8.2 BULLARD WASH

8.2.1 Background and Summary of Impacts

8.2.1.1 General Information

The proposed Bullard Wash SEZ is located in Yavapai County in west–central Arizona (Figure 8.2.1.1-1). The SEZ has a total area of 7,239 acres (29.3 km^2). In 2008, the county population was 214,930, while adjacent Maricopa County to the south had a population of 3,958,263. The nearest town is Aguila, Arizona, about 12 mi (19 km) south in Maricopa County, with a population of approximately 1,000. The Phoenix metropolitan area is approximately 70 mi (113 km) to the southeast of the SEZ.

The nearest major road access to the SEZ is via State Route 71, which passes 5 mi (8 km) southeast of the southeastern tip of the SEZ along the southern border of the Bullard Wash SEZ. The nearest railroad stop is approximately 17 mi (19 km) away, in Congress. The nearest airport, Wickenburg Municipal Airport, is 22 mi (35 km) to the southeast of the SEZ and does not have regularly scheduled passenger service. Phoenix Sky Harbor International Airport is a major airport in Phoenix (86 mi [138 km]) to the east.

A 500-kV transmission line passes 5 mi (8 km) northeast 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 8.2.1.1.2).

There are no ROW applications for solar projects within the SEZ; however, there are 17 pending ROW applications for solar projects that would be located within 50 mi (80 km) of the SEZ. These applications are discussed in Section 8.2.22.2.1.

The proposed Bullard Wash SEZ is undeveloped and rural, with few permanent residents in the area. The SEZ is located in the Date Creek basin, in a valley lying between the Black Mountains to the north, the Date Creek Mountains to the northeast, and the Harcuvar Mountains to the southwest. Land within the SEZ is undeveloped scrubland characteristic of a semiarid basin.

The proposed Bullard Wash SEZ and other relevant information are shown in Figure 8.2.1.1-1. 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 Bullard Wash SEZ, other restrictions might be appropriate. The analyses in the following sections address the affected environment and potential impacts associated with utility-scale solar energy

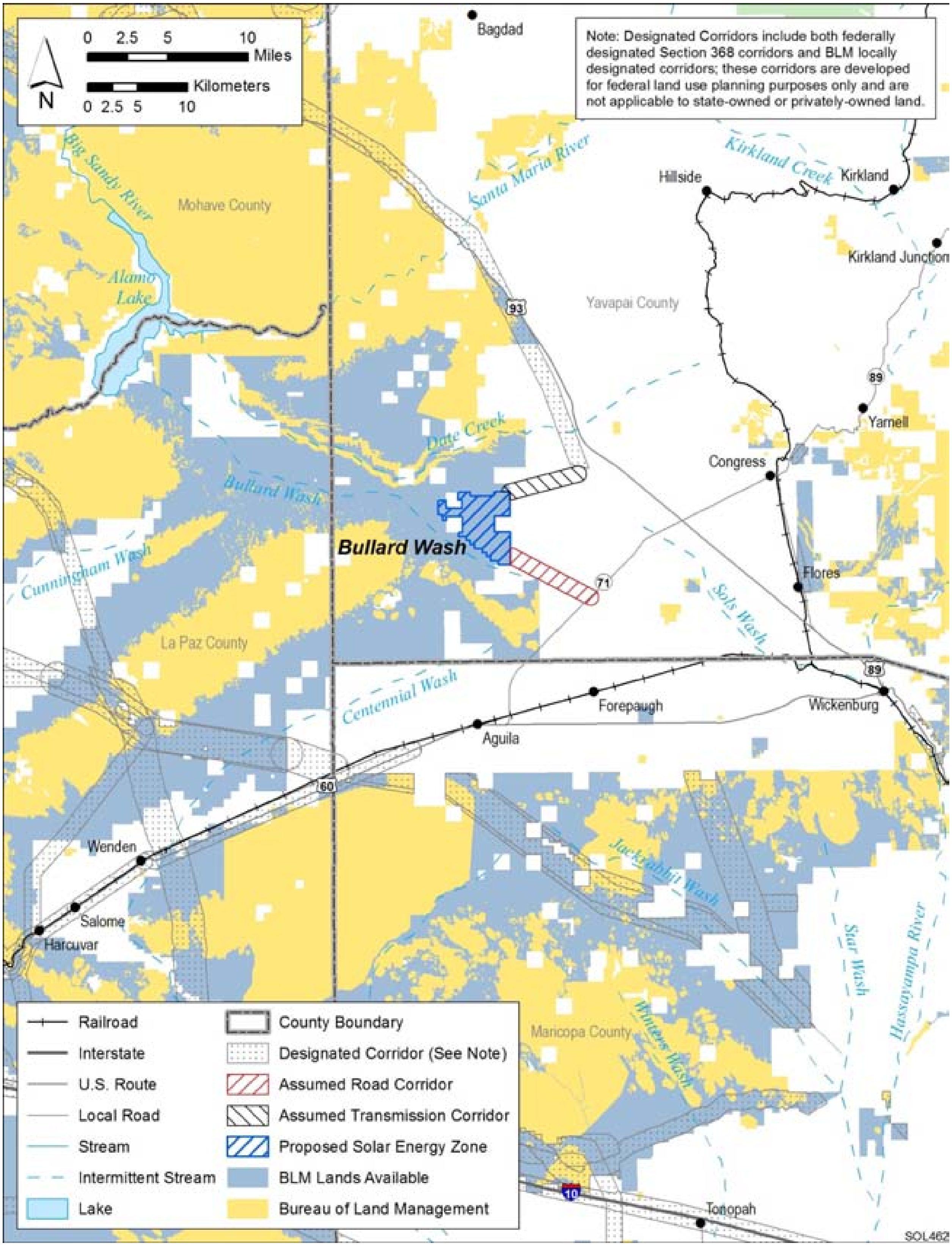


FIGURE 8.2.1.1-1 Proposed Bullard Wash SEZ

development in the proposed SEZ for important environmental, cultural, and socioeconomic resources.

