. The viewpoint is about 130 ft (40 m) higher in elevation than the SEZ. The power tower in the visualization

FIGURE 10.3.14.2-7 Google Earth Visualization of the Proposed Fourmile East SEZ (shown in orange tint) and Surrounding Lands, as Seen from Viewpoint on Old Spanish National Historic Trail

is 2.5 mi (4 km) from the viewpoint. The SEZ area is depicted in orange; the heliostat field in blue.

The visualization suggests that solar facilities within the SEZ would be in full view from this point on the Old Spanish National Historic Trail. Because the SEZ is so close to the viewpoint, the SEZ is too large to be encompassed in one view, and viewers would need to turn their heads to scan across the whole SEZ. Under the 80% development scenario analyzed in the PEIS, solar facilities within the SEZ would likely dominate the view from this location.

The viewpoint on the trail is slightly elevated with respect to the SEZ, and the tops of the solar collector/reflector arrays might be visible, depending on their height. The collector array would repeat the strong line of the horizon, tending to decrease visual contrast; however, for facilities in the closest portion of the SEZ, collector/reflector elements could be close enough that their forms and structural details would be visible. This would increase contrast.

Taller ancillary facilities, such as buildings, transmission structures, cooling towers, and plumes (if present) would likely be visible projecting above the collector/reflector arrays, and their structural details could be evident, at least for nearby facilities. The ancillary facilities would likely create form and line contrasts with the strongly horizontal, regular, and repeating forms and lines of the collector/reflector arrays. Color and texture contrasts would also be likely, but their extent would depend on the materials and surface treatments used in the facilities.

Operating power towers within the nearest portions of the SEZ would likely appear as brilliant white non-point (i.e., with a visible cylindrical or rectangular shape) light sources atop clearly discernable tower structures. Also, during certain times of the day from certain angles, sunlight on dust particles in the air might result in the appearance of light streaming down from the towers. When operating, the power towers would likely strongly attract visual attention, as seen from this viewpoint.

At night, if sufficiently tall, power towers in the SEZ could have red or white flashing hazard navigation lighting that would likely be very conspicuous from this viewpoint, although light from other sources in the San Luis Valley and other light associated with solar facilities in the SEZ would likely be visible as well.

Under the 80% development scenario analyzed in this PEIS, solar energy development within the SEZ would be expected to create strong visual contrasts for trail users at this viewpoint.

For southbound/eastbound, the high potential segment of the Old Spanish National Historic Trail enters the 25-mi (40-km) SEZ viewshed approximately

7 mi (11 km) south of the community of Crestone at the base of the Sangre de Cristo Range, at which point the SEZ would come into view as trail users cross ridges in the foothills of the Sangre de Cristo Range, in the absence of screening by vegetation. As successive ridges are crossed, the very distant SEZ would alternately be visible from ridge tops the trail crosses, then not visible where the trail crosses washes between the ridges, but gradually increasing in apparent size as trail users move southward on the trail. Where visible, the SEZ would appear just to the right of the center of the field of view looking down the trail.

Frequent intermittent visibility of the SEZ would continue until trail users cross the Great Sand Dunes dune field (approximately 11.5 mi [18.5 km] north of the SEZ). From this point southward, the land is somewhat more level, and the SEZ would more often be in view and sometimes centered in the field of view looking down the trail.

At approximately 6.5 mi (10.5 km), the trail begins to increase in elevation gradually and steadily, so that intermittent visibility of the SEZ would end, and the SEZ would be in full view. As the distance to the SEZ shortens and the viewpoint elevation rises, the level of potential visual contrast associated with solar energy development within the SEZ would increase. At approximately 4 mi (6 km), the SEZ would occupy a substantial portion of the field of view, but the angle of view would still be low enough that solar arrays would repeat the strong horizontal line of the valley floor, and this would tend to reduce visual contrast.

At 3.3 mi (5.3 km) north of the SEZ, the trail begins a slightly steeper climb, so that by the end of the high-potential trail segment (1.3 mi [2.0 km] from the SEZ), the trail is more than 300 ft (90 m) above the SEZ.

Figure 10.3.14.2-8 is a Google Earth visualization that depicts a view of the SEZ as seen from a point near the southern end of the high-potential segment of the Old Spanish National Historic Trail route, about 1.3 mi (2.0 km) from the SEZ. The SEZ area is depicted in orange; the heliostat field in blue.

The visualization suggests that solar energy facilities within the SEZ would occupy most of the horizontal field of view of trail users looking out to the southwest over the valley and would be expected to dominate their views in that direction.

The elevated viewpoint would make the very regular geometry of the solar collector field apparent; structural details of facility components could be visible; and power tower receivers and other tall solar facility components (e.g., associated transmission towers) would be seen in the BLM foreground-middleground distance, and this would tend to increase visual contrast.

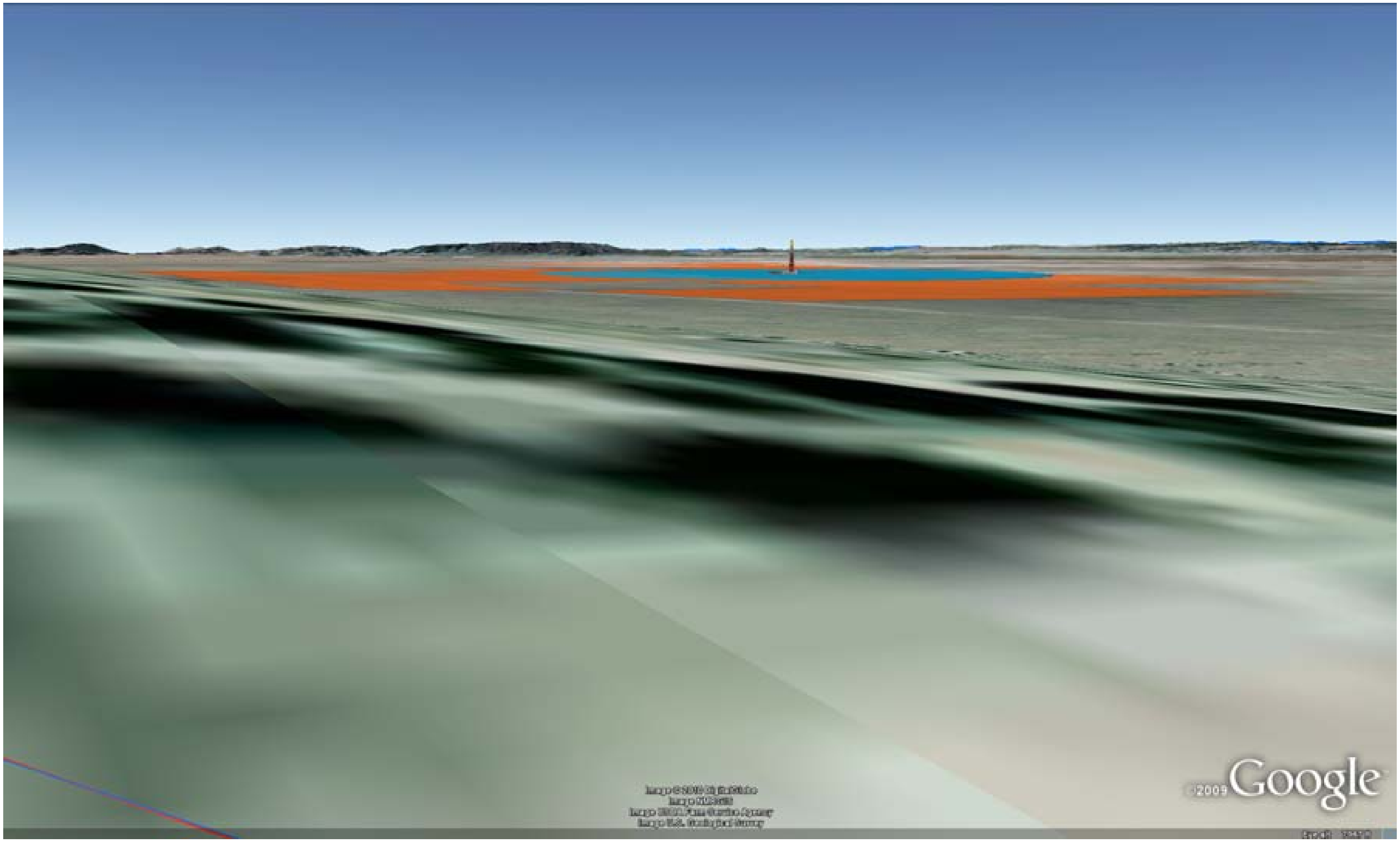

FIGURE 10.3.14.2-8 Google Earth Visualization of the Proposed Fourmile East SEZ (shown in orange tint) and Surrounding Lands, as Seen from Viewpoint on High-Potential Segment of Old Spanish National Historic Trail

Operating power towers within the nearest portions of the SEZ would likely appear as brilliant white non-point (i.e., with a visible cylindrical or rectangular shape) light sources atop clearly discernable tower structures. Also, during certain times of the day from certain angles, sunlight on dust particles in the air might result in the appearance of light streaming down from the towers. When operating, the power towers would likely strongly attract visual attention, as seen from this viewpoint.

At night, if sufficiently tall, power towers in the SEZ could have red or white flashing hazard navigation lighting that would likely be very conspicuous from this viewpoint, although light from other sources in the San Luis Valley and other light associated with solar facilities in the SEZ would likely be visible as well.

From the elevated viewpoints in this portion of the high-potential trail segment and with the short distance to the SEZ, under the 80% development scenario analyzed in this PEIS, solar energy development within the SEZ would be expected to create strong visual contrasts for trail users.

Past the end of the high-potential trail segment, impacts would continue to increase because the angle of view continues to increase while distance to the SEZ decreases. However, within about 0.5 mi (0.8 km) of the southern end of the high-potential segment, the trail elevation begins to fall and the distance to the SEZ begins to increase, so visual contrasts would be expected to diminish.

In summary, nearby elevated locations on the Old Spanish National Historic Trail with open views of the SEZ could be subject to strong levels of visual contrast associated with solar energy facilities within the SEZ. Some viewpoints at lower elevations on the trail would still have expansive views of the SEZ, but because of the lower viewing angle, these viewpoints would be expected to be subjected to substantially lower levels of visual contrast. Expected contrast levels would range from minimal levels for distant or low-elevation points on the trail to strong levels for viewpoints very close to the SEZ, and especially for those points on the trail at higher elevations than the SEZ.

National Historic Landmarks

- *Pike's Stockade*—Although the original 1807 stockade is no longer standing, this archeological site with a reconstructed stockade is located 15.6 mi (25.1 km) southwest of the southwest corner of the Fourmile East SEZ. It is contained within the SEZ viewshed.

  Pike's Stockade is located within a heavily wooded riparian area along the Rio Grande. It is likely that vegetation would screen the site from views of the

SEZ; however, visitors driving to or from Pike's Stockade would be outside the wooded area when going to or from the site and might have open views of the SEZ. Pike's Stockade is approximately 55 ft (17 m) lower in elevation than the lowest point in the SEZ, so if solar energy facilities were visible within the SEZ, the associated collector/reflector arrays would repeat the line of the horizon and this would tend to reduce apparent contrast. Power tower receivers would not project above the distant line of the Sangre de Cristo range and, at the relatively long distance to the SEZ, would appear as distant points of light. Primarily because of vegetative screening, visual impacts from solar energy development within the SEZ would not be expected at the Pike's Stockade site, but if screening were absent in the surrounding area, minimal visual contrast would be expected.

National Wildlife Refuges

- *Alamosa*—The 12,098-acre (48.96-km^2) Alamosa NWR contains the headquarters and visitor center for the San Luis Valley National Wildlife Refuge Complex. The refuge is a haven for migratory birds and other wildlife. The Alamosa NWR consists of wet meadows, river oxbows and riparian corridor primarily within the flood plain of the Rio Grande, and dry uplands vegetated with greasewood and saltbush. It is located 5.1 mi (8.2 km) east–southeast of the SEZ at the closest point of approach. Approximately 11,219 acres (45.402 km^2) of the site is within the 650-ft (198.1-m) viewshed of the SEZ, but only 5,038 acres (20.39 km^2) is within the 24.6-ft (7.5-m) viewshed.

  Much of the NWR is located in a shallow depression with a higher ridge extending from north to south along the eastern side of the NWR. The ridge would screen views of low-height solar facilities for much of the eastern portion of the NWR, although the upper parts of sufficiently tall operating power tower receivers would be visible over the ridge in almost all of the refuge, appearing as very bright light sources at the base of Blanca Peak. The elevation of the NWR is slightly lower than that of the SEZ, so the angle of view is low. Figure 10.3.14.2-9 is a Google Earth three-dimensional visualization of the SEZ as seen from the Alamosa NWR. The viewpoint is 5.1 mi (8.2 km) from the nearest point in the SEZ, and is about 90 ft (27 m) lower in elevation than the SEZ. The SEZ would occupy a small portion of the field of view, and because the viewpoint is lower than the SEZ, the vertical angle of view would be very low, so that collector/reflector arrays of solar facilities within the SEZ would be seen edge-on. This would make the large areal extent and regular geometry of the arrays less apparent, and they would appear as thin lines on the horizon. Lower-height facility components in the SEZ would be partially screened because of the low viewpoint elevation, but taller ancillary facilities, such as transmission components, cooling towers, and others, could be visible projecting above the arrays and could contrast in

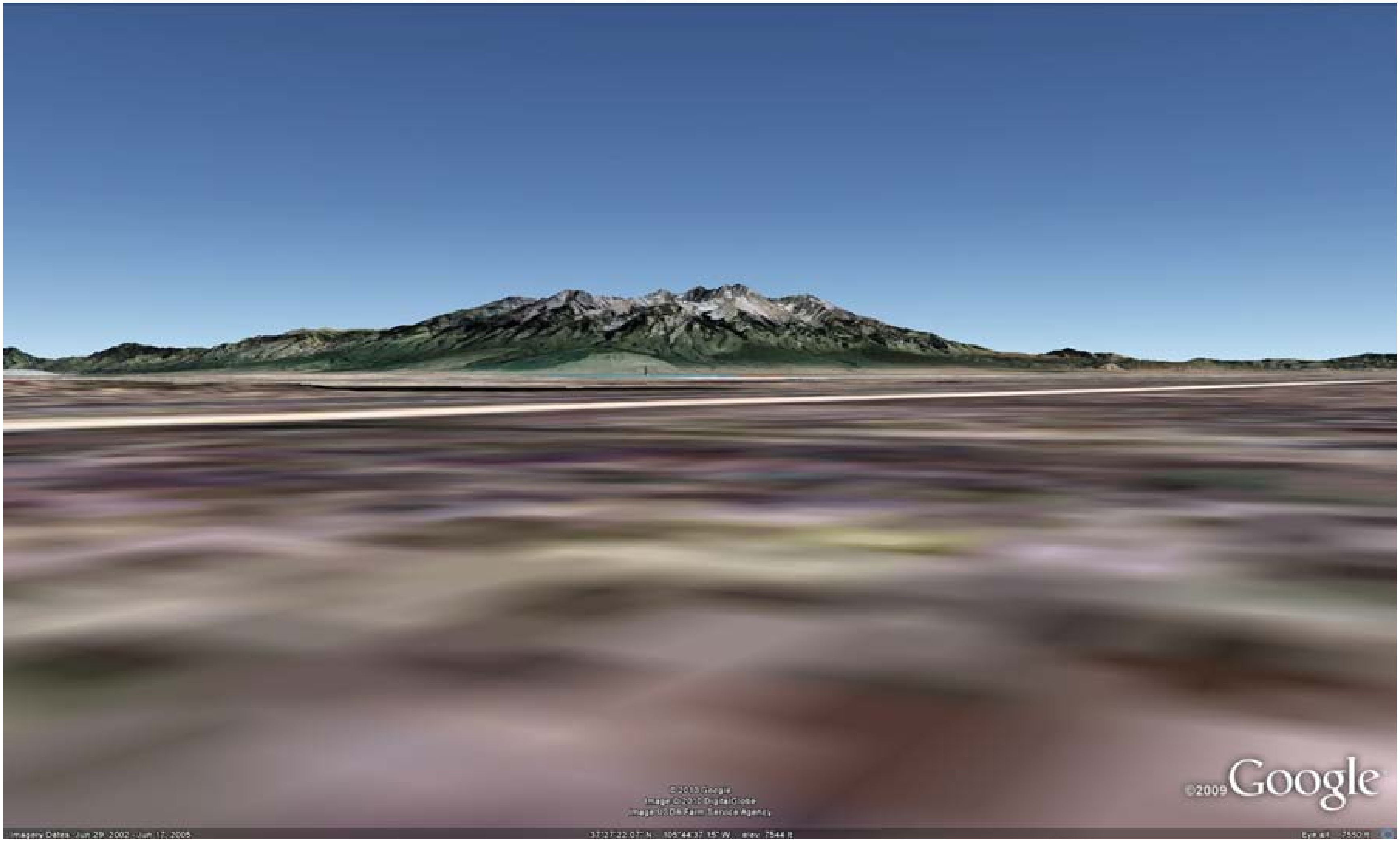

FIGURE 10.3.14.2-9 Google Earth Visualization of the Proposed Fourmile East SEZ and Surrounding Lands, with Power Tower Wireframe Model, as Seen from Alamosa NWR

form, line, and possibly color with the very regular and strongly horizontal collector/reflector arrays.

Operating power towers within the SEZ would likely appear as very bright white lights atop discernable tower structures. They would likely attract visual attention, as seen from this viewpoint.

At night, if sufficiently tall, power towers in the SEZ could have red or white flashing hazard navigation lighting that would likely be visible from this viewpoint, although light from other sources in the San Luis Valley and other light associated with solar facilities in the SEZ could also be visible.

Under the 80% development scenario analyzed in this PEIS, solar facilities within the SEZ would be expected to create weak contrasts as viewed from the NWR, depending on viewer location and other visibility factors, with lower contrasts levels visible from the southern portions of the NWR.

- *Baca*—The 92,596-acre (374.72-km^2) Baca NWR is located approximately 14 mi (23 km) at the closest point of approach northwest of the SEZ. Approximately 48,118 acres (194.73 km^2), or 52% of the Baca NWR total acreage, is contained within the 650-ft (198.1-m) viewshed of the SEZ, and 9,761 acres (39.50 km^2), or 11% of the NWR total acreage, is within the 24.6-ft (7.5-m) viewshed. From the point of closest approach at the northwest corner of the SEZ, the NWR stretches another 12 mi (19 km) beyond the extent of the 25-mi (40-km) distance zone. The refuge is currently closed to the public.

  The elevation of the NWR is slightly lower than that of the SEZ, so the angle of view is low. Because of the relatively long distance from the NWR to the SEZ and the lower elevation of the NWR relative to the SEZ, low-height solar facilities within the SEZ would be difficult to see from the NWR. Where visible, the solar collector fields would repeat the horizontal line of the landscape, tending to reduce visual contrast. The upper parts of sufficiently tall power tower receivers would be visible in almost all of the refuge, however, likely appearing as distant points of light at the base of the Sangre de Cristo Range.

  At night, if sufficiently tall, power towers in the SEZ could have red or white flashing hazard navigation lighting that would likely be visible from the NWR, although light from other sources in the San Luis Valley would likely be visible as well.

  Under the development scenario analyzed in this PEIS, solar facilities within the SEZ would be expected to create minimal to weak contrasts as viewed from the NWR, depending on viewer location and other visibility factors, with lower contrasts visible from the northern portions of the NWR.

- *Monte Vista*—The 14,761-acre (59.74-km^2) Monte Vista NWR includes more than 11,000 acres (45 km^2) of wetlands located primarily within the Rio Grande flood plain. The refuge is located 19.8 mi (31.9 km) due west of the SEZ and is entirely contained within the viewshed of the SEZ. The NWR's wet meadows, river oxbows, and riparian corridors provide habitat for migratory birds and other wildlife. The NWR can be viewed from county roads and on a 4-mi (6.4-km) auto tour.

  The elevation of the NWR is approximately the same as that of the SEZ, so the angle of view between the NWR and the SEZ would be very low. Because of the very long distance from the NWR to the SEZ and the low viewing angle, the SEZ and solar facilities within the SEZ would occupy a very small portion of the visual field for viewers in the NWR. From portions of the NWR, operating power towers within the SEZ could be visible as distant lights on the horizon. At night, if sufficiently tall, power towers in the SEZ could have red or white flashing hazard navigation lighting that could be visible from the NWR, although light from other sources in the San Luis Valley would likely be visible as well. Visual contrast levels from solar energy development within the SEZ as seen from the NWR would likely be minimal.

ACECs Designated for Outstanding Scenic Qualities

- *Rio Grande River Corridor*—The Rio Grande River Corridor ACEC is a 4,644-acre (18.79-km^2) BLM-designated ACEC that follows the Rio Grande for 22 mi (35.4 km), beginning just south of La Sauses Cemetery in Colorado and extending to the New Mexico state line. The ACEC was designated to provide special management for the significant natural, scenic, and recreational values along this stretch of the Rio Grande. The ACEC is located 18 mi (29 km) south–southwest of the SEZ at the point of closest approach. The area of the ACEC within the viewshed of the SEZ includes the northern-most portion of the ACEC and extends south for approximately 1.9 mi (3.1 km). It encompasses 133 acres (0.538 km^2) in the 650-ft (198.1-m) viewshed, or 3% of the total ACEC acreage. Portions of the ACEC within the 24.6-ft (7.5-m) viewshed include approximately 20 acres (0.08 km^2), or 0.5% of the total ACEC acreage.

  Because the Rio Grande is located within a canyon in the ACEC vicinity, persons on the water would not see the SEZ or solar development within the SEZ; however, the SEZ is visible from some locations in the Fairy Hills and from local peaks such as Sugarloaf. Vegetation in these areas is sparse and likely would not screen views of the SEZ. The elevation at the northern end of the ACEC is about the same as that of the SEZ, though local peaks like Sugarloaf are a few hundred feet higher; thus the angle of view is low. Because the distance from the ACEC to the SEZ exceeds 17 mi (27 km), the

SEZ would occupy a very small portion of the field of view. Where visible, any operating power tower receivers within the SEZ would be seen as distant points of light at the base of the Sangre de Cristo Range. At night, if sufficiently tall, power towers in the SEZ could have red or white flashing hazard navigation lighting that could be visible from the ACEC, although light from other sources in the San Luis Valley would likely be visible as well. In some areas, intervening terrain would obstruct views of low-height facility components, and much of the southern portion of the SEZ would be screened as well. Under the 80% development scenario analyzed in this PEIS, solar energy development within the SEZ would be expected to create minimal visual contrasts as viewed from the ACEC.

- *San Luis Hills*—The San Luis Hills ACEC is a 39,421-acre (159.53-km^2) BLM-designated ACEC located approximately 16 mi (26 km) southwest of the SEZ at the point of closest approach. The ACEC encompasses the Pinyon Hills, Flattop, nearby hills, and the lower slopes of some of these hills. The ACEC also encompasses the San Luis Hills WSA, and both the ACEC and the WSA were designated in part for their scenic values and opportunities for solitude. The ACEC provides panoramic views of the San Luis Valley and the surrounding mountain ranges. Views toward the SEZ include agricultural areas with center-pivot irrigation circles, other agricultural fields, roads, scrub, and wetlands.

  The SEZ viewshed includes the northeast-facing slopes of the Pinyon Hills and Flattop. The area of the ACEC within the 650-ft (198.1-m) viewshed of the SEZ includes 5,956 acres (24.10 km^2), or 15% of the total ACEC acreage. The area within the 24.6-ft (7.5-m) viewshed of the SEZ includes 4,214 acres (17.05 km^2), or 11% of the total ACEC acreage. The portions of the ACEC with potential visibility of solar facilities in the SEZ extend to approximately 21.3 mi (34.3 km) from the SEZ.

  The upper slopes and peaks of the Pinyon Hills and Flattop are sparsely vegetated, have relatively open views of the SEZ, but are far enough away from the SEZ that the SEZ occupies a very small portion of the field of view. At the highest elevations within the ACEC, the angle of view is great enough that the tops of solar collector arrays might be visible. The angle of view is not so high, however, that the arrays would not repeat the line of the plain in which the SEZ is located, tending to reduce apparent visual contrast.

  Where visible, any operating power tower receivers within the SEZ would be seen as distant points of light at the base of the Sangre de Cristo Range, just east of the Great Sand Dunes dune field. At night, if sufficiently tall, power towers in the SEZ could have red or white flashing hazard navigation lighting that could be visible from the ACEC, although light from other sources in the San Luis Valley would likely be visible as well.

Under the 80% development scenario analyzed in this PEIS, solar facilities within the SEZ would be expected to create minimal to weak visual contrasts as viewed from the ACEC, and contrast levels would generally be expected to be lower for viewpoints in the southern part of the ACEC.

Special Recreation Management Areas

- *Blanca Wetlands*—The 8,599-acre (34.8-km^2) Blanca Wetlands SRMA/ACEC comprises two separate units. The southern unit is located 0.5 mi (0.8 km) from the western edge of the SEZ at the point of closest approach. The northern unit is located 1.8 mi from the northwest corner of the SEZ. The area of the SRMA/ACEC within the 650-ft (198.1-m) viewshed of the SEZ includes all 8,598 acres (34.79 km^2), or 100% of the total SRMA acreage, including 7,452 acres (30.16 km^2) within the BLM foreground-middleground distance of 5 mi (8 km). The area within the 24.6-ft (7.5-m) viewshed of the SEZ includes 7,907 acres (32.00 km^2), or 92% of the total SRMA acreage. The SEZ is visible from within the SRMA at distances between 0.5 and 6.7 mi (0.8 and 10.7 km).

  The Blanca Wetlands SRMA/ACEC was designated to protect both wildlife and recreation resources. The area that is a designated Watchable Wildlife Area contains wetland habitats important for waterfowl, shorebirds, and other wildlife and a day-use recreation area with restroom facilities and an interpretive loop trail; it is seasonally open to fishing and waterfowl hunting. The SRMA has seasonal public closures to allow for water bird production. The area is relatively flat and is composed of sparsely vegetated sand dunes. In 2004, 4,500 vehicles were recorded visiting the SRMA.

  Elevations within the SRMA range from approximately 5 to 70 ft (2 to 21 m) lower than in the SEZ; thus the angle of view would be very low. The land between the SRMA and the SEZ is grazing land with few cultural disturbances visible except unpaved roads and fences. Solar collector arrays and other low-height components of solar facilities within the SEZ would be viewed edge-on and so would tend to repeat the strong horizontal line of the plain in which the SRMA and the SEZ are located, and this would tend to reduce visual contrast. Less reflective objects, such as PV panel arrays, might be difficult to distinguish against the background. Power towers, transmission towers, and other power block facilities and plumes would likely be visible above the collector arrays, creating contrasts in form, line, and potentially color, depending on the mitigation measures employed.

  At locations within the SRMA nearest to the SEZ, facilities in the western portions of the SEZ could be close enough that they would extend across the entire horizontal field of view and could potentially create strong visual contrasts. Facilities would be viewed against the backdrop of Blanca Peak, which has high scenic value and is a strong focal point for views in the entire area. Structural details of some facility components might be visible at the closest ranges. There would be proportionally smaller visual impacts for facilities located farther from the western boundary of the SEZ and for viewpoints further west in the SRMA.

Figure 10.3.14.2-10 is a three-dimensional perspective visualization created with Google Earth depicting the SEZ as it would be seen from the closest point on a road within the SRMA's southern unit, 0.5 mi (0.8 km) due west of the SEZ. The viewpoint is about 60 ft (18 m) lower in elevation than the SEZ. The visualization includes a simplified wireframe model of a hypothetical solar power tower facility. The SEZ area is depicted in orange; the heliostat fields in blue. The distance from the viewpoint to the closest edge of the heliostat field is approximately 1.4 mi (2.3 km).

The visualization suggests that solar energy facilities within the SEZ would occupy most of the horizontal field of view of viewers looking toward Blanca Peak and would be expected to dominate their views in that direction.

Because the viewpoint is lower than the SEZ, the vertical angle of view would be very low, so that collector/reflector arrays of solar facilities within the SEZ would be seen edge-on. This would make the large areal extent and regular geometry of the arrays less apparent, and they would appear as thin lines on the horizon. Nevertheless, if very close to the viewpoint, their forms and structural details could be evident, thereby increasing contrasts. Taller ancillary facilities, such as transmission components, cooling towers, and others, would likely be visible projecting above the arrays, and could contrast in form, line, and possibly color with the very regular and strongly horizontal collector/reflector arrays.

Operating power towers within the nearest portions of the SEZ would likely appear as brilliant white non-point (i.e., with a visible cylindrical or rectangular shape) light sources atop clearly discernable tower structures. Also, during certain times of the day from certain angles, sunlight on dust particles in the air might result in the appearance of light streaming down from the towers. When operating, the power towers would likely strongly attract visual attention, as seen from this viewpoint.

At night, if sufficiently tall, power towers in the SEZ could have red or white flashing hazard navigation lighting that would likely be very conspicuous from this viewpoint, although light from other sources in the San Luis Valley and other light associated with solar facilities in the SEZ would likely be visible as well.

Potential visual contrasts observed in the SRMA arising from solar energy development within the SEZ would depend on viewer and project location,

FIGURE 10.3.14.2-10 Google Earth Visualization of the Proposed Fourmile East SEZ (shown in orange tint) and Surrounding Lands, with Power Tower Wireframe Model, as Seen from Blanca Wetlands SRMA

project technology, and other visibility factors. Under the 80% development scenario analyzed in this PEIS, solar energy development within the SEZ would be expected to cause weak to strong visual contrasts with the generally natural-appearing surroundings, as seen from the SRMA.

- *Rio Grande Corridor*—The Rio Grande Corridor SRMA is a 4,368-acre (17.67-km^2) BLM-designated SRMA that follows the Rio Grande for 22 mi (35.4 km), beginning just south of La Sauses Cemetery in Colorado and extending to the New Mexico state line. It is located 18.0 mi (29.0 km) southwest of the SEZ at the point of closest approach. The area of the SRMA within the SEZ 25-mi (40-km) viewshed extends from the northern-most portion of the ACEC south for approximately 1.9 mi (3.1 km). It encompasses 324 acres (1.31 km^2) in the 650-ft (198.1-m) viewshed, or 7% of the total SRMA acreage. Portions of the SRMA within the 24.6-ft (7.5-m) viewshed include approximately 20 acres (0.08 km^2), or 0.5% of the total SRMA acreage.

  The Rio Grande Corridor SRMA encompasses the Rio Grande River Corridor ACEC and is nearly identical in size and affected lands to the ACEC. Impacts on the SRMA are the same as those on the ACEC (see description above under *ACECs Designated for Outstanding Scenic Qualities*).

- *Zapata Falls*—The 3,702-acre (14.98-km^2) Zapata Falls SRMA is located 4.6 mi (7.4 km) from the northeast corner of the SEZ at the point of closest approach. As shown in Figure 10.3.14.2-2, the SRMA consists of three separate land parcels part way up the western slope of Blanca Peak. The area of the SRMA within the 650-ft (198.1-m) viewshed of the SEZ includes 22,338 acres (9.461 km^2), or 63% of the total SRMA acreage, including 104 acres (0.421 km^2) within the BLM foreground-middleground distance of 5 mi (8 km). The area within the 24.6-ft (7.5-m) viewshed of the SEZ includes 1,715 acres (6.940 km^2), or 46% of the total SRMA acreage. The visible area extends from the point of closest approach to 7.0 mi (11.3 km) from the SEZ.

  The Zapata Falls SRMA is primarily a day-use area that provides picnic and restroom facilities and an interpretive area. The area provides overnight parking facilities for visitors to the Sangre de Cristo WA. Activities and attractions include viewing Zapata Falls and surrounding scenery, hiking, mountain biking, and horseback riding. Because of its proximity to the Great Sand Dunes National Park, visitation is high, with up to 70,000 vehicle visits recorded in 2004. The highlights of the site are a 50-ft (15-m) waterfall in a narrow canyon and the scenic vistas of the San Luis Valley and the Sangre de Cristo mountains, particularly at sunrise and sunset. Zapata Falls is managed as a VRM Class II area by BLM.

  Views of the SEZ from much of the SRMA, including the trail to Zapata Falls and the falls themselves, are screened by landform or vegetation. However, where not screened by vegetation, the SEZ is visible from nearly the entire access road that leads to the parking area and from ridge tops throughout the SRMA. At these locations, the elevated viewpoint and relatively close proximity of the SEZ result in a high viewing angle, and the tops of solar collectors would be visible depending on their orientation. A larger portion of the solar facilities would be visible relative to low-angle views, increasing potential visual contrasts from the facilities. The high viewing angle would also make the regular geometry of visible solar facilities more apparent, and it would generally be inconsistent with the natural background in terms of form, line, and texture, and possibly color, depending on mitigation employed.

Figure 10.3.14.2-11 is a Google Earth visualization depicting the SEZ as it would be seen from the access road to Zapata Falls, 0.25 mi (0.4 km) southwest of the parking lot, approximately 5.8 mi (9.4 km) north–northeast of the SEZ's northeast corner. The SEZ area is depicted in orange; the heliostat fields in blue.

The visualization shows that nearly the entire SEZ is visible from this location and that the viewing angle is high enough that the tops of collector/reflector arrays of solar facilities in the SEZ would be visible, which would make the large areal extent and regular geometry of the arrays apparent, and thereby likely increasing contrasts with the more natural-appearing surroundings. Note that the visualization does not show the height of foreground vegetation, which in this area provides screening of views of the SEZ from much (but not all) of the access road.

Taller ancillary facilities, such as transmission components, cooling towers, and others, would likely be visible projecting above the arrays and could contrast in form, line, and possibly color with the arrays' very regular and strongly horizontal geometry.

Operating power towers within the nearest portions of the SEZ would likely appear as very bright light sources atop discernable tower structures. They would likely attract visual attention, as seen from this viewpoint.

At night, if sufficiently tall, power towers in the SEZ could have red or white flashing hazard navigation lighting that would likely be visible from this viewpoint, although light from other sources in the San Luis Valley and other light associated with solar facilities in the SEZ could be visible as well.