As initially announced in the *Federal Register* on June 30, 2009, the proposed Bullard Wash SEZ encompassed 8,201 acres (33 km^2). Subsequent to the study area scoping period, the boundaries of the proposed Bullard Wash SEZ were altered somewhat to facilitate the BLM's administration of the SEZ area. Borders with irregularly shaped boundaries were adjusted to match the section boundaries of the Public Lands Survey System (PLSS) (BLM and USFS 2010c). The revised SEZ is approximately 962 acres (4 km^2) smaller than the original SEZ as published in June 2009.

8.2.1.2 Development Assumptions for the Impact Analysis

Maximum solar development of the Bullard Wash SEZ is assumed to be 80% of the SEZ area over a period of 20 years, a maximum of 5,791 acres (23 km^2). These values are shown in Table 8.2.1.2-1, along with other development assumptions. Full development of the Bullard Wash SEZ would allow development of facilities with an estimated total of 643 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 1,158 MW of power if solar trough technologies were used, assuming 5 acres/MW (0.02 km^2/MW) of land required.

Availability of transmission from SEZs to load centers will be an important consideration for future development in SEZs. The nearest existing transmission line is a 500-kV line 5 mi (8 km) northeast of the SEZ. It is possible that a new transmission line could be constructed from the SEZ to this existing line, but the 500-kV capacity of that line could be inadequate for 643 to 1,158 MW of new capacity (note that a 500-kV line can accommodate approximately the load of one 700-MW facility). At full build-out capacity, new transmission and/or upgrades of existing transmission lines (in addition to or instead of construction of a connection to the nearest existing line) might be required to bring electricity from the proposed Bullard Wash 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 for various resources are discussed in Chapter 5. Project-specific analyses would need to identify the specific impacts of new transmission construction and line upgrades for any projects proposed within the SEZ.

For purposes of as complete an analysis of impacts of development in the SEZ as possible, it was assumed that, at a minimum, a transmission line segment would be constructed from the proposed Bullard Wash SEZ to the nearest existing transmission line to connect the SEZ to the transmission grid. This assumption was made without additional 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 Bullard Wash SEZ would involve the construction of about 5 mi (8 km) of new transmission line outside of the SEZ. The ROW for this transmission line would occupy approximately 152 acres (0.61 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

TABLE 8.2.1.2-1 Proposed Bullard Wash SEZ—Assumed Development Acreages, 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 Designated Corridor[e]
7,239 acres and 5,791 acres[a]	643 MW[b] and 1,158 MW[c]	State Route71 5 mi[d]	5 mi and 500 kV	152 acres; 36 acres	4 mi

[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 (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.

to a different off-site grid 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.

State Route 71 lies about 5 mi (8 km) to the southeast of the proposed Bullard Wash SEZ. Assuming construction of a new access road to reach State Route 71 would be needed to support construction and operation of solar facilities, approximately 36 acres (0.15 km^2) of land disturbance would occur (a 60-ft [18.3-m] wide ROW was assumed).

8.2.1.3 Summary of Major Impacts and SEZ-Specific Design Features

In this section, the impacts and SEZ-specific design features assessed in Sections 8.2.2 through 8.2.21 for the proposed Bullard Wash SEZ are summarized in tabular form. Table 8.2.1.3-1 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 8.2.22 discusses potential cumulative impacts from solar energy development in the proposed SEZ.

Only those design features specific to the proposed Bullard Wash SEZ are included in Sections 8.2.2 through 8.2.21 and in the summary table. The detailed programmatic design features for each resource area to be required under BLM's proposed Solar Energy Program are presented in Appendix A, Section A.2.2. These programmatic design features would also be required for development in this and other SEZs.

TABLE 8.2.1.3-1 Summary of Impacts of Solar Energy Development within the Proposed Bullard Wash SEZ and SEZ-Specific Design Features[a]

Resource Area	Environmental Impacts—Proposed Bullard Wash SEZ	SEZ-Specific Design Features
Lands and Realty	Full development of the SEZ could disturb up to 5,791 acres (23 km^2). Development of the SEZ for utility-scale solar energy production would establish a large, isolated industrial area that would exclude many existing and potential uses of the land, perhaps in perpetuity. Since the SEZ is rural and undeveloped, utility-scale solar energy development would be a new and dominant land use in the area.	None.
	Construction of new transmission facilities to connect solar facilities in the SEZ to the regional grid would disturb 152 acres (0.6 km^2) of land.	None.
	Construction of a new 5-mi (8-km) long road to connect the south end of the SEZ to that highway would result in new surface disturbance of about 36 acres (0.1 km^2) of public land.	Priority consideration should be given to utilizing the existing Alamo Road to provide construction and operational access to the SEZ.
Specially Designated Areas and Lands with Wilderness Characteristics	Wilderness characteristics in the Tres Alamos WA between 3.5 and 7 mi (6 and 11 km) of the border of the SEZ and within the viewshed of the SEZ would be adversely affected.	Consideration should be given to restricting development of solar facilities within 5 mi (8 km) of the Tres Alamos WA to avoid the most serious impacts on the WA. Consideration should be given to restricting solar facilities within the SEZ to lower profile facilities.
Rangeland Resources: Livestock Grazing	There would be small adverse impacts on the Pipeline Ranch and Central Arizona Ranch Company allotments.	Development of additional range improvements within the allotments should be considered to reduce the expected loss of livestock forage.
Rangeland Resources: Wild Horses and Burros	None.	None.
Recreation	Areas developed for solar energy production would be closed to recreational use. Inventoried OHV routes would be closed.	None.