From many viewing locations within the Zapata Falls SRMA, the SEZ would occupy enough of the visual field that given the potential levels of contrast likely to occur under the 80% development scenario analyzed in this PEIS, solar facilities within the SEZ would likely attract attention but would be unlikely to dominate the view. Visual contrasts associated with solar energy

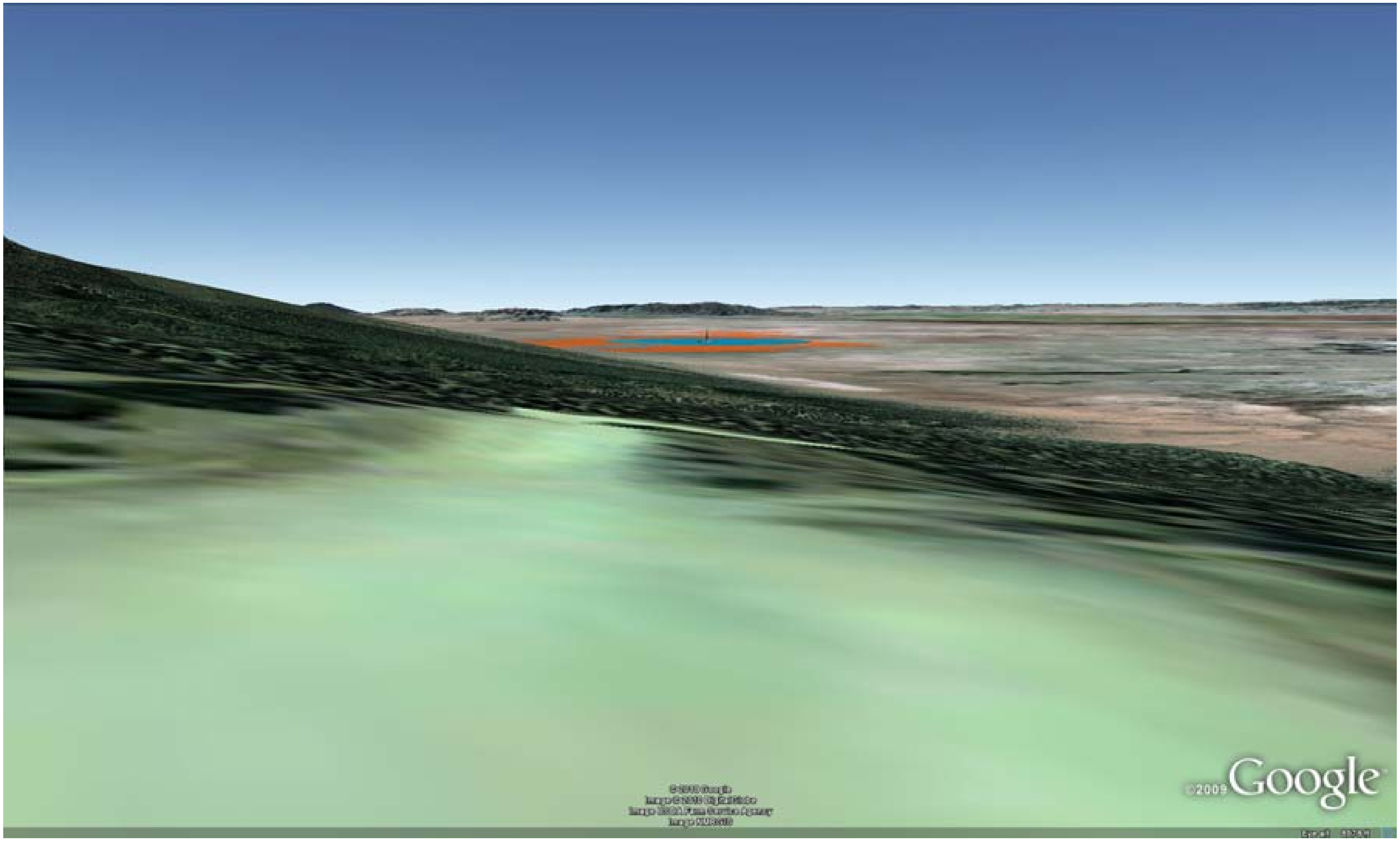

FIGURE 10.3.14.2-11 Google Earth Visualization of the Proposed Fourmile East SEZ (shown in orange tint) and Surrounding Lands, with Power Tower Wireframe Model, as Seen from Zapata Falls SRMA Access Road

development within the SEZ would be expected to create weak to moderate contrasts, as seen from visible locations within the SRMA.

Scenic Highways/Byways

- *Los Caminos Antiguos*—The Los Caminos Antiguos Scenic Byway is a state- and BLM-designated scenic byway that runs through a large section of the San Luis Valley and is located in close proximity to several of the proposed SEZs, including Fourmile East, which it intersects. The byway is an important tourist attraction, and in addition to scenic views of the San Luis Valley and surrounding mountain ranges, it provides access to numerous historic sites and cultural attractions.

  As shown in Figure 10.3.14.2-2, approximately 71 mi (114 km) of the byway is within the calculated 650-ft (198.1-m) viewshed of the SEZ. Undulations in topography, roadside trees, and other vegetation, as well as buildings in local communities screen views of much or all of the SEZ from many locations along the byway. However, there are many open views of the SEZ from the byway, and the byway actually passes through the far eastern portion of the SEZ for a distance of 1.0 mi (1.6 km) and is immediately adjacent to the SEZ for an additional 1.5 mi (2.4 km). The course of the byway takes it around or through the SEZ in every direction but southwest, so it can be thought of as "looping around" the SEZ.

  Due south of the SEZ, elevations along the byway are higher than the SEZ, but the distance is large enough (19 mi+ [31 km+]) that the angle of view is still very low. At the long distances involved, vegetative and other screening would be very likely to make low-height solar facilities not visible to byway travelers, with a slight chance that power tower receivers within the SEZ would be visible as distant points of light on the horizon. Visual contrasts from solar energy development within the SEZ would be expected to be minimal to weak until byway travelers going northward on the byway pass through the community of Blanca on U.S. 160.

  Just west of Blanca, the byway turns northwest and heads generally toward the SEZ. As travelers approach the SEZ, solar development within the SEZ would occupy more of the field of view, with increasing levels of visual contrast apparent. Approximately 4 mi (7 km) northwest of Blanca, the byway turns due west for a short distance, so that the SEZ would become more prominent on the right side of the byway.

  Just beyond the eastern boundary of the SEZ, the byway turns north onto CO 150. At this point, northward-bound travelers would be heading straight north, approaching the far eastern portion of the SEZ, with the SEZ spreading out across the full field of view toward the northwest. Solar facilities within the SEZ would be in full view, and facilities located within the southeastern portion of the SEZ would strongly attract the eye, likely dominating views from the byway. Views of the San Luis Valley to the west and northwest would be completely or partially screened by solar facilities, and views north toward Great Sand Dunes National Park and Preserve could be fully or near fully screened as well, depending on the layout of solar facilities within the SEZ. Because of the very short distance from the byway, strong visual contrasts could result, depending on solar project characteristics and location within the SEZ.

If power tower facilities were located in the SEZ, when operating, the receivers could appear as brilliant cylindrical or rectangular light sources atop very tall tower structures west of the byway and would strongly attract views, likely dominating views to the west. Looking down the byway towards Great Sand Dunes National Park and Preserve, if solar facilities were located on both the east and west sides of the byway, the banks of solar collectors on both sides of the byway could form a visual "tunnel" that travelers would pass through briefly (about 1 minute at highway speeds). After passing through the section of SEZ, travelers would still see the SEZ immediately adjacent to the byway on one or the other side of the highway for about 1 minute (for motorized vehicles at highway speed), with contrast levels dependent on the presence of solar facilities in areas near the byway and on solar facility characteristics.

As byway travelers approach and pass through the SEZ, depending on the solar technologies present, facility layout, and mitigation measures employed, there would be the potential for significant levels of glint and glare from reflective surfaces. These potential impacts could be reduced by siting reflective components away from the byway, employing various screening mechanisms, and/or adjusting the mirror operations to reduce potential impacts; however, because of the height of power towers, the light from the receivers likely could not be screened from the roadway.

Figure 10.3.14.2-12 is a Google Earth visualization of the SEZ as seen from Los Caminos Antiguos Scenic Byway on State Route 150, 1.0 mi (1.6 km) south of the intersection of the byway and the SEZ, facing northwest toward the center of the SEZ. The viewpoint is only a few feet (less than 1 m) higher than the nearest point in the SEZ.

The SEZ area is depicted in orange; the heliostat fields in blue. The power tower receiver visible is approximately 2.3 mi (3.7 km) northwest of the viewpoint.

The visualization suggests that because the SEZ is so close to the viewpoint, the SEZ is too large to be encompassed in one view. Viewers would need to turn their heads to scan across the whole SEZ. Under the 80% development

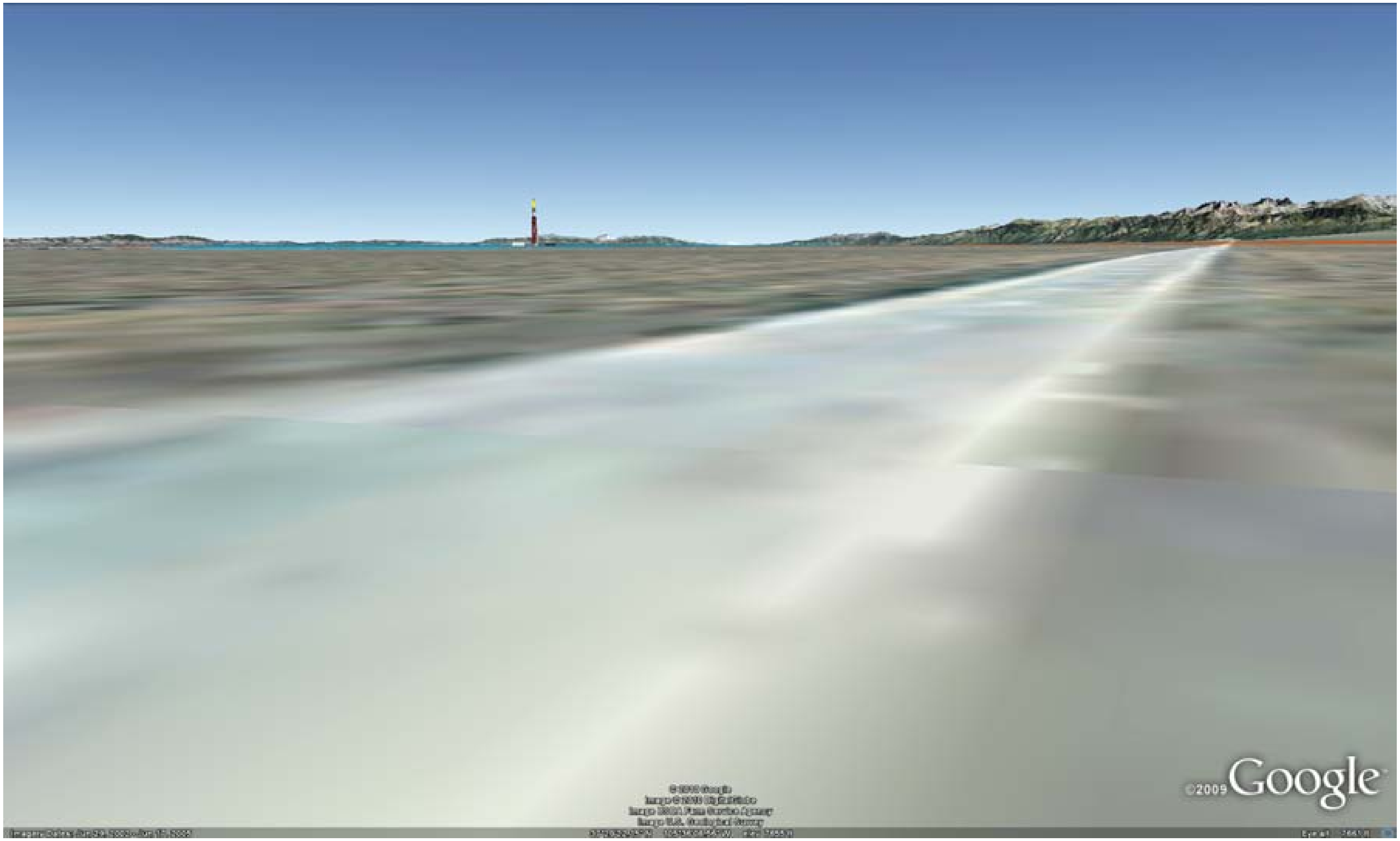

FIGURE 10.3.14.2-12 Google Earth Visualization of the Proposed Fourmile East SEZ (shown in orange tint) and Surrounding Lands, with Power Tower Wireframe Model, as Seen from Los Caminos Antiguos Scenic Byway One Mile South of the SEZ

scenario analyzed in the PEIS, solar facilities within the SEZ would likely dominate the view from this location.

Because the viewpoint is at essentially the same elevation as the SEZ, the vertical angle of view would be very low, so that collector/reflector arrays of solar facilities within the SEZ would be seen edge-on. This would make the large areal extent and regular geometry of the arrays less apparent, and they would appear as thin lines on the horizon. Nevertheless, if the arrays were very close to the viewpoint, their forms and structural details could be evident, thereby increasing contrasts. Taller ancillary facilities, such as transmission components, cooling towers, and others would likely be visible projecting above the arrays and could contrast strongly in form, line, and possibly color with the very regular and strongly horizontal collector/reflector arrays.

If power tower facilities were located in the SEZ, when operating, the receivers could appear as brilliant cylindrical or rectangular light sources atop very tall tower structures west of the byway and would strongly attract views, likely dominating views to the west. Also, during certain times of the day from certain angles, sunlight on dust particles in the air might result in the appearance of light streaming down from the towers. Looking down the byway towards Great Sand Dunes National Park and Preserve, if solar facilities were located on both the east and west sides of the byway, the banks of solar collectors on both sides of the byway could form a visual “tunnel” that travelers would pass through briefly (about 1 minute at highway speeds). After passing through the section of SEZ, travelers would still see the SEZ immediately adjacent to the byway on one side or the other of the highway for about 1 minute (for motorized vehicles at highway speed), with contrast levels dependent on the presence of solar facilities in areas near the byway and on solar facility characteristics.

As byway travelers approached and passed through the SEZ, depending on the solar technologies present, facility layout, and mitigation measures employed, the potential would exist for significant levels of glint and glare from reflective surfaces. These potential impacts could be reduced by siting reflective components away from the byway, employing various screening mechanisms, and/or adjusting the mirror operations to reduce potential impacts. Nevertheless, because of the height of power towers, the light from the receivers likely could not be screened from the roadway.

Potential visual contrasts from solar energy development within the SEZ as seen from this viewpoint would depend on project location, project technology, and other visibility factors. Under the 80% development scenario analyzed in this PEIS, solar energy development within the SEZ would be expected to cause strong visual contrasts with the generally natural-appearing surroundings.

> North and west of the SEZ, the byway is much farther from the SEZ, and while the SEZ would be visible from many locations along the byway, the angle of view would be low and the SEZ distant, so that visual contrast levels would be expected to range from minimal to weak.
>
> Byway travelers heading south on the byway would in general be subjected to the same types of visual contrasts, but the order would be reversed, and this could change the perceived impact levels, partly because of different expectations about the visual experience of traveling the byway. For example, heading south from Great Sand Dunes National Park and Preserve on the byway, travelers would be going away from Great Sand Dunes, having already seen or visited it and would therefore not see visible solar facilities as spoiling much anticipated views of the park; this could result in lower perceived visual impacts.
>
> In summary, the range of impacts experienced by byway travelers would be highly dependent on viewer location, project types, locations, sizes, and layouts, as well as the presence of screening. Under the 80% development scenario analyzed in this PEIS, solar facilities within the SEZ would have little visual effect on much of the byway, but could dominate views (if screening was absent) from some locations close to the SEZ. At and near the point of intersection of the byway and the SEZ, solar energy development within the SEZ could potentially create strong visual contrasts as viewed from the byway.

Additional scenic resources exist at the national, state, and local levels, and impacts may occur on both federal and nonfederal lands, including sensitive traditional cultural properties important to Tribes. In addition to the resource types and specific resources analyzed in this PEIS, future site-specific NEPA analyses would include state and local parks, recreation areas, other sensitive visual resources, and communities close enough to the proposed project to be affected by visual impacts. Selected other lands and resources are included in the discussion below.

In addition to impacts associated with the solar energy facilities themselves, the SEZ, surrounding lands, and sensitive visual resources within the project's viewshed could be affected by facilities that would be built and operated in conjunction with the solar facilities. With respect to visual impacts, the most important associated facilities would be access roads and transmission lines, the precise location of which cannot be determined until a specific solar energy project is proposed. There is currently no transmission line within the SEZ, so construction and operation of a transmission line both inside and outside the SEZ will be required; however, an existing transmission line is located within 2.3 mi (3.7 km) of the southern boundary of the SEZ. If this transmission line can be utilized for the project, visual impacts associated with transmission line construction and operation would likely be smaller than if construction of a longer line was required. Note that depending on project- and site-specific conditions, visual impacts associated with access roads, and particularly transmission lines, could be large. Detailed information about visual impacts associated with transmission lines is presented in Section 5.7.1 of this PEIS. A detailed site-specific NEPA analysis would be required to determine visibility and associated impacts precisely for any future solar projects, based on more precise knowledge of facility location and characteristics.

Impacts on Selected Other Lands and Resources

West Fork of the North Branch of the Old Spanish Trail. As shown in Figure 10.3.14.2-2, approximately 3.8 mi (6.1 km) of the West Fork of the North Branch of the Old Spanish Trail is also within the western portion of the viewshed of the Fourmile East SEZ; however, this portion of the trail has yet to receive congressional designation. The visible portion of the trail within the 25-mi (40-km) limit of analysis for visual impacts is just under 25 mi (40 km) from the SEZ. Because both the SEZ and the trail in this area are located on the valley floor, the angle of view between them is extremely low, and at the very long distance involved, minimal visual impacts on trail users would be expected.

Blanca Peak. Blanca Peak is a 14,000-ft+ (4,267-m+) peak that dominates views in much of the San Luis Valley and is located approximately 7 mi (11 km) northeast of the SEZ. The area is of special significance to the Navajo Tribe, and the surrounding area is used for recreation, such as hiking and mountain climbing.

Blanca Peak is just outside the boundary of the Sangre de Cristo WA and only a short distance from Ellingwood Point, a prominent peak within the WA. Figure 10.3.14.2-6 is a Google Earth visualization of the SEZ as seen from Ellingwood Point. The view of the SEZ from Blanca Peak would be very similar but would have full visibility of the SEZ, because there is no intervening landform.

As seen from Blanca Peak, the SEZ would occupy a substantial part of the observer's field of view, which would tend to increase the observed visual contrast levels. The visualization also shows that in addition to the Fourmile East SEZ, both the Antonito Southeast and Los Mogotes East SEZs would be visible from Blanca Peak, although the much greater distance to these SEZs and the resultant lower viewing angle suggest much smaller visual impacts from solar energy development in these SEZs. Under the 80% development scenario analyzed in this PEIS, solar energy development within the Fourmile East SEZ would be likely to attract attention, though it would not be expected to dominate the view and would thus be expected to create moderate levels of visual contrasts as seen from Blanca Peak.

Communities of Alamosa, Blanca, and Mosca. As shown in Figure 10.3.14.2-2, the viewshed analyses indicate visibility of the SEZ from the communities of Alamosa (approximately 11.8 mi [18.9 km] west-southwest of the SEZ), Blanca (approximately 6.4 mi [10.3 km] southeast of the SEZ), and Mosca (approximately 15.1 mi [24.3 km] west-southwest of the SEZ). However, a site visit in July 2009 indicated at least partial screening of ground-level views of the SEZ from these communities, because of either slight variations in topography, vegetation, or both. A detailed future site-specific NEPA analysis is required to determine visibility precisely; however, note that even with the existing screening, solar power towers, cooling towers, plumes, transmission lines and towers, or other tall structures associated with the development could potentially be tall enough to exceed the height of any screening and could in some cases cause visual impacts on these communities.

The elevation in Alamosa is slightly lower than that in the SEZ, so there is a low angle of view between Alamosa and the SEZ. In Alamosa, where screening was absent, because of the low angle of view and distance to the SEZ, minimal to weak visual contrasts would be expected.

Blanca is also lower in elevation than the SEZ and so would have a low angle of view; however, because of intervening terrain, low-height solar facilities within the SEZ might not be visible from some locations in Blanca. From unscreened locations within Blanca, power tower receivers within the SEZ could be visible and would be seen as bright points of light against a sky backdrop. Because of the low angle of view and distance to the SEZ, weak visual contrasts would be expected.

Mosca is also at a slightly lower elevation than the SEZ, but is just over 15 mi (24 km) distant. Where screening was absent, because of a low angle of view and the long distance to the SEZ, minimal to weak visual contrasts would be expected.

Regardless of visibility from within these communities, residents, workers, and visitors to the area would be likely to experience visual impacts from solar energy facilities located within the SEZ (as well as any associated access roads and transmission lines) as they travel area roads, including State Route 150 and U.S. 160.

Nearby Residents. As noted above, there are scattered ranches and other residences on private lands immediately adjacent or close to the SEZ and within the SEZ viewshed. Depending on technology- and project-specific factors, because of the close proximity and large size of likely developments, these residents could be subjected to large visual impacts from solar energy development within the SEZ. These impacts would be determined in the course of a site-specific environmental impact analysis.

Rio Grande Scenic Railroad. The Rio Grande Scenic Railroad is a privately run scenic/historic train service that is an important tourist destination within the San Luis Valley. The rail line serves Alamosa, passes within 2.3 mi (3.7 km) of the southern boundary of the SEZ, and is within the SEZ viewshed. A site visit in July 2009 indicated there may be at least partial screening of ground-level views of the SEZ from some portions of the rail line, because of either slight variations in topography, vegetation, or both; however, there are clear views of the SEZ from much of the rail line in the area.

Figure 10.3.14.2-13 is a Google Earth visualization of the SEZ as seen from the Rio Grande Scenic Railroad, 2.6 mi (4.2 km) south of the SEZ, facing north toward the center of the SEZ. The viewpoint is about 20 ft (6 m) higher than the nearest point in the SEZ. The viewpoint

FIGURE 10.3.14.2-13 Google Earth Visualization of the Proposed Fourmile East SEZ (shown in orange tint) and Surrounding Lands, with Power Tower Wireframe Model, as Seen from Rio Grande Scenic Railway

is about 20 ft (6 m) higher in elevation than the nearest point in the SEZ. The power tower model in the visualization is about 5 mi (8 km) from the viewpoint.

The angle of view between the SEZ and the railroad is very low, but the distance (near the point of closest approach) is less than half the BLM foreground-middleground distance (5 mi [8 km]). Although the ground surface is partially screened from view in the visualization, all of the railroad line south of the SEZ is within the SEZ 24.6-ft (7.5-m) viewshed, and in fact, under the 80% development scenario analyzed in the PEIS, solar facilities in the SEZ could occupy most of the horizontal field of view to the north.

Because the viewpoint is only slightly elevated above the SEZ, the vertical angle of view would be very low, so that collector/reflector arrays of solar facilities within the SEZ would be seen edge-on. This would make the large areal extent and regular geometry of the arrays less apparent, and they would appear as thin lines on the northern horizon. Taller ancillary facilities, such as transmission components and cooling towers, would likely be visible projecting above the arrays and could contrast strongly in form, line, and possibly color with the very regular and strongly horizontal collector/reflector arrays.

If power tower facilities were located in the SEZ, when operating, the receivers could appear as very bright non-point (i.e., cylindrical or rectangular) light sources atop clearly discernable tower structures, and would strongly attract views.

Potential visual contrasts from solar energy development within the SEZ as seen from this viewpoint would depend on project location, project technology, and other visibility factors. Under the 80% development scenario analyzed in this PEIS, solar energy development within the SEZ would be expected to cause strong visual contrasts with the generally natural-appearing surroundings. Because this viewpoint is near the closest point on the railroad to the SEZ, other potential viewpoints on the railroad would be subject to similar or lower contrast levels.

Other Impacts. In addition to the impacts described for the resource areas above, nearby residents and visitors to the area may experience visual impacts from solar energy facilities located within the SEZ (as well as any associated access roads and transmission lines) as they travel area roads. The range of impacts experienced would be highly dependent on viewer location and project types, locations, sizes, and layouts, as well as the presence of screening, but under the 80% development scenario analyzed in the PEIS, major visual contrast from solar development within the SEZ could potentially be observed from some locations.

10.3.14.2.3 Summary of Visual Resource Impacts for the Proposed Fourmile East SEZ

Under the 80% development scenario analyzed in this PEIS, there could be multiple solar facilities within the Fourmile East SEZ, a variety of technologies employed, and a range of supporting facilities (such as transmission towers and lines, substations, power block components, and roads) that would contribute to visual impacts. The resulting visually complex landscape would be essentially industrial in appearance and would contrast greatly with the surrounding mostly natural-appearing landscape. Large visual impacts on the SEZ and surrounding lands within the SEZ viewshed would be associated with solar energy development within the SEZ because of major modification of the character of the existing landscape. Additional impacts could occur from construction and operation of transmission lines and access roads within and/or outside the SEZ.

The SEZ is in an area of low scenic quality, with major cultural disturbances already present in and around the SEZ. Visitors to the area, workers, and residents of nearby areas may experience visual impacts from solar energy facilities located within the SEZ (as well as any associated access roads and transmission lines) as they travel area roads.

Utility-scale solar energy development within the proposed Fourmile East SEZ is likely to result in strong visual contrasts for some viewpoints in the Sangre de Cristo WA, which is located 2.8 mi (4.5 km) northeast of the SEZ.

Nearly 50 mi (80.5 km) of the Old Spanish NHT, including 25 mi (40 km) of a high-potential segment, fall within the SEZ 25-mi (40-km) viewshed. Trail users would be expected to observe strong visual contrasts from solar energy development within the SEZ at some points on the trail.

Strong visual contrast levels would be expected for some viewpoints in the Blanca Wetlands SRMA/ACEC, located about 0.5 mi (0.8 km) from the western edge of the SEZ.

Moderate visual contrast levels would be expected for some viewpoints in the Zapata Falls SRMA, located about 4.6 mi (7.4 km) northeast of the SEZ.

Moderate visual contrast levels would be expected for some viewpoints on Blanca Peak, located about 7 mi (11 km) northeast of the SEZ.

Almost 71 mi (114 km) of Los Caminos Antiguos Scenic Byway are within the Fourmile East SEZ viewshed. Travelers on the byway would be likely to observe strong visual contrasts from solar energy development within the SEZ at some locations on the byway.

Portions of the Rio Grande Scenic Railway are within the SEZ viewshed. Railroad passengers would be likely to observe strong visual contrasts from solar energy development within the SEZ at some points on the railroad.

Minimal to weak visual contrasts would be expected for some viewpoints within other sensitive visual resource areas within the SEZ 25-mi (40-km) viewshed.

10.3.14.3 SEZ-Specific Design Features and Design Feature Effectiveness

The presence and operation of large-scale solar energy facilities and equipment would introduce major visual changes into nonindustrialized landscapes and could create strong visual contrasts in line, form, color, and texture that could not easily be mitigated substantially. However, the implementation of required programmatic design features presented in Appendix A, Section A.2.2, would reduce the magnitude of visual impacts experienced. While the applicability and appropriateness of some design features would depend on site- and project-specific information that would be available only after a specific solar energy project had been proposed, some SEZ-specific design features can be identified for the Fourmile East SEZ at this time, as follows:

- The development of power tower facilities should be prohibited within the SEZ.

- Within the SEZ, in areas visible from and within 0.25 mi (0.4 km) of the Los Caminos Antiguos Scenic Byway, visual impacts associated with solar energy project operation should be consistent with VRM Class II management objectives (see Table 10.3.14.3.-1), as experienced from key observation points on the byway.

- Within the SEZ, in areas visible from and within 3 mi (4.8 km) of the centerline of the high-potential segment of the Old Spanish National Historic Trail, visual impacts associated with solar energy project operation should be consistent with VRM Class II management objectives, as experienced from key observation points on the high-potential segment of the Old Spanish National Historic Trail. Within the SEZ, in areas visible from and between 3 mi (4.8 km) and 5 mi (8 km) of the centerline of the high-potential segment of the Old Spanish National Historic Trail, visual impacts associated with solar energy project operation should be consistent with VRM Class III management objectives, as experienced from key observation points on the high-potential segment of the Old Spanish National Historic Trail.

- Within the SEZ, in areas visible from and within 3 mi (4.8 km) of the Sangre de Cristo WA, visual impacts associated with solar energy project operation should be consistent with VRM Class II management objectives, as experienced from key observation points within the WA. Within the SEZ, in areas visible from and between 3 mi (4.8 km) and 5 mi (8 km) of the Sangre de Cristo WA, visual impacts associated with solar energy project operation should be consistent with VRM Class III management objectives, as experienced from key observation points within the WA.

Areas within the SEZ affected by these design features are shown in Figure 10.3.14.3-1. The VRM Class II consistency design feature would apply to 1,578 acres (6.39 km^2), or 41% of the SEZ. The VRM Class III consistency design feature would apply to 1,647 additional acres (6.67 km^2), or 42% of the SEZ.

Application of the SEZ-specific design features would substantially reduce visual impacts associated with solar energy development within the SEZ.

TABLE 10.3.14.3-1 VRM Management Class Objectives

	Description
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 low. Management activities may be seen but should not attract the 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 modification 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 repeating the basic elements.

Source: BLM (1986b).

The height of solar power tower receiver structures, combined with the intense light generated by the receivers atop the towers, would be expected to create strong visual contrasts that could not be effectively screened from view for most areas surrounding the SEZ, given the broad, flat, and generally treeless expanse of the San Juan Valley. In addition, for power towers exceeding 200 ft (61 m) in height, hazard navigation lighting that could be visible for very long distances would likely be required. Prohibiting the development of power tower facilities would remove this source of impacts, thus substantially reducing potential visual impacts on the Old Spanish National Historic Trail; Sangre de Cristo WA; Los Caminos Antiguos Scenic Byway; the other sensitive visual resource areas identified above; the communities of Alamosa, Blanca, and Mosca; and other residents of and visitors to the San Luis Valley, a regionally important tourist destination.

Application of the distance-based design feature to restrict allowable visual impacts associated with solar energy project operations to within 5 mi (8 km) of the high-potential segment of the Old Spanish National Historic Trail and the Sangre de Cristo WA would substantially reduce potential visual impacts on those resources by limiting impacts within the BLM-defined foreground of the viewshed of the trail, where potential visual impacts would be greatest. In addition, this measure would also substantially reduce potential visual impacts on the other sensitive visual resource areas identified above and on other residents of and visitors to the San Luis Valley.

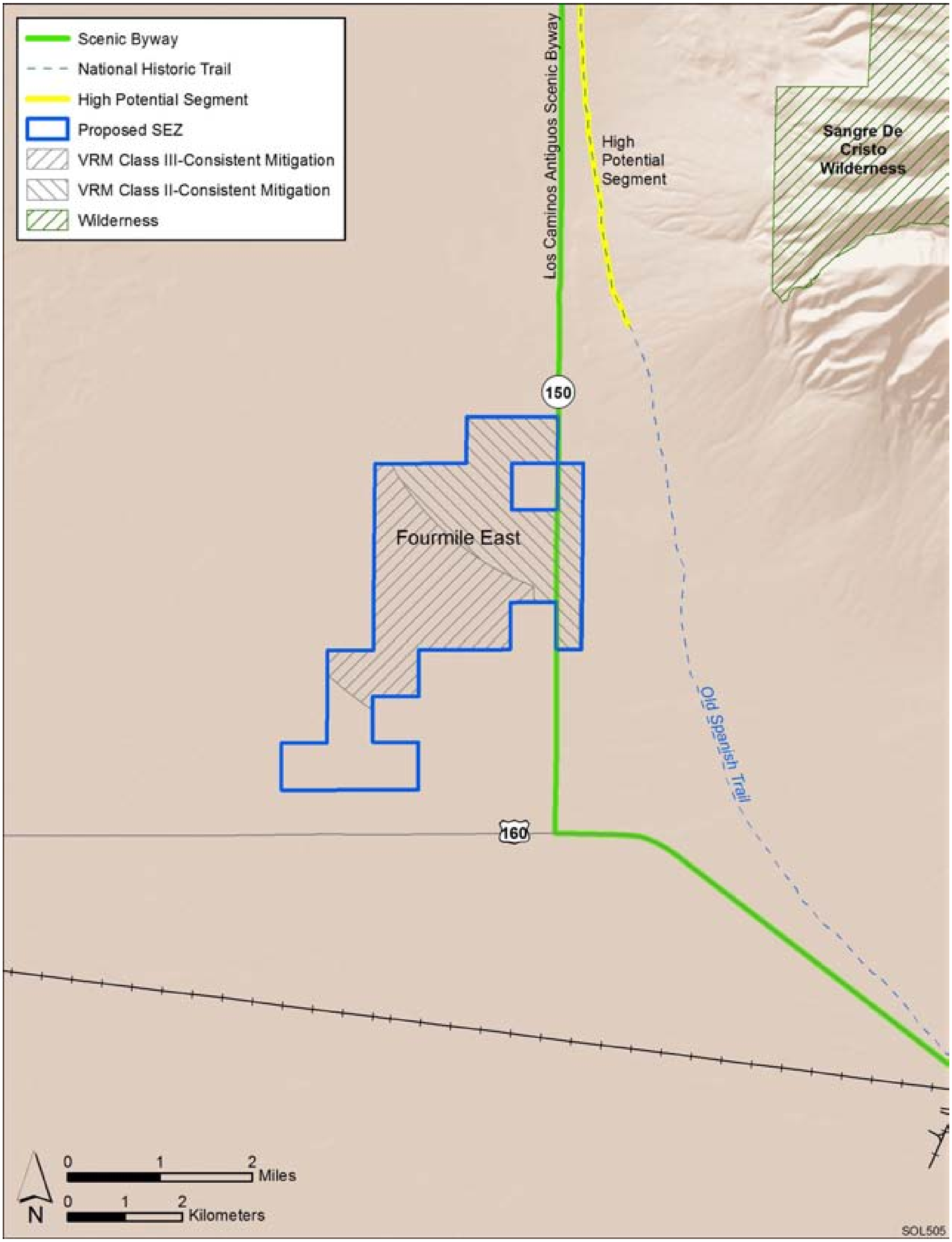

FIGURE 10.3.14.3-1 Areas within the Proposed Fourmile East SEZ Affected by SEZ-Specific Distance-Based Visual Impact Design Features

Application of the distance-based design feature to restrict allowable visual impacts associated with solar energy project operations to within 0.25 mi (0.4 km) of the Los Caminos Antiguos Scenic Byway would substantially reduce potential visual impacts on the byway by restricting visual intrusions in the immediate foreground of the byway, where potential visual impacts would be greatest, and would reduce the visual "tunnel" effect that could result if solar collector arrays were placed on both sides of and immediately adjacent to the byway.

Implementation of the programmatic and SEZ-specific design features intended to reduce visual impacts (described in Appendix A, Section A.2.2 of this PEIS) would be expected to reduce visual impacts associated with utility-scale solar energy development within the SEZ; however, the degree of effectiveness of these design features can be assessed only at the site- and project-specific level. Given the large scale reflective surfaces and strong regular geometry of utility-scale solar energy facilities and the lack of screening vegetation and landforms within the SEZ viewshed, siting the facilities away from sensitive visual resource areas and other sensitive viewing areas would be the primary means of mitigating visual impacts. The effectiveness of other visual impact mitigation measures would generally be limited.

10.3.15 Acoustic Environment

10.3.15.1 Affected Environment

The proposed Fourmile East SEZ is in the southeastern portion of Alamosa County in south-central Colorado, which has no quantitative noise-level regulations. The State of Colorado, however, has established the maximum permissible noise levels for the state by land use zone and by time of day, as shown in Table 4.13.1-1.