TABLE 8.2.1.3-1 (Cont.)

Resource Area	Environmental Impacts—Proposed Bullard Wash SEZ	SEZ-Specific Design Features
Military and Civilian Aviation	The military has expressed concern that any development in the SEZ that exceeds 250 ft (76 m) in height would interfere with military operations in three MTRs.	None.
	There would be no effect on civilian aviation facilities.	None.
Geologic Setting and Soil Resources	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. 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).	None.
Minerals (fluids, solids, and geothermal resources)	None.	None.
Water Resources	Ground-disturbance activities (affecting 41% of the total area in the peak construction year) could affect surface water quality due to surface runoff, sediment erosion, and contaminant spills. Construction activities may require up to 1,816 ac-ft (2.3 million m^3) of water during the peak construction year. Construction activities would generate as high as 74 ac-ft (91,000 m^3) of sanitary wastewater. Assuming full development of the SEZ, operations would use the following amounts of water:	Water resource analysis indicates that wet-cooling options would not be feasible. Other technologies should incorporate water conservation measures. 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 8.2.1.3-1 (Cont.)

Resource Area	Environmental Impacts—Proposed Bullard Wash SEZ	SEZ-Specific Design Features
Water Resources *(Cont.)*	• For parabolic trough facilities (1,158-MW capacity), 827 to 1,754 ac-ft/yr (1.0 million to 2.2 million m^3/yr) for dry-cooled systems; 5,807 to 17,390 ac-ft/yr (7.2 million to 21.5 million m^3/yr) for wet-cooled systems. • For power tower facilities (643-MW capacity), 458 to 972 ac-ft/yr (0.6 million to 1.2 million m^3/yr) for dry-cooled systems; 3,225 to 9,659 ac-ft/yr (4.0 million to 12 million m^3/yr) for wet-cooled systems. • For dish engine facilities (643-MW capacity), 329 ac-ft/yr (406,000 m^3/yr). • For PV facilities (643-MW capacity), 33 ac-ft/yr (40,700 m^3/yr). • Assuming full development of the SEZ, operations would generate up to 16 ac-ft/yr (20,000 m^3/yr) of sanitary wastewater.	Before a new well is drilled within the Bill Williams basin, a Notice of Intent to Drill must be filed with ADWR, and any groundwater rights policy of the ADWR must be followed 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 Arizona Department of Environmental Quality. Water for potable uses would have to meet or be treated to meet drinking water quality standards. Land disturbance and operations activities should prevent erosion and sedimentation in the vicinity of the ephemeral washes present on the site and downstream in Bullard Wash.
Vegetation[b]	Up to 80% (5,791 acres [23.4 km^2]) of the SEZ would be cleared of vegetation; re-establishment of shrub communities in disturbed areas would likely be very difficult because of the arid conditions. Noxious weeds could become established in disturbed areas and colonize adjacent undisturbed habitats, thus reducing restoration success and potentially resulting in widespread habitat degradation. The deposition of fugitive dust from large areas of disturbed soil onto habitats outside a solar project area could result in reduced productivity or changes in plant community composition.	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 creosotebush-white bursage desert scrub communities and other affected habitats and to minimize the potential for the spread of noxious weeds or invasive species, such as those occurring in Yavapai County or the Bradshaw-Harquahala Planning Area, that could be introduced

TABLE 8.2.1.3-1 (Cont.)

Resource Area	Environmental Impacts—Proposed Bullard Wash SEZ	SEZ-Specific Design Features
Vegetation[b] *(Cont.)*	Grading could affect wetland, dry wash, dry wash woodland, mesquite bosque, riparian, Joshua tree, and saguaro cactus communities within the SEZ, access road, and transmission line corridors. Alteration of surface drainage patterns or hydrology could adversely affect downstream communities.	as a result of solar energy project activities (see Section 8.2.10.2.2). Invasive species control should focus on biological and mechanical methods where possible to reduce the use of herbicides. All wetland, dry wash, woodland, mesquite bosque, riparian, Joshua tree, and saguaro cactus communities within the SEZ or corridors should be avoided to the extent practicable and any impacts minimized and mitigated. Any Joshua trees or cacti that cannot be avoided should be salvaged. A buffer area should be maintained around wetland, dry washes, dry wash woodland, mesquite bosque habitats, and riparian habitats to reduce the potential for impacts. Transmission line towers should be sited and constructed to minimize impacts on these habitats and to span them whenever practicable. Appropriate engineering controls should be used to minimize impacts on wetland, dry wash, dry wash woodland, mesquite bosque, and riparian habitats, including downstream occurrences resulting from surface water runoff, erosion, sedimentation, altered hydrology, accidental spills, or fugitive dust deposition. Appropriate buffers and engineering controls would be determined through agency consultation. Groundwater withdrawals should be limited to reduce the potential for indirect impacts on groundwater-dependent communities, such as mesquite bosque communities, or riparian communities associated with springs, such as Yerba Mansa Spring or Tres Alamos Spring, or along the Santa Maria River.

TABLE 8.2.1.3-1 (Cont.)

Resource Area	Environmental Impacts—Proposed Bullard Wash SEZ	SEZ-Specific Design Features
Wildlife: Amphibians and Reptiles[b]	Direct impacts on amphibians and reptiles from development on the SEZ would be small (loss of ≤1.0% of potentially suitable habitats identified for the species in the SEZ region). With implementation of proposed design features, indirect impacts would be expected to be negligible.	Isolated wetlands should be avoided.
Wildlife: Birds[b]	Direct impacts on bird species would be small (loss of ≤1.0% of potentially suitable habitats identified for the species in the SEZ region). Other impacts on birds could result from collision with vehicles and infrastructure (e.g., buildings and fences), 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 the implementation of design features.	The requirements contained within the 2010 Memorandum of Understanding between the BLM and USFWS to promote the conservation of migratory birds will be followed. 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 Arizona Game and Fish Department. A permit may be required under the Bald and Golden Eagle Protection Act. Wetland habitats, which could provide occasional watering and feeding sites for some bird species, should be avoided.
Wildlife: Mammals[b]	Direct impacts on big game, small game, furbearers, and small mammals from habitat disturbance and long-term habitat reduction/ fragmentation would be small (loss of ≤1.0% of potentially suitable habitats identified for the species in the SEZ region). In addition to habitat loss, other direct impacts on mammals could result from collision with vehicles and infrastructure (e.g., fences). Indirect impacts on mammals could result from surface water and sediment runoff from disturbed areas, fugitive dust generated by project activities, accidental spills, and harassment. These indirect impacts are expected to be negligible with the implementation of design features.	The fencing around solar energy projects should not block the free movement of mammals, particularly big game species. Wetland habitats, which could provide occasional watering and feeding sites for some mammal species, should be avoided.

TABLE 8.2.1.3-1 (Cont.)

Resource Area	Environmental Impacts—Proposed Bullard Wash SEZ	SEZ-Specific Design Features
Aquatic Biota[b]	There are no permanent water bodies, streams, or wetlands present within the area of direct effects of either the proposed Bullard Wash SEZ or the presumed new access road and transmission line corridors. In the area of indirect effects, there are no perennial surface water features, but two intermittent and ephemeral streams (Creek and Bullard Wash) are present, Date Creek may contain aquatic habitat and biota, and both streams also flow into perennial surface waters. There is the potential that groundwater withdrawals could reduce surface water levels in streams and wetlands outside of the proposed SEZ. Because construction activities occur at least 0.2 mi (0.3 km) from any surface water features, the potential for introducing contaminants would be small, especially assuming required design features are implemented.	Any wetlands within the SEZ should be avoided.
Special Status Species[b]	Potentially suitable habitat for 39 special status species occurs in the affected area of the Bullard Wash SEZ. For all of these special status species, less than 1% of the potentially suitable habitat in the region occurs in the area of direct effects. There are four groundwater dependent species that occur outside of the areas of direct and indirect effects. Potential impacts on these species could range from small to large depending on the solar energy technology deployed, the scale of development within the SEZ, and the cumulative rate of groundwater withdrawals.	Pre-disturbance surveys should be conducted within the area of direct effects 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 for some species, 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 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. Consultation with the USFWS and AZGFD should be conducted to address the potential for impacts on the following species currently listed as threatened or endangered under the ESA: Arizona cliff rose, desert

TABLE 8.2.1.3-1 (Cont.)

Resource Area	Environmental Impacts—Proposed Bullard Wash SEZ	SEZ-Specific Design Features
Special Status Species[b] *(Cont.)*		pupfish, Gila topminnow, Sonoran bald eagle, and southwestern willow flycatcher. Consultation would identify an appropriate survey protocol, avoidance and minimization measures, and, if appropriate, reasonable and prudent alternatives, reasonable and prudent measures, and terms and conditions for incidental take statements (if necessary). Coordination with the USFWS and AZGFD should be conducted to address the potential for impacts on the Sonoran population of the desert tortoise, a species under review for listing under the ESA. Coordination would identify an appropriate survey protocol, and mitigation requirements, which may include avoidance, minimization, translocation, or compensation. Avoiding or minimizing disturbance to desert wash or riparian habitat within the area of direct effects could reduce or eliminate impacts on 15 special status species. Avoidance or minimization of groundwater withdrawals to serve solar energy development on the SEZ could reduce or eliminate impacts on four special status species. In particular, impacts on aquatic and riparian habitat associated with the Tres Alamos and Yerba Mansa springs should be avoided.

TABLE 8.2.1.3-1 (Cont.)

Resource Area	Environmental Impacts—Proposed Bullard Wash SEZ	SEZ-Specific Design Features
Special Status Species[b] *(Cont.)*		Harassment or disturbance of special status 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 AZGFD.
Air Quality and Climate	*Construction*: Predicted 24-hour and annual PM_{10} and $PM_{2.5}$ concentration levels could exceed the AAQS at the SEZ boundaries and in the immediate surrounding areas during the construction of solar facilities. However, concentrations would decrease quickly with distance. Modeling indicates that emissions from construction activities are not anticipated to exceed Class I PSD PM_{10} increments at the nearest federal Class I area. In addition, construction emissions from the engine exhaust of heavy equipment and vehicles could affect somewhat AQRVs at nearby federal Class I areas. *Operations*: Positive impact due to avoided emission of air pollutants from combustion-related power generation: 1.6 to 2.9% of total SO_2, NO_x, Hg, and CO_2 emissions from electric power systems in the state of Arizona avoided (up to 1,563 tons/yr SO_2, 2,406 tons/yr NO_x, 0.022 tons/yr Hg, and 1,725,000 tons/yr CO_2).	None.
Visual Resources	Solar development could produce large visual impacts on the SEZ and surrounding lands within the SEZ viewshed due to major modification of the character of the existing landscape. The SEZ is in an area of low scenic quality, but with few cultural disturbances present. 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. The residents nearest to the SEZ could be subjected to strong visual contrasts from solar energy development within the SEZ.	None.