U.S. 160 lies about 0.5 mi (0.8 km) to the south of the Fourmile East SEZ, and State Highway 150 runs through the east side of the SEZ. Three county roads also provide good access to the SEZ. The nearest railroad runs as close as about 2.3 mi (3.7 km) to the south. The nearest airport is Blanca Airport, about 6.5 mi (10.5 km) southeast of the SEZ. Other nearby airports include San Luis Valley Regional Airport, Monte Vista Municipal Airport, and McCullough Airport, which are located about 12 mi (19 km) west–southwest, about 21 mi (34 km) west, and 24 mi (39 km) west–northwest of the SEZ, respectively. Developed small-scale irrigated agricultural activities occur about 1 mi (1.6 km) to the south; large-scale agricultural activities occur beyond about 4 mi (6 km) to the southeast around Blanca. Active cattle grazing occurs on-site, but no industrial activities exist around the SEZ. No sensitive receptors (e.g., hospitals, schools, or nursing homes) exist around the proposed Fourmile East SEZ. The nearest residence from the boundary of the SEZ is located about 0.8 mi (1.3 km) to the southwest. The closest population center with schools or town infrastructure is Alamosa, which is located about 12 mi (19 km) west of the SEZ. Accordingly, noise sources around the SEZ include road traffic, railroad traffic, aircraft flyover, agricultural activities, and animal noise. Another noise source is hunting on-site. The proposed Fourmile East SEZ is mostly undeveloped, the overall character of which is considered rural. To date, no environmental noise survey has been conducted in the vicinity of the Fourmile East SEZ. On the basis of the population density, the day-night average sound level (L_{dn} or DNL) is estimated to be 35 dBA for Alamosa County, the low end of 33 to 47 dBA L_{dn}, which is typical of a rural area[10] (Eldred 1982; Miller 2002).

10.3.15.2 Impacts

Potential noise impacts associated with solar projects in the proposed Fourmile East SEZ would occur during all phases of the projects. During the construction phase, potential noise impacts associated with the operation of heavy equipment and vehicular traffic on the nearest residence (within 0.8 mi [1.3 km] from the SEZ boundary) would be anticipated, albeit of short duration. During the operations phase, potential impacts on nearby residences would be anticipated, depending on the solar technologies employed. Noise impacts shared by all solar technologies are discussed in detail in Section 5.13.1, and technology-specific impacts are presented in Section 5.13.2. Impacts specific to the Fourmile East SEZ are presented in this

[10] Rural and undeveloped areas have sound levels in the range of 33 to 47 dBA as L_{dn} (Eldred 1982). Typically, the nighttime level is 10 dBA lower than daytime level, and it can be interpreted as 33 to 47 dBA (mean 40 dBA) during the daytime hours and 23 to 37 dBA (mean 30 dBA) during nighttime hours.

section. Any such impacts would be minimized through the implementation of required programmatic design features described in Appendix A, Section A.2.2, and through any additional SEZ-specific design features applied (see Section 10.3.15.3). This section primarily addresses potential noise impacts on humans, although potential impacts on wildlife at nearby sensitive areas are discussed. Additional discussion on potential noise impacts on wildlife is presented in Section 5.10.2.

10.3.15.2.1 Construction

The proposed Fourmile East SEZ has a relatively flat terrain, thus, minimal site preparation activities would be required, and associated noise levels would be lower than those during general construction (e.g., erecting building structures, equipment installation, piping, and electrical installation). Solar array construction would also generate noise, but it would be spread over a wide area.

For the parabolic trough and power tower technologies, the highest construction noise levels would occur at the power block area, where key components (e.g., steam turbine/generator) needed to generate electricity are located; a maximum of 95 dBA at a distance of 50 ft (15 m) is assumed, if not using impact equipment such as pile drivers or rock drills. Typically, the power block area is located in the center of a solar facility, at a distance of more than 0.5 mi (0.8 km) to the facility boundary. Noise levels from construction of the solar array would be lower than 95 dBA. Considering geometric spreading and ground effects, as explained in Section 4.13.1, noise levels would attenuate to about 40 dBA at a distance of 1.2 mi (1.9 km) from the power block area. This noise level is typical of daytime mean rural background levels. In addition, mid- and high-frequency noise from construction activities is significantly attenuated by atmospheric absorption under low humidity conditions that would be typical of an arid desert environment, and by temperature lapse conditions typical of daytime hours. Thus noise attenuation to a 40-dBA level would occur at distances somewhat shorter than the aforementioned distances. If a 10-hour daytime work schedule is considered, the EPA guideline level of 55 dBA L_{dn} for residential areas (EPA 1974) would occur at about 1,200 ft (370 m) from the power block area, which would be well within the facility boundary. For construction activities occurring near the residence closest to the southwestern SEZ boundary, estimated noise levels at this residence would be about 44 dBA, which is somewhat higher than a typical daytime mean rural background level of 40 dBA. However, estimated 43 dBA L_{dn}[11] at this residence falls well below the EPA guideline of 55 dBA L_{dn} for residential areas.

In addition, noise levels were estimated at the specially designated areas within a 5-mi (8-km) range of the Fourmile East SEZ, which is the farthest distance that noise (except extremely loud noise) would be discernable. The Blanca Wetlands SRMA/ACEC and Old Spanish National Historic Trail, which lie as close as 0.5 mi (0.8 km) to the west and 0.9 mi (1.4 km) to the east of the SEZ boundary, are within the range where noise might be an issue. For construction activities occurring near the western SEZ boundary, the estimated noise level at the

[11] For this analysis, background levels of 40 and 30 dBA for daytime and nighttime hours, respectively, are assumed, which result in day-night average noise level (L_{dn}) of 40 dBA.

Blanca Wetlands SRMA/ACEC would be about 50 dBA, which is higher than the typical daytime mean rural background level of 40 dBA. However, construction noise from the SEZ is not likely to adversely affect wildlife at the Blanca Wetlands SRMA/ACEC (Manci et al. 1988), as discussed in Section 5.10.2. For construction activities occurring near the eastern SEZ boundary, the estimated noise level at the Old Spanish National Historic Trail would be about 43 dBA, which is a little higher than the typical daytime mean rural background level of 40 dBA. Accordingly, construction occurring near the eastern SEZ boundary could result in minor noise impacts on the Old Spanish National Historic Trail but these would be temporary in nature.

Depending on the soil conditions, pile driving might be required for the installation of solar dish engines. However, the pile drivers to be used, such as vibratory or sonic drivers, would be relatively small and quiet as opposed to the impulsive impact pile drivers that are frequently seen at large-scale construction sites. Potential impacts on neighboring residences would be anticipated to be minor, considering the distance to the nearest residence (more than 0.8 mi [1.3 km] from the SEZ boundary).

It is assumed that most construction activities would occur during the day, when noise is better tolerated than at night because of the masking effects of background noise. In addition, construction activities for a utility-scale facility are temporary in nature (typically a few years). Construction would cause some unavoidable but localized short-term impacts on neighboring communities, particularly for activities occurring near the southwestern proposed SEZ boundary, close to nearby residences.

Construction activities could result in various degrees of ground vibration, depending on the equipment used and construction methods employed. All construction equipment causes ground vibration to some degree, but activities that typically generate the most severe vibrations are high-explosive detonations and impact pile driving. As is the case for noise, vibration would diminish in strength with distance. For example, vibration levels at receptors beyond 140 ft (43 m) from a large bulldozer (87 VdB at 25 ft [7.6 m]) would diminish below the threshold of perception for humans, which is about 65 VdB (Hanson et al. 2006). During the construction phase, no major construction equipment that can cause ground vibration would be used, and no residences or sensitive structures are located in close proximity. Therefore, no adverse vibration impacts are anticipated from construction activities, including from pile driving for dish engines.

It is assumed that a transmission line would need to be constructed to connect to the nearest existing regional 69-kV line located about 2 mi (3 km) south of the Fourmile East SEZ. Because of the short distance to the regional grid, such construction could be performed in a short time period (likely a few months). Construction sites along a new transmission line ROW would move continuously, and thus, no particular area would be exposed to noise for a prolonged period. The potential noise impacts on nearby residences along the transmission line ROW would therefore be minor and temporary in nature.

10.3.15.2.2 Operations

Noise sources common to all or most types of solar technologies include equipment motion from solar tracking; maintenance and repair activities (e.g., washing of mirrors or replacement of broken mirrors) at the solar array area; commuter/visitor/support/delivery traffic within and around the solar facility; and control/administrative buildings, warehouses, and other auxiliary buildings/structures. Diesel-fired emergency power generators and fire-water pump engines would be additional sources of noise, but their operations would be limited to several hours per month (for preventive maintenance testing).

With respect to the main solar energy technologies, noise-generating activities in the PV solar array area would be minimal, related mainly to solar tracking, if used. Dish engine technology, which employs collector and converter devices in a single unit, on the other hand, generally has the strongest noise sources.

For the parabolic trough and power tower technologies, most noise sources during operations would come from the power block area, including the turbine generator (typically in an enclosure), pumps, boilers, and dry- or wet-cooling systems. The power block is typically located in the center of the facility. On the basis of a 250-MW parabolic trough facility with a cooling tower (Beacon Solar, LLC 2008), simple noise modeling indicates that noise levels around the power block would be more than 85 dBA, but about 51 dBA at the facility boundary, about 0.5 mi (0.8 km) from the power block area. For a facility located near the southwestern boundary of the SEZ, the predicted noise level from the power block would be around 42 dBA at the nearest residence, located 0.8 mi (1.3 km) from the SEZ boundary,[12] which is a little higher than the typical daytime mean rural background level of 40 dBA. If TES were not used (i.e., if the operation were limited to daytime, 12 hours only[13]), the EPA guideline of 55 dBA (as L_{dn} for residential areas) would occur at about 1,370 ft (420 m) from the power block, and thus would not be exceeded outside of the proposed SEZ boundary. At the nearest residence, about 43 dBA L_{dn} would be estimated, which is well below the EPA guideline of 55 dBA L_{dn} for residential areas. However, day-night average noise levels higher than those estimated above by using the simple noise modeling would be anticipated if TES were used during nighttime hours, as explained below and in Section 4.13.1.

On a calm, clear night typical of the proposed Fourmile East SEZ setting, the air temperature would likely increase with height (temperature inversion) because of strong radiative cooling. Such a temperature profile tends to focus noise downward toward the ground. There would be little, if any, shadow zone[14] at all, within 1 or 2 mi (1.6 or 3 km) of the source, in the presence of a strong temperature inversion (Beranek 1988). In particular, such conditions

[12] The nearest residence is located near the southwestern panhandle area of the SEZ, which does not have enough area for the 0.5-mi (0.8-km) buffer to the site boundary. In reality, this residence would be located more than 1.3 mi (2.1 km) from the power block area.

[13] Maximally possible operating hours around the summer solstice but limited to 7 to 8 hours around the winter solstice.

[14] A shadow zone is defined as the region where direct sound does not penetrate because of upward diffraction.

add to the effect of noise being more discernable during nighttime hours, when the background levels are the lowest. To estimate the day-night average sound level (L_{dn}), 6-hour nighttime generation with TES is assumed after 12-hour daytime generation. For nighttime hours under temperature inversion, 10 dB is added to noise levels estimated from the uniform atmosphere (see Section 4.13.1). Using these assumptions, the estimated nighttime noise level at the nearest residence (about 0.8 mi [1.3 km] from the southwestern SEZ boundary) would be about 52 dBA, which is higher than the typical nighttime mean rural background level of 30 dBA. The day-night average noise level is estimated to be about 53 dBA L_{dn}, which is lower than EPA guideline of 55 dBA L_{dn} for residential areas. The assumptions are conservative in terms of operating hours, and no credit was given to other attenuation mechanisms. Thus it is likely that noise levels would be lower than 53 dBA L_{dn} at the nearest residence, even if TES were used at a solar facility. Consequently, operating parabolic trough or power tower facilities using TES and located near the southwestern SEZ boundary could result in potential noise impacts on the nearest residence, depending on background noise levels and meteorological conditions.

For a parabolic trough or power tower solar facility located near the western SEZ boundary, estimated daytime and nighttime noise levels at the Blanca Wetlands SRMA/ACEC would be about 45 and 55 dBA, respectively, which are higher than typical daytime and nighttime mean rural background levels of 40 and 30 dBA. However, operation noise from the SEZ is not likely to adversely affect wildlife at the Blanca Wetlands SRMA/ACEC (Manci et al. 1988). For a solar facility located near the eastern boundary, estimated daytime and nighttime noise levels at the Old Spanish National Historic Trail would be about 41 and 51 dBA, respectively, which are comparable to and higher than typical daytime and nighttime mean rural background levels of 40 and 30 dBA. Accordingly, a solar facility located near the eastern SEZ boundary could result in noise impacts on the Old Spanish National Historic Trail.

In the permitting process, refined noise propagation modeling would be warranted along with measurement of background noise levels.

The solar dish engine is unique among CSP technologies because it generates electricity directly, and this technology does not need a power block. A single, large solar dish engine has relatively low noise levels; a solar facility might employ thousands of dish engines, however, which would cause high noise levels around such a facility. For example, the proposed 750-MW SES Solar Two dish engine facility in California would employ as many as 30,000 dish engines (SES Solar Two, LLC 2008). At the proposed Fourmile East SEZ, assuming a dish engine facility of up to 345 MW capacity (covering 80% of the total area or 3,105 acres [12.6 km^2]), up to 13,800 25-kW dish engines could be employed. Also, for a large dish engine facility, a couple of hundred step-up transformers would be embedded in the dish engine solar field, along with a substation; the noise from these sources, however, would be masked by dish engine noise.

The composite noise level of a single dish engine would be about 88 dBA at a distance of 3 ft (0.9 m) (SES Solar Two, LLC 2008). This noise level would be attenuated to about 40 dBA (typical of the mean rural daytime environment) within 320 ft (100 m). However, the combined noise level from tens of thousands of dish engines operating simultaneously would be high in the immediate vicinity of the facility, for example, about 48 dBA at 1.0 mi (1.6 km) and 43 dBA at 2 mi (3 km) from the boundary of the square-shaped dish engine solar field; both values are higher than the typical daytime mean rural background level of 40 dBA. However, these levels would occur at somewhat shorter distances than the aforementioned distances, considering noise attenuation by atmospheric absorption and temperature lapse during daytime hours. To estimate noise levels at the nearest residence, it was assumed that dish engines were placed all over the Fourmile East SEZ at intervals of 98 ft (30 m). Under these assumptions, the estimated noise level at the nearest residence, about 0.8 mi (1.3 km) from the SEZ boundary, would be about 44 dBA, which is somewhat higher than the typical daytime mean rural background level of 40 dBA. On the basis of 12-hour daytime operation, the estimated 43 dBA L_{dn} at this residence is well below the EPA guideline of 55 dBA L_{dn} for residential areas. On the basis of other attenuation mechanisms, noise levels at the nearest residence would be lower than the values estimated above. Noise from dish engines could adversely affect the nearest residence, depending on background noise levels and meteorological conditions.

For dish engines placed all over the SEZ, the estimated noise levels would be about 49 and 46 dBA at the Blanca Wetlands SRMA/ACEC and Old Spanish National Historic Trail, which are higher than the typical daytime mean rural background level of 40 dBA. Dish engine noise from the SEZ is not likely to adversely affect wildlife at the Blanca Wetlands SRMA/ACEC (Manci et al. 1988) but is likely to have potential noise impacts on the Old Spanish National Historic Trail.

Consideration of minimizing noise impacts is very important during the siting of dish engine facilities. Direct mitigation of dish engine noise through noise control engineering could also limit noise impacts.

During operations, no major ground-vibrating equipment would be used. In addition, no sensitive structures are located close enough to the proposed Fourmile East SEZ to experience physical damage. Therefore, potential vibration impacts on surrounding communities and vibration-sensitive structures during operation of any solar facility would be minimal.

Transformer-generated humming noise and switchyard impulsive noises would be generated during the operation of solar facilities. These noise sources would be placed near the power block area, typically near the center of a solar facility. Noise from these sources would generally be limited within the facility boundary and rarely be heard at nearby residences, assuming a 1.3-mi (2.1-km) distance (at least 0.5 mi [0.8 km] to the facility boundary and another 0.8 mi [1.3 km] to the nearest residence). Accordingly, potential impacts of these noise sources on the nearest residence would be minimal.

Regarding impacts from transmission line corona discharge noise (Section 5.13.1.5), during rainfall events the noise level at 50 ft (15 m) and 300 ft (91 m) from the center of a 230-kV transmission line tower would be about 39 and 31 dBA (Lee et al. 1996), respectively, typical of daytime and nighttime mean background levels in rural environments. Corona noise includes high-frequency components that may be judged to be more annoying than other environmental noises. However, corona noise would not likely cause impacts unless a residence is located close to it (e.g., within 500 ft [152 m] of a 230-kV transmission line). The proposed Fourmile East SEZ is located in an arid desert environment, and incidents of corona discharge are infrequent. Therefore, potential impacts associated with transmission lines on nearby residents along the transmission lines ROW would be negligible.

10.3.15.2.3 Decommissioning/Reclamation

Decommissioning/reclamation requires many of the same procedures and equipment used in traditional construction. Decommissioning/reclamation would include dismantling of solar facilities, support facilities such as buildings/structures and mechanical/electrical installations, disposal of debris, grading, and revegetation as needed. Activities for decommissioning would be similar to those used for construction but on a more limited scale. Potential noise impacts on surrounding communities would be correspondingly less than those for construction activities. Decommissioning activities would be of short duration, and their potential impacts would be minor and temporary in nature. The same mitigation measures adopted during the construction phase could also be implemented during the decommissioning phase.

Similarly, potential vibration impacts on surrounding communities and vibration-sensitive structures during decommissioning of any solar facility would be less than those during construction and thus minimal.

10.3.15.3 SEZ-Specific Design Features and Design Feature Effectiveness

The implementation of required programmatic design features described in Appendix A, Section A.2.2, would greatly reduce or eliminate the potential for noise impacts from the development and operation of solar energy facilities. While some SEZ-specific design features are best established when specific project details are being considered, measures that can be identified at this time include the following:

- Noise levels from cooling systems equipped with TES should be managed so that levels at the nearest residence to the southwest of the SEZ are kept within applicable guidelines. This could be accomplished in several ways, for example, through placing the power block approximately 1 to 2 mi (1.6 to 3 km) or more from residences, limiting operations to a few hours after sunset, and/or installing fan silencers.

- Dish engine facilities within the Fourmile East SEZ should be located more than 1 to 2 mi (1.6 to 3 km) from the nearest residence located to the southwest of the SEZ (i.e., the facilities should be located in the central or northern portion of the proposed SEZ). Direct noise control measures applied to individual dish engine systems could also be used to reduce noise impacts at nearby residences.

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10.3.16 Paleontological Resources

The paleontological conditions of the San Luis Valley, which encompasses the proposed Fourmile East proposed SEZ, are described in Section 10.1.16.

10.3.16.1 Affected Environment

The proposed Fourmile East SEZ is composed entirely (100%) of unclassified Quaternary surface deposits (classified as QTsa on geologic maps) overlying the Alamosa Formation. The PFYC (as discussed in Section 4.14) for QTsa is Class 4/5 (on the basis of the PFYC map from the Colorado State Office; see Murphey and Daitch 2007), although no known paleontological resources from these deposits in the San Luis Valley have been recorded (Lindsey 1983). The nearest identified exposures of the Alamosa Formation are located at Hansen's Bluff, southwest of the Fourmile East SEZ. Areas immediately adjacent to the SEZ are also composed of QTsa and are likewise also classified as PFYC 4/5.

10.3.16.2 Impacts

On the basis of the PFYC classification for this area, there could be impacts on significant paleontological resources in the proposed Fourmile East SEZ, although the presence of such resources is currently unknown. A more detailed look at the geological deposits of the SEZ and their depth is needed, as well as a possible paleontological survey prior to development, as per BLM IM2008-009 and IM2009-011 (BLM 2007, 2008). If significant paleontological resources are found to be present within the Fourmile East SEZ during a paleontological survey, Section 5.14 discusses the types of impacts that could occur. Because it is also possible that no significant paleontological resources are present within the SEZ, there may not be any impacts on this resource as a result of construction and operation of a solar facility. Programmatic design features (as described in Section A.2.2) assume that any necessary surveys would occur.

Indirect impacts on paleontological resources outside of the SEZ, such as through looting or vandalism, are unknown but unlikely as any such resources would be below the surface and not readily accessed. Programmatic design features for controlling water runoff and sedimentation would prevent erosion-related impacts on buried deposits outside of the SEZ.

No new roads have been assessed for the proposed SEZ, assuming existing roads would be used and no new areas of potential paleontological interest would be opened to increased access; impacts on paleontological resources related to the creation of a new corridor would be evaluated at the project-specific level if new road construction was to occur. However, construction of approximately 2 mi (3 km) of transmission line is anticipated to connect to the nearest existing line. The ROW would occur in areas classified as PFYC Class 4/5, and therefore impacts on significant paleontological resources are possible. A detailed look at the geological deposits and their depth and a paleontological survey may be needed along the ROW, and implementation of the design features assumes that the prerequisite survey may occur.

The design feature requiring a stop work order in the event of an inadvertent discovery of paleontological resources would reduce impacts by preserving some information and allowing possible excavation of the resource, if warranted. Depending on the significance of the find, it could also result in some modifications to the project footprint. Since the SEZ is located in an area classified as PFYC 4/5, it is recommended that a stipulation be included in the permitting document to alert the solar energy developer that there is the possibility of a delay if paleontological resources are uncovered during surface-disturbing activities.

10.3.16.3 SEZ-Specific Design Features and Design Feature Effectiveness

Impacts would be minimized through the implementation of required programmatic design features, including a stop-work stipulation in the event that paleontological resources are encountered during construction, as described in Appendix A, Section A.2.2. SEZ-specific design features include:

- The depth to the Alamosa Formation within the proposed Fourmile East SEZ should be determined to identify what design features, might be needed in that area if solar energy development occurs.

10.3.17 Cultural Resources

The general culture history of the San Luis Valley, which encompasses the proposed Fourmile East SEZ, is described in Section 10.1.17.

10.3.17.1 Affected Environment

Although only a few archaeological sites have been reported from within the proposed Fourmile East SEZ, the presence of important archaeological resources in adjacent areas indicates a high potential for archaeological sites within the SEZ. No systematic cultural resource surveys are known to have been conducted in the SEZ according to the Colorado SHPO GIS data files. However, the same files indicate that six archaeological sites have been recorded within the SEZ (Colorado SHPO 2009). The SHPO GIS files associate these sites with the BOR's Closed Basin Project, which began archaeological surveys in 1976 for a water conveyance system. Most survey locations from the GIS that are associated with that project are identified to the west of the Fourmile East SEZ. All six of the sites are prehistoric open camps containing fire cracked rock, various tools and tool fragments, and debitage (lithic flakes created during tool manufacturing). The largest of the six sites also appears to contain two hearth features. None of the sites have been evaluated for listing in the NRHP. Numerous sites associated with the Blanca Wetlands are recorded west of the SEZ. Within a 5-mi (8-km) radius of the proposed Fourmile East SEZ, 113 site points are recorded in the Colorado SHPO's GIS, including 37 isolated finds, 8 isolated features, 41 open camps (one with a burial), 14 open lithic sites, 4 homesteads, 1 historic cemetery, 1 human burial site, 1 historic trash scatter, and 3 irrigation ditches (3 sites had no information for site type). Nearly half of these sites (55 sites) were recorded as part of the BOR's Closed Basin Project. A map of historic trails in the area indicates the possibility that a stage road may also have gone through the proposed SEZ (Scott 2001).

None of the 14 properties currently listed in the NRHP for Alamosa County are located within the SEZ. Nine listed properties are located approximately 11 mi (18 km) or more from the SEZ to the west in the town of Alamosa, Colorado, and one is located 20 mi (32 km) northwest in the town of Hooper. The remaining four properties are north of the SEZ. They consist of the Superintendent's Residence at the Great Sand Dunes National Park and Preserve 13 mi (21 km) north of the SEZ, Zapata Ranch Headquarters less than 8 mi (13 km) north of the SEZ, Medano Ranch Headquarters (12 mi [19 km]), and Trujillo Homestead (15 mi [24 km]). One of the important San Luis Valley Folsom bison kill sites (the Linger Site) is located within the Zapata Ranch property, as well as another Folsom site (the Zapata Site) and two mammoth sites (one with associated Paleoindian artifacts). Zapata Ranch (including Medano Ranch on its north end) is part of a Nature Conservancy Preserve with a working cattle, bison, and guest ranch. In adjacent Costilla County, the NRHP-listed sites of the San Luis Southern Railway Trestle and Fort Garland are located approximately 8 and 11 mi (13 and 18 km) to the southeast of the SEZ, respectively.

No traditional cultural properties have been identified within the SEZ during government-to-government consultations, nor have concerns been raised to date for traditional cultural properties or sacred areas located in the vicinity of the SEZ, including Blanca Peak, the Great Sand Dunes, and the San Luis Lakes (see also Section 10.3.18).

The proposed Fourmile East SEZ has the potential to contain significant cultural resources. The potential for finding significant Paleoindian sites exists throughout the entire valley. Well-known Folsom sites, such as the Reddin, Linger, Stewart's Cattleguard, and Zapata sites, are located in deflated dune areas north of the project area. Late Archaic sites have also been recorded near the Blanca Wetlands. The Great Sand Dunes National Park abuts the base of the Sangre de Cristo Mountains north of Fourmile East. Native American burials have been encountered in the National Park as a result of shifting dunes. They have also been noted in the northern portion of the valley, including in at least six locations in the vicinity of the Fourmile East SEZ (to the west and north) (Martorano et al. 1999). Past research suggests that prehistoric sites are likely to be encountered in the Fourmile East SEZ, in the semidune environment near the Blanca Wetlands. The large number of archaeological sites and isolated finds currently recorded in this vicinity, even with a small number of surveys completed, implies that the location has a high potential for containing significant cultural resources. Blowout areas within the SEZ yielded some artifacts during the preliminary site visit, such as a projectile point fragment and a possible fragment of a shell or bone bead.

The East Fork of the North Branch of the Old Spanish National Historic Trail is located within 1 mi (1.6 km) of the eastern edge of the SEZ. The mapped location of the congressionally designated trail is considered approximate, as the precise location of this segment of trail has not been ground-truthed. Although the precise location of the trail is unknown, the congressionally identified route requires the trail, trail resources, and setting to be managed in accordance with the National Trail System Act. The segment to the north, where the trail follows along the base of the Sangre de Cristo Mountains and across the Great Sand Dunes, has been designated a high-potential segment, because it retains its historical character. A Class III cultural resources inventory was recently conducted by RMC Consultants, Inc., on six parcels of BLM-administered lands adjacent to or containing segments of this high-potential segment to the north. Preliminary results include the recording of three new sites, one of which is potentially associated with the trail, two isolated finds, and the relocation of a previously known site that is also potentially associated with the trail; the report has not yet been submitted to the BLM. The BLM and USFS are in the process of determining a management approach for addressing the high-potential segments.

The proposed Fourmile East SEZ is also the closest of the four Colorado SEZs to Blanca Peak and the San Luis Lakes, although the peak can be seen from all four of the SEZs. As stated above, no issues have been identified during scoping or government-to-government consultations with the Navajo, several northern Pueblos, the Ute, the Jicarilla Apache, or any other Native American governments pertaining to these areas and solar energy development (see Appendix K and Section 10.3.18).

10.3.17.2 Impacts

Direct impacts on significant cultural resources could occur in the proposed Fourmile East SEZ and are highly likely given the number of sites present in the surrounding areas, despite minimal survey coverage; further investigation is needed. A cultural resource survey of the entire area of potential effect would be required to identify archaeological sites, historic structures or features, and traditional cultural properties, and an evaluation would follow to determine which recorded sites meet the criteria for eligibility for listing in the NRHP. Section 5.15 discusses the types of impacts that could occur on any significant cultural resources found to be present within the proposed SEZ. Impacts would be minimized to the extent possible through the implementation of required programmatic design features described in Appendix A, Section A.2.2. Programmatic design features assume that the necessary surveys, evaluations, and consultations would occur.

Required surveys would also include a survey of the Old Spanish National Historic Trail in the vicinity of the SEZ to determine its location relative to the SEZ and the integrity of the trail segment, as well as the presence of associated artifacts and features. It is already known that the southern end of a high-potential segment is located approximately 1 mi (2 km) northeast of the SEZ and is within the viewshed if a solar facility was to be installed, regardless of technology type[15] (see viewshed analysis for the proposed Fourmile East SEZ in Section 10.3.1.4.2 and Figures 10.3.14.2-7 and 10.3.14.2-8). The high-potential segment would be adversely affected by solar energy development resulting from visual impacts on the resource. If additional portions of the trail to the south of the high-potential segment are also determined to be significant as a result of future survey, these portions would also be adversely affected, with possible reductions in level of impact the farther the significant portions of the trail are from the SEZ. Previous surface disturbances within and adjacent to the proposed SEZ that contribute to the visual landscape include an unpaved road network, active grazing, and State Highway 150, which is the main road to the Great Sand Dunes National Park and Preserve entrance.

Indirect impacts on cultural resources located outside of the SEZ boundary (including along ROWs) as a result of erosion are unlikely, assuming design features to reduce water runoff and sedimentation are implemented (as described in Section A.2.2). Two unevaluated archaeological open camp sites[16] and four isolated finds were recorded during a survey of U.S. 160 very near (within 0.5 mi [0.8 km]) to a reasonable location for a new transmission line to connect a potential solar facility in the SEZ to an existing 69-kV line. These, or similar types of sites that could be encountered during an archaeological survey for the transmission ROW, could be directly affected during construction, depending on the location of the ROW. Indirect impacts are possible from unauthorized surface collection depending on the proximity of the ROW to the sites. No new roads have been assessed for the proposed SEZ, assuming existing roads would be used and no new areas of potential cultural significance would be opened to increased access; impacts on cultural resources related to the creation of a new corridor would be evaluated at the project-specific level if new road construction was to occur.

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[15] Although the visual impact of a PV installation (approximate height of 25 ft [7.5 m]) would be less obvious than a power tower (approximate height of 650 ft [198 m]) at that distance.

[16] Site location information from Colorado SHPO (2009).

10.3.17.3 SEZ-Specific Design Features and Design Feature Effectiveness

Impacts would be minimized through the implementation of required programmatic design features described in Appendix A, Section A.2.2. Programmatic design features assume that the necessary surveys, evaluations, and consultations will occur.

Even assuming the implementation of design features, adverse effects on historic properties in the proposed Fourmile East SEZ are likely to occur. Three factors lead to this conclusion: (1) the area's high potential to contain significant cultural sites, including Native American human remains and associated cultural items; (2) its proximity (and visual impacts) to at least three areas previously identified as traditionally significant to the Navajo and the Tewa Clans of the Upper Rio Grande Pueblos, and possibly the Ute and Jicarilla Apache (i.e., the Great Sand Dunes, San Luis Lakes, and Blanca Peak), and (3) its proximity to a congressionally designated route of the Old Spanish National Historic Trail, such that solar energy development would result in visual impacts on a high-potential segment of the trail.

Ongoing consultation with the Colorado SHPO and the appropriate Native American governments would be conducted during the development of the proposed Fourmile East SEZ. It is likely that some adverse effects on significant resources in the valley could be mitigated to some degree through such efforts, although not enough to eliminate the effects unless significant resources are avoided entirely. SEZ-specific design features could include:

- Development of a Programmatic Agreement (PA) among the BLM, DOE, Colorado SHPO, and ACHP to consistently address impacts on significant cultural resources from solar energy development. Should a PA be developed to incorporate mitigation measures for resolving adverse effects on the Old Spanish National Historic Trail or the West Fork of the North Branch of the Old Spanish Trail, the Trail Administration for the Old Spanish Trail (BLM-NMSO and NPS Intermountain Trails Office, Santa Fe) also should be included in the development of that PA. See also Section 10.3.18.3.

- Because of the possibility of encountering Native American human remains in the vicinity of the proposed Fourmile East SEZ, it is recommended that, for surveys conducted in the SEZ, consideration be given to including Native American participation in the development of survey designs and historic property treatment and monitoring plans.

10.3.18 Native American Concerns

10.3.18.1 Affected Environment

For a discussion of issues of possible Native American concern, several sections in this PEIS should be consulted. General topics of concern are addressed in Section 4.16. Specifically for the proposed Fourmile East SEZ, Section 10.3.17 discusses archaeological sites, structures, landscapes, trails, and traditional cultural properties, and Section 10.1.17 describes the general cultural history of the San Luis Valley; Section 10.3.9.1.3 discusses water rights and water use; Section 10.3.10 discusses plant species; 10.3.11 discusses wildlife species, including wildlife migration patterns; Sections 10.3.19 and 10.3.20 discuss socioeconomics and environmental justice, respectively; and issues of human health and safety are discussed in Section 5.21.

Historically, the valley was predominantly used by Tribes for hunting and trading rather than long-term settlement. The nearest Tribal land claims (judicially established as traditional tribal territory) to the proposed Fourmile East SEZ are for the Jicarilla Apache, approximately 25 mi (40 km) to the south, and the Cheyenne and Arapaho, Northern Cheyenne, and Northern Arapaho, approximately 60 mi (97 km) to the north of the SEZ.

Consultation for the Colorado SEZs has been initiated by the BLM with the Tribes[17] shown in Table 10.3.18.1-1. Details on government-to-government consultation efforts are presented in Chapter 14 and Appendix K. Plants and other resources of potential importance within the San Luis Valley are discussed in Sections 10.1.18.1.1 and 10.1.18.1.2.

10.3.18.2 Impacts

To date, no comments have been received from the Tribes referencing the proposed Fourmile East SEZ specifically. The Navajo Nation has responded that "the proposed undertaking/project area will not impact any Navajo traditional cultural properties," with the caveat that the Nation be notified of any inadvertent discoveries that might take place related to the undertaking (Joe 2008; Joe 2009). No direct impacts from disturbance would occur to judicially established Tribal land claims or to areas previously indicated as culturally significant (San Luis Lakes, the Great Sand Dunes, Blanca Peak). It is possible that there will be Native American concerns about potential visual effects and the effects of noise from solar energy development on these areas (Section 10.3.17) or on the valley as a whole as consultation continues and additional analyses are undertaken. It is also highly likely that archaeological sites are present within the Fourmile East SEZ (Section 10.3.17). While it is not known whether any sites will be considered significant to the Tribes, Tribes typically regard prehistoric archaeological sites as the remains of their ancestors and consider them culturally important. Given the location of the SEZ relative to previous finds of Native American human remains and

[17] Plains Tribes that may have used the valley ranged widely and may have been settled a great distance from the valley in Oklahoma and South Dakota.

TABLE 10.3.18.1-1 Federally Recognized Tribes with Traditional Ties to the Proposed SEZs in San Luis Valley

Tribe	Location	State
Cheyenne and Arapaho Tribes of Oklahoma	Concho	Oklahoma
Comanche Nation	Lawton	Oklahoma
Eastern Shoshone	Fort Washakie	Wyoming
Fort Sill Apache Tribe of Oklahoma	Apache	Oklahoma
Hopi	Kykotsmovi	Arizona
Jicarilla Apache Nation	Dulce	New Mexico
Kiowa Tribe of Oklahoma	Carnegie	Oklahoma
Navajo Nation	Window Rock	Arizona
Northern Arapaho	Fort Washakie	Wyoming
Northern Cheyenne	Lame Deer	Montana
Ohkay Owingeh	San Juan Pueblo	New Mexico
Pueblo of Nambe	Santa Fe	New Mexico
Pueblo of Santa Ana	Santa Ana Pueblo	New Mexico
Pueblo of Santo Domingo	Santo Domingo Pueblo	New Mexico
San Ildefonso Pueblo	Santa Fe	New Mexico
Santa Clara Pueblo	Espanola	New Mexico
Southern Ute	Ignacio	Colorado
Taos Pueblo	Taos	New Mexico
Tesuque Pueblo	Santa Fe	New Mexico
Ute Mountain Ute	Towaoc	Colorado
Ute Tribe of the Uinta and Ouray Reservation	Fort Duchesne	Utah
White Mesa Ute	Blanding	Utah

associated cultural items, it is also possible that Native American burials are present. If 80% of the proposed SEZ is developed, it is likely that some plants traditionally important to Native Americans will be destroyed and that habitat of traditionally important animals will be lost. Given that similar plants and habitat would remain in the valley, project-level consultation with affected Tribes will be necessary to determine the importance of the traditional resources impacted.

Groundwater withdrawals in the valley are tightly regulated, and use of programmatic design features described in Appendix A, Section A.2.2, would ensure that minimal impacts on surface waters and springs would occur.

Whether there are any specific issues relative to socioeconomics, environmental justice, or health and safety relative to Native American populations is yet to be determined.

Possible impacts from solar energy development on resources of concern that are encountered within the SEZ, as well as general mitigation measures, are described in more detail in Section 5.16.

10.3.18.3 SEZ-Specific Design Features and Design Feature Effectiveness

Impacts would be minimized through the implementation of required programmatic design features, such as avoidance of sacred sites, water sources, and tribally important plant and animal species described in Appendix A, Section A.2.2. Programmatic design features require that the necessary surveys, evaluations, and consultations would occur. The Tribes would be notified regarding the results of archaeological surveys, and they would be contacted immediately upon any discovery of Native American human remains and associated cultural items.

The need for and nature of SEZ-specific design features regarding potential issues of concern would be determined during government-to-government consultation with affected Tribes listed in Table 10.3.18.1-1.

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10.3.19 Socioeconomics

10.3.19.1 Affected Environment

This section describes current socioeconomic conditions and local community services within the ROI surrounding the proposed Fourmile East SEZ. The ROI is a four-county area composed of Alamosa, Conejos, Costilla, and Rio Grande Counties in Colorado. It encompasses the area in which workers are expected to spend most of their salaries and in which a portion of site purchases and nonpayroll expenditures from the construction, operation, and decommissioning phases of the proposed SEZ facility are expected to take place.

10.3.19.1.1 ROI Employment

In 2008, employment in the ROI stood at 18,645 (Table 10.3.19.1-1). Over the period 1999 to 2008, annual average employment growth rates were higher in Rio Grande County (2.4%) than elsewhere in the ROI, while employment in Conejos County (–0.3%) declined over this period. At 0.7%, growth rates in the ROI as a whole were lower than the average rate for Colorado (1.5%).

In 2006, agriculture provided the highest percentage of employment in the ROI at 35.5%, followed by the service sector (34.6%) and wholesale and retail trade (18.5%) (Table 10.3.19.1-2). Smaller employment shares were held by finance, insurance, and real estate (5.4%) and by construction (4.4%). Within the ROI, the distribution of employment

TABLE 10.3.19.1-1 ROI Employment for the Proposed Fourmile East SEZ

Location	1999	2008	Average Annual Growth Rate, 1999–2008 (%)
Alamosa County	7,885	7,935	0.1
Conejos County	3,498	3,402	–0.3
Costilla County	1,234	1,268	0.3
Rio Grande County	4,784	6,040	2.4
ROI	17,401	18,645	0.7
Colorado	2,269,668	2,596,309	1.5

Sources: U.S Department of Labor (2009a,b).

TABLE 10.3.19.1-2 ROI Employment by Sector for the Proposed Fourmile East SEZ, 2006[a]

	Alamosa County		Conejos County		Costilla County	
	Employment	% of Total	Employment	% of Total	Employment	% of Total
Agriculture[a]	1,470	22.4	488	42.8	484	77.0
Mining	10	0.2	10	0.9	0	0.0
Construction	324	4.9	39	3.4	14	2.2
Manufacturing	93	1.4	60	5.3	10	1.6
Transportation and public utilities	201	3.1	100	8.8	10	1.6
Wholesale and retail trade	1,300	19.8	159	14.0	90	14.3
Finance, insurance, and real estate	434	6.6	41	3.6	10	1.6
Services	2,752	41.9	299	26.3	114	18.1
Other	9	0.1	0	0.0	10	1.6
Total	6,575		1,139		631	

	Rio Grande County		ROI	
	Employment	% of Total	Employment	% of Total
Agriculture[a]	1,763	41.9	4,207	35.5
Mining	0	0.0	20	0.2
Construction	179	4.3	556	4.4
Manufacturing	79	1.9	242	1.9
Transportation and public utilities	70	1.7	381	3.0
Wholesale and retail trade	769	18.3	2,318	18.5
Finance, insurance, and real estate	197	4.7	682	5.4
Services	1,172	27.9	4,337	34.6
Other	10	0.2	29	0.2
Total	4,207		12,552	

[a] Agricultural employment includes 2007 data for hired farmworkers.

Sources: U.S. Bureau of the Census (2009a); USDA (2009).

across sectors varied somewhat compared with the ROI as a whole, with a higher percentage of employment in agriculture in Conejos (42.8%), Costilla (77.0%), and Rio Grande (41.9%) Counties than in Alamosa County (22.4%). The first three counties had lower shares of employment in services compared with the ROI as a whole.

10.3.19.1.2 ROI Unemployment

Unemployment rates have varied across the three counties in the ROI. Over the period 1999 to 2008, the average rate in Costilla County was 9.2% and in Conejos County, 6.9%, with rates exceeding 5% in all counties except Alamosa County over this period (Table 10.3.19.1-3). Rates have fallen over the period; in 1999, for example, Conejos experienced rates higher than 11%. The average rate in the ROI over this period was 5.8%, higher than the average rate for Colorado (4.5%). Unemployment rates for the first five months of 2009 contrast with rates for 2008 as a whole; in Costilla County the unemployment rate increased to 11.1%, while rates reached 9.9% and 8.1% in Conejos and Rio Grande Counties, respectively. The average rates for the ROI (8.4%) and for Colorado (7.5%) were also higher during this period than the corresponding average rate for 2008.

10.3.19.1.3 ROI Urban Population

The population of the ROI in 2008 was 16% urban, with two larger towns, Alamosa, which had an estimated 2008 population of 8,746, and Monte Vista (4,015) (Table 10.3.19.1-4). In addition, there are eight smaller towns in the ROI with 2008 population of less than 1,500.

TABLE 10.3.19.1-3 ROI Unemployment Rates (%) for the Proposed Fourmile East SEZ

Location	1999–2008	2008	2009[a]
Alamosa County	5.0	5.3	7.6
Conejos County	6.9	7.5	9.9
Costilla County	9.2	7.6	11.1
Rio Grande County	5.6	5.8	8.1
ROI	5.8	6.0	8.4
Colorado	4.5	4.2	7.5

[a] Rates for 2009 are the average for January through May.

Sources: U.S. Department of Labor (2009a–c).

TABLE 10.3.19.1-4 ROI Urban Population and Income for the Proposed Fourmile East SEZ

	Population			Median Household Income ($ 2008)		
City	2000	2008	Average Annual Growth Rate, 2000–2008 (%)	1999	2006–2008	Average Annual Growth Rate, 1999 and 2006–2008 (%)[a]
Alamosa	7,960	8,746	1.2	32,771	NA	NA
Monte Vista	4,529	4,015	–1.5	36,556	NA	NA
Manassa	1,042	936	–1.3	29,731	NA	NA
La Jara	877	784	–1.4	31,115	NA	NA
Antonito	873	776	–1.5	24,727	NA	NA
Sanford	817	733	–1.3	32,993	NA	NA
San Luis	739	641	–1.8	18,299	NA	NA
Blanca	391	343	–1.6	29,452	NA	NA
Romeo	375	340	–1.2	24,857	NA	NA
Hooper	123	125	0.2	41,154	NA	NA

[a] Data are averages for the period 2006 to 2008.

Source: U.S. Bureau of the Census (2009b-d).

Population growth rates in the ROI have varied over the period 2000 to 2008 (Table 10.3.19.1-4). Alamosa grew at an annual rate of 1.2%, while the remaining towns experienced lower growth rates between 2000 and 2008, with majority of these cities experiencing negative growth rates during this period.

10.3.19.1.4 ROI Urban Income

Median household incomes vary across urban areas in the ROI. No data are available for cities in the ROI for 2006 to 2008. In 2000, none of the towns in the ROI had median incomes that were higher than the average for Colorado ($56,574) (Table 10.3.19.1-4).

10.3.19.1.5 ROI Population

Table 10.3.19.1-5 presents recent and projected populations in the ROI and states as a whole. Population in the ROI stood at 39,759 in 2008, having grown at an average annual rate of 0.1% since 2000. Growth rates for the ROI were lower than the rate for Colorado (1.9%) over the same period.

Population in Alamosa County grew by 0.7% between 2000 and 2008, while the remaining counties saw declines in population of less than 1.0%. The ROI population is expected to increase to 47,895 by 2021 and to 49,117 by 2023.

TABLE 10.3.19.1-5 ROI Population for the Proposed Fourmile East SEZ

Location	2000	2008	Average Annual Growth Rate, 2000–2008 (%)	2021	2023
Alamosa County	14,966	15,783	0.7	20,210	20,943
Conejos County	8,400	8,232	–0.3	9,322	9,453
Costillao County	3,663	3,465	–0.7	3,898	3,945
Rio Grande County	12,413	12,279	–0.1	14,465	14,776
ROI	39,442	39,759	0.1	47,895	49,117
Colorado	4,301,261	5,010,395	1.9	6,398,532	6,613,747

Sources: U.S. Bureau of the Census (2009e,f); State Demography Office (2009).

10.3.19.1.6 ROI Income

Personal income in the ROI stood at $1.0 billion in 2007 and has grown at an annual average rate of 0.9% over the period 1998 to 2007 (Table 10.3.19.1-6). ROI per-capita income also rose over the same period at a rate of 0.5%, increasing from $24,465 to $25,622. Per-capita incomes were higher in Rio Grande ($27,814) and Alamosa ($27,238) Counties in 2007 than elsewhere in the ROI. For per-capita income, the growth rate in Costilla County was higher than the state rate; per-capita incomes, however, were significantly lower in all counties than for Colorado as a whole ($41,955).

Median household income over the period 2006 to 2008 varied between $25,146 in Costilla County and $40,989 in Rio Grande County (U.S. Bureau of the Census 2009d).

10.3.19.1.7 ROI Housing

In 2007, almost 19,700 housing units were located in the four ROI counties, with more than 66% of these located in Alamosa and Rio Grande Counties (Table 10.3.19.1-7). Owner-occupied units compose approximately 70% of the occupied units in the four counties, with rental housing making up 30% of the total. Vacancy rates in 2007 were significantly higher in Costilla County (31.7%) than elsewhere in the ROI. With an overall vacancy rate of 19.5% in the ROI in 2007, there were 3,831 vacant housing units, of which 1,124 are estimated to be rental units that would be available to construction workers. There were 1,827 seasonal, recreational, or occasional-use units vacant at the time of the 2000 Census.

Housing stock in the ROI as a whole grew at an annual rate of 1.2% over the period 2000 to 2007, with 1,519 new units added to the existing housing stock in the ROI (Table 10.3.19.1-7).

TABLE 10.3.19.1-6 ROI Personal Income for the Proposed Fourmile East SEZ

Location	1998	2007	Average Annual Growth Rate, 1998–2007 (%)
Alamosa County			
Total income[a]	0.4	0.4	1.1
Per-capita income	26,089	27,238	0.4
Conejos County			
Total income[a]	0.2	0.2	0.9
Per-capita income	18,795	20,161	0.7
Costilla County			
Total income[a]	0.1	0.1	0.9
Per-capita income	20,755	23,273	1.2
Rio Grande County			
Total income[a]	0.3	0.4	0.5
Per-capita income	27,435	27,814	0.1
ROI			
Total income[a]	0.9	1.0	0.9
Per-capita income	24,465	25,622	0.5
Colorado			
Total income[a]	118.5	199.5	2.8
Per-capita income	37,878	41,955	1.0

[a] Unless indicated otherwise, values are reported in $ billion 2008.

Sources: U.S. Department of Commerce (2009); U.S. Bureau of the Census (2009e,f).

The median value of owner-occupied housing in 2006 to 2008 varied between $58,980 in Costilla County and $90,953 in Alamosa County (U.S. Bureau of the Census 2009g).

10.3.19.1.8 ROI Local Government Organizations

The various local and county government organizations in the ROI are listed in Table 10.3.19.1-8. There are no Tribal governments located in the ROI, although there are members of other Tribal groups located in the ROI whose Tribal governments are located in adjacent counties or states.

TABLE 10.3.19.1-7 ROI Housing Characteristics for the Proposed Fourmile East SEZ

Parameter	2000	2007[a]
Alamosa County		
Owner-occupied	3,498	3,713
Rental	1,969	2,090
Vacant units	621	659
Seasonal and recreational use	75	NA[b]
Total units	6,088	6,463
Conejos County		
Owner-occupied	2,347	2,590
Rental	633	699
Vacant units	906	1,000
Seasonal and recreational use	544	NA
Total units	3,886	4,289
Costilla County		
Owner-occupied	1,175	1,230
Rental	328	343
Vacant units	699	732
Seasonal and recreational use	447	NA
Total units	2,202	2,305
Rio Grande County		
Owner-occupied	3,323	3,676
Rental	1,378	1,524
Vacant units	1,302	1,440
Seasonal and recreational use	761	NA
Total units	6,003	6,641
ROI Total		
Owner-occupied	10,343	11,210
Rental	4,308	4,657
Vacant units	3,528	3,831
Seasonal and recreational use	1,827	NA
Total units	18,179	19,698

[a] 2007 data for number of owner-occupied, rental, and vacant units for Colorado counties are not available; data are based on 2007 total housing units and 2000 data on housing tenure.

[b] NA = data not available.

Sources: U.S. Bureau of the Census (2009h-j).

TABLE 10.3.19.1-8 ROI Local Government Organizations and Social Institutions for the Proposed Fourmile East SEZ

Governments	
City	
Alamosa	Manassa
Antonito	Monte Vista
Blanca	Romeo
Hooper	San Luis
La Jara	Sanford
County	
Alamosa County	Costilla County
Conejos County	Rio Grande County
Tribal	
None	

Sources: U.S. Bureau of the Census (2009b); U.S. Department of the Interior (2010).

10.3.19.1.9 ROI Community and Social Services

This section describes educational, health care, law enforcement, and firefighting resources in the ROI.

Schools

In 2007, the four-county ROI had a total of 37 public and private elementary, middle, and high schools (NCES 2009). Table 10.3.19.1-9 provides summary statistics for enrollment, educational staffing, and two indices of educational quality—student-teacher ratios and levels of service (number of teachers per 1,000 population). The student-teacher ratio in Costilla County schools (11.1) is slightly lower than that for schools in the remaining three counties, while the level of service is highest in Conejos County (15.4) and lowest in Alamosa County (10.5).

Health Care

While Alamosa County has a much larger number of physicians (41), the number of doctors per 1,000 population is also significantly higher than that in the remaining counties in the ROI (Table 10.3.19.1-10). The smaller number of health care professionals in Conejos and Costilla Counties may mean that residents of these counties have poorer access to health care; a substantial number of county residents might also travel to other counties in the ROI for their medical care.

TABLE 10.3.19.1-9 ROI School District Data for the Proposed Fourmile East SEZ, 2007

Location	Number of Students	Number of Teachers	Student-Teacher Ratio	Level of Service[a]
Alamosa County	2,483	166	14.9	10.5
Conejos County	1,830	129	14.2	15.4
Costilla County	535	48	11.1	13.6
Rio Grande County	2,272	170	13.4	13.5
ROI	7,120	513	13.9	12.7

[a] Number of teachers per 1,000 population.

Source: NCES (2009).

TABLE 10.3.19.1-10 Physicians in the ROI for the Proposed Fourmile East SEZ, 2007

Location	Number of Primary Care Physicians	Level of Service[a]
Alamosa County	41	2.6
Conejos County	8	1.0
Costilla County	3	0.8
Rio Grande County	13	1.0
ROI	65	1.6

[a] Number of physicians per 1,000 population.

Source: AMA (2009).

Public Safety

Several state, county, and local police departments provide law enforcement in the ROI (Table 10.3.19.1-11). Conejos County has seven officers and would provide law enforcement services to the SEZ; there are 34 officers in the remainder of the ROI counties. Currently, there are no professional firefighters in the ROI; the majority of firefighting services are provided by volunteers. The level of service of police protection in Costilla County (1.4) and in Alamosa County (1.3) is higher than that in the remaining counties of the ROI and is lowest in Rio Grande County (0.6).

TABLE 10.3.19.1-11 Public Safety Employment in the ROI for the Proposed Fourmile East SEZ

Location	Number of Police Officers[a]	Level of Service[b]	Number of Firefighters[c]	Level of Service
Alamosa County	21	1.3	0	0.0
Conejos County	7	0.8	0	0.0
Costilla County	5	1.4	0	0.0
Rio Grande County	8	0.6	0	0.0
ROI	41	1.0	0	0.0

[a] 2007 data.

[b] Number per 1,000 population.

[c] 2008 data; number does not include volunteers.

Sources: U.S. Department of Justice (2008); Fire Departments Network (2009).

10.3.19.1.10 ROI Social Structures and Social Change

Community social structures and other forms of social organization within the ROI are related to various factors, including historical development, major economic activities and sources of employment, income levels, race and ethnicity, and forms of local political organization. Although an analysis of the character of community social structures is beyond the scope of the current programmatic analysis, project-level NEPA analyses would include a description of ROI social structures, contributing factors, their uniqueness, and, consequently, the susceptibility of local communities to various forms of social disruption and social change.

Various energy development studies have suggested that once the annual growth in population is between 5 and 15% in smaller rural communities, alcoholism, depression, suicide, social conflict, divorce, and delinquency would increase and levels of community satisfaction would deteriorate (BLM 1980, 1983, 1996). Tables 10.3.19.1-12 and 10.3.19.1-13 present data for a number of indicators of social change, including violent and property crime rates, alcoholism and illicit drug use, mental health, and divorce, that might be used to indicate social change.

There is some variation in the level of crime across the ROI, with higher rates of violent crime in Alamosa County (4.1 per 1000 population) than in Rio Grande County (2.1) (Table 10.3.19.1-12). Property-related crime rates were much higher in Alamosa County (30.2) than in Rio Grande County (11.3); that is, overall crime rates in Alamosa County were almost twice the rate for the ROI as a whole. No crime rates were reported for Conejos County and Costilla County.

TABLE 10.3.19.1-12 County and ROI Crime Rates for the Proposed Fourmile East SEZ[a]

	Violent Crime[b]		Property Crime[c]		All Crime	
Location	Offenses	Rate	Offenses	Rate	Offenses	Rate
Alamosa County	65	4.1	477	30.2	542	34.3
Conejos County	NA[d]	NA	NA	NA	NA	NA
Costilla County	NA	NA	NA	NA	NA	NA
Rio Grande County	26	2.1	139	11.3	165	13.4
ROI	91	2.3	616	15.5	707	17.8

[a] Rates are the number of crimes per 1,000 population.

[b] Violent crime includes murder and non-negligent manslaughter, forcible rape, robbery, and aggravated assault.

[c] Property crime includes burglary, larceny, theft, motor vehicle theft, and arson.

[d] NA = data not available.

Source: U.S. Department of Justice (2009a,b).

Other measures of social change—alcoholism, illicit drug use, and mental health—are not available at the county level but are presented for the region in which the ROI is located (Table 10.3.19.1-13). Divorce rates for Colorado as a whole are also presented.

10.3.19.1.11 ROI Recreation

Various areas in the vicinity of the proposed SEZ are used for recreational purposes, with natural, ecological, and cultural resources in the ROI attracting visitors for a range of activities, including hunting, fishing, boating, canoeing, wildlife watching, camping, hiking, horseback riding, mountain climbing, and sightseeing. These activities are discussed in Section 10.3.5.

Because the number of visitors using state and federal lands for recreational activities is not available from the various administering agencies, the value of recreational resources in these areas, based solely on the number of recorded visitors, is likely to be an underestimation. In addition to visitation rates, the economic valuation of certain natural resources can also be assessed in terms of the potential recreational destination for current and future users, that is, their nonmarket value (see Section 5.17.1.1.1).

TABLE 10.3.19.1-13 Alcoholism, Drug Use, Mental Health, and Divorce in the ROI for the Proposed Fourmile East SEZ[a]

Geographic Area	Alcoholism	Illicit Drug Use	Mental Health	Divorce[b]
Colorado Region 4 (includes Alamosa County, Conejos County, Costilla County, and Rio Grande County)	9.7	3.1	10.2	–[d]
Colorado				4.4

[a] Data for alcoholism, drug use, represent percentage of the population over 12 years of age with dependence or abuse of alcohol, illicit drugs. Data are averages for 2004 to 2006.

[b] Data for mental health represent percentage of the population over 18 years of age suffering from serious psychological distress. Data are averages for 2002 to 2004.

[c] Divorce rates are the number of divorces per 1,000 population. Data are for 2004.

[d] A dash indicates not applicable.

Sources: SAMHSA (2009); CDC (2009).

Another method is to estimate the economic impact of the various recreational activities supported by natural resources on public land in the vicinity of the proposed solar facilities, by identifying sectors in the economy in which expenditures on recreational activities occur. Not all activities in these sectors are directly related to recreation on state and federal lands, with some activity occurring on private land (e.g., dude ranches, golf courses, bowling alleys, and movie theaters). Expenditures associated with recreational activities form an important part of the economy of the ROI. In 2007, 1,509 people were employed in the ROI in the various sectors identified as recreation, constituting 7.9% of total ROI employment (Table 10.3.19.1-14). Recreation spending also produced almost $26.4 million in income in the ROI in 2007. The primary sources of recreation-related employment were eating and drinking places.

10.3.19.2 Impacts

The following analysis begins with a description of the common impacts of solar development, including common impacts on recreation, social change, and livestock grazing. These impacts would occur regardless of the solar technology developed in the SEZ. Impacts associated with the construction of off-site transmission lines are described next. Finally, impacts of facilities employing various solar energy technologies are analyzed in detail in subsequent sections.

10.3.19.2.1 Common Impacts

Construction and operation of a solar energy facility at the proposed Fourmile East SEZ would produce direct and indirect economic impacts. Direct impacts would occur as a result of

TABLE 10.3.19.1-14 Recreation Sector Activity in the Proposed Fourmile East SEZ ROI, 2007

ROI	Employment	Income ($ million)
Amusement and recreation services	56	1.0
Automotive rental	2	0.1
Eating and drinking places	1,046	15.6
Hotels and lodging places	229	4.1
Museums and historic sites	1	0.2
Recreational vehicle parks and campsites	64	1.2
Scenic tours	69	3.4
Sporting goods retailers	42	0.7
Total ROI	1,509	26.4

Source: MIG, Inc. (2010).

expenditures of wages and salaries, procurement of goods and services required for project construction and operation, and the collection of state sales and income taxes. Indirect impacts would occur as project wages and salaries, procurement expenditures, and tax revenues subsequently circulate through the economy of each state, thereby creating additional employment, income, and tax revenues. Facility construction and operation would also require in-migration of workers and their families into the ROI surrounding the site, which would affect population, rental housing, health service employment, and public safety employment. Socioeconomic impacts common to all utility-scale solar energy facilities are discussed in detail in Section 5.17. These impacts will be minimized through the implementation of programmatic design features described in Appendix A, Section A.2.2.

Recreation Impacts

Estimating the impact of solar facilities on recreation is problematic because it is not clear how solar development in the SEZ would affect recreational visitation and nonmarket values (i.e., the value of recreational resources for potential or future visits). While it is clear that some land in the ROI would no longer be accessible for recreation, the majority of popular recreational locations would be precluded from solar development. It is also possible that solar facilities in the ROI would be visible from popular recreation locations, and that construction workers residing temporarily in the ROI would occupy accommodations otherwise used for recreational visits, thus reducing visitation and consequently affecting the economy of the ROI.

Social Change

Although an extensive literature in sociology documents the most significant components of social change in energy boomtowns, the nature and magnitude of the social impact of energy developments in small rural communities are still unclear (see Section 5.17.1.1.4). While some degree of social disruption is likely to accompany large-scale in-migration during the boom phase, there is insufficient evidence to predict the extent to which specific communities are likely to be impacted, which population groups within each community are likely to be most affected, and the extent to which social disruption is likely to persist beyond the end of the boom period (Smith et al. 2001). Accordingly, because of the lack of adequate social baseline data, it has been suggested that social disruption is likely to occur once an arbitrary population growth rate associated with solar energy development projects has been reached, with an annual rate of between 5 and 10% growth in population assumed to result in a breakdown in social structures, with a consequent increase in alcoholism, depression, suicide, social conflict, divorce, delinquency, and deterioration in levels of community satisfaction (BLM 1980, 1983, 1996).

In overall terms, the in-migration of workers and their families into the ROI would represent an increase of 3.8% in ROI population during construction of the trough technology, with smaller increases for the power tower, dish engine, and PV technologies, and during the operation of each technology. While it is possible that some construction and operations workers will choose to locate in communities closer to the SEZ, the lack of available housing to accommodate all in-migrating workers and families in smaller rural communities in the ROI and the insufficient range of housing choices to suit all solar occupations make it likely that many workers will commute to the SEZ from larger communities elsewhere in the ROI, reducing the potential impact of solar developments on social change. Regardless of the pace of population growth associated with the commercial development of solar resources, and the likely residential location of in-migrating workers and families in communities some distance from the SEZ itself, the number of new residents from outside the region of influence is likely to lead to some demographic and social change in small rural communities in the ROI. Communities hosting solar development are likely to be required to adapt to a different quality of life, with a transition away from a more traditional lifestyle involving ranching and taking place in small, isolated, close-knit, homogenous communities with a strong orientation toward personal and family relationships, toward a more urban lifestyle, with increasing cultural and ethnic diversity and increasing dependence on formal social relationships within the community.

Livestock Grazing Impacts

*C*attle ranching and farming supported 847 jobs, and was responsible for $5.0 million in income in the ROI in 2007 (MIG, Inc. 2010). The construction and operation of solar facilities in the proposed SEZ could result in a decline in the amount of land available for livestock grazing, resulting in the loss of a total (direct plus indirect) of 20 jobs and $0.3 million in income in the ROI. There would also be a decline in grazing fees payable to the BLM and to the USFS by individual permittees based on the number of AUMs required to support livestock on public land. Assuming the 2008 fee of $1.35 per AUM, grazing fee losses would amount to $35 annually on land dedicated to solar developments in the SEZ.

Transmission Line Impacts

Construction. The impacts of transmission line construction could include the addition of 9 jobs in the ROI (including direct and indirect impacts) in the peak year of construction (Table 10.3.19.2-1). Construction activities would constitute less than 0.1% of total ROI employment. A transmission line would also produce $0.4 million in income. Direct sales taxes would be less than $0.1 million, and direct income taxes, less than $0.1 million.

Given the likelihood of local worker availability in the required occupational categories, construction of a transmission line would mean that some in-migration of workers and their families from outside the ROI would be required, with 11 persons in-migrating into the ROI.

TABLE 10.3.19.2-1 Proposed Fourmile East SEZ ROI Socioeconomic Impacts of Transmission Line Facilities[a]

Parameter	Construction	Operations
Employment (no.)		
Direct	4	<1
Total	9	<1
Income[b]		
Total	0.4	<0.1
Direct state taxes[b]		
Sales	<0.1	<0.1
Income	<0.1	<0.1
In-migrants (no.)	11	<1
Vacant housing[c] (no.)	5	<1
Local community service employment		
Teachers (no.)	<1	<1
Physicians (no.)	<1	<1
Public safety (no.)	<1	<1

[a] Construction impacts assume 2 mi (3 km) of transmission line is required to connect SEZ solar facilities to the grid. Construction impacts were assessed for a single representative year, 2021.

[b] Unless indicated otherwise, values are reported in $ million 2008.

[c] Construction activities would affect vacant rental housing; operations activities would affect vacant owner-occupied housing.

Although in-migration may potentially affect local housing markets, the relatively small number of in-migrants and the availability of temporary accommodation (hotels, motels, and mobile home parks) would mean that the impact of solar facility construction on the number of vacant rental housing units is not expected to be large, with five rental units expected to be occupied in the ROI. This occupancy rate would represent less than 0.1% of the vacant rental units expected to be available in the ROI.

No new community service employment would be required in order to meet existing levels of service in the ROI.

Operations. Total operations employment impacts in the ROI (including direct and indirect impacts) of a transmission line would be less than one job (Table 10.3.19.2-2) and would produce less than $0.1 million in income. Direct sales taxes would be less than $0.1 million, and direct income taxes, less than $0.1 million.

Operation of a transmission line would not require the in-migration of workers and their families from outside the ROI; consequently, no impacts on housing markets in the ROI would be expected, and no new community service employment would be required in order to meet existing levels of service in the ROI.

Access Road Impacts

Construction of an access road to connect to the Bullard Wash SEZ could include the addition of 59 jobs in the ROI (including direct and indirect impacts) in the peak year of construction (Table 10.3.19.2-2). Construction activities in the peak year would constitute less than 1% of total ROI employment. Access road construction would also produce $1.8 million in ROI income. Direct sales taxes and direct income taxes would each be less than $0.1 million.

Total operations (maintenance) employment impacts in the ROI (including direct and indirect impacts) of an access road would be less than 1 job during the first year of operation (Table 10.3.19.2-2) and would also produce less than $0.1 million in income. Direct sales taxes would be less than $0.1 million in the first year, with direct income taxes of less than $0.1 million.

Construction and operation of an access road would not require the in-migration of workers and their families from outside the ROI; consequently, no impacts on housing markets in the ROI would be expected, and no new community service employment would be required in order to meet existing levels of service in the ROI.

10.3.19.2.2 Technology-Specific Impacts

The economic impacts of solar energy development in the proposed SEZ were measured in terms of employment, income, state tax revenues (sales and income), BLM acreage rental and

TABLE 10.3.19.2-2 ROI Socioeconomic Impacts of an Access Road Connecting the Proposed Fourmile East SEZ[a]

Parameter	Maximum Annual Construction Impacts	Operations
Employment (no.)		
Direct	35	<1
Total	59	<1
Income[b]		
Total	1.8	<0.1
Direct state taxes[b]		
Sales	<0.1	<0.1
Income	<0.1	<0.1
In-migrants (no.)	0	0
Vacant housing[c] (no.)	0	0
Local community service employment		
Teachers (no.)	0	0
Physicians (no.)	0	0
Public safety (no.)	0	0

a Construction impacts assume 3 mi (5 km) of access road are required for the SEZ. Construction impacts are assessed for the peak year of construction.

b Unless indicated otherwise, values are reported in $ million 2008.

c Construction activities would affect vacant rental housing; operations activities would affect vacant owner-occupied housing.

capacity payments, population in-migration, housing, and community service employment (education, health, and public safety). More information on the data and methods used in the analysis can be found in Appendix M.

The assessment of the impact of the construction and operation of each technology was based on SEZ acreage, assuming 80% of the area could be developed. To capture a range of possible impacts, solar facility size was estimated on the basis of the land requirements of various solar technologies, assuming that 9 acres/MW (0.04 km^2/MW) would be required for power tower, dish engine, and PV technologies and 5 acres/MW (0.02 km^2/MW) for solar trough technologies. Impacts of multiple facilities employing a given technology at each SEZ were assumed to be the same as impacts for a single facility with the same total capacity. Construction impacts were assessed for a representative peak year of construction, assumed to be 2021 for each technology. Construction impacts assumed that a maximum of one project could be constructed within a given year, with a corresponding maximum land disturbance of up to 3,000 acres (12 km^2). For operations impacts, a representative first year of operations was assumed to be 2023 for each technology. The years of construction and operations were selected as representative of the entire 20-year study period because they are the approximate midpoint; construction and operations could begin earlier.

Solar Trough

Construction. Total construction employment impacts on the ROI (including direct and indirect impacts) from the use of solar trough technologies would be 2,804 jobs (Table 10.3.19.2-3), assuming that one 600-MW facility was constructed. Construction activities would constitute 12.5% of total ROI employment. A solar development would also produce $152.6 million in income. Direct sales taxes would be $0.1 million, and direct income taxes, $5.9 million.

Given the scale of construction activities and the likelihood of local worker availability in the required occupational categories, construction of a solar facility would mean that some in-migration of workers and their families from outside the ROI would be required, with 1,827 persons in-migrating into the ROI. Although in-migration may potentially affect local housing markets, the relatively small number of in-migrants and the availability of temporary accommodation (hotels, motels, and mobile home parks) would mean that the impact of solar facility construction on the number of vacant rental housing units is not expected to be large, with 914 rental units expected to be occupied in the ROI. This occupancy rate would represent 66.9% of the vacant rental units expected to be available in the ROI.

In addition to the potential impact on housing markets, in-migration would affect community service employment (education, health, and public safety). An increase in such employment would be required to meet existing levels of service in the ROI. Accordingly, 25 new teachers, 3 physicians, and 2 public safety employees (career firefighters and uniformed police officers) would be required in the ROI. These increases would represent 3.8% of total ROI employment expected in these occupations.

Operations. Total operations employment impacts on the ROI (including direct and indirect impacts) of a build-out using solar trough technologies would be 203 jobs (Table 10.3.19.2-3). Such a solar development would also produce $6.6 million in income. Direct sales taxes would be $0.1 million, and direct income taxes, $0.2 million. Based on fees established by the BLM in its Solar Energy Interim Rental Policy (BLM 2010b), acreage rental payments would be $0.2 million, and solar generating capacity payments would total at least $4.1 million.

TABLE 10.3.19.2-3 ROI Socioeconomic Impacts Assuming Full Build-out of the Proposed Fourmile East SEZ with Trough Facilities[a]

Parameter	Construction	Operations
Employment (no.)		
Direct	1,641	135
Total	2,804	203
Income[b]		
Total	152.6	6.6
Direct state taxes[b]		
Sales	0.1	0.1
Income	5.9	0.2
BLM Payments[b]		
Rental	NA[c]	0.2
Capacity[d]	NA	4.1
In-migrants (no.)	1,827	86
Vacant housing[e] (no.)	914	78
Local community service employment		
Teachers (no.)	25	1
Physicians (no.)	3	0
Public safety (no.)	2	0

a Construction impacts are based on the development at the site in a single year; it was assumed that several facilities with a combined capacity of up to 600 MW (corresponding to 3,000 acres [12 km^2] of land disturbance) could be built. Operations impacts were based on full build-out of the site, producing a total output of 621 MW.

b Unless indicated otherwise, values are reported in $ million 2008.

c NA = not applicable.

d The BLM annual capacity payment was based on a fee of $6,570 per MW, established by the BLM in its Solar Energy Interim Rental Policy (BLM 2010b), assuming a solar facility with no storage capability, and full build-out of the site. Projects with three or more hours of storage would generate higher payments, based on a fee of $7,884 per MW.

e Construction activities would affect vacant rental housing; operations activities would affect vacant owner-occupied housing.

Given the likelihood of local worker availability in the required occupational categories, operation of a solar facility would mean that some in-migration of workers and their families from outside the ROI would be required, with 86 persons in-migrating into the ROI. Although in-migration may potentially affect local housing markets, the relatively small number of in-migrants and the availability of temporary accommodations (hotels, motels, and mobile home parks) would mean that the impact of solar facility operation on the number of vacant owner-occupied housing units is not expected to be large, with 78 owner-occupied units expected to be occupied in the ROI.