TABLE 8.2.1.3-1 (Cont.)

Resource Area	Environmental Impacts—Proposed Bullard Wash SEZ	SEZ-Specific Design Features
Visual Resources *(Cont.)*	The SEZ is located 3.5 mi (5.6 km) from the Tres Alamos WA. Because of the open views of the SEZ and elevated viewpoints, strong visual contrasts could be observed by WA visitors. The SEZ is located 8.6 mi (13.8 km) from the Arrastra Mountain WA. Because of the open views of the SEZ and elevated viewpoints, weak to moderate visual contrasts could be observed by WA visitors. Joshua Forest Scenic Road passes within 5.5 mi (8.9 km) of the SEZ and is in the viewshed of the SEZ for about 14 mi (22.5 km). Because of the proximity of Joshua Forest Scenic Road to the SEZ, moderate to strong visual contrasts could be observed by travelers on Joshua Forest Scenic Road.	
Acoustic Environment	*Construction*. For construction activities occurring near the southern SEZ boundary, estimated noise levels at the nearest residences located about 5.6 mi (9 km) from the SEZ boundary would be well below a typical daytime mean rural background level of 40 dBA. In addition, an estimated 40 dBA L_{dn} at these residences is well below the EPA guidance of 55 dBA L_{dn} for residential areas. *Operations*. For a facility located near the southern SEZ boundary, the predicted noise level from a parabolic trough or power tower facility would be about 27 dBA at the nearest residences, which is much lower than 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), the EPA guideline level of 55 dBA (as L_{dn} for residential areas) would not be exceeded outside of the proposed SEZ boundary. In the case of 6-hour TES, the estimated noise level at the nearest residences would be 37 dBA, which is higher than typical nighttime mean rural background level of 30 dBA. The day-night average noise level is estimated to be about 42 dBA L_{dn}, which is well below the EPA guideline of 55 dBA L_{dn} for residential areas.	None.

TABLE 8.2.1.3-1 (Cont.)

Resource Area	Environmental Impacts—Proposed Bullard Wash SEZ	SEZ-Specific Design Features
Acoustic Environment *(Cont.)*	If the SEZ was developed with dish engine facilities, the estimated noise level at the nearest residences about 5.6 mi (9.0 km) from the SEZ boundary would be about 36 dBA, which is below typical daytime mean rural background level of 40 dBA. If assuming 12-hour daytime operation, the estimated 41 dBA L_{dn} at these residences would be well below the EPA guideline of 55 dBA L_{dn} for residential areas.	
Paleontological Resources	The potential for impacts on significant paleontological resources in the proposed SEZ is unknown. A more detailed investigation of the alluvial deposits is needed prior to project approval. A paleontological survey will likely be needed	The need for and the nature of any SEZ-specific design features would depend on the results of future paleontological investigations.
Cultural Resources	No surveys have been conducted in the proposed SEZ and no sites have been recorded to date. Direct impacts on significant cultural resources could occur in the proposed Bullard Wash SEZ; however, further investigation is needed. A cultural resources survey of the entire area of potential effects of any project proposed would first need to be conducted to identify archaeological sites, historic structures and features, and traditional cultural properties, and an evaluation would need to follow to determine whether any are eligible for listing in the NRHP. Impacts on cultural resources also are possible in areas related to the transmission line ROW, as new areas of potential cultural significance could be directly affected by construction or opened to increased access from use.	SEZ-specific design features would be determined during consultations with the Arizona SHPO and affected Tribes and would depend on the findings of cultural surveys.

TABLE 8.2.1.3-1 (Cont.)

Resource Area	Environmental Impacts—Proposed Bullard Wash SEZ	SEZ-Specific Design Features
Native American Concerns	The proposed SEZ is adjacent to montane areas formerly inhabited by the Yavapai that may be culturally important. Development within the SEZ may result in visual or audible disturbance to sacred areas in the mountains. The SEZ itself does contain plant and animal species traditionally important to the Yavapai. Development in the proposed SEZ would eliminate some traditionally important plants and some habitat of traditionally important animals. The importance of these resources relative to the plants and animal habitat that will remain undisturbed outside the SEZ must be determined in consultation with the affected Native American Tribe(s).	The need for and nature of SEZ-specific design features would be determined during government-to-government consultation with the affected Tribes.
Socioeconomics	*Construction:* 480 to 5,477 total jobs; \$28.4 million to \$339 million income in ROI for construction of solar facilities in the SEZ. *Operations:* 18 to 414 annual total jobs; \$0.6 million to \$16.2 million annual income in the ROI. *Construction of new transmission line:* 27 total jobs; \$1.4 million income. *Construction of access road:* 122 total jobs; \$4.7 million income.	None.
Environmental Justice	There are no minority and low-income populations within the 50 mi (80 km) radius around the boundary of the SEZ. Therefore, according to CEQ guidelines, there would be no impacts on minority or low-income populations.	None.
Transportation	The primary transportation impacts are anticipated to be from commuting worker traffic. Single projects could involve up to 1,000 workers each day, with an additional 2,000 vehicle trips per day (maximum). This additional volume of traffic on U.S. 93 would represent an increase in traffic of about 30% percent for a single project in the area of the Bullard Wash SEZ.	None.