In addition to the potential impact on housing markets, in-migration would affect community service (education, health, and public safety) employment. An increase in such employment would be required to meet existing levels of service in the ROI. Accordingly, one new teacher would be required in the ROI.

Power Tower

Construction. Total construction employment impacts in the ROI (including direct and indirect impacts) from the use of power tower technologies would be 1,117 jobs (Table 10.3.19.2-4), assuming that one 333-MW facility was constructed. Construction activities would constitute 5.0% of total ROI employment. Such a solar development would also produce $60.8 million in income. Direct sales taxes would be less than $0.1 million, and direct income taxes, $2.4 million.

Given the scale of construction activities and the likelihood of local worker availability in the required occupational categories, construction of a solar facility would mean that some in-migration of workers and their families from outside the ROI would be required, with 728 persons in-migrating into the ROI. Although in-migration may potentially affect local housing markets, the relatively small number of in-migrants and the availability of temporary accommodations (hotels, motels, and mobile home parks) would mean that the impact of solar facility construction on the number of vacant rental housing units is not expected to be large, with 364 rental units expected to be occupied in the ROI. This occupancy rate would represent 26.6% of the vacant rental units expected to be available in the ROI.

In addition to the potential impact on housing markets, in-migration would affect community service (education, health, and public safety) employment. An increase in such employment would be required to meet existing levels of service in the ROI. Accordingly, 10 new teachers, 1 physician, and 1 public safety employee (career firefighters and uniformed police officers) would be required in the ROI. These increases would represent 1.5% of total ROI employment expected in these occupations.

Operations. Total operations employment impacts on the ROI (including direct and indirect impacts) of a build-out using power tower technologies would be 97 jobs

TABLE 10.3.19.2-4 ROI Socioeconomic Impacts Assuming Full Build-out of the Proposed Fourmile East SEZ with Power Tower Facilities[a]

Parameter	Construction	Operations
Employment (no.)		
Direct	654	70
Total	1,117	97
Income[b]		
Total	60.8	3.0
Direct state taxes[b]		
Sales	<0.1	<0.1
Income	2.4	0.1
BLM payments[b]		
Rental	NA[c]	0.2
Capacity[d]	NA	2.3
In-migrants (no.)	728	45
Vacant housing[e] (no.)	364	40
Local community service employment		
Teachers (no.)	10	1
Physicians (no.)	1	0
Public safety (no.)	1	0

[a] Construction impacts are based on the development at the site in a single year; it was assumed that several facilities with a combined capacity of up to 333 MW (corresponding to 3,000 acres [12 km^2] of land disturbance) could be built. Operations impacts were based on full build-out of the site, producing a total output of 345 MW.

[b] Unless indicated otherwise, values are reported in $ million 2008.

[c] NA = not applicable.

[d] The BLM annual capacity payment was based on a fee of $6,570 per MW, established by the BLM in its Solar Energy Interim Rental Policy (BLM 2010b), assuming a solar facility with no storage capability, and full build-out of the site. Projects with three or more hours of storage would generate higher payments, based on a fee of $7,884 per MW.

[e] Construction activities would affect vacant rental housing; operations activities would affect vacant owner-occupied housing.

(Table 10.3.19.2-4). Such a solar development would also produce $3.0 million in income. Direct sales taxes would be less than $0.1 million and direct income taxes, $0.1 million. Based on fees established by the BLM in its Solar Energy Interim Rental Policy (BLM 2010b), acreage rental payments would be $0.2 million, and solar generating capacity payments would total at least $2.3 million.

Given the likelihood of local worker availability in the required occupational categories, operation of a solar facility would mean that some in-migration of workers and their families from outside the ROI would be required, with 45 persons in-migrating into the ROI. Although in-migration may potentially affect local housing markets, the relatively small number of in-migrants and the availability of temporary accommodations (hotels, motels, and mobile home parks) would mean that the impact of solar facility operation on the number of vacant owner-occupied housing units is not expected to be large, with 40 owner-occupied units expected to be required in the ROI.

In addition to the potential impact on housing markets, in-migration would also affect community service (education, health, and public safety) employment. An increase in such employment would be required to meet existing levels of service in the ROI. Accordingly, one new teacher would be required in the ROI.

Dish Engine

Construction. Total construction employment impacts on the ROI (including direct and indirect impacts) from the use of dish engine technologies would be 454 jobs (Table 10.3.19.2-5), assuming that one 333-MW facility was constructed. Construction activities would constitute 2.0% of total ROI employment. Such a solar development would also produce $24.7 million in income. Direct sales taxes would be less than $0.1 million, and direct income taxes, $1.0 million.

Given the scale of construction activities and the likelihood of local worker availability in the required occupational categories, construction of a solar facility would mean that some in-migration of workers and their families from outside the ROI would be required, with 296 persons in-migrating into the ROI. Although in-migration may potentially affect local housing markets, the relatively small number of in-migrants and the availability of temporary accommodations (hotels, motels, and mobile home parks) would mean that the impact of solar facility construction on the number of vacant rental housing units is not expected to be large, with 148 rental units expected to be occupied in the ROI. This occupancy rate would represent 10.8% of the vacant rental units expected to be available in the ROI.

In addition to the potential impact on housing markets, in-migration would affect community service (education, health, and public safety) employment. An increase in such employment would be required to meet existing levels of service in the ROI. Accordingly, 4 new teachers and 1 physician would be required in the ROI. This increase would represent 0.6% of total ROI employment expected in this occupation.

TABLE 10.3.19.2-5 ROI Socioeconomic Impacts Assuming Full Build-out of the Proposed Fourmile East SEZ with Dish Engine Facilities[a]

Parameter	Construction	Operations
Employment (no.)		
Direct	266	68
Total	454	94
Income[b]		
Total	24.7	2.9
Direct state taxes[b]		
Sales	<0.1	<0.1
Income	1.0	0.1
BLM payments[b]		
Rental	NA[c]	0.2
Capacity[d]	NA	2.3
In-migrants (no.)	296	43
Vacant housing[e] (no.)	148	39
Local community service employment		
Teachers (no.)	4	1
Physicians (no.)	1	0
Public safety (no.)	0	0

[a] Construction impacts are based on the development at the site in a single year; it was assumed that several facilities with a combined capacity of up to 333 MW (corresponding to 3,000 acres [12 km^2] of land disturbance) could be built. Operations impacts were based on full build-out of the site, producing a total output of 345 MW.

[b] Unless indicated otherwise, values are reported in $ million 2008.

[c] NA = not applicable.

[d] The BLM annual capacity payment was based on a fee of $6,570 per MW, established by the BLM in its Solar Energy Interim Rental Policy (BLM 2010b), assuming a solar facility with no storage capability, and full build-out of the site. Projects with three or more hours of storage would generate higher payments, based on a fee of $7,884 per MW.

[e] Construction activities would affect vacant rental housing; operations activities would affect vacant owner-occupied housing.

Operations. Total operations employment impacts in the ROI (including direct and indirect impacts) of a build-out using dish engine technologies would be 94 jobs (Table 10.3.19.2-5). Such a solar development would also produce $2.9 million in income. Direct sales taxes would be less than $0.1 million, and direct income taxes, $0.1 million. Based on fees established by the BLM in its Solar Energy Interim Rental Policy (BLM 2010b), acreage rental payments would be $0.2 million, and solar generating capacity payments would total at least $2.3 million.

Given the likelihood of local worker availability in the required occupational categories, operation of a dish engine solar facility would mean that some in-migration of workers and their families from outside the ROI would be required, with 43 persons in-migrating into the ROI. Although in-migration may potentially affect local housing markets, the relatively small number of in-migrants and the availability of temporary accommodation (hotels, motels, and mobile home parks) would mean that the impact of solar facility operation on the number of vacant owner-occupied housing units is not expected to be large, with 39 owner-occupied units expected to be required in the ROI.

In addition to the potential impact on housing markets, in-migration would affect community service (education, health, and public safety) employment. An increase in such employment would be required to meet existing levels of service in the ROI. Accordingly, one new teacher would be required in the ROI.

Photovoltaic

Construction. Total construction employment impacts in the ROI (including direct and indirect impacts) from the use of PV technologies would be 212 jobs (Table 10.3.19.2-6), assuming that one 333-MW facility was constructed. Construction activities would constitute 0.9% of total ROI employment. Such a solar development would also produce $11.5 million in income. Direct sales taxes would be less than $0.1 million, and direct income taxes, $0.4 million.

Given the scale of construction activities and the likelihood of local worker availability in the required occupational categories, construction of a solar facility would mean that some in-migration of workers and their families from outside the ROI would be required, with 138 persons in-migrating into the ROI. Although in-migration may potentially affect local housing markets, the relatively small number of in-migrants and the availability of temporary accommodations (hotels, motels, and mobile home parks) would mean that the impact of solar facility construction on the number of vacant rental housing units is not expected to be large, with 69 rental units expected to be occupied in the ROI. This occupancy rate would represent 5.1% of the vacant rental units expected to be available in the ROI.

In addition to the potential impact on housing markets, in-migration would affect community service (education, health, and public safety) employment. An increase in such employment would be required to meet existing levels of service in the ROI. Accordingly,

TABLE 10.3.19.2-6 ROI Socioeconomic Impacts Assuming Full Build-out of the Proposed Fourmile East SEZ with PV Facilities[a]

Parameter	Construction	Operations
Employment (no.)		
Direct	124	7
Total	212	9
Income[b]		
Total	11.5	0.3
Direct state taxes[b]		
Sales	<0.1	<0.1
Income	0.4	<0.1
BLM payments[b]		
Rental	NA[c]	0.2
Capacity[d]	NA	1.8
In-migrants (no.)	138	4
Vacant housing[e] (no.)	69	4
Local community service employment		
Teachers (no.)	2	0
Physicians (no.)	0	0
Public safety (no.)	0	0

[a] Construction impacts are based on the development at the site in a single year; it was assumed that several facilities with a combined capacity of up to 333 MW (corresponding to 3,000 acres [12 km^2] of land disturbance) could be built. Operations impacts were based on full build-out of the site, producing a total output of 345 MW.

[b] Unless indicated otherwise, values are reported in $ million 2008.

[c] NA = not applicable.

[d] The BLM annual capacity payment was based on a fee of $5,256 per MW, established by the BLM in its Solar Energy Interim Rental Policy (BLM 2010b), assuming full build-out of the site.

[e] Construction activities would affect vacant rental housing; operations activities would affect owner-occupied housing.

two new teachers would be required in the ROI. This increase would represent 0.3% of total ROI employment expected in this occupation.

Operations. Total operations employment impacts in the ROI (including direct and indirect impacts) of a build-out using PV technologies would be 9 jobs (Table 10.3.19.2-6). Such a solar development would also produce $0.3 million in income. Direct sales taxes would be less than $0.1 million, and direct income taxes, less than $0.1 million. Based on fees established by the BLM in its Solar Energy Interim Rental Policy (BLM 2010), acreage rental payments would be $0.2 million, and solar generating capacity payments would total at least $1.8 million.

Given the likelihood of local worker availability in the required occupational categories, operation of a solar facility would mean that some in-migration of workers and their families from outside the ROI would be required, with 4 persons in-migrating into the ROI. Although in-migration may potentially affect local housing markets, the relatively small number of in-migrants and the availability of temporary accommodation (hotels, motels, and mobile home parks) would mean that the impact of solar facility operation on the number of vacant owner-occupied housing units is not expected to be large, with 4 owner-occupied units expected to be required in the ROI.

No new community service employment would be required to meet existing levels of service in the ROI.

10.3.19.3 SEZ-Specific Design Features and Design Feature Effectiveness

No SEZ-specific design features addressing socioeconomic impacts have been identified for the proposed Fourmile East SEZ. Implementing the programmatic design features described in Appendix A, Section A.2.2, as required under BLM's Solar Energy Program, would reduce the potential for socioeconomic impacts during all project phases.

10.3.20 Environmental Justice

10.3.20.1 Affected Environment

On February 11, 1994, the President signed E.O. 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations," which formally requires federal agencies to incorporate environmental justice as part of their missions (*Federal Register*, Volume 59, page 7626, Feb. 11, 1994). Specifically, it directs them to address, as appropriate, any disproportionately high and adverse human health or environmental effects of their actions, programs, or policies on minority and low-income populations.

The analysis of the impacts of solar energy projects on environmental justice issues follows guidelines described in the CEQ's *Environmental Justice Guidance under the National Environmental Policy Act* (CEQ 1997). The analysis method has three parts: (1) a description of the geographic distribution of low-income and minority populations in the affected area is undertaken; (2) an assessment is conducted to determine whether the impacts of construction and operation would produce impacts that are high and adverse; and (3) if impacts are high and adverse, a determination is made as to whether these impacts disproportionately affect minority and low-income populations.

Construction and operation of solar energy projects in the proposed SEZ could affect environmental justice if any adverse health and environmental impacts resulting from either phase of development are significantly high and if these impacts would disproportionately affect minority and low-income populations. If the analysis determines that health and environmental impacts are not significant, there can be no disproportionate impacts on minority and low-income populations. In the event impacts are significant, disproportionality would be determined by comparing the proximity of any high and adverse impacts to the location of low-income and minority populations.

The analysis of environmental justice issues associated with the development of solar facilities considered impacts within the SEZ and an associated 50-mi (80-km) radius around the boundary of the SEZ. A description of the geographic distribution of minority and low-income groups in the affected area was based on demographic data from the 2000 Census (U.S. Bureau of the Census 2009k,l). The following definitions were used to define minority and low-income population groups:

- **Minority.** Persons are included in the minority category if they identify themselves as belonging to any of the following racial groups: (1) Hispanic, (2) Black (not of Hispanic origin) or African American, (3) American Indian or Alaska Native, (4) Asian, or (5) Native Hawaiian or Other Pacific Islander.

  Beginning with the 2000 Census, where appropriate, the census form allows individuals to designate multiple population group categories to reflect their ethnic or racial origin. In addition, persons who classify themselves as being of multiple racial origins may choose up to six racial groups as the basis of their racial origins. The term minority includes all persons, including those classifying themselves in multiple racial categories, except those who classify themselves as not of Hispanic origin and as White or "Other Race" (U.S. Bureau of the Census 2009k).

The CEQ guidance proposed that minority populations should be identified where either (1) the minority population of the affected area exceeds 50% or (2) the minority population percentage of the affected area is meaningfully greater than the minority population percentage in the general population or other appropriate unit of geographic analysis.

This PEIS applies both criteria in using the Census Bureau data for census block groups, wherein consideration is given to the minority population that is both over 50% and 20 percentage points higher than in the state (the reference geographic unit).

- **Low-Income.** Individuals who fall below the poverty line. The poverty line takes into account family size and age of individuals in the family. In 1999, for example, the poverty line for a family of five with three children below the age of 18 was $19,882. For any given family below the poverty line, all family members are considered as being below the poverty line for the purposes of analysis (U.S. Bureau of the Census 2009l).

The data in Table 10.3.20.1-1 show the minority and low-income composition of total population located in the SEZ based on 2000 Census data and CEQ Guidelines. Individuals identifying themselves as Hispanic or Latino are included in the table as a separate entry. However, because Hispanics can be of any race, this number also includes individuals also identifying themselves as being part of one or more of the population groups listed in the table.

A large number of minority and low-income individuals are located in the 50-mi (80-km) area around the boundary of the SEZ. Within the 50-mi (80-km) radius in Colorado, 42.2% of the population is classified as minority, while 17.7% is classified as low-income. The number of minority or low-income individuals does not exceed the state average by 20 percentage points or more and does not exceed 50% of the total population in the radius, meaning that there are no minority or low-income populations in the Colorado portion of the 50-mile area based on 2000 Census data and CEQ guidelines.

Within the 50-mi (80-km) radius in New Mexico, 55.6% of the population is classified as minority, while 17.4% is classified as low-income. Although the number of minority individuals does not exceed the state average by 20 percentage points or more, the number of minority individuals exceeds 50% of the total population in the radius area, meaning that there are minority populations in the 50-mi (80-km) radius based on 2000 Census data and CEQ guidelines. The number of low-income individuals does not exceed the state average by 20 percentage points or more and does not exceed 50% of the total population in the radius, meaning that there are no low-income populations in the New Mexico portion of the 50-mile area.

TABLE 10.3.20.1-1 Minority and Low-Income Populations within the 50-mi (80-km) Radius Surrounding the Proposed Fourmile East SEZ

Parameter	Colorado	New Mexico
Total population	68,522	9,859
White, non-Hispanic	39,581	4,374
Hispanic or Latino	26,562	5,147
Non-Hispanic or Latino minorities	2,379	338
One race	1,485	171
Black or African American	405	18
American Indian or Alaskan Native	679	93
Asian	269	30
Native Hawaiian or other Pacific Islander	26	3
Some other race	106	27
Two or more races	894	167
Total minority	28,941	5,485
Low-income	12,116	1,720
Percentage minority	42.2	55.6
State percentage minority	25.5	55.3
Percentage low-income	17.7	17.4
State percentage low-income	9.3	18.4

Source: U.S. Bureau of the Census (2009k,l).

Figures 10.3.20.1-1 and 10.3.20.1-2 show the locations of minority and low-income population groups in the 50-mi (80-km) radius around the boundary of the SEZ.

In the Colorado portion of the 50-mi (80-km) radius, more than 50% of the population in all but one of the block groups in Conejos County is made up of minority population groups, together with all of the block groups in adjacent Costilla County. Block groups in the cities of Alamosa (Alamosa County), Monte Vista and Del Norte (both in Rio Grande County), Center (Saguache County), and Walsenburg (Huerfano County) are also more than 50% minority. In the New Mexico portion of the radius, Rio Arriba County has one block group in which the minority population is more than 20 percentage points higher than the state average, while there are two block groups with more than 50% minority in Taos County.

Low-income populations in the 50-mi (80-km) radius are limited to two block groups in the Colorado portion, in the cities of San Luis (Costilla County) and Alamosa, both of which have low-income population shares that are more than 20 percentage points higher than the state average.

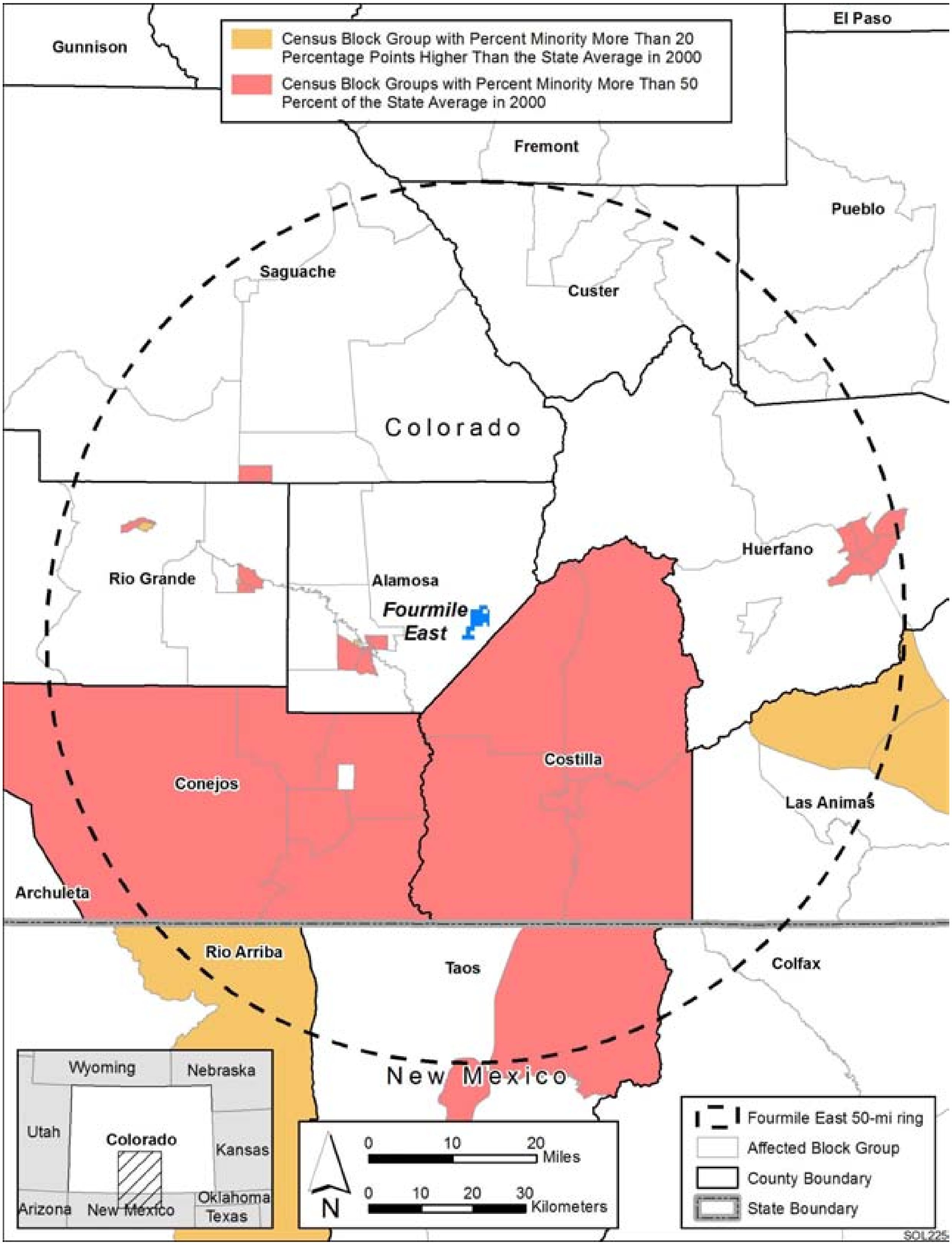

FIGURE 10.3.20.1-1 Minority Population Groups within the 50-mi (80-km) Radius Surrounding the Proposed Fourmile East SEZ

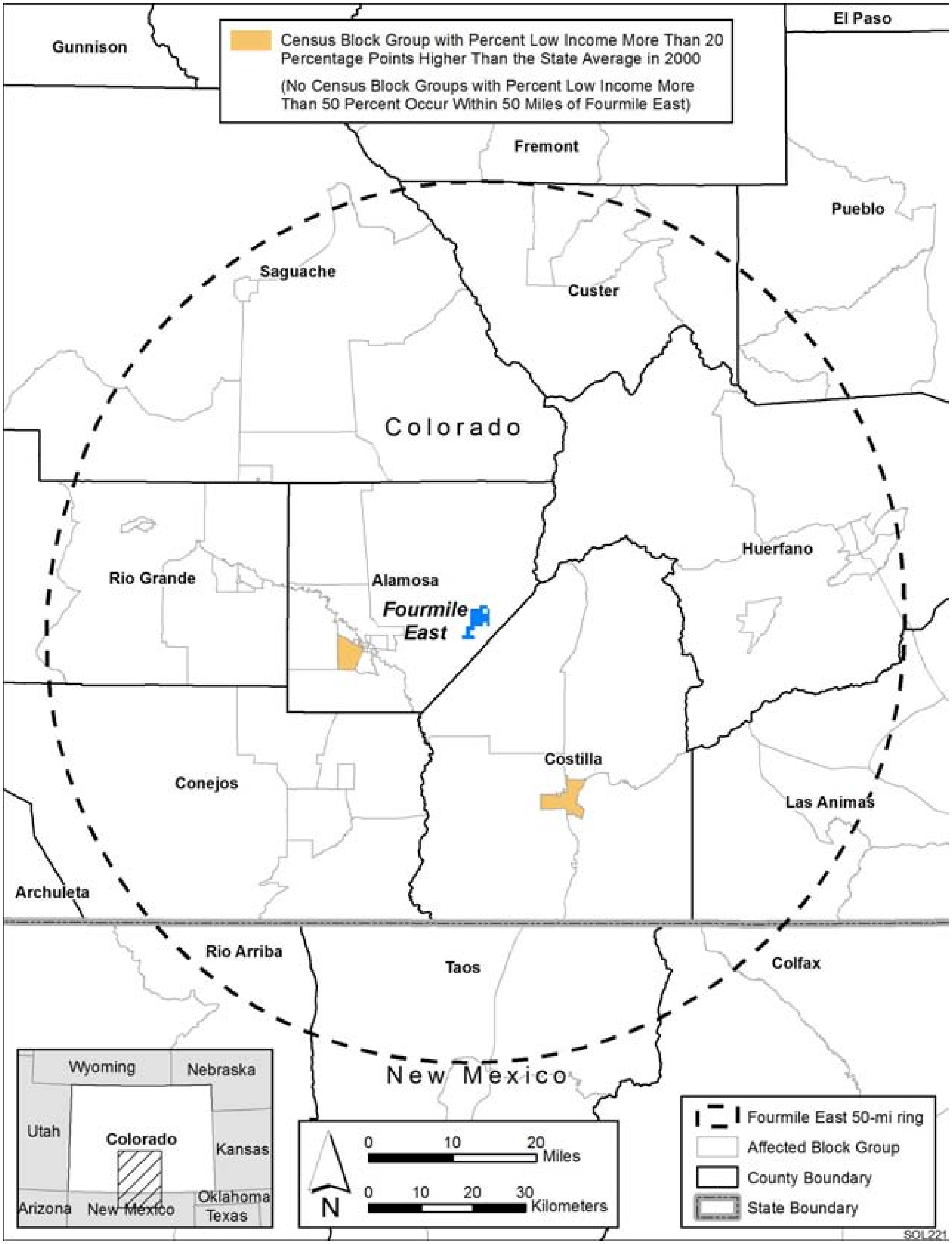

FIGURE 10.3.20.1-2 Low-Income Population Groups within the 50-mi (80-km) Radius Surrounding the Proposed Fourmile East SEZ

10.3.20.2 Impacts

Environmental justice concerns common to all utility-scale solar energy facilities are described in detail in Section 5.18. These impacts will be minimized through the implementation of programmatic design features described in Appendix A, Section A.2.2, which address the underlying environmental impacts contributing to the concerns. The analysis of impacts considered noise and dust during the construction of solar facilities; noise and EMF effects associated with solar project operations; the visual impacts of solar generation and auxiliary facilities, including transmission lines; access to land used for economic, cultural, or religious purposes; and effects on property values as areas of concern that might potentially affect minority and low-income populations.

Potential impacts on low-income and minority populations could be incurred as a result of the construction and operation of solar facilities involving each of the four technologies. Although impacts are likely to be small, there are minority populations defined by CEQ guidelines (Section 10.3.20.1) within the New Mexico portion of the 50-mi (80-km) radius around the boundary of the SEZ; thus any adverse impacts of solar projects would disproportionately affect minority populations. Because there are also low-income populations within the 50-mi (80-km) radius, according to CEQ guidelines, there would also be impacts on low-income populations.

10.3.20.3 SEZ-Specific Design Features and Design Feature Effectiveness

No SEZ-specific design features addressing environmental justice impacts have been identified for the proposed Fourmile East SEZ. Implementing the programmatic design features described in Appendix A, Section A.2.2, as required under BLM's Solar Energy Program, would reduce the potential for environmental justice impacts during all project phases.

10.3.21 Transportation

The proposed Fourmile East SEZ is accessible by road and rail networks. One U.S. highway and one regional railroad serve the area. A small regional airport is located 12 mi (19 km) west of the SEZ. General transportation considerations and impacts are discussed in Sections 3.4 and 5.19, respectively.

10.3.21.1 Affected Environment

U.S. 160, a two-lane highway, passes near the southern border of the proposed Fourmile East SEZ, as shown in Figure 10.3.21.1-1. The small town of Blanca is located a few miles to the southeast of the SEZ along U.S. 160, and Alamosa is located 10 mi (16 km) to the west along U.S. 160. CO 150 runs north-south through the eastern portion of the SEZ and joins U.S. 160 to the south (Figure 10.3.21.1-1). A number of local roads cross the SEZ. Annual average traffic volumes for the major roads for 2008 are provided in Table 10.3.21.1-1.

The SLRG Railroad serves the area (SLRG 2009). This regional railroad has rail stops in the towns of Blanca and Fort Garland, approximately 8 and 14 mi (13 and 23 km), respectively, to the east-southeast of the SEZ along U.S. 160. A freight dock and warehouse are also available to the west in Alamosa. The SLRG Railroad runs to the east from the SEZ for a distance of approximately 60 mi (97 km), where it connects to the UP Railroad in Walsenburg.

The nearest public airport is San Luis Valley Regional Airport located 12 mi (19 km) west of the SEZ in Alamosa along U.S. 160. The airport has two runways, one of which is restricted to light aircraft. One regional airline provides daily scheduled service to Denver. No commercial cargo shipped to or from the airport has been reported by the BTS, and about 7,800 passengers departed from or arrived at the airport in 2008 (BTS 2008).

10.3.21.2 Impacts

As discussed in Section 5.19, the primary transportation impacts are anticipated to be from commuting worker traffic. U.S. 160 provides a regional traffic corridor that could experience moderate impacts for projects that may have up to 1,000 daily workers with an additional 2,000 vehicle trips per day (maximum). Some parts of U.S. 160 could experience approximately a 50% increase in the daily traffic load, as summarized in Table 10.3.21.1-1, and the amount of traffic currently using CO 150 could increase approximately threefold. Local road improvements would be necessary in any portion of the SEZ along U.S. 160 that might be developed so as not to overwhelm the local roads near any site access point(s). CO 150 and any other access roads connected to it would require road improvements to handle the additional traffic.

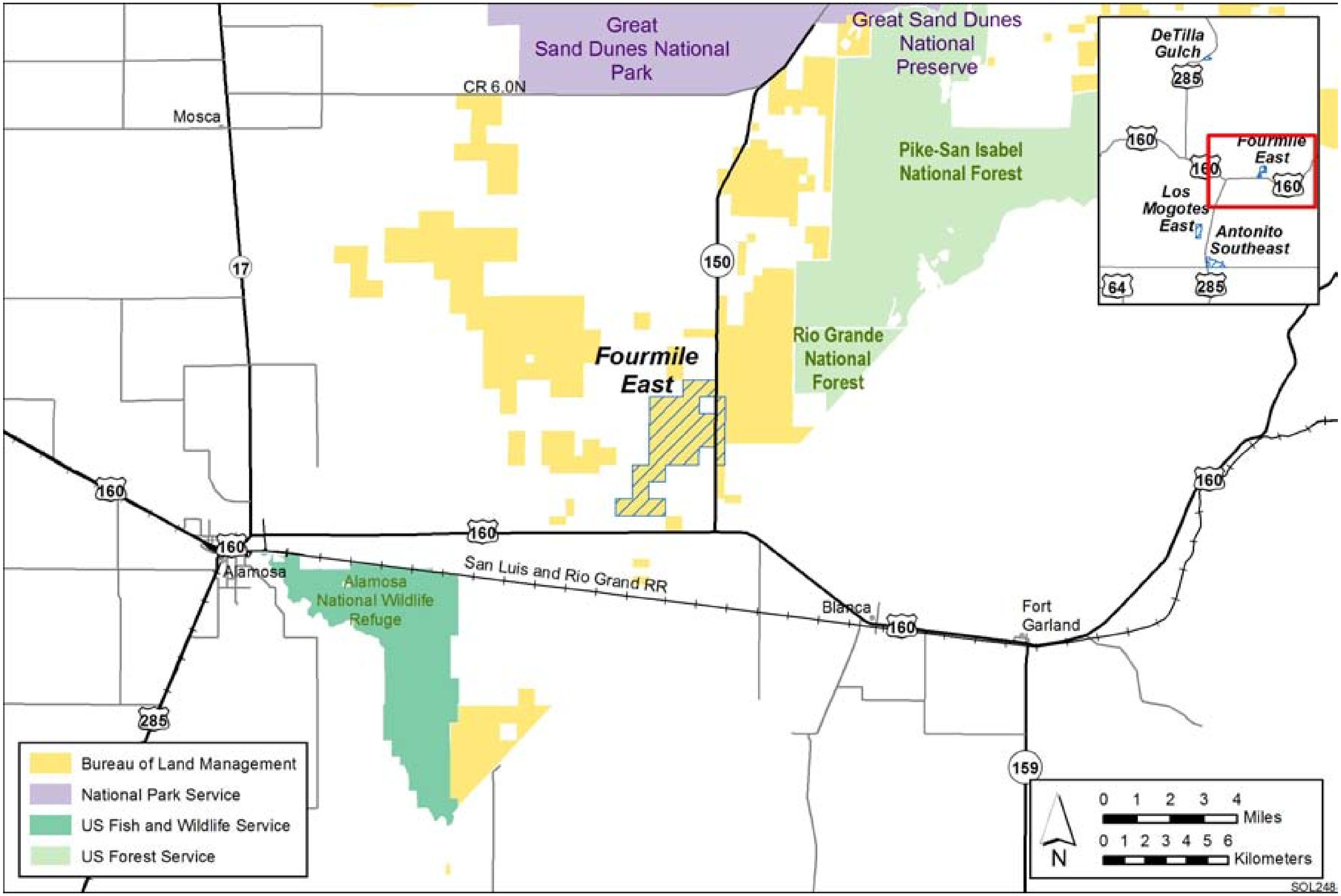

FIGURE 10.3.21.1-1 Local Transportation Network Serving the Proposed Fourmile East SEZ

TABLE 10.3.21.1-1 Annual Average Daily Traffic (AADT) on Major Roads near the Proposed Fourmile East SEZ, 2008

Road	General Direction	Location	AADT (Vehicles)
U.S. Highway 160	East-west	West side of Alamosa Junction with Craft Drive	19,100
		Junction with State Avenue in central Alamosa	14,300
		East side of Alamosa; junction with El Rancho Lane	3,600
		Junction with CO 150, south of the SEZ	3,700
		Junction with Broadway Avenue in Blanca	5,000
		Junction with CO 159 in Fort Garland	3,500
CO 150	North-south	North of junction with U.S. 160	610

Source: CDOT (undated).

Solar development within the SEZ would affect public access along OHV routes designated open and available for public use. If such routes were identified during project-specific analyses, they would be re-designated as closed (see Section 5.5.1 for more details on how routes coinciding with proposed solar facilities would be treated).

10.3.21.3 SEZ-Specific Design Features and Design Feature Effectiveness

No SEZ-specific design features have been identified related to impacts on transportation systems around the Fourmile East SEZ. The programmatic design features described in Appendix A, Section A.2.2, including local road improvements, multiple site access locations, staggered work schedules, and ride sharing, would all provide some relief to traffic congestion on local roads leading to the site. Depending on the locations of solar facilities within the SEZ, more specific access locations and local road improvements could be implemented.

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10.3.22 Cumulative Impacts

The analysis presented in this section addresses the potential cumulative impacts in the vicinity of the proposed Fourmile East SEZ in the eastern part of the San Luis Valley, Colorado. The CEQ guidelines for implementing NEPA define cumulative impacts as environmental impacts resulting from the incremental impacts of an action when added to other past, present, and reasonably foreseeable future actions (40 CFR 1508.7). The impacts of other actions are considered without regard to what agency (federal or nonfederal), organization, or person undertakes them. The time frame of this cumulative impact assessment could appropriately include activities that would occur up to 20 years in the future (the general time frame for PEIS analyses), but little or no information is available for projects that could occur further than 5 to 10 years in the future.