Footnotes on next page.

TABLE 8.2.1.3-1 (Cont.)

Abbreviations: AAQS = ambient air quality standards; AGFD = Arizona Game and Fish Department; ANHP = Arizona National Heritage Program; AQRV= air quality-related value; BLM = Bureau of Land Management; BMP = best management practice; CEQ = Council on Environmental Quality; CO_2 = carbon dioxide; dBA = A-weighted decibel; DoD = U.S. Department of Defense; EPA = U.S. Environmental Protection Agency; ESA = Endangered Species Act; Hg = mercury; L_{dn} = day-night average sound level; MTR = military training route; NO_x = nitrogen oxides; NP = National Park; NRHP = *National Register of Historic Places*; OHV = off-highway vehicle; PEIS = programmatic environmental impact statement; $PM_{2.5}$ = 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; PV = photovoltaic; ROI = region of influence; ROW = right-of-way; SEZ = solar energy zone; SHPO = State Historic Preservation Office; SO_2 = sulfur dioxide; SRMA = Special Recreation Management Area; TES = thermal energy storage; USFWS = U.S. Fish and Wildlife Service; WA = Wilderness Area.

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

[b] The scientific names of all plants, wildlife, aquatic biota, and special status species are provided in Sections 8.2.10 through 8.2.12.

8.2.2 Lands and Realty

8.2.2.1 Affected Environment

The proposed Bullard Wash SEZ is a relatively small SEZ that is located on the eastern edge of a large block of undeveloped public land administered by the BLM. The SEZ is bordered to the east by a large block of undeveloped state land. The overall character of the land in the SEZ area is rural and undeveloped and is used primarily for grazing and some recreational use. A gravel and dirt road, known as Alamo Road, provides supplemental access to the Alamo Reservoir from U.S. 93 and passes less than 0.5 mi (0.8 km) north of the SEZ. The SEZ is located about 25 mi (40 km) northwest of Wickenberg, Arizona. There are no existing ROWs within the proposed SEZ.

As of February 2010, there were no ROW applications for solar energy facility development on the SEZ; there are, however, numerous applications on public lands to the south of the SEZ (see Figure 8.2.22-1).

8.2.2.2 Impacts

8.2.2.2.1 Construction and Operations

Full development of the proposed Bullard Wash SEZ could disturb up to 5,791 acres (23 km^2) (Table 8.2.1.2-1). Development of the SEZ for utility-scale solar energy production would establish an isolated, industrial area that would exclude many existing and potential uses of the land, perhaps in perpetuity. Since the SEZ is rural and undeveloped, utility-scale solar energy development would be a new and dominant land use in the area. It also is possible that state lands located adjacent to the SEZ, with the State's agreement, could be developed in the same or complementary manner as the public lands.

Should the proposed SEZ be identified as an SEZ in the ROD for this PEIS, the BLM would still have discretion to authorize 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. It is not anticipated that approval of solar energy development within the SEZ would have a significant impact on public lands available for future ROWs in the area.

8.2.2.2.2 Transmission Facilities and Other Off-Site Infrastructure

Delivery of energy produced in the SEZ would require establishing connection to the regional grid. For analysis purposes, it is assumed that initial connection to the grid would be made to an existing 500-kV transmission line that is located 5 mi (8 km) northeast of the SEZ. Construction of a new 5-mi (8-km) line to connect to this line would result in the disturbance of about 152 acres (0.6 km^2). Because State Route 71 is the closest highway to the SEZ, it is assumed that a new 5-mi (8-km) road would be constructed to connect the south end of the SEZ to that highway. This would result in the surface disturbance of about 36 acres (0.1 km^2) of public land. Alternative or additional access to the SEZ could be provided from U.S. 93, which passes near the eastern side of the SEZ. In this case, improvement of the existing Alamo Road could be undertaken. Roads and transmission lines would be constructed within the SEZ as part of the development of the area.

8.2.2.3 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 proposed Solar Energy Program would provide adequate mitigation for some identified impacts.

A proposed design feature specific to the proposed SEZ is:

- Priority consideration should be given to utilizing the existing Alamo Road to provide construction and operational access to the SEZ.

8.2.3 Specially Designated Areas and Lands with Wilderness Characteristics

8.2.3.1 Affected Environment

There are 13 specially designated areas within 25 mi (40 km) of the proposed Bullard Wash SEZ that potentially could be affected by solar energy development within the SEZ. The listed ACECs all have scenic values as one of the components supporting the designation. All but one of these areas is more than 5 mi (8 km) from the SEZ. The areas include (see Figure 8.2.3.1-1) the following:

- Wilderness Areas
  - Arrastra Mountain
  - Harcuvar Mountains
  - Harquahala Mountains
  - Hummingbird Springs
  - Rawhide Mountains
  - Tres Alamos

- Areas of Critical Environmental Concern
  - Three Rivers Riparian
  - Poachie Desert Tortoise Habitat
  - Harquahala
  - Black Butte
  - Vulture Mountains

- Scenic Roads/Back Country Byways
  - U.S. 93, Joshua Forest Scenic Road
  - Harquahala Back Country Byway

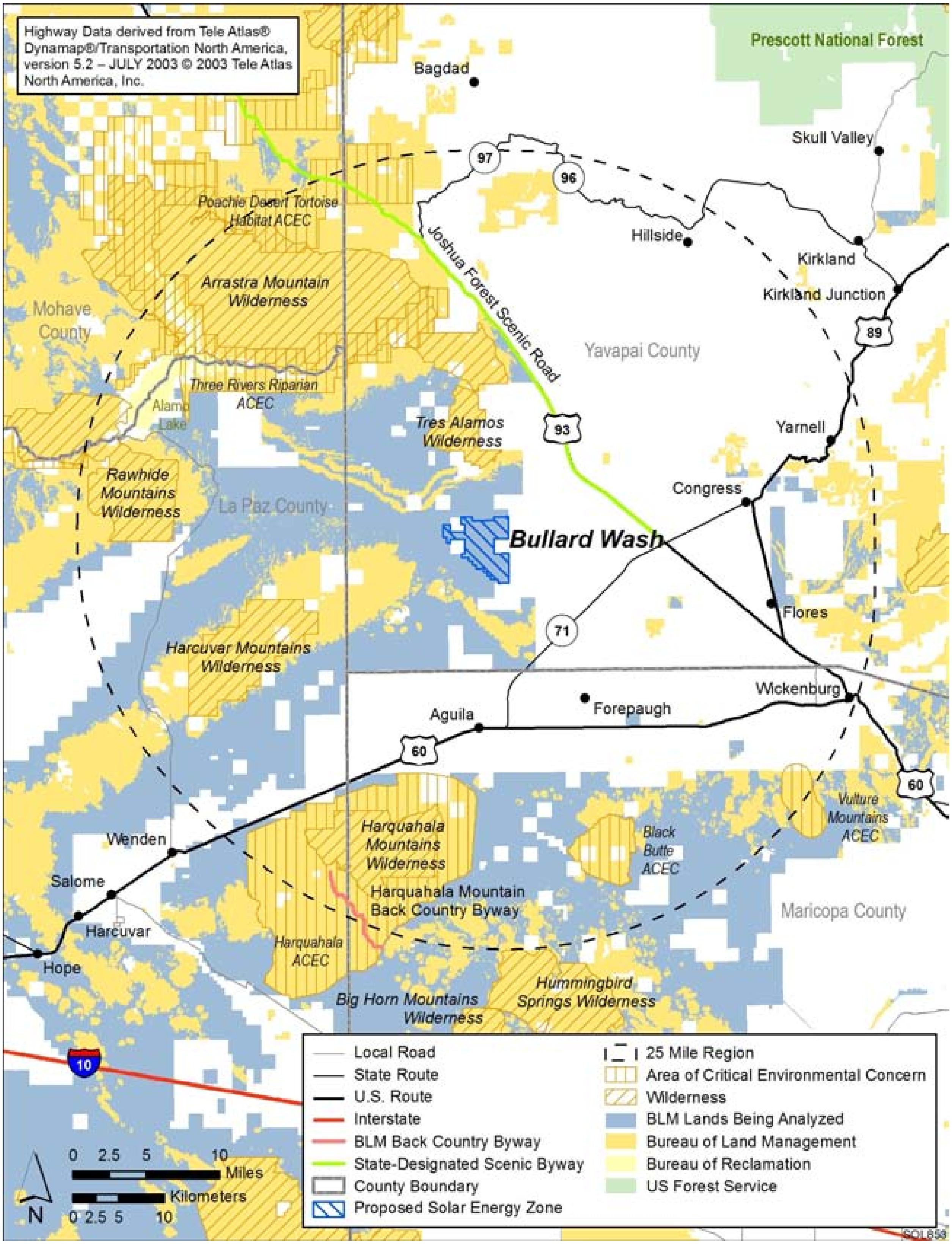
Viewshed analyses show that the Black Butte and Vulture Mountains ACECs and the Hummingbird Springs WA have less than 5% of their area in the viewshed of the SEZ, and that which is in the viewshed is more than 15 mi (24 km) from the SEZ. The Harquahala Back Country Byway is not in the viewshed of the SEZ. Because of these factors, these four areas are not considered further.

No undesignated areas with wilderness characteristics have been identified near the SEZ.

8.2.3.2 Impacts

8.2.3.2.1 Construction and Operations

The primary potential impact on the nine remaining areas near the SEZ would be from visual impacts of solar energy development that could affect scenic, recreational, or wilderness

1


2 **FIGURE 8.2.3.1-1 Specially Designated Areas in the Vicinity of the Proposed Bullard Wash SEZ**

characteristics of the areas. The visual impact on specially designated areas is difficult to determine and would vary by solar technology employed, the specific area being affected, and the perception of individuals viewing or using the areas. Development of the SEZ, especially full development, would be an important visual component in the viewshed from portions of some of these specially designated areas, as summarized in Table 8.2.3.2-1. The data provided in the table, which shows the potential area of impact, assume the use of power tower solar energy technology, which because of the potential height of these facilities, could be visible from the largest amount of land of the technologies being considered in the PEIS. Viewshed analysis for this SEZ has shown that the visibility of shorter solar energy facilities would be considerably less in some areas than power tower technology (Section 8.2.14 provides detail on all viewshed analyses discussed in this section). Potential impacts included below are general and assessment of the visual impact of solar energy projects must be conducted on a site-specific and technology-specific basis to accurately identify impacts.