The proposed Fourmile East SEZ is located about 12 mi (19 km) east of Alamosa, Colorado, in Alamosa County. It is located on the east side of the San Luis Valley and is in an area predominantly surrounded by private lands where there is a scattering of home sites and land that has been subdivided, although the overall character of the area is rural. Some irrigated agriculture occurs on private lands to the southeast of the SEZ. To the west of the SEZ are two blocks of BLM-administered land that are designated as the Blanca Wetlands Area, and about 2 mi (3 km) to the east is the San Isabel National Forest. The area is located within the boundaries of the Sangre de Cristo NHA and is located near Blanca Peak, which is sacred to some Native American Tribes. CO 150, which is designated as the Los Caminos Antiguos Scenic Byway, passes through the SEZ and is a major access route to the Great Sand Dunes National Park. The area is part of a grazing allotment and is being actively grazed. There are no active mining claims or active or closed oil and gas leases in the vicinity of the SEZ. The SEZ is within a DoD airspace consultation area (BLM and USFS 2009).

The geographic extent of cumulative impact analyses for potentially affected resources near the Fourmile East SEZ is identified in Section 10.3.22.1. An overview of ongoing and reasonably foreseeable future actions is presented in Section 10.3.22.2. General trends in population growth, energy demand, water availability, and climate change are discussed in Section 10.3.22.3. Cumulative impacts for each resource area are discussed in Section 10.3.22.4.

10.3.22.1 Geographic Extent of the Cumulative Impacts Analysis

Table 10.3.22.1-1 presents the geographic extent of the cumulative impacts analysis for potentially affected resources evaluated near the Fourmile East SEZ. These geographic areas define the geographic boundaries of areas encompassing potentially affected resources. Their extent may vary on the basis of the nature of the resource being evaluated and the distance at which an impact may occur (thus, for example, the evaluation of air quality may have a greater regional extent of impact than visual resources). Lands around the SEZ are privately owned, or administered by the USFS, NPS, or the BLM. The BLM administers approximately 11% of the lands within a 50-mi (80-km) radius of the Fourmile East SEZ.

TABLE 10.3.22.1-1 Geographic Extent of the Cumulative Impacts Analysis by Resource Area: Proposed Fourmile East SEZ

Resource Area	Geographic Extent
Lands and Realty	East Central San Luis Valley
Specially Designated Areas and Lands with Wilderness Characteristics	East Central San Luis Valley
Rangeland Resources	East Central San Luis Valley
Recreation	East Central San Luis Valley
Military and Civilian Aviation	East Central San Luis Valley
Soil Resources	Areas within and adjacent to the Fourmile East SEZ
Minerals	East Central San Luis Valley
Water Resources	
Surface Water	Ute Creek, Sangre de Cristo Creek, Smith Reservoir, Trinchera Creek, and Rio Grande
Groundwater	Upper Rio Grande Basin within the San Luis Valley (unconfined and confined aquifers)
Vegetation, Wildlife and Aquatic Biota, Special Status Species	Known or potential occurrences within a 50-mi (80-km) radius of the Fourmile East SEZ, including Alamosa, Conejos, Costilla, Rio Grande, Saguache, Custer, Huerfano, and Las Animas Counties, Colorado; Rio Arriba and Taos Counties, New Mexico.
Air Quality and Climate	San Luis Valley and beyond
Visual Resources	Viewshed within a 25-mi (40-km) radius of the Fourmile East SEZ
Acoustic Environment (noise)	Areas adjacent to the Fourmile East SEZ
Paleontological Resources	Areas within and adjacent to the Fourmile East SEZ
Cultural Resources	Areas within and adjacent to the Fourmile East SEZ for archaeological sites; viewshed within a 25-mi (40-km) radius of the Fourmile East SEZ for other properties, such as historic trails and traditional cultural properties.
Native American Concerns	San Luis Valley; viewshed within a 25-mi (40-km) radius of the Fourmile East SEZ
Socioeconomics	Alamosa, Conejos, Costilla, and Rio Grande Counties
Environmental Justice	Alamosa, Conejos, Costilla, Rio Grande, Saguache, Custer, Huerfano, and Las Animas Counties, Colorado; Rio Arriba and Taos Counties, New Mexico
Transportation	U.S. 160 and CO 150

10.3.22.2 Overview of Ongoing and Reasonably Foreseeable Future Actions

The future actions described below are those that are "reasonably foreseeable"; that is, they have already occurred, are ongoing, are funded for future implementation, or are included in firm near-term plans. Types of proposals with firm near-term plans include the following:

- Proposals for which NEPA documents are in preparation or finalized;
- Proposals in a detailed design phase;
- Proposals listed in formal NOIs published in the Federal Register or state publications;
- Proposals for which enabling legislation has been passed; and
- Proposals that have been submitted to federal, state, or county regulators to begin a permitting process.

Projects in the bidding or research phase or that have been put on hold (e.g., the Lexam Explorations, Inc., oil and gas drilling project at the Baca National Wildlife Refuge) were not included in the cumulative impacts analysis.

The ongoing and reasonably foreseeable future actions described below are grouped into two categories: (1) actions that relate to energy production and distribution, including potential solar energy projects under the proposed action (Section 10.3.22.2.1), and (2) other ongoing and reasonably foreseeable actions, including those related to mining and mineral processing, grazing management, transportation, recreation, water management, and conservation (Section 10.3.22.2.2). Together, these actions and trends have the potential to affect human and environmental receptors within the San Luis Valley over the next 20 years.

10.3.22.2.1 Energy Production and Distribution

Reasonably foreseeable future actions related to energy development and distribution within the San Luis Valley are identified in Table 10.3.22.2-1 and are described in the following sections. Figure 10.3.22.2-1 shows the approximate locations of the key projects.

Renewable Energy Development

In 2007, the State of Colorado increased its Renewable Portfolio Standard by requiring that large investor-owned utilities produce 20% of their energy from renewable resources by 2020; of this total, 4% must come from solar-electric technologies. Municipal utilities and rural electric providers must provide 10% of their electricity from renewable sources by 2020 (Pew Center on Global Climate Change 2009).

TABLE 10.3.22.2-1 Reasonably Foreseeable Future Actions Related to Energy Development and Distribution near the Proposed Fourmile East SEZ and in the San Luis Valley

Description	Status	Resources Affected	Primary Impact Location
Renewable Energy Development			
Renewable Portfolio Standards	Ongoing	Land use	State of Colorado
San Luis Valley GDA (Solar) Designation	Ongoing	Land use	San Luis Valley
Xcel Energy/SunEdison Project; 8.2 MW, PV	Ongoing	Land use, ecological resources, visual	San Luis Valley GDA
Alamosa Solar Energy Project; 30 MW, PV	Underway	Land use, ecological resources, visual	San Luis Valley GDA
Greater Sandhill Solar Project; 17 MW, PV	Underway	Land use, ecological resources, visual	San Luis Valley GDA
San Luis Valley Solar Project; Tessera Solar, 200 MW, dish engine	Proposed	Land use, ecological resources, visual, cultural	San Luis Valley GDA
Solar Reserve; 200 MW, solar tower	Preliminary Application	Land use, ecological resources, visual	San Luis Valley GDA (Saguache)
Cogentrix Solar Services; 30 MW, CPV	Approved/ Underway	Land use, ecological resources, visual	San Luis Valley GDA
Lincoln Renewables; 37 MW PV	County Permit approved	Land use, ecological resources, visual	San Luis Valley GDA
NextEra; 30 MW, PV	County Permit approved	Land use, ecological resources, visual	San Luis Valley GDA
Transmission and Distribution Systems			
San Luis Valley–Calumet-Comanche Transmission Project	Proposed	Land use, ecological resources, visual, cultural	San Luis Valley (select counties)

Also in 2007, the General Assembly of Colorado passed Colorado Senate Bill (SB) 07-100 that established a task force to develop a map of existing generation and transmission lines and to identify potential development areas for renewable energy resources within Colorado. These areas, called GDAs, are regions within Colorado with a concentration of renewable resources that provide a minimum of 1,000 MW of developable electric generating capacity. The task force identified eight wind GDAs (mainly on the Eastern Plain) and two solar GDAs. NREL conducted detailed analyses of these areas and concluded that the San Luis Valley

GDA is one of two regions in southern Colorado capable of generating large blocks of power—as much as 5.5 GW—via utility-scale solar power technologies. Although geothermal power is a potentially vast resource in Colorado (and in the San Luis Valley), no single site was found to generate 1,000 MW. As a result, the task force did not identify geothermal GDAs (Colorado Governor's Energy Office 2007).

In addition to the Fourmile East SEZ, the BLM has proposed three other SEZs in the San Luis Valley: the Antonito Southeast SEZ (9,729 acres [39.4 km^2]), the De Tilla Gulch SEZ (1,522 acres [6.2 km^2]), and the Los Mogotes SEZ (5,918 acres [23.9 km^2]) (Figure 10.3.22.2-1). The four proposed SEZs together constitute 21,050 acres (85 km^2) of land and could provide as much as 3,368 MW of solar energy capacity. The Antonito Southeast and Los Mogotes SEZs are located about 40 mi (70 km) and 30 mi (48 km), respectively, to the southwest of the Fourmile East SEZ, and the De Tilla Gulch SEZ is about 50 mi (80 km) to the northwest.

Solar Energy Development. Several solar power projects are planned or underway in the San Luis Valley GDA. These include the following:

- *Xcel Energy/Sun Edison Project.* The 8.2-MW project began operations in August 2007. Located on 82 acres (0.3 km^2) of private land just west of CO 17 near Mosca in Alamosa County, the facility consists of three different solar technologies, including an array of PV panels, a PV system of single-axis trackers, and a system of CSP units. It generates power for distribution both within the San Luis Valley and outside the region.

- *Alamosa Solar Energy Project.* The 30-MW PV project will be located near Mosca, just west of CO 17 and 8 Mile Lane North, on private land currently being used for agriculture. The facility is being built by Iberdrola Renewables in two 15-MW phases and will connect to the San Luis Valley Substation, about 4.5 mi (7.2 km) to the west of the project site. A Special Use and Site Plan application was submitted to Alamosa County in July 2009; the first half of the facility is scheduled to begin operations in early 2011.

- *Greater Sandhill Solar Project.* Located on 200 acres (0.8 km^2) to the east of CO 17 near Mosca (across from the Xcel Energy/Sun Edison Project), the 17-MW PV facility to be built by Xcel Energy and SunPower has been approved by the Colorado Public Utilities Commission and will begin operations in 2011.

- *San Luis Valley Solar Project.* Tessera Solar North America submitted a Final 1041 Permit Application to Saguache County in June 2010 for a 200-MW dish engine solar facility to be built on a 1,525-acre (6.2-km^2) site near Saguache. The facility would employ 8,000 SunCatcher dish engines and cost $300 to $500 to build. It would use only 10 ac-ft/yr (12,335 m^3/yr) of water for operation and maintenance and would employ 45 full-time workers. The permit application identified expected significant effects of the proposed

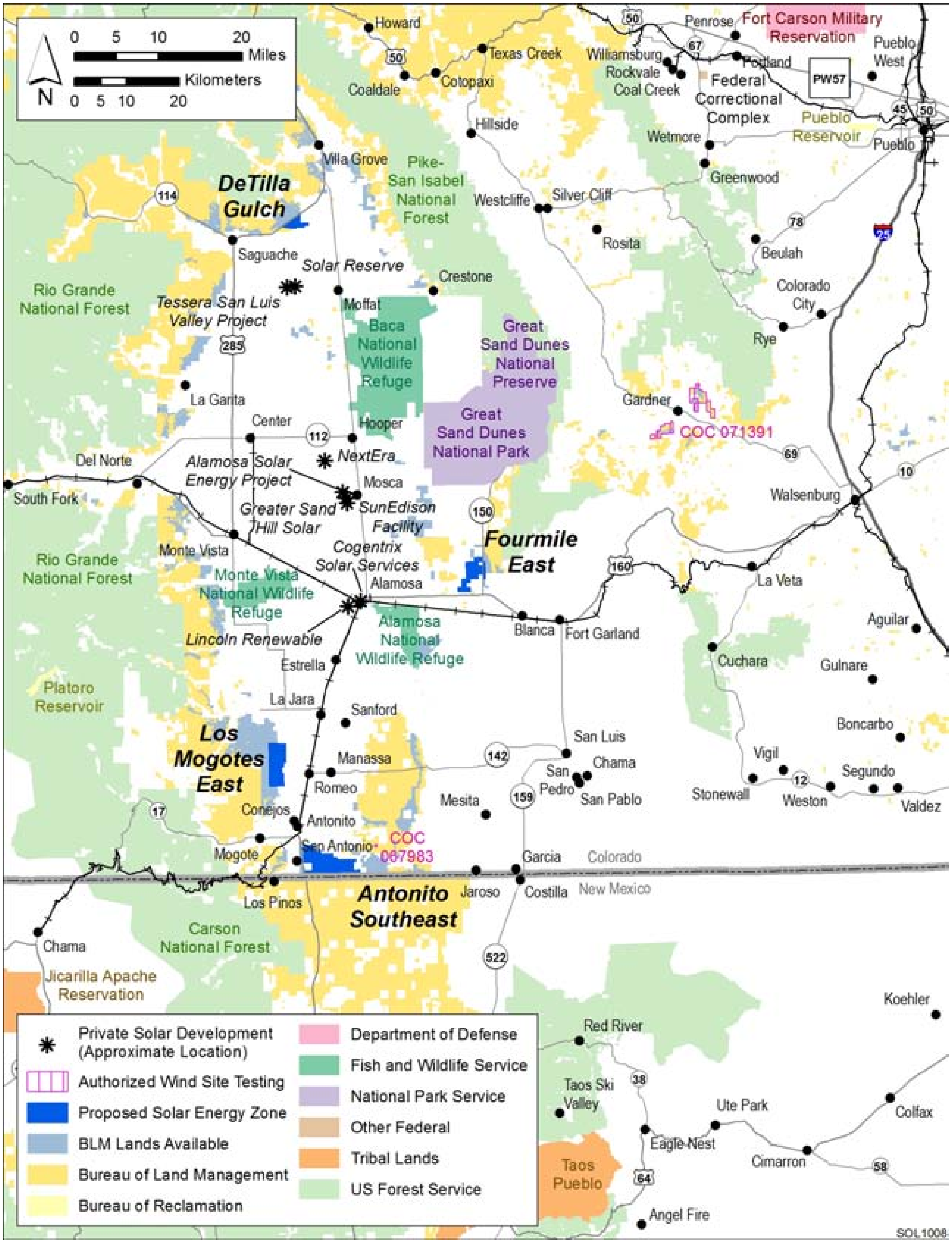

FIGURE 10.3.22.2-1 Existing and Proposed Energy Development Projects within the San Luis Valley

facility on visual resources and socioeconomics, while effects on biological, cultural, and water resources and from noise were expected to be not significant. Construction would start in late 2010 (TSNA 2010). Tessera has offered to sell power to Xcel Energy. A 500-ft (150-m) transmission line would be built to connect to an existing 230-kV line owned by Xcel.

- *Solar Reserve.* Solar Reserve submitted a preliminary 1041 Permit Application to Saguache County in July 2010 for a 200-MW solar tower facility. The project would be built in two 100-MW phases, each covering 1,400 acres (5.7 km2) and employing 17,500 heliostats serving a 650-ft (200-m) power tower in southern Saguache County. A power block will house a steam turbine generator and molten salt thermal energy storage tanks. The facility would use wet cooling. Total water required for operation would be up to 1,200 ac-ft/yr (1.48 million m^3/yr). An on-site switchyard would connect to an existing 230-kV line crossing the site. Construction would start in 2011 and operation in June 2013, employing 250 and 50 workers on average, respectively (Solar Reserve 2010).

- *Cogentrix Solar Services.* Cogentrix Energy plans to build a 30-MW PV facility near Alamosa. The facility would use dual-axis mounted concentrating solar cells from Amonix and would be the largest facility using this technology. The facility would cost $140 to $150 million and would be located on 225 acres (0.9 km^2) adjacent to an existing Xcel Energy transmission line. It would employ up to 140 during construction and 5 to 10 during operation, which would begin in mid-2012. Cogentrix would sell power to Xcel Energy.

- *Lincoln Renewables.* Alamosa County issued a permit to Lincoln Renewables in April 2010 to build a 37-MW PV facility on 255 acres (1.0 km^2) south of Alamosa. As of that date, the project was still in need of interconnection and power purchase agreements. Construction would be completed by 2012, employing 125 workers. Operation would require only a couple of full time workers.

- *NextEra.* Alamosa County issued a permit to NextEra in August 2010 to build a 30-MW PV facility on 279 acres (1.1 km^2) in northern Alamosa County. As of that date, the project was still in need of a power purchase agreement. Construction would start in 2011, employing 125 workers. Operation would require 1 to 3 full time workers. The plant would require a 3.5-mi (5.6-km) transmission line to connect to the power grid.

Transmission and Distribution Systems

Colorado SB 07-100 also directed rate-regulated utilities, such as Xcel Energy's Public Service Company of Colorado (Public Service), to develop plans to construct or expand transmission facilities to provide for the delivery of electric power consistent with the timing of the development of beneficial energy (including renewable) resources in Colorado. In response, Public Service has identified transmission-constrained areas in south-central Colorado, including the San Luis Valley and Walsenburg areas. Tri-State Generation and Transmission Association (Tri-State) and Public Service are proposing to construct a transmission project called the San Luis Valley–Calumet-Comanche Transmission project to meet the requirements of SB 07-100 and to improve the load service and system reliability throughout the San Luis Valley (Tri-State Generation and Transmission Association, Inc. 2008, 2009; Tri-State and Public Service Company of Colorado 2009) and are pursuing financial support from the USDA's Rural Utilities Service electric program. The proposed project would consist of four parts:

1. A new 345- to 230-kV substation called Calumet, located about 6 mi (10 km) north of Tri-State's existing Walsenburg Substation in Huerfano County;

2. A double-circuit 230-kV line between the San Luis Valley Substation just north of Alamosa and the Calumet Substation;

3. A new (second) single-circuit 230-kV line between the Calumet Substation and Tri-State's existing Walsenburg Substation; and

4. A new double-circuit 345-kV transmission line connecting the Calumet Substation to the existing Comanche Substation in Pueblo County.

Parts 2 and 3, the 230-kV projects between the San Luis Valley and Walsenburg to Calumet, would take the place of Tri-State's proposed San Luis Valley Electric System Improvement project.

The segment crossing the San Luis Valley would consist of a new double-circuit 230-kV transmission line extending 95 mi (153 km) from the San Luis Valley Substation near Alamosa eastward to the Walsenburg Substation. The San Luis Valley Substation would also be expanded to a five-breaker ring to allow for the two new 230-kV line bays and future generator interconnections (Tri-State Generation and Transmission Association, Inc. 2009).

A detailed EA of the San Luis Valley–Calumet-Comanche Transmission project is planned; public meetings were held in August 2009. Route refinement workshops are scheduled to occur by the end of 2010. The partnership plans to have the transmission lines in service by May 2013 (Tri-State and Public Service Company of Colorado 2009).

10.3.22.2.2 Other Actions

Other ongoing and reasonably foreseeable future actions within the San Luis Valley are identified in Table 10.3.22.2-2 and are described in the following sections.

TABLE 10.3.22.2-2 Reasonably Foreseeable Future Actions near the Proposed Fourmile East SEZ and in the San Luis Valley

Description	Status	Resources Affected	Primary Impact Location
Transportation			
Travel Management Plan (BLM)	Proposed	Transportation, ecological resources, recreation	San Luis Valley
Recreation			
Rio Grande Scenic Railroad	Ongoing	Visual, ecological resources, socioeconomics	San Luis Valley, including routes adjacent to the Fourmile East SEZ (Alamosa County)
Zapata Falls Campground Construction (BLM)	Proposed	Land use	North of Fourmile East SEZ
Water Management			
Rio Grande Compact	Ongoing	Water, ecological resources	San Luis Valley
San Luis Valley Project—Closed Basin Division Project (BOR)	Ongoing	Water, ecological resources	San Luis Valley
Sub-District 1 Water Management Plan (RGWCD)	Underway	Land use, water, ecological resources, socioeconomics	San Luis Valley
Conservation			
Old Spanish National Historic Trail Comprehensive Management Plan (BLM and NPS)	Proposed	Cultural, visual resources	San Luis Valley (and immediately east of the Fourmile SEZ)
Sangre de Cristo National Heritage Area	Ongoing	Cultural, visual resources	San Luis Valley (areas along the east side)
South San Luis Lakes Wetlands Restoration Project	EA issued Oct 2009	Wildlife, aquatic biota, vegetation, cultural resources, land use	About 8 mi (13 km) northwest of the Fourmile East SEZ

Mining and Mineral Processing

The nearest mining activity is an active sand and gravel pit on the east side of State Highway 150, about 3 mi (5 km) north of the northern border of the Fourmile East SEZ. There are no other mining or mineral processing activities in the immediate vicinity of the SEZ.

Grazing Management

Within the San Luis Valley, the BLM's La Jara and Saguache Field Offices authorize grazing use on public lands. The current average active grazing use authorized by these offices is 13,719 and 17,506 AUMs, respectively. While many factors could influence the level of authorized use, including livestock market conditions, natural drought cycles, increasing nonagricultural land development, and long-term climate change, it is anticipated that this average level of use will continue in the near term. Grazing use on private lands in the San Luis Valley is frequently (but not always) related to grazing use of public and other federal lands since it is common for federal grazing permittees to utilize USFS- and BLM-administered lands as part of their annual operating cycle. For these operations, a long-term reduction or increase in federal authorized grazing use would affect the value of the private grazing lands.

Transportation

The travel planning area addressed in the BLM's Travel Management Plan encompasses BLM lands within the San Luis Valley and includes portions of Saguache, Rio Grande, Alamosa, Conejos, and Costilla Counties. The plan for the San Luis Resource Area amends the San Luis Resource Area RMP by changing all area OHV designations of "OHV Open" to "OHV Limited" on various designated roads and trails. The two exceptions to the amendment are the Manassa area of 179 acres (0.7 km^2) and the Antonito area of 82 acres (0.3 km^2), which will be retained as OHV Open areas. Prior to this amendment, 389,279 acres (1,575 km^2) of the 520,945 acres (2,108 km^2) with OHV area designations (i.e., OHV Open, OHV Limited, OHV Closed) was designated as "OHV Open." The proposed ROD was signed on June 4, 2009 (BLM and USFS 2009).

Recreation

Planned and ongoing recreation activities include the following:

- *Rio Grande Scenic Railroad.* Operated by the SLR&G Railroad, the scenic railroad has about 17,600 visitors each year. Scenic routes run between Alamosa and La Veta, Alamosa and Monte Vista, and Alamosa and Chama (New Mexico) via Antonito. The route between Alamosa and La Veta is especially famous for traversing over the historic La Veta Pass, the highest point (at 9,242 ft [2,817 m]) that standard gauge track crosses the Rocky Mountains (RGSR 2009).

- *Zapata Falls* Campground *Construction.* The campground construction project near Zapata Falls (Sangre de Cristo Mountains) is to be completed by the BLM with ARRA funds. An EA for the action is underway.

Water Management

Water management is of great importance in the San Luis Valley because it supports agriculture and the raising of livestock, the primary economic activities in the valley. It is estimated that an average of more than 2.8 million ac-ft (3.5 billion m^3) of water enter and leave the valley each year. Surface water inputs are estimated to be about 1.2 million ac-ft (1.5 billion m^3), providing recharge to the valley's aquifers and nearly all the water for irrigation. Several actions by the State of Colorado, the RGWCD, and the BOR affect the distribution priorities of water in the San Luis Valley. These include the Rio Grande Compact, the San Luis Valley Project (Conejos and Closed Basin Divisions), and the recent Subdistrict 1 Water Management Plan.

Rio Grande Compact. The Rio Grande Compact is an agreement among the states of Colorado, New Mexico, and Texas signed in 1938 and ratified in 1939 to apportion the waters of the Upper Rio Grande Basin (north of Fort Quitman, Texas) among the three states The compact established a sliding scale for the annual volume of water that must be delivered to the Colorado–New Mexico border (as measured at the Lobatos streamflow gauge) that depends on the volume of water measured each year at the Del Norte, Colorado streamflow gauge. Under the compact, Colorado is obligated to provide an annual delivery of 10,000 ac-ft (12 million m^3) of water into the Rio Grande River at the Colorado–New Mexico state line (as measured at the Lobatos gauging station) less quantities available for depletion from the Rio Grande River at Del Norte and the Conejos River. If the delivery is not met, it creates a debit that has to be repaid in later years. Delivery requirements are administered by the State Engineer and the Colorado Division of Water Resources, Water Division III, in Alamosa (Hinderlider et al. 1939; SLV Development Resources Group 2007).

San Luis Valley Project—Closed Basin Division. Managed by the BOR, the Closed Basin Division Project withdraws groundwater from the unconfined aquifer in the northern part of the Rio Grande Basin to help Colorado meet its commitment to the states of New Mexico and Texas under the Rio Grande Compact. A series of salvage wells completed at depths of 85 to 110 ft (26 to 34 m) and with yields ranging from 50 to 1,100 gpm (190 to 4,200 L/min) pump groundwater into 115 mi (185 km) of pipeline laterals that connect to a PVC-lined conveyance channel with a design capacity of 45 to 160 ft^3s (1.3 to 4.5 m^3/s). Because the water quality varies, the pumped waters are blended in order to meet the quality terms of the Rio Grande Compact. The 42-mi (68-km) conveyance channel transports the water to the Rio Grande and also delivers water to the Alamosa National Wildlife Refuge, Blanca Wildlife Habitat Area, and San Luis Lake. Currently, water production averages less than 20,000 ac-ft/yr (25 million m^3/yr) (BOR 2009; USACE 2007; SLV Development Resources Group 2007).

Sub-District Water Management Plan. On May 11, 2009, the RGWCD submitted a revised draft Proposed Plan of Water Management to Colorado's Division 3 Water Court for approval on behalf of the Board of Managers of Special Improvement District 1 (also referred to as Subdistrict 1). Subdistrict 1 is composed of landowners within the RGWCD who rely on wells in the closed basin for all or part of their irrigation water supply. Because consumption within the subdistrict has increased (and currently exceeds the rate of natural recharge) and water levels within the unconfined aquifer are declining, its members are concerned about the sustainability of the water supply from the unconfined aquifer and are proposing reductions in total groundwater consumption to avoid adverse impacts, such as loss of well productivity, on irrigated agriculture in the San Luis Valley. The main objective of the management plan is to set up a voluntary system of self-regulation by using economic incentives to promote responsible irrigation water management and protect senior surface water rights as an alternative to state-imposed regulations that would limit well pumping within the subdistrict (RGWCD 2009).

The management plan proposes to permanently reduce the number of irrigated acres by 40,000, and Subdistrict 1 has made a proposal to the USDA for help in paying farmers to take their land out of production. By fallowing 40,000 acres (162 km^2) of irrigated cropland, the subdistrict hopes to mitigate depletions to the surface water system caused by well pumping, replenish groundwater in the unconfined aquifer, and eventually maintain a sustainable irrigation water supply. Achieving these goals would also ensure that Colorado meets its obligations under the Rio Grande Compact (RGWCD 2009; Hildner 2009a). On February 18, 2009, the Division 3 Water Court requested an amendment to lay out the time frame and methodology to determine and replace prior injurious depletions to the Rio Grande River, its tributaries, and senior water rights holders. An amended plan was accepted by the State Engineer's office in May 2009 (Hildner 2009b).

Conservation

There are several conservation-related projects and plans being implemented in the San Luis Valley. There include the following.

Old Spanish Historic Trail Comprehensive Management Plan. In preparation by the BLM and the NPS. The purpose of the plan is to provide a long-term strategy for managing and interpreting the Old Spanish Historic Trail.

Sangre de Cristo National Heritage Area. The Sangre de Cristo NHA was designated in March 2009. NHAs are designated by Congress and are intended to encourage the conservation of historic, cultural, and natural resources within the area of their designation. NHAs are managed by the NPS (Heide 2009; NPS 2009).

The Sangre de Cristo NHA covers more than 3,000 mi^2 (7,770 km^2) of land in Alamosa, Conejos, and Costilla Counties and encompasses the Monte Vista National Wildlife Refuge, the Baca National Wildlife Refuge, and the Great Sand Dunes National Park and Preserve. In addition, it has more than 20 cultural properties listed on the NRHP (including the Cumbres & Toltec Scenic Railroad). The NHA has been home to native tribes, Spanish explorers, and European settlers over more than 11,000 years of settlement (NPS 2009; SLV Development Resources Group 2009). Three of the four SEZs (Antonito Southeast, Fourmile East, and

Los Mogotes East) are within the Sangre de Cristo NHA; the De Tilla Gulch SEZ is about 15 mi (24 km) to the north.

South San Luis Lakes Wetlands Restoration Project. The San Luis Valley BLM La Jara Field Office is proposing to restore up to 1,330 acres (5.4 km^2) of wetlands within the South San Luis Lakes System. The project area includes approximately 534 acres (2.2 km^2) of public land managed by BLM and 1,992 acres (8.1 km^2) of land managed by The Nature Conservancy (TNC) located along the northern boundary of Blanca Wetlands ACEC, which would be expanded by this action. Irrigation water would be pumped from the Franklin-Eddy closed basin canal through a system of ditches and dikes designed to direct flow. An environmental assessment (EA) was issued in October 2009 (BLM 2009c) for irrigating approximately 342 acres (1.4 km^2) of BLM lands and 988 acres (4.0 km^2) of TNC lands in South San Luis Lakes. Ditch and dike construction would disturb no more than 5 acres (0.02 km^2) within the first two years and no more than one acre (0.004 km^2) per year thereafter. The project would provide habitat for shorebirds during migration and nesting seasons in concert with the Blanca Wetland's core area and replace habitat that is being dried in that area to aid wetland function (BLM 2009c).

Miscellaneous Other Actions

The BLM has several small-scale and administrative projects that require NEPA documentation that are not addressed individually in this cumulative impacts analysis. These include many that pertain to grazing permits, such as permit renewals, transfer of permits, changes in grazing dates (seasons), changes in pasture rotations; and changes in AUMs. Other small-scale projects on the NEPA register include the construction of a wildlife boundary fence, an illegal dump remediation project, rock removal, weed control, and a creek restoration project. Some of these projects could occur within 50 mi (80 km) of the Fourmile East SEZ.

10.3.22.3 General Trends

Table 10.3.22.3-1 lists general trends within the San Luis Valley with the potential to contribute to cumulative impacts; the trends are discussed in the following sections.

10.3.22.3.1 Population Growth

The 2006 official population estimate for the San Luis Valley (48,291) represents a 4.5% increase over that reported by the 2000 Census, with an annual increase of about 0.75% over the 6-year period (Table 10.3.22.3-2). The growth rate in Alamosa County over the same 6-year period was 5.3%. Alamosa County has the highest concentration of population in the San Luis Valley, with about 54% in the town of Alamosa. Population growth within the valley is expected to increase at a rate of about 0.6% each year from 2006 to 2011; then 1.1% each year after that to 2016. This represents about 60 to 70% of the projected Colorado statewide growth

TABLE 10.3.22.3-1 General Trends in the San Luis Valley

General Trend	Impacting Factors
Population growth	Urbanization Increased use of roads and traffic Land use modification Employment Education and training Increased resource use (e.g., water and energy) Tax revenue
Energy demand	Increased resource use Energy development (including alternative energy sources) Energy transmission and distribution
Water availability	Drought conditions and water loss Conservation practices Changes in water distribution
Climate change	Water cycle changes Increased wildland fires Habitat changes Changes in farming production and costs

TABLE 10.3.22.3-2 Population Change in the San Luis Valley Counties and Colorado from 2000 to 2006, with Population Forecast to 2016

	Population			Population Forecast		
	2000	2006	Percent Increase 2000 to 2006	2011	2016	Percent Increase 2006 to 2016
San Luis Valley	46,190	48,291	4.5	51,293	54,765	18.6
Colorado	4,301,261	4,812,289	11.9	5,308,500	5,308,300	23.4
Counties						
Alamosa	14,966	15,765	5.3	16,948	18,326	22.5
Conejos	8,400	8,587	2.2	8,966	9,373	11.6
Saguache	5,917	6,568	11.0	7,078	7,582	28.1

Source: SLV Development Resources Group (2007).

rate of 1.0% (2006 to 2011) and 1.5% (2012 to 2016). In the 10-year period between 2006 and 2016, population growth within Alamosa County is projected to be 16.2% (SLV Development Resources Group 2007).

10.3.22.3.2 Energy Demand

The growth in energy demand is related to population growth through increases in housing, commercial floorspace, transportation, manufacturing, and services. Given that population growth is expected in the San Luis Valley (by as much as 19% between 2006 and 2016), an increase in energy demand is also expected. However, the EIA projects a decline in per capita energy use through 2030, mainly because of improvements in energy efficiency and the high cost of oil throughout the projection period. Primary energy consumption in the United States between 2007 and 2030 is expected to grow by about 0.5% each year, with the fastest growth projected for the commercial sector (at 1.1% each year). Transportation, residential, and industrial energy consumption are expected to grow by about 0.5%, 0.4%, and 0.1% each year, respectively (EIA 2009).

10.3.22.3.3 Water Availability

Significant water loss has occurred in the San Luis Valley over the past century. Since 1890, the average annual surface water flows of the Rio Grande River (near Del Norte) have averaged about 700,000 ac-ft (863 million m^3). Annual flows peaked in 1920 with a flow of 1 million ac-ft (1.2 billion m^3; about 143% of the average). The lowest annual flows were recorded in 2002 at 154,000 ac-ft (190 million m^3; about 24% of the average). Three of the five years between 2003 and 2007 have been below the average; although flows in 2007 have measured slightly above it (710,000 ac-ft or 876 million m^3). A comparison of streamflows across the valley shows a similar trend; with both surface water and groundwater data in 2002 indicating extreme to exceptional drought severity. Data from 2007, however, suggest a possible easing of the drought (Thompson 2002; SLV Development Resources Group 2007).

Water in the San Luis Valley is used predominantly for crop irrigation; including both center pivot and flood irrigation techniques. For a typical potato farm, a sprinkler system on a 125-acre (0.5-km^2) circle applies about 210 ac-ft (259,000 m^3) during a 100-day growing season, 70% of which (146 ac-ft or 180,000 m^3) is consumed in the growing crop. In comparison, flood irrigation (not common for potato farming) draws 290 ac-ft (358,000 m^3) during a 100-day growing season and consumes about 50% (144 ac-ft or 178,000 m^3). An alfalfa farm requires about one and a half times the water required by a typical potato or barley farm.
Table 10.3.22.3-3 compares daily water use by sector. Total daily water withdrawals and consumptive use are highest in Conejos County, a county that has a large share of its crops in alfalfa (accounting for greater than one-third of its water consumption) (SLV Development Resources Group 2007).

Over the past 20 years, groundwater consumption in the San Luis Valley has increased. This increase is attributed mainly to changes in crop patterns from less water-consumptive crops

TABLE 10.3.22.3-3 Daily Water Use by Sector in Colorado, 1995

	Withdrawals						
			Sector (Mgal)				
Region	Total (Mgal)	Percent Groundwater	Irrigation	Public Supply	Industrial	Consumptive Use (Mgal)
Alamosa	414	29	411 (109)[a]	2	2	171
Conejos	732	3.9	727 (111)	3	–[b]	264
Saguache	426	34	423 (210)	2	–	66
San Luis Valley	2,176	19	2,159	15	4	843
Colorado	13,840	16	12,735 (3,404)	705	123	5,235

[a] Number in parentheses represents the number of irrigated acres (in thousands) in the region (USGS 2000).

[b] A dash indicates no water use for the sector.

Source: SLV Development Resources Group (2007).

to more water-consumptive crops; changes in the type and frequency of irrigation; the increasing number of acres under irrigation; and more heavy reliance on wells that were formally only used sporadically for irrigation. These changes, combined with a declining water supply due to prolonged drought conditions over the past decade, have reduced the groundwater supply available for crop irrigation. Since 1976, it is estimated that the unconfined aquifer has lost more than 1 million ac-ft (1.2 billion m^3) (RGWCD 2009; SLV Development Resources Group 2007).

The severe drought recorded in 2002 marked an unparalleled situation in the San Luis Valley in terms of the lack of surface water supplies, a lack of precipitation, a lack of residual soil moisture, and poor vegetation health. Well production decreased significantly with declining groundwater levels in the unconfined aquifer and decreasing artesian pressure in the confined aquifer. In response, water conservation and irrigation strategies (including crop abandonment) were considered by area farmers to minimize water usage (and evapotranspiration rates) and reduce the risk of over-irrigating crops (Thompson 2002).

Most of the cities in the San Luis Valley draw their water from deep wells in the confined aquifer. Water used for the public supply is only a small fraction of that used for agriculture (Table 10.3.22.3-3). Because of drought conditions over the past decade, some residential wells in the San Luis Valley are drying up. Since 1972, the State Engineer has not allowed any new high-capacity wells (i.e., wells with yields greater than 300 gpm or 1,136 L/min) to be constructed in the confined aquifer (SLV Development Resources Group 2007).

The San Luis Valley has about 230,000 acres (931 km^2) of wetlands that provide important wildlife habitat. Only about 10% of the wetlands in the valley occur on public land; conservation efforts with landowner cooperation are becoming popular through the use of land trusts and similar alternatives. Streams, reservoirs, and lakes within the San Luis Valley provide high-quality water and, when sufficient water levels are present, support trout fisheries. Boating in the valley's streams, reservoirs, and lakes has declined in recent years. Drought impacts over the past decade have reduced the depths of surface water bodies in the valley; many are completely dry (SLV Development Resources Group 2007).

10.3.22.3.4 Climate Change

According to a recent report prepared for the CWCB (Ray et al. 2008), temperatures in Colorado have increased by about 2°F (1.1°C) between 1977 and 2006. Climate models project continued increasing temperatures in Colorado—as much as 2.5°F (1.4°C) by 2025 and 4°F (2.2°C) by 2050 (relative to the 1950 to 1999 baseline temperature). In 2050, seasonal increases in temperature could rise as much as 5°F (2.8°C) in summer and 3°F (1.7°C) in winter. These changes in temperature would have the effect of shifting the climate typical of the Eastern Plains of Colorado westward and upslope, bringing temperature regimes that currently occur near the Colorado-Kansas border into the Front Range.

Because of the high variability in precipitation across the state, current climate models have not been able to identify consistent long-term trends in annual precipitation. However, projections do indicate a seasonal shift in precipitation, with a significant increase in the proportion of precipitation falling as rain rather than snow. A precipitous decline in snowpack at lower elevations (below 8,200 ft [2,499 m]) is expected by 2050.

In the past 30 years, the onset of streamflows from melting snow (called the "spring pulse") has shifted earlier in the season by two weeks. This trend is expected to continue as spring temperatures warm. Projections also suggest a decline in runoff for most of the river basins in Colorado by 2050. Hydrologic studies of the Upper Colorado River Basin estimate average decreases in runoff of 6 to 20% by 2050 (as compared to the twentieth century average).[18] These changes in the water cycle, combined with increasing temperatures and related changes in groundwater recharge rates and soil moisture and evaporation rates, will increase the potential for severe drought and reduce the total water supply, while creating greater demand pressures on water resources.

In general, the physical effects of climate change in the western United States include warmer springs (with earlier snowmelt), melting glaciers, longer summer drought, and increased wildland fire activity (Westerling et al. 2006). All these factors contribute to detrimental changes to ecosystems (e.g., increases in insect and disease infestations, shifts in species distribution, and changing in the timing of natural events). Adverse impacts on human health, agriculture (crops and livestock), infrastructure, water supplies, energy demand (due to increased intensity of extreme weather and reduced water for hydropower), and fishing, ranching, and other resource-use activities are also predicted (Backlund et al. 2008; GAO 2007; NSTC 2008).

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[18] The effects of climate change are not as well studied in the Rio Grande Basin as in the Upper Colorado River Basin.

The State of Colorado has plans to reduce its GHG emissions by 80% over the next 40 years (Ritter 2007). Initiatives to accomplish this goal will focus on modifying farm practices (e.g., less frequent tilling, improving storage and management of livestock manure, and capturing livestock-produced methane), improving standards in the transportation sector, providing reliable and sustainable energy supplies (e.g., small-scale hydropower, solar, wind, and geothermal energy), and joining the Climate Registry of North American GHG emissions, among others.

10.3.22.4 Cumulative Impacts on Resources

This section addresses potential cumulative impacts in the proposed Fourmile East SEZ on the basis of the following assumptions: (1) because of the relatively small size of the proposed SEZ (less than 10,000 acres [40.5 km^2]), only one project would be constructed at a time, and (2) maximum total disturbance over 20 years would be about 3,105 acres (12.6 km^2) (80% of the entire proposed SEZ). For purposes of analysis, it is also assumed that no more than 3,000 acres (12.1 km^2) would be disturbed per project annually and 250 acres (1.01 km^2) monthly on the basis of construction schedules planned in current applications. In addition, about 2 mi (3.2 km) of new transmission line will be needed to reach the nearest existing line, a 69-kV transmission line located to the south of the Fourmile East SEZ. Another alternative would be connecting to a 230-kV transmission line about 8 mi (13 km) to the north of the SEZ. The cumulative impacts discussions in this section include the impacts that would be associated with these potential transmission line connections. The SEZ would most likely be accessed from existing CO 150 running within the eastern boundary of the SEZ, and therefore, no road construction outside of the SEZ would be needed for development to occur in the SEZ.

Cumulative impacts would result from the construction, operation, and decommissioning of solar energy development projects within the proposed SEZ and any associated transmission lines outside the SEZ, when added to impacts from other past, present, and reasonably foreseeable future actions described in the previous section in each resource area. At this stage of development, because of the uncertain nature of the future projects in terms of location within the proposed SEZ, size, number, and the types of technology that would be employed, the impacts are discussed qualitatively or semi-quantitatively, with ranges given as appropriate. More detailed analyses of cumulative impacts would be performed in the environmental reviews for the specific projects in relation to all other existing and proposed projects in the geographic areas.

10.3.22.4.1 Lands and Realty

The area covered by the proposed Fourmile East SEZ is largely undeveloped and is rural in nature. There is currently a proposed transmission corridor that fully covers the SEZ. This represents a potential conflict with future solar development in the SEZ. Construction of utility-scale solar energy facilities within the SEZ would preclude use of those areas occupied by the solar energy facilities for other purposes. The areas that would be occupied by the solar facilities would be fenced, and access to those areas by both the general public and wildlife would be eliminated. Traditional uses of public lands (there is no agriculture on these sites) would no longer be allowed.

If the area is developed as an SEZ, it is likely that improvements to the infrastructure and increased availability of energy from the solar facilities could attract other users to the area. As a result, the area could acquire more industry, and additional solar energy facilities may be built outside of the SEZ on private lands. Development of the SEZ could introduce a highly contrasting industrialized land use into areas that are largely rural. Consequently, the contribution to cumulative impacts of utility-scale solar projects on public lands on and around the Fourmile East SEZ could be significant, particularly if the SEZ is fully developed with solar projects.

10.3.22.4.2 Specially Designated Areas and Lands with Wilderness Characteristics

There are no specially designated areas within the SEZ, but there are such areas in the general vicinity within the viewshed of the SEZ. These areas include the BLM-administered Zapata Falls SRMA and Blanca Wetlands SRMA/ACEC, Sangre de Cristo Wilderness, and Great Sand Dunes National Park. In addition, several scenic byways and a National Historic Trail (the Old Spanish National Historic Trail) pass nearby the SEZ. Construction of utility-scale solar energy facilities within the SEZ would have the potential for cumulatively contributing to the visual impacts on these specially designated areas and lands with wilderness character. The exact nature of impacts would depend on the specific technologies employed and the locations selected within the SEZ. These impacts would be in addition to impacts from any other ongoing or future activities. However, development of the SEZ, especially full development, would be a dominant factor in the viewshed from large portions of these specially designated areas and lands with wilderness character.

10.3.22.4.3 Rangeland Resources

The SEZ includes portions of two grazing allotments. If utility-scale solar facilities are constructed on the SEZ, those areas occupied by the solar projects would be excluded from grazing. Depending on the number and size of potential projects, the impact on one of the rangers who currently utilize the same lands could be significant. If water rights supporting agricultural use are purchased to support solar development, some areas that are currently farmed by using that water would be converted to dryland uses.

Because there are no wild horse HMAs in the vicinity of the proposed SEZ, solar energy development would not contribute to cumulative impacts on wild horses and burros managed by the BLM.

10.3.22.4.4 Recreation

It is likely that limited outdoor recreation (e.g., backcountry driving, OHV use, and small game hunting) occurs on or in the immediate vicinity of the SEZ. Construction of utility-scale solar projects on the SEZ would preclude recreational use of the affected lands for the duration of the projects. However, increased availability of access roads could increase the amount of recreational use in unaffected areas of the SEZ or in the immediate vicinity. There would be a potential for visual impacts on recreational users of the surrounding specially designated areas and lands with wilderness character (Section 10.3.22.4.2). The overall cumulative impacts on recreation could be large for the users of the areas affected by the solar projects, but would be relatively small for users of areas outside of the affected areas.

10.3.22.4.5 Military and Civilian Aviation

The SEZ is located under an MTR. The San Luis Valley Regional airport is located near Alamosa, about 12 mi (19 km) west-southwest of the SEZ. Recent information from DoD indicates that there are no concerns about solar development in the SEZ. Considering other ongoing and reasonably foreseeable future actions discussed in Section 10.3.22.2, the cumulative impacts on military and civilian aviation from the solar energy development in the proposed SEZ would be small.

10.3.22.4.6 Soil Resources

Ground-disturbing activities (e.g., grading, excavating, and drilling) during the construction phase of a solar project, including any associated transmission lines, would contribute to the soil loss due to wind erosion. Construction of new roads within the SEZ, or improvements to existing roads would also contribute to soil erosion. During construction, operations, and decommissioning of the solar facilities, travel back and forth by the workers at the facilities, visitors and delivery personnel to the facilities, or waste haulers from the facilities would also contribute to soil loss. These losses would be in addition to losses occurring as a result of disturbance caused by other users in the area, including from construction of other renewable energy facilities, recreational users, and agricultural users. Erosion of exposed soils could also lead to the generation of fugitive dust, which could affect local air quality (see Section 10.3.22.4.12). Programmatic and SEZ-specific design features would be employed to minimize erosion and loss of soil during the construction, operation, and decommissioning phases of the solar facilities and any associated transmission lines. Overall, SEZ contributions to cumulative impacts on soil resources would be small and temporary during the construction and decommissioning of the facilities.

Landscaping of solar energy facility areas could alter drainage patterns and lead to increased siltation of surface water streambeds, in addition to that from other development activities and agriculture. However, with the required design features in place, cumulative impacts would be small.

10.3.22.4.7 Minerals (Fluids, Solids, and Geothermal Resources)

There are no mining claims or oil and gas leases in the SEZ. Lands in the SEZ were recently closed to "locatable mineral" entry, pending the outcome of this PEIS. These lands would continue to be closed to all incompatible forms of mineral development if the area is designated as an SEZ. However, some mineral uses might be allowed. For example, oil and gas development utilizing directional drilling techniques would still be possible. Also, the production of common minerals, such as sand and gravel and mineral materials used for road construction, might take place in areas not directly developed for solar energy production. No geothermal development has occurred within or adjacent to the SEZ, nor are there any known or expected future development of geothermal resources in the same area.

10.3.22.4.8 Water Resources

The water requirements for various technologies if they were to be employed on the proposed SEZ to develop utility-scale solar energy facilities are described in Sections 10.3.9.2. It is stated that if the SEZ was to be fully developed over 80% of its available land area, the amount of water needed during the peak construction year for all evaluated solar technologies would be 686 to 964 ac-ft (846,200 to 1.2 million m^3). During operations, the amount of water needed would be a strong function of the cooling technology employed, ranging from 17 ac-ft/yr (21,000 m^3/yr) for PV systems to as high as 9,325 ac-ft/yr (11.5 million m^3/yr) for wet-cooled technologies. The amount of water needed during decommissioning would be similar to or less than the amount used during construction. These numbers would compare with 835 ac-ft/day (305,017 ac-ft/yr) in Alamosa County that was withdrawn from surface water and groundwater resources in 2005. Therefore, cumulatively, the additional water resource needed for solar facilities in the SEZ would constitute a relatively small increment (0.006 to 3%, the ratio of the annual operations water requirement to the annual amount withdrawn in Alamosa County). However, as discussed in Sections 10.3.9.1.3, the water resources in the area are fully appropriated, and any new users would have to purchase a more senior water right (e.g., an old irrigation right), retire that historic consumptive use, and transfer that amount of historic consumptive use to the new project. Additionally, the proposed water management rules being developed for the Rio Grande Basin will impose limits on groundwater withdrawals and set requirements for having augmentation water plans that can affect the process of securing water supplies (see Sections 10.3.9.1.3 and 10.3.9.2.4). The strict management of water resources in the Rio Grande Basin acts to ensure that any impacts from a new water use would continue to be equivalent or less than those from current uses, and no net increase would occur in the total amount of water used.

Small quantities of sanitary wastewater would be generated during the construction and operation of the potential utility-scale solar energy facilities. The amount generated from solar facilities would be in the range of 9 to 74 ac-ft (11,100 to 91,300 m^3) during the peak construction year and would range from less than 1 to 9 ac-ft/yr (up to 11,100 m^3/yr) during operations. Because of the small quantity, the sanitary wastewater generated by the solar energy facilities would not be expected to put undue strain on available sanitary wastewater treatment facilities in the general area of the SEZ. For technologies that rely on conventional wet or dry-cooling systems, there would also be from 98 to 176 ac-ft/yr (120,900 to 217,100 m^3) of blowdown water from cooling towers. This water would be treated on-site (e.g., in settling ponds) and injected into the ground, released to surface water bodies, or reused.

10.3.22.4.9 Vegetation

The proposed Fourmile East SEZ is located within the Salt Flats ecoregion, which supports shrubland plant communities. These plant community types generally have a wide distribution within the San Luis Valley area, and thus other ongoing and reasonably foreseeable future actions would have a cumulative effect on them. Because of the long history of livestock grazing, the plant communities present within the SEZ have likely been affected by grazing. If utility-scale solar energy projects were to be constructed within the SEZ, all vegetation within the footprints of the facilities would likely be removed during land-clearing and land-grading operations. In addition, any wetlands within the footprint of the facility would need to be avoided or impacts mitigated. Wetland or riparian habitats outside of the SEZ that are supported by groundwater discharge could be affected by hydrologic changes resulting from project activities. The fugitive dust generated during the construction of the solar facilities could increase the dust loading in habitats outside a solar project area, which could result in reduced productivity or changes in plant community composition. Similarly, surface runoff from project areas after heavy rains could increase sedimentation and siltation in areas downstream. Other activities that would contribute to the overall dust generation in the area would include construction of new solar facilities or other facilities, agriculture, recreation, and transportation. Implementation of programmatic and SEZ-specific design features would reduce the impacts from solar energy projects and thus reduce the overall cumulative impacts on plant communities and habitats.

10.3.22.4.10 Wildlife and Aquatic Biota

As discussed in Section 10.3.11, a number of amphibian, reptile, bird, and mammal species occur in and around the proposed Fourmile East SEZ. The construction of utility-scale solar energy projects in the SEZ and any associated transmission lines and roads in or near the SEZ would affect wildlife through habitat disturbance (i.e., habitat reduction, fragmentation, and alteration), wildlife disturbance, and wildlife injury or mortality. Unless mitigated, these impacts, when added to impacts that would result from other activities in the general area, could be moderate to large. In general, impacted species with broad distributions and occurring in a variety of habitats would be less affected than species with a narrowly defined habitat within a restricted area. Implementation of programmatic and SEZ-specific design features would reduce the severity of impacts on wildlife. The design features include pre-disturbance biological surveys to identify key habitat areas used by wildlife followed by avoidance or minimization of disturbance to those habitats.

The proposed Fourmile SEZ is quite distant from the other three proposed SEZs in the San Luis Valley. These developments are likely too far away from the Fourmile SEZ to have cumulative impacts on wildlife and aquatic biota. Also, the operating and planned solar facilities on private lands near the Fourmile East SEZ are small, and therefore not likely to result in cumulative impacts on wildlife and aquatic biota. Additionally, many of the wildlife species have extensive available habitat within the affected counties (e.g., elk and pronghorn). Nevertheless, other ongoing and reasonably foreseeable future actions (Section 10.3.22.2) could have a cumulative impact on wildlife. Where projects are closely spaced, the cumulative impact on a particular species could be moderate to large. For example, solar energy development in the proposed Fourmile East SEZ would encompass an area of severe winter range for elk. The implementation of programmatic and SEZ-specific design features would reduce the impacts from solar energy projects and thus reduce the overall cumulative impacts on wildlife.

There are no permanent water bodies or perennial streams within the boundaries of the proposed SEZ or within the potential transmission line connections. A small number of palustrine wetlands with emergent plant communities have been identified at or just outside the western boundary of the SEZ (Section 10.3.11.4). Cumulative impacts on aquatic biota and habitats resulting from solar facilities within the SEZ and other reasonably foreseeable activities would most likely occur as a result of groundwater drawdown or sedimentation of downgradient streams. Although there may be a small net increase in impacts on aquatic biota in certain areas around the SEZ, since net groundwater use should not change because of regulations governing use in the San Luis Valley, cumulative impacts on aquatic biota and habitats from groundwater drawdown should not occur. Programmatic and SEZ-specific design features to prevent erosion and sedimentation could reduce cumulative impacts on stream habitat and aquatic biota.

10.3.22.4.11 Special Status Species (Threatened, Endangered, Sensitive and Rare Species)

One species listed under the ESA (southwestern willow flycatcher) has the potential to occur within the affected area of the SEZ. The Gunnison's prairie dog is the only species that is a candidate for listing as threatened or endangered under the ESA that occurs on or near the proposed Fourmile East SEZ. Two species occurring on or in the vicinity of the SEZ are listed as threatened or endangered by the State of Colorado (southwestern willow flycatcher and bald eagle). In addition, 15 species are listed as sensitive by the BLM. The impacts of full-scale solar energy development on threatened, endangered, and sensitive species would be minimized if design features were implemented, including avoidance of habitat and minimization of erosion, sedimentation, and dust deposition; avoidance of occupied areas; and translocation of individuals. This approach would also minimize the contribution of potential solar energy projects to cumulative impacts on protected species.

Solar facilities in the proposed De Tilla Gulch, Antonito Southeast, and Los Mogotes SEZs, are likely too far away from the Fourmile East SEZ to have cumulative impacts on special status species. Also, the operating and planned solar facilities on private lands near the Fourmile East SEZ are small, and therefore not likely to result in cumulative impacts on special status species. However, depending on other projects occurring in the area at a given time, there may still be some cumulative impacts on protected species. Other projects would likely also employ mitigation measures to reduce or eliminate the impacts on protected species as required by the ESA and other applicable federal and state laws and regulations.

10.3.22.4.12 Air Quality and Climate

While solar energy generates minimal emissions compared with fossil fuels, the site preparation and construction activities associated with solar energy facilities would be responsible for some amount of air pollutants. Most of the emissions would be particulate matter (fugitive dust) and emissions from vehicles and construction equipment. When these emissions are combined with those from other projects near solar energy development or when they are added to natural dust generation from winds and windstorms, the air quality in the general vicinity of the projects could be temporarily degraded. For example, the maximum 24-hour PM_{10} concentration at or near the SEZ boundaries could at times exceed the applicable standard of 150 $\mu g/m^3$. The dust generation from the construction activities can be controlled by implementing aggressive dust control measures, such as increased watering frequency, or road paving or treatment.

Other planned energy production and distribution activities in the San Luis Valley include construction and operation of two smaller (less than 300 acres [1.2 km^2]) PV facilities near the Fourmile East SEZ, and construction of a power line running east from Alamosa to Walsenburg. In addition, a 30-MW PV facility is being constructed in Colfax County in northeastern New Mexico. Construction of these projects would result in a temporary increase in particulate emissions.

Over the long term and across the region, the development of solar energy may have beneficial cumulative impacts on the air quality and atmospheric values by offsetting the need for energy production that results in higher levels of emissions, such as coal, oil, and natural gas. As discussed in Section 10.3.13, during operations of solar energy facilities, only a few sources of air emissions exist, and their emissions would typically be relatively small. However, the amount of criteria air pollutant, VOC, TAP, and GHG emissions that would be avoided if the solar facilities were to displace the energy that otherwise would have been generated from fossil fuels could be relative large. For example, if the Fourmile East SEZ was fully developed with solar facilities up to 80% of its size, the quantity of pollutants avoided could be as large as 2.3% of all emissions from the current electric power systems in Colorado.

10.3.22.4.13 Visual Resources

The San Luis Valley floor is very flat and is characterized by wide open views. Generally good air quality and a lack of obstructions allow visibility for 50 mi (80 km) or more under favorable atmospheric conditions. The proposed SEZ is a generally flat to gently rolling, largely treeless plain, with the strong horizon line being the dominant visual feature. The VRI values for the SEZ and immediate surroundings are VRI Class III, indicating moderate relative visual values. The inventory indicates relatively low levels of use and public interest; however, the site is within the viewshed of the Los Caminos Antiguos Scenic Byway, the Old Spanish National Historic Trail, lands with wilderness characteristics, and several other specially designated areas, indicating high visual sensitivity.

Development of utility-scale solar energy projects within the SEZ would contribute to the cumulative visual impacts in the general vicinity of the SEZ and in the San Luis Valley. However, the exact nature of the visual impact and the mitigation measures that would be appropriate would depend on the specific project locations within the SEZ and on the solar technologies used for the projects. Such impacts and potential mitigation measures would be considered in visual analyses conducted for future specific projects. In general, large visual impacts on the SEZ would be expected to occur as a result of the construction, operation, and decommissioning of utility-scale solar energy projects. These impacts would be expected to involve major modification of the existing character of the landscape and could dominate the views for some nearby viewers. Additional impacts would occur as a result of the construction, operation, and decommissioning of related facilities, such as access roads and electric transmission lines.

Because of the large size of utility-scale solar energy facilities and the generally flat, open nature of the proposed SEZ, some lands outside the SEZ would also be subjected to visual impacts related to the construction, operation, and decommissioning of utility-scale solar energy development. Some of the affected lands outside the SEZ would include potentially sensitive scenic resource areas, including a high-potential segment of the Old Spanish National Historic Trail, the Sangre de Cristo Wilderness, Blanca Wetlands Area, and the Los Caminos Antiguos Scenic Byway.

Visual impacts resulting from solar energy development within the SEZ would be in addition to impacts caused by other potential projects in the area such as other solar facilities on private lands, transmission lines, and other renewable energy facilities, like wind mills. The presence of new facilities would normally be accompanied by increased numbers of workers in the area, traffic on local roadways, and support facilities, all of which would add to cumulative visual impacts.

In addition to cumulative visual impacts associated with views of particular future development, as additional facilities are added, several projects might become visible from one location, or in succession, as viewers move through the landscape, such as driving on local roads. In general, the new facilities would likely vary in appearance, and, depending on the number and type of facilities, the resulting visual disharmony could exceed the visual absorption capability of the landscape and add significantly to the cumulative visual impact.

10.3.22.4.14 Acoustic Environment

The areas around the proposed Fourmile East SEZ and in the San Luis Valley area, in general, are relatively quiet. The existing noise sources include road traffic, railroad traffic, aircraft flyover, agricultural activities, and animal noise along with hunting. The construction of solar energy facilities could increase the noise levels over short durations because of the noise generated by construction equipment during the day. After the facilities are constructed and begin operating, there would be little or minor noise impacts for any of the technologies except from solar dish engine facilities and from parabolic trough or power tower facilities using TES. If one or more of these types of facilities were constructed close to the boundaries of the SEZ, residents living nearby could be affected by the noise generated by these machines, particularly at night, when the noise is more discernable due to relatively low background levels.

10.3.22.4.15 Paleontological Resources

Little surveying for paleontological resources has been conducted in the San Luis Valley. For reasons described in Section 10.3.16, impacts on significant paleontological resources are possible in the proposed SEZ. However, the specific sites selected for future projects would be surveyed, if determined necessary by the BLM, and any paleontological resources discovered through surveys or during the construction of the projects would be avoided or mitigated to the extent possible. No significant cumulative impacts on paleontological resources are expected.

10.3.22.4.16 Cultural Resources

The San Luis Valley is rich in cultural history with settlements dating as far back as 11,000 years. Several geographic features in the valley may have cultural significance. The area occupied by the proposed SEZ has not been surveyed for cultural resources, although six archaeological sites have been recorded within the SEZ. The area has a high potential for containing archaeological sites, including a potential for human burials, In addition, a high-potential segment of the congressionally designated Old Spanish National Historic Trail, which follows a north-south direction to the northeast of the Fourmile East SEZ, is located approximately 1 mi (1.6 km) from the SEZ. Development of utility-scale solar energy projects in the SEZ, when added to other potential projects likely to occur in the area, would contribute cumulatively to cultural resource impacts on archaeological sites and visual impacts on traditionally significant cultural properties (Blanca Peak, San Luis Lakes and Great Sand Dunes) and the congressionally designated National Historic Trail. The specific sites selected for future projects would be surveyed, and any cultural resources discovered through surveys or during the construction of the projects would be avoided or mitigated to the extent possible. Similarly, through ongoing consultation with the Colorado SHPO and appropriate Native American governments, it is likely that many adverse effects on significant resources in the San Luis Valley could be mitigated to some degree; however some adverse effects may not be mitigable.

10.3.22.4.17 Native American Concerns

Government-to-government consultation is underway with Native American governments with possible traditional ties to the San Luis Valley. To date, no specific concerns regarding the proposed Fourmile East SEZ have been raised to the BLM. The Jicarilla Apache have judicially established Tribal land claims south of the SEZ, and the Cheyenne and Arapaho, Northern Cheyenne, and Northern Arapaho have judicially established Tribal land claims north of the SEZ. On the basis of available maps, however, these claims do not appear to include any portions of the SEZ and should not contribute to any impacts on those claims. The San Luis Lakes, the Great Sand Dunes, and Blanca Peak have been identified within the valley as culturally significant locations for the Navajo, Ute, and Tewa Clans of the Upper Rio Grande

Pueblos. Blanca Peak is also potentially significant to the Jicarilla Apache. It is possible that the development of utility-scale solar energy projects in the Fourmile East SEZ, when added to other potential projects likely to occur in the area, could contribute cumulatively to visual impacts in the valley as viewed from these locations and to the loss of traditionally important plant species and animal habitat, as well as to additional cultural resource impacts on archaeological sites of interest to the Tribes, especially to any human burials encountered. Continued discussions with the area Tribes through government-to-government consultation is necessary to effectively consider and mitigate the Tribes' issues of concern tied to solar energy development in the San Luis Valley.

10.3.22.4.18 Socioeconomics

Solar energy development projects in the proposed Fourmile East SEZ could cumulatively contribute to socioeconomic effects in the immediate vicinity of the SEZs and in the surrounding multicounty ROI. The effects could be positive (e.g., creation of jobs and generation of extra income, increased revenues to local governmental organizations through additional taxes paid by the developers and workers) or negative (e.g., added strain on social institutions such as schools, police protection, and health care facilities). Impacts from solar development would be most intense during facility construction, but of greatest duration during operations. Construction would temporarily increase the number of workers in the area needing housing and services in combination with temporary workers involved in other new development in the area, including other renewable energy development. The number of workers involved in the construction of solar projects in the peak construction year could range from about 120 to 1,600 depending on the technology being employed, with solar PV facilities at the low end and solar trough facilities at the high end. The total number of jobs created in the area could range from approximately 210 (solar PV) to as high as 2,800 (solar trough). Construction of transmission line connections would only add a minimal number of workers in the ROI; with approximately two workers directly involved in the construction of transmission lines and five total additional jobs created in the general vicinity. Cumulative socioeconomic effects in the ROI from construction of solar facilities would occur to the extent that multiple construction projects of any type were ongoing at the same time. It is a reasonable expectation that this condition would occur within a 50-mi (80-km) radius of the SEZ occasionally over the 20-or-more year solar development period.

Annual impacts during the operation of solar facilities would be less, but of 20- to 30-year duration, and could combine with those from other new facilities in the area. The number of workers needed at the solar facilities would be in the range of 7 to 135, with approximately 9 to 203 total jobs created in the region. Population increases would contribute to general upward trends in the region in recent years. The socioeconomic impacts overall would be positive, through the creation of additional jobs and income. The negative impacts, including some short-term disruption of rural community quality of life, would not likely be considered large enough to require specific mitigation measures.

10.3.22.4.19 Environmental Justice

Both minority and low-income populations have been identified within 50 mi (80 km) of the proposed SEZ. Any impacts from solar development could have cumulative impacts on minority and low-income populations in combination with other development in the area. Such impacts could be both positive, such as from increased economic activity, and negative, such as visual impacts, noise, fugitive dust, and loss of agricultural jobs from conversion of lands. However, these impacts are not expected to be disproportionately high on the minority and low-income populations. If needed, mitigation measures can be employed to reduce the impacts on the population in the vicinity of the SEZ, including the minority and low-income populations. As the overall scale and environmental impacts from potential development within the ROI are expected to be generally low, it is not expected that the proposed Fourmile East SEZ would contribute to cumulative impacts on minority and low-income populations.

10.3.22.4.20 Transportation

A two-lane highway (U.S. 160) passes near the southern border of the proposed Fourmile East SEZ. State Route 150 runs north-south through the eastern portion of the SEZ and joins U.S. 160 to the south. The SLRG Railroad also serves the area. The AADT on these highways currently ranges from about 600 on State Route 150 to 19,000 on U.S. 160 near Alamosa. During construction activities, there could be up to 1,000 workers commuting to the construction site at the SEZ, which could increase the AADT on these highways by 2,000 vehicles. This increase in highway traffic from construction workers could have moderate cumulative impacts in combination with existing traffic levels and increases from additional future development in the area. State Route 150 and any site access roads connected to it would require road improvements to handle the additional traffic. Any impacts during construction activities would be temporary. The impacts could be mitigated to some degree by staggered work hours and ride-sharing programs. Traffic increases during operation would be relatively small because of the low number of workers needed to operate solar facilities and would have little contribution to cumulative impacts.

10.3.23 References

Note to Reader: This list of references identifies Web pages and associated URLs where reference data were obtained for the analyses presented in this PEIS. It is likely that at the time of publication of this PEIS, some of these Web pages may no longer be available or their URL addresses may have changed. The original information has been retained and is available through the Public Information Docket for this PEIS.

AECOM (Architectural Engineering, Consulting, Operations and Maintenance), 2009, *Project Design Refinements*. Available at http://energy.ca.gov/sitingcases/beacon/documents/applicant/refinements/002_WEST1011185v2_Project_Design_Refinements.pdf. Accessed Sept. 2009.

Alamosa-La Jara Water Users Protection Association v. Gould, 1983, 674 P.2d 914, 931 Colo.

AMA (American Medical Association), 2009, *Physician Characteristics and Distribution in the U.S.*, Chicago, Ill. Available at http://www.ama-assn.org/ama/pub/category/2676.html.

Backlund, P., et al., 2008, *The Effects of Climate Change on Agriculture, Land Resources, Water Resources, and Biodiversity in the United States*, Synthesis and Assessment Product 4.3, U.S. Climate Change Science Program and the Subcommittee on Global Change Research, Washington, D.C., May. Available at http://www.sap43.ucar.edu/documents/SAP_4.3_6.18.pdf. Accessed July 2008.

Beacon Solar, LLC, 2008, *Application for Certification for the Beacon Solar Energy Project*, submitted to the California Energy Commission, March. Available at http://www.energy.ca.gov/sitingcases/beacon/index.html.

Beranek, L.L., 1988, *Noise and Vibration Control*, rev. ed., Institute of Noise Control Engineering, Washington, D.C.

BLM (Bureau of Land Management), 1980, *Green River—Hams Fork Draft Environmental Impact Statement: Coal*, Denver, Colo.

BLM, 1983, *Final Supplemental Environmental Impact Statement for the Prototype Oil Shale Leasing Program,* Colorado State Office, Denver, Colo., Jan.

BLM, 1984, *Visual Resource Management*, BLM Manual Handbook 8400, Release 8-24, U.S. Department of the Interior.

BLM, 1986a, *Visual Resource Inventory*, BLM Manual Handbook 8410-1, Release 8-28, U.S. Department of the Interior, Jan.

BLM, 1986b, *Visual Resource Contrast Rating*, BLM Manual Handbook 8431-1, Release 8-30, U.S. Department of the Interior, Jan.

BLM, 1991, *San Luis Resource Area*, *Proposed Resource Management Plan and Final Environmental Impact Statement,* U.S. Department of the Interior, Sept.

BLM, 1996, *White River Resource Area Proposed Resource Management Plan and Final Environmental Impact Statement*, Colorado State Office, White River Resource Area, Craig District, Colo., June.

BLM, 2001, *Colorado Water Rights Fact Sheet*. Available at http://www.blm.gov/nstc/WaterLaws/colorado.html. Accessed Nov. 2009.

BLM, 2007, *Proposed Oil Shale and Tar Sands Resource Management Plan Amendments to Address Land Use Allocations in Colorado, Utah, and Wyoming and Programmatic Environmental Impact Statement,* FES 08-2, Sept.

BLM, 2008*, Assessment and Mitigation of Potential Impacts to Paleontological Resources*, Instruction Memorandum No. 2009-011, with attachments, Washington, D.C., Oct. 10.

BLM, 2009a*, Rangeland Administration System*. Available at http://www.blm.gov/ras/index.htm. Last updated Aug. 24, 2009. Accessed Nov. 24, 2009.

BLM, 2009b, *Environmental Assessment, Zapata Falls Campground Construction Project,* MT-DOI-BLM-CO-140-2009-017-EA, Dec. 7.

BLM, 2009c, *South San Luis Lakes Wetland Restoration Project Environmental Assessment,* DOI-BLM-CO-140-2010-009-EA, Oct. 28.

BLM, 2010a, *San Luis Valley Resource Area Noxious and Invasive Species Management Environmental Assessment*, DOI-BLM-CO-140-2009-004-EA.

BLM, 2010b, *Solar Energy Interim Rental Policy,* U.S. Department of the Interior. Available at http://www.blm.gov/wo/st/en/info/regulations/Instruction_Memos_and_Bulletins/national_instruction/2010/IM_2010-141.html.

BLM, 2010c, *Visual Resource Inventory,* prepared for the U.S. Department of the Interior, Bureau of Land Management, La Jara Field Office, San Luis Valley Public Lands Center, Monte Vista, Colo., Oct.

BLM and USFS, 2009, *GeoCommunicator—NILS National Integrated Land System Interactive Maps*. Available at http://www.geocommunicator.gov/GeoComm/index.shtm. Accessed Nov. 15, 2009.

BLM and USFS, 2010a, *GeoCommunicator—Mining Claim Map*. Available at http://www.geocommunicator.gov/GeoComm/index.shtm. Accessed June 21, 2010.

BLM and USFS, 2010b, *GeoCommunicator—Energy Map*. Available at http://www.geocommunicator.gov/GeoComm/index.shtm. Accessed June 21, 2010.

Blume, F., and A.F. Sheehan, 2002, *Quantifying Seismic Hazard in the Southern Rocky Mountains through GPS Measurements of Crustal Deformation—Abstract*, Paper No. 227-5, The Geological Society of America, 2002 Annual Meeting, Denver, Colo.

BOR (Bureau of Reclamation), 2009, "San Luis Valley Project, Closed Basin Division, Colorado," prepared by BOR Alamosa Field Division, Alamosa, Colo., for *Geologic Excursions to the Rocky Mountains and Beyond, Field Trip Guidebook*, Geological Society of America-Colorado Geological Survey. Available at http://www.nps.gov/archive/grsa/resources/docs/TOC.PDF. Accessed Nov. 10, 2009.

Brendle, D.L., 2002, *Geophysical Logging to Determine Construction, Contributing Zones, and Appropriate Use of Water Levels Measured in Confined-Aquifer Network Wells, San Luis Valley, Colorado*, *1998–2000*, U.S. Geological Survey, Water Resources Investigations Report 02–4058.

Brister, B.S., and R.R. Gries, 1994, *Tertiary Stratigraphy and Tectonic Development of the Alamosa Basin (Northern San Luis Basin), Rio Grande Rift, South-Central Colorado*, Geological Society of America Special Paper 291.

BTS (Bureau of Transportation Statistics), 2008, *Air Carriers: T-100 Domestic Segment (All Carriers)*, Research and Innovative Technology Administration, Bureau of Transportation Statistics, U.S. Department of Transportation, Dec. Available at http://www.transtats.bts.gov/Fields.asp?Table_ID=311. Accessed June 23, 2009.

Burnell, J.R., et al., 2008, *Colorado Mineral and Energy Industry Activities, 2007*, Colorado Geological Survey, Department of Natural Resources, Denver, Colo.

Burroughs, R.L., 1974, *Neogene Volcanism in the Southern San Luis Basin*, *New Mexico,* Geological Society Guidebook, 25th Field Conference, Ghost Ranch (Central-Northern New Mexico). Available at http://nmgs.nmt.edu/publications/guidebooks/downloads/25/25_p0291_p0294.pdf. Accessed Jan. 20, 2010.

Burroughs, R.L., 1981, *A Summary of the Geology of the San Luis Basin, Colorado–New Mexico with Emphasis on the Geothermal Potential for the Monte Vista Graben*, Special Publication 17, DOE/ET/28365-10, Colorado Geological Survey, Department of Natural Resources, Denver, Colo.

CDA (Colorado Department of Agriculture), 2010, *Colorado Department of Agriculture, Noxious Weed Management Program, Noxious Weed List*. Available at http://www.colorado.gov/cs/Satellite?c=Page&cid=1174084048733&pagename=Agriculture-Main%2FCDAGLayout. Accessed Jan. 22, 2010.

CDC (Centers for Disease Control and Prevention), 2009, *Divorce Rates by State: 1990, 1995, 1999–2007*. Available at http://www.cdc.gov/nchs/data/nvss/Divorce%20Rates%2090%2095%20and%2099-07.pdf.

CDOT (Colorado Department of Transportation), undated, *Traffic Information for Conejos County*. Available at http://www.dot.state.co.us/App_DTD_DataAccess/Traffic/index.cfm?fuseaction=TrafficMain&MenuType=Traffic. Accessed June 20, 2009.

CDOW (Colorado Division of Wildlife), 2008, *Natural Diversity Information Source Data*, Denver, Colo. Available at http://ndis.nrel.colostate.edu/ftp/ftp_response.asp. Accessed Oct. 21, 2009.

CDOW, 2009, *Natural Diversity Information Source, Wildlife Species Page,* Denver, Colo. Available at http://ndis.nrel.colostate.edu/wildlife.asp. Accessed Aug. 29, 2009.

CDPHE (Colorado Department of Public Health and Environment), 2008a, *Colorado 2007 Air Quality Data Report*, Air Quality Control Division, Denver, Colo., July. Available at http://www.colorado.gov/airquality/documents/2007AnnualDataReport.pdf. Accessed Sept. 2, 2009.

CDPHE, 2008b, *Colorado's Stormwater Program Fact Sheet*. Available at http://www.cdphe.state.co.us/wq/permitsunit.

CEQ (Council on Environmental Quality), 1997, *Environmental Justice Guidance under the National Environmental Policy Act*, Executive Office of the President, Washington, D.C., Dec. Available at http://www.whitehouse.gov/CEQ.

CGS (Colorado Geological Survey), 2001, "When the Ground Lets You Down—Ground Subsidence and Settlement Hazards in Colorado," in *Rock Talk*, Vol. 4, No. 4, Oct.

Chapman, S.S., et al., 2006, *Ecoregions of Colorado* (color poster with map, descriptive text, summary tables, and photographs; map scale 1:1,200,000), U.S. Geological Survey, Reston, Va.

Chick, N., 2009, personal communication from Chick (Colorado Department of Public Health and Environment, Denver, Colo.) to Y.-S. Chang (Argonne National Laboratory, Argonne, Ill.), Sept. 4.

CNHP (Colorado Natural Heritage Program), 2009, *Colorado Natural Heritage Program*. Available at http://www.cnhp.colostate.edu. Accessed Sept. 9, 2009.

Colorado District Court, 2004, *Case Number 2004CW24, Concerning the Matter of the Rules Governing New Withdrawals of Ground Water in Water Division No. 3 Affecting the Rate or Direction of Movement of Water in the Confined Aquifer System*, District Court, Water Division No. 3.

Colorado District Court, 2010, *Case Number 06CV64 & 07CW52, In the Matter of the Rio Grande Water Conservation District, in Alamosa County, Colorado and Concerning the Office of the State Engineer's Approval of the Plan of Water Management for Special Improvement District No. 1 of the Rio Grande Water Conservation District*, District Court, Water Division No. 3.

Colorado DWR (Division of Water Resources), 2005, *Water Well Construction Rules*, 2 CCR 402-2.

Colorado DWR, 2008, *Guide to Colorado Well Permits, Water Rights, and Water Administration*, Jan.

Colorado DWR, 2010a, *Edge of the Confining Clays of the San Luis Valley*. Available at http://www.water.state.co.us/wateradmin/SanLuisValley/Tab%20D%20-%20Map%20of%20the%20San%20Luis%20Valley.pdf. Accessed Feb. 10, 2010.

Colorado DWR, 2010b, *History of Water Rights in Colorado*. Available at http://water.state.co.us/org/history.asp. Accessed Aug. 3, 2010.

Colorado DWR, 2010c, *Draft: Ground Water Rules for Division 3*, July 27.

Colorado Governor's Energy Office, 2007, *Connecting Colorado's Renewable Resources to the Markets—Report of the Colorado Senate Bill 07-091 Renewable Resource Generation Development Areas Task Force*, Denver, Colo.

Colorado SHPO (Colorado State Historic Preservation Office), 2009, Data on file at the Colorado State Historic Preservation Office, Denver, Colo.

Cowherd, C., et al., 1988, *Control of Open Fugitive Dust Sources*, EPA 450/3-88-008, U.S. Environmental Protection Agency, Research Triangle Park, N.C.

Diefenbach, A.K., et al., 2009, *Chronology and References of Volcanic Eruptions and Selected Unrest in the United States, 1980-2008*, U.S. Geological Survey Open File Report 2009-1118.

DOE (U.S. Department of Energy), 2009, *Report to Congress, Concentrating Solar Power Commercial Application Study: Reducing Water Consumption of Concentrating Solar Power Electricity Generation*, Jan. 13.

EIA (Energy Information Administration), 2009, *Annual Energy Outlook 2009 with Projections to 2030*, DOE/EIA-0383, March.

Eldred, K.M., 1982, "Standards and Criteria for Noise Control—An Overview," *Noise Control Engineering* 18(1)16–23.

Emery, P.A., 1979, "Geohydrology of the San Luis Valley, Colorado, USA," IAHS-AISH Publication No. 128 in *The Hydrology of Areas of Low Precipitation—L'Hydrologie des Régions à Faibles Precipitations*, Proceedings of the Canberra Symposium (Actes du Colloque de Canberra), Dec.

Emery, P.A., 1994, *Hydrogeology of the San Luis Valley, Colorado, An Overview—National Park Service*, Field Trip 20, Section 2, Paper 3. Available at www.nps.gov/archive/grsa/resources/docs/Trip2023.pdf. Accessed June 29, 2009.

EPA (U.S. Environmental Protection Agency), 1974, *Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety*, EPA-550/9-74-004, Washington, D.C., March. Available at http://www.nonoise.org/library/levels74/levels74.htm. Accessed Nov. 17, 2008.

EPA, 2009a, *Energy CO_2 Emissions by State*. Available at http://www.epa.gov/climatechange/emissions/state_energyco2inv.html, last updated June 12, 2009. Accessed June 23, 2009.

EPA, 2009b, *AirData: Access to Air Pollution Data*. Available at http://www.epa.gov/oar/data/. Accessed Sept. 12, 2009.

EPA, 2009c, *Preferred/Recommended Models—AERMOD Modeling System.* Available at http://www.epa.gov/scram001/dispersion_prefrec.htm. Accessed Nov. 8, 2009.

EPA, 2009d, *eGRID.* Available at http://www.epa.gov/cleanenergy/energy-resources/egrid/index.html, last updated Oct. 16, 2008. Accessed Jan. 12, 2009.

EPA, 2010, *National Ambient Air Quality Standards (NAAQS)*. Available at http://www.epa.gov/air/criteria.html, last updated June 3, 2010. Accessed June 4, 2010.

FEMA (Federal Emergency Management Agency), 2009, *FEMA Map Service Center*. Available at http://www.fema.gov. Accessed Nov. 20, 2009.

Fire Departments Network, 2009, *Fire Departments by State*. Available at http://www.firedepartments.net.

GAO (Government Accounting Office), 2007, *Climate Change: Agencies Should Develop Guidance for Addressing the Effects on Federal Land and Water Resources*, Report to Congressional Requesters, GAO-07-863, Aug.

Gibson 2010, personal communication from Gibson (San Luis Valley Water Conservancy District, Alamosa, Colo.) to B. O'Connor (Argonne National Laboratory, Argonne, Ill.), Aug. 9.

Hanson, C.E., et al., 2006, *Transit Noise and Vibration Impact Assessment*, FTA-VA-90-1003-06, prepared by Harris Miller Miller & Hanson Inc., Burlington, Mass., for U.S. Department of Transportation, Federal Transit Administration, Washington, D.C., May. Available at http://www.fta.dot.gov/documents/FTA_Noise_and_Vibration_Manual.pdf.

Heide, R., 2009, *National Heritage Area in the Works*. Available at http://www.coloradopreservation.org/news/articlesHeritage_Area_04.doc. Accessed Oct. 19, 2009.

Hildner, M., 2009a, "Plan to Reduce Groundwater Pumping Could Cost $125.8 Million," in *Pueblo Chieftain*, Feb. 14.

Hildner, M., 2009b, "Court Hearing Next for Valley Water Project—State Engineer Signs Off On Amendments to a Groundwater Management Proposal," in *Pueblo Chieftain*, May 20.

Hinderlider, M.C., et al., 1939, *Rio Grande Compact, with Amendments,* adopted Dec. 19. Available at http://wrri.nmsu.edu/wrdis/compacts/Rio-Grande-Compact.pdf. Accessed Nov. 10, 2009.

Joe, T., 2008, personal communication from Joe (Program Manager for the Navajo Nation Historic Preservation Department—Traditional Cultural Program, Window Rock, Ariz.) to S. Sierra (State Director, Bureau of Land Management, Salt Lake City, Utah), July 3.

Joe, T.H., Jr., 2009, personal communication from Joe (Supervisory Anthropologist for the Navajo Nation Historic Preservation Department—Traditional Cultural Program, Window Rock, Ariz.) to S. Borchard (California Desert District Manager, Bureau of Land Management, Riverside, Calif.), July 3.

Kenny, J.F, et al., 2009, *Estimated Use of Water in the United States in 2005*, U.S. Geological Survey, Circular 1344. Available at http://pubs.usgs.gov/circ/1344. Accessed Jan. 4, 2010.

Kirkham, R.M. (compiler), 1998, "Fault Number 2315, Faults near Monte Vista," in *Quaternary Fault and Fold Database of the United States*. Available at http://earthquakes.usgs.gov/regional/qfaults. Accessed Sept. 11, 2009.

Kirkham, R.M., and W.P. Rogers, 1981, "Earthquake Potential in Colorado," *Colorado Geological Survey Bulletin 43*.

Laney, P., and J. Brizzee, 2005, *Colorado Geothermal Resources*, INEEL/MIS-2002-1614, Rev. 1, prepared for U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, Geothermal Technologies Program, Nov.

Lee, J.M., et al., 1996, *Electrical and Biological Effects of Transmission Lines: A Review*, Bonneville Power Administration, Portland, Ore., Dec.

Leonard, G.J., and K.R. Watts, 1989, *Hydrogeology and Simulated Effects of Ground-Water Development on an Unconfined Aquifer in the Closed Basin Division, San Luis Valley*, *Colorado*, U.S. Geological Survey, Water Resources Investigations Report 87-4284, Denver, Colo.

Lindsey, K.D., 1983, *Paleontological Inventory and Assessment of the San Luis Resource Area,* prepared by Denver Museum of Natural History for U.S. Department of the Interior, Bureau of Land Management, Canon City District, Dec. 31.

Lipman, P.W., 2006, *Geologic Map of the Central San Juan Caldera Cluster, Southwestern Colorado*, U.S. Geological Survey pamphlet to accompany Geologic Investigations Series I-2799.

Lipman, P.W., and H.H. Mehnert, 1979, "The Taos Plateau Volcanic Field, Northern Rio Grande Rift, New Mexico," in *Rio Grande Rift: Tectonics and Magmatism*, R.E. Riecker (editor), American Geophysical Union.

Lipman, P.W., et al., 1970, *Volcanic History of the San Juan Mountains, Colorado, as Indicated by Potassium-Argon Dating*, Geological Society of America Bulletin, Vol. 81.

Mackelprang, C.E., 1983, *Results of a Detailed Gravity Survey in the Alamosa Area, Alamosa County, Colorado*, University of Utah Research Institute, Earth Science Laboratory Report No. ESL-126, DOE/ID/12079-109.

Martorano, M.A, et al., 1999, *Colorado Prehistory: A Context for the Rio Grande Basin*, Colorado Council of Professional Archaeologists.

Mayo, A.L., et al., 2007, "Groundwater Flow Patterns in the San Luis Valley, Colorado, USA Revisited: An Evaluation of Solute and Isotopic Data," *Hydrogeology Journal* 15:383–408.

McDermott, P., 2010, personal communication from McDermott (Engineer, Colorado Division of Water Resources, Division 3) to B. O'Connor (Argonne National Laboratory, Argonne, Ill.), Aug. 9.

MIG (Minnesota IMPLAN Group), Inc., 2010, *State Data Files*, Stillwater, Minn.

Miller, N.P., 2002, "Transportation Noise and Recreational Lands," *Proceedings of Inter-Noise 2002*, Dearborn, Mich., Aug. 19–21. Available at http://www.hmmh.com/cmsdocuments/N011.pdf. Accessed Aug. 30, 2007.

Molenar, C.M., 1988, *Petroleum Geology and Hydrocarbon Plays of the Albuquerque-San Luis Rift Basin, New Mexico and Colorado*, U.S. Geological Survey Open-File Report 87-450-S.

Murphey, P.C., and D. Daitch, 2007, "Figure D2, Colorado-PFYC," in *Paleontological Overview of Oil Shale and Tar Sands Areas in Colorado, Utah, and Wyoming*, prepared for U.S Department of the Interior, Bureau of Land Management, Dec.

National Research Council, 1996, *Alluvial Fan Flooding*, Committee on Alluvial Fan Flooding, Water Science and Technology Board, and Commission on Geosciences, Environment, and Resources, National Academy Press, Washington D.C.

NatureServe, 2010, *NatureServe Explorer: An Online Encyclopedia of Life*. Available at http://www.natureserve.org/explorer. Accessed Sept. 9, 2009.

NCDC (National Climatic Data Center), 2009a, *2008 Local Climatological Data Annual Summary with Comparative Data, Alamosa, Colorado (KALS)*, National Oceanic and Atmospheric Administration (NOAA). Available at http://www7.ncdc.noaa.gov/IPS/lcd/lcd.html. Accessed Aug. 26, 2009.

NCDC, 2009b, *Integrated Surface Data (ISD), DS3505 Format*, database, Asheville, N.C. Available at ftp://ftp3.ncdc.noaa.gov/pub/data/noaa. Accessed Aug. 26, 2009.

NCDC, 2009c, *Climates of the States (CLIM60): Climate of Colorado*, National Oceanic and Atmospheric Administration Satellite and Information Service. Available at http://cdo.ncdc.noaa.gov/cgi-bin/climatenormals/climatenormals.pl. Accessed Aug. 26, 2009.

NCDC, 2010, *Storm Events*, National Oceanic and Atmospheric Administration Satellite and Information Service. Available at http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwEvent~Storms. Accessed Oct. 8, 2010.

NCES (National Center for Education Statistics), 2009, *Search for Public School Districts*, U.S. Department of Education. Available at http://www.nces.ed.gov/ccd/districtsearch.

NMDGF (New Mexico Department of Game and Fish), 2009, *Biota Information System of New Mexico Database Query*, Santa Fe, N.M. Available at http://www.bison-m.org/databasequery.aspx. Accessed Oct. 9, 2009.

NPS (National Park Service), 2008, *National Heritage Areas*, National Heritage Areas Program Office, Washington, D.C. Available at http://www.nps.gov/history/heritageareas.

NPS, 2009, *Sangre de Cristo National Heritage Area*. Available at http://www.nps.gov/grsa/parknews/sangre-de-cristo-nha.htm. Accessed Nov. 10, 2009.

NRCS (Natural Resources Conservation Service), 2008, *Soil Survey Geographic (SSURGO) Database for Alamosa County, Colorado*. Available at http://SoilDataMart.nrcs.usds.gov.

NRCS, 2009, *Custom Soil Resource Report for Alamosa County (covering the proposed Fourmile East SEZ), Colorado*, U.S. Department of Agriculture, Washington, D.C., Aug. 21.

NSTC (National Science and Technology Council), 2008, *Scientific Assessment of the Effects of Global Change on the United States*, A Report of the Committee on Environment and Natural Resources, May.

Pew Center on Global Climate Change, 2009, *Renewable and Alternative Energy Portfolio Standards (with reference to Colorado House Bill 07-1281)*. Available at http://www.pewclimate.org/what_s_being_done/in_the_states/rps.cfm. Accessed Nov. 4, 2009.

Ray, A.J., et al., 2008, *Climate Change in Colorado: A Synthesis to Support Water Resources Management and Adaptation*, Western Water Assessment for the Colorado Water Conservation Board. Available at http://cwcb.state.co.us/NR/rdonlyres/B37476F5-BE76-4E99-AB01-6D37E352D09E/0/ClimateChange_FULL_Web.pdf. Accessed Nov. 2, 2009.

RGSR (Rio Grande Scenic Railroad), 2009, *Rio Grande Scenic Railroad Information Web Site*. Available at http://www.riograndescenicrailroad.com. Accessed Nov. 11, 2009.

RGWCD (Rio Grande Water Conservation District), 2009, *Proposed Plan of Water Management—Special Improvement District 1 (aka Closed Basin Subdistrict)*, May 11, 2009 draft. Available at http://www.rgwcd.org/Pages/Subdistricts/Subdistrict1_1.htm. Accessed Nov. 9, 2009.

RGWCD, 2010, *Draft: San Luis Valley Well and Water-Level Database*. Available at http://www.rgwcd.org/wl. Accessed Aug. 4, 2010.

Ritter, B., Jr., 2007, *Colorado Climate Action Plan: A Strategy to Address Global Warming*, Nov.

Robson, S.G., and E.R. Banta, 1995, *Ground Water Atlas of the United States: Arizona, Colorado, New Mexico, Utah*, U.S. Geological Survey, HA 730-C.

Ruleman, C., and M. Machette, 2007, "An Overview of the Sangre de Cristo Fault System and New Insights to Interactions between Quaternary Faults in the Northern Rio Grande Rift," Chapter J in *2007 Rocky Mountain Section Friends of the Pleistocene Field Trip—Quaternary Geology of the San Luis Basin of Colorado and New Mexico, September 7–9, 2007*, M.N. Machette et al. (editors), U.S. Geological Survey Open-File Report 2007-1193.

SAMHSA (Substance Abuse and Mental Health Services Administration), 2009, *National Survey on Drug Use and Health, 2004, 2005 and 2006*, Office of Applied Studies, U.S. Department of Health and Human Services. Available at http://oas.samhsa.gov/substate2k8/StateFiles/TOC.htm#TopOfPage.

Scott, G., 2001, *Historic Trail Map of the Trinidad*, Geological Investigations Series I-2745, U.S. Department of the Interior, U.S. Geological Survey, Denver, Colo. Available at http://pubs.usgs.gov/imap/i-2745/i-2745.pdf. Accessed Oct. 6, 2010.

SES (Sterling Energy Systems) Solar Two, LLC, 2008, Application for Certification, submitted to the Bureau of Land Management, El Centro, Calif., and the California Energy Commission, Sacramento, Calif., June. Available at http://www.energy.ca.gov/sitingcases/solartwo/documents/applicant/afc/index.php. Accessed Oct. 2008.

SLRG (San Luis & Rio Grande Railroad), 2009, *San Luis & Rio Grande Railroad.* Available at http://www.sanluisandriogranderailroad.com. Accessed June 25, 2009.

SLV (San Luis Valley) Development Resources Group, 2007, *Comprehensive Economic Development Strategy*, prepared with support from Planning and Assistance Grant 05-83-04371, Alamosa, Colo. Available at http://www.slvdrg.org/ceds.php. Accessed Nov. 3, 2009.

SLV Development Resources Group, 2009, *SLV TIGER Discretionary Grant Application with Appendices (Appendix 1—SLVRMI Map Showing the Sangre de Cristo NHA).* Available at http://slvdrg.org/tigergrant.php. Accessed Nov. 10, 2009.

Smith, M.D., et al., 2001, "Growth, Decline, Stability and Disruption: A Longitudinal Analysis of Social Well-Being in Four Western Communities," *Rural Sociology* 66:425-450.

Solar Partners I, LLC, 2007, *Application for Certification*, submitted to California Energy Commission, Sacramento, Calif., Aug.

Solar Reserve, 2010, *Saguache Solar Energy Project, Preliminary 1041 Permit Application for Saguache County, Colorado*, July 20, 2010.

State Demography Office, 2009, *Preliminary Population Forecasts for Colorado Counties, 2000–2010*. Available at http://dola.colorado.gov/dlg/demog/population/forecasts/counties1yr.xls.

Stebbins, R.C., 2003, *A Field Guide to Western Reptiles and Amphibians*, Houghton Mifflin Company, Boston, Mass.

Stoeser, D.B., et al., 2007, *Preliminary Integrated Geologic Map Databases for the United States: Central States—Montana, Wyoming, Colorado, New Mexico, North Dakota, South Dakota, Nebraska, Kansas, Oklahoma, Texas, Iowa, Missouri, Arkansas, and Louisiana, Version 1.2*, U.S. Geological Survey Open File Report 2005-1351, updated December 2007.

Stout, D., 2009, personal communication from Stout (U.S. Fish and Wildlife Service, Acting Assistant Director for Fisheries and Habitat Conservation, Washington, D.C.) to L. Jorgensen (Bureau of Land Management, Washington, D.C.), and L. Resseguie (Bureau of Land Management, Washington, D.C.), Sept. 14, 2009.

Strait, R., et al., 2007, *Colorado Greenhouse Gas Inventory and Reference Case Projections 1990–2020*, prepared by Center for Climate Strategies, Washington, D.C., for Colorado Department of Public Health and Environment, Denver, Colo., Jan. Available at http://www.cdphe.state.co.us/ap/down/GHGEIJan07.pdf. Accessed Sept. 11, 2009.

Texas v. Colorado, 1968, 391 U.S. 901, 88 S. Ct. 1649, 20 L. Ed.2d 416 1968.

Thompson, K., 2002, *Dealing with Drought: Part Two*, prepared for Agro Engineering, Inc. Available at http://www.agro.com/WaterResources/Dealingwithdrought2.PDF. Accessed Nov. 9, 2009.

Thompson, R.A., et al., 1991, "Oligocene Basaltic Volcanism of the Northern Rio Grande Rift: San Luis Hills, Colorado," *Journal of Geophysical Research*, Vol. 96, No. B8, July 30.

Topper, R. et al., 2003, *Ground Water Atlas of Colorado*, Colorado Geological Survey, Special Publication 53. Available at http://geosurvey.state.co.us/wateratlas.

Tri-State Generation and Transmission Association, Inc., 2008, *San Luis Valley Electric System Improvement Project Alternative Evaluation and Macro Corridor Study*, submitted to U.S. Department of Agriculture Rural Development, June.

Tri-State Generation and Transmission Association, Inc., 2009, *San Luis Valley–Calumet–Comanche Transmission Project Alternative Evaluation*, submitted to U.S. Department of Agriculture Rural Development, June.

Tri-State and Public Service Company of Colorado, 2009, *Southern Colorado Transmission Improvements—Renewable Energy Development.* Available at http://www.socotransmission.com/Purpose/renewables.cfm. Accessed Nov. 4, 2009.

TSNA (Tessera Solar North America), 2010, *San Luis Valley Solar Project Tessera Solar North America 1041 Final Application to Saguache County, Colorado*, June.

Tweto, O., 1979, Geologic Map of Colorado (Scale 1:500,000), U.S. Geological Survey, prepared in cooperation with the Geological Survey of Colorado.

USACE (U.S. Army Corps of Engineers), 2007, *Upper Rio Grande Basin Water Operations Review—Final Environmental Impact Statement Summary*, with the U.S. Department of the Interior, Bureau of Reclamation, and the New Mexico Interstate Stream Commission, FES-07-05, April.

U.S. Bureau of the Census, 2009a, *County Business Patterns, 2006*, Washington, D.C. Available at http://www.census.gov/ftp/pub/epcd/cbp/view/cbpview.html.

U.S. Bureau of the Census, 2009b, *GCT-T1. Population Estimates*. Available at http://factfinder.census.gov/.

U.S. Bureau of the Census, 2009c, *QT-P32. Income Distribution in 1999 of Households and Families: 2000. Census 2000 Summary File (SF 3) – Sample Data*. Available at http://factfinder.census.gov/.

U.S. Bureau of the Census, 2009d, *S1901. Income in the Past 12 Months. 2006-2008 American Community Survey 3-Year Estimates*. Available at http://factfinder.census.gov/.

U.S. Bureau of the Census, 2009e, *GCT-PH1. Population, Housing Units, Area, and Density: 2000. Census 2000 Summary File (SF 1) – 100-Percent Data.* Available at http://factfinder.census.gov/.

U.S. Bureau of the Census, 2009f, *T1. Population Estimates.* Available at http://factfinder.census.gov/.

U.S. Bureau of the Census, 2009g, *GCT2510. Median Housing Value of Owner-Occupied Housing Units (Dollars). 2006-2008 American Community Survey 3-Year Estimates.* Available at http://factfinder.census.gov/.

U.S. Bureau of the Census, 2009h, *QT-H1. General Housing Characteristics, 2000. Census 2000 Summary File 1 (SF 1) 100-Percent Data*. Available at http://factfinder.census.gov/.

U.S. Bureau of the Census, 2009i, *GCT-T9-R. Housing Units, 2008. Population Estimates.* Available at http://factfinder.census.gov/.

U.S. Bureau of the Census, 2009j, *S2504. Physical Housing Characteristics for Occupied Housing Units 2006-2008 American Community Survey 3-Year Estimates*. Available at http://factfinder.census.gov/.

U.S. Bureau of the Census, 2009k, *Census 2000 Summary File 1 (SF 1) 100-Percent Data*. Available at http://factfinder.census.gov/.

U.S. Bureau of the Census, 2009l, *Census 2000 Summary File 3 (SF 3) – Sample Data.* Available at http://factfinder.census.gov/.

USDA (U.S. Department of Agriculture), 1968, *Soil Survey of Alamosa Area, Colorado*, Soil Conservation Service, Washington, D.C.

USDA, 2004*, Understanding Soil Risks and Hazards—Using Soil Survey to Identify Areas with Risks and Hazards to Human Life and Property*, G.B. Muckel (editor).

USDA, 2009, *2007 Census of Agriculture: Colorado State and County Data, Volume 1, Geographic Area Series*, National Agricultural Statistics Service, Washington, D.C. Available at http://www.agcensus.usda.gov/Publications/2007/Full_Report/Volume_1,_Chapter_2_County_Level/Colorado/index.asp.

USDA, 2010, *United States Department of Agriculture Plants Database*. Available at http://plants.usda.gov/index.html. Accessed Jan. 25, 2010.

U.S. Department of Commerce, 2009, *Local Area Personal Income*, Bureau of Economic Analysis. Available at http://www.bea.doc.gov/bea/regional/reis.

U.S. Department of the Interior, 2010, *Native American Consultation Database*, National NAGPRA Online Databases, National Park Service. Available at http://grants.cr.nps.gov/nacd/index.cfm.

U.S. Department of Justice, 2008, "Table 80: Full-time Law Enforcement Employees, by State by Metropolitan and Nonmetropolitan Counties, 2007," *2007 Crime in the United States*, Federal Bureau of Investigation, Criminal Justice Information Services Division, Sept. Available at http://www.fbi.gov/ucr/cius2007/data/table_80.html. Accessed June 17, 2010.

U.S. Department of Justice, 2009a, "Table 8: Offences Known to Law Enforcement, by State and City," *2008 Crime in the United States*, Federal Bureau of Investigation, Criminal Justice Information Services Division. Available at http://www.fbi.gov/ucr/cius2008/data/table_08.html.

U.S. Department of Justice, 2009b, "Table 10: Offences Known to Law Enforcement, by State and by Metropolitan and Non-metropolitan Counties," *2008 Crime in the United States*, Federal Bureau of Investigation, Criminal Justice Information Services Division. Available at http://www.fbi.gov/ucr/cius2008/data/table_08.html.

U.S. Department of Labor, 2009a*, Local Area Unemployment Statistics: States and Selected Areas: Employment Status of the Civilian Noninstitutional Population, 1976 to 2007, Annual Averages*, Bureau of Labor Statistics. Available at http://www.bls.gov/lau/staadata.txt.

U.S. Department of Labor, 2009b, *Local Area Unemployment Statistics: Unemployment Rates by State*, Bureau of Labor Statistics. Available at http://www.bls.gov/web/laumstrk.htm.

U.S. Department of Labor, 2009c, *Local Area Unemployment Statistics: County Data*, Bureau of Labor Statistics. Available at http://www.bls.gov/lau.

U.S. Department of Labor, 2009d, *Consumer Price Index, All Urban Consumers—(CPI-U) U.S. City Average, All Items*, Bureau of Labor Statistics. Available at ftp://ftp.bls.gov/pub/special.requests/cpi/cpiai.txt.

USFWS (U.S. Fish and Wildlife Service), 2009, *National Wetlands Inventory,* U.S. Department of the Interior, Washington, D.C. Available at http://www.fws.gov/wetlands.

USFWS, 2010, *Environmental Conservation Online System (ECOS)*. Available at http://www.fws.gov/ecos/ajax/ecos/indexPublic.do. Accessed May 28, 2010.

USGS (U.S. Geological Survey), 2000, *Estimated Use of Water in the United States, County Level Data for 2000*. Available at http://water.usgs.gov/watuse/data/2000. Accessed Oct. 22, 2009.

USGS, 2004, *National Gap Analysis Program, Provisional Digital Land Cover Map for the Southwestern United States*, Version 1.0, RS/GIS Laboratory, College of Natural Resources, Utah State University.

USGS, 2005, *National Gap Analysis Program, Southwest Regional GAP Analysis Project—Land Cover Descriptions,* RS/GIS Laboratory, College of Natural Resources, Utah State University.

USGS, 2007, *National Gap Analysis Program*, 2007, *Digital Animal-Habitat Models for the Southwestern United States*, Version 1.0, Center for Applied Spatial Ecology, New Mexico Cooperative Fish and Wildlife Research Unit, New Mexico State University. Available at http://fws-nmcfwru.nmsu.edu/swregap/HabitatModels/default.htm. Accessed Jan. 22, 2010.

USGS, 2008, *National Seismic Hazard Maps—Peak Horizontal Acceleration (%g) with 10% Probability of Exceedance in 50 Years (Interactive Map)*. Available at http://gldims.cr.usgs.gov/nshmp2008/viewer.htm. Accessed August 4, 2010.

USGS, 2010a, *Water Resources of the United States—Hydrologic Unit Maps*. Available at http://water.usgs.gov/GIS/huc.html. Accessed April 12, 2010.

USGS, 2010b, *National Water Information System*. Available at http://wdr.water.usgs.gov/nwisgmap. Accessed Aug 3.

USGS, 2010a, *National Earthquake Information Center (NEIC)—Circular Area Database Search (within 100-km of the center of the proposed Fourmile East SEZ)*. Available at http://earthquake.usgs.gov/earthquakes/eqarchives/epic/epic_circ.php. Accessed Aug. 5, 2010.

USGS and CGS (U.S. Geological Survey and Colorado Geological Survey), 2009, *Quaternary Fault and Fold Database for the United States*. Available at http://earthquake.usgs.gov/regional/qfaults. Accessed Sept. 11, 2009.

Westerling, A.L., et al., 2006, "Warming and Earlier Spring Increase Western U.S. Forest Wildfire Activity," *Science* 313: 940–943.

Wolfe, D., 2008, *Order Establishing Advisory Committee for Rules and Regulations Governing the Diversion and Use of Underground Waters in Water Division 3*, Colorado Division of Water Resources, Dec. 31. Available at http://water.state.co.us/SurfaceWater/RulemakingAndAdvising/SLVAC/Pages/SLVNews.aspx.

WRAP (Western Regional Air Partnership), 2009, *Emissions Data Management System (EDMS)*. Available at http://www.wrapedms.org/default.aspx. Accessed June 4, 2009.

WRCC (Western Regional Climate Center), 2009, *Western U.S. Climate Historical Summaries.* Available at http://www.wrcc.dri.edu/Climsum.html. Accessed Aug. 21, 2009.

WRCC, 2010a, *Monthly Climate Summary, Blanca, Colorado (050776)*. Available at http://www.wrcc.dri.edu/cgi-bin/cliMAIN.pl?co0776. Accessed July 22, 2010.

WRCC, 2010b, *Monthly Climate Summary, La Vetta Pass, Colorado (054870)*. Available at http://www.wrcc.dri.edu/cgi-bin/cliMAIN.pl?co4870. Accessed July 22, 2010.

WRCC, 2010c, *Average Pan Evaporation Data by State*. Available at http://www.wrcc.dri.edu/htmlfiles/westevap.final.html. Accessed Jan. 19, 2010.

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