In general, the closer a viewer is to solar development, the greater the effect is on an individual's perception of impact. From a visual analysis perspective, the most sensitive viewing distances generally are from 0 to 5 mi (0 to 8 km). The viewing height above or below a solar energy development area, the size of the solar development area, and the purpose for which a person is visiting an area are also important. Individuals seeking a wilderness or scenic experience within these specially designated areas could be expected to be more adversely affected than those simply traveling along the highway with another destination in mind. In the case of the Bullard Wash SEZ the low-lying location of the SEZ in relation to portions of some of the surrounding specially-designated areas would highlight the industrial-like development in the SEZ.

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 that were used to assess potential impacts on specially designated areas 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.

Wilderness Areas

Tres Alamos. This WA is the specially designated area closest to the SEZ. The area in the WA that has visibility of the SEZ is 3.5 to 7 mi (6 to 11 km) from the SEZ. Wilderness characteristics in the WA within 5 mi (8 km) of the border of the SEZ and within the viewshed of the SEZ would be adversely affected by development within the SEZ because of the strong visual contrast that would be created by solar facilities. Since visual impact can be considered as a gradation of effect over distance as the distance from the SEZ increases, the level of impact on wilderness characteristics would likely decrease. However, because such a large percentage of the WA would be in the viewshed of the SEZ and within 7 mi (11 km) of the SEZ, the ability to avoid the view of the SEZ is limited and may contribute to adverse effects on wilderness characteristics over longer distances. It is anticipated that wilderness characteristics between

TABLE 8.2.3.2-1 Potentially Affected Specially Designated Areas within a 25-mi (40-km) Viewshed of the Proposed Bullard Wash SEZ[a]

		Feature Area or Highway Length[c]		
Feature Type	Feature Name (Total Acreage/Highway Length)[b]	Visible within 5 mi	Visible within 5 and 15 mi	Visible within 15 and 25 mi
WAs	Arrastra Mountain (129,413 acres)	0 acres	3,653 acres (<1%)	16,727 acres (13%)
	Harcuvar Mountains (25,178 acres)	0 acres	796 acres (3%)	2,036 acres (8%)
	Harquahala Mountains (22,947 acres)	0 acres	0 acres	4,933 acres (22%)
	Hummingbird Springs (31,429 acres)	0 acres	0 acres	3 acres (<1%)
	Rawhide Mountains (37,968 acres)	0 acres	0 acres	4,433 acres (12%)
	Tres Alamos (8,278 acres)	1,694 acres (20%)	5,144 acres (62%)	5,144 acres (62 %)
ACECs	Three Rivers Riparian (87,716 acres)	0 acres	503 acres (<1%)	3,981 acres (5%)
	Poachie Desert Tortoise Habitat (33,512 acres)	0 acres	0 acres	1,764 acres (5%)
	Harquahala (22,947 acres)	0 acres	3,180 acres (4%)	16,192 acres (21%)
	Black Butte (9,549 acres)	0 acres	0 acres	422 acres (4%)
	Vulture Mountains (6,497 acres)	0 acres	0 acres	128 acres (2%)
Scenic Roads	Joshua Forest Scenic Road (51 mi)	0 mi	14 mi (27%)	0 mi
	Harquahala Back Country Byway (7.6 mi)	0 mi	0 mi	0 mi

a Assuming power tower technology with a height of 650 ft (198.1 m).

b To convert acres to km^2, multiply by 0.004047. To convert mi to km, multiply by 1.609.

c Percentage of total feature acreage or road length viewable.

5 and 7 mi (8 and 11 km) would also be adversely affected. In this case, the viewshed analysis shows that shorter solar facilities would dramatically reduce the area in which wilderness characteristics would be adversely affected (see Section 8.2.14 for a more thorough review of the visual analysis).

Arrastra Mountain WA. The portion of the Arrastra Mountain WA nearest to the SEZ is about 9 mi (14 km) distant. Between 9 and 15 mi (14 and 24 km) of the SEZ, less than 3% of the WA is within the viewshed of the SEZ. At this distance, while solar development would be visible, the contrast and field of view would be much reduced and would likely have only a minimal impact on wilderness characteristics. Between 15 and 25 mi (24 and 40 km), another 10% of the WA would be within the viewshed of the SEZ. However, at this distance, the impact on wilderness characteristics is anticipated to be minimal.

Harcuvar Mountains WA. The area of this WA within the viewshed of the SEZ is between 9 and 20 mi (14 and 32 km) from the SEZ. Because the axis of the mountain range within the WA is roughly perpendicular to the SEZ and because of some topographic screening, generally only the higher elevations of the WA would have a view of development within the SEZ. In the small percentage of the WA between 9 and 15 mi (14 and 24 km) of the SEZ, the level of contrast and the field of view of the SEZ would be much reduced and would likely have only a minimal effect on wilderness characteristics. Between 15 and 20 mi (24 and 32 km), a larger percentage of the SEZ would be distantly visible but at this distance, because of the loss of detail and contrast and the very narrow field of view of the SEZ, it is anticipated that there would be no effect on wilderness characteristics. In addition, much of the southeastern side of the WA would have a clear and closer view of agricultural and residential development in the Aguila Valley that would also affect wilderness characteristics.

Harquahala Mountains WA. The portion of this WA nearest the SEZ is about 16 mi (26 km) distant, and the area with visibility of the SEZ stretches to about 22 mi (35 km). While solar facilities in the SEZ would be visible from slightly more than 20% of the area, because of the distance from the SEZ, the level of contrast, and detail of solar facilities in the SEZ, the field of view would be so reduced as to have a minimal impact on wilderness characteristics. This WA also overlooks the development in the Aguila Valley, which would be viewed at the same time as development in the SEZ and would further dilute the effect of the view of the SEZ.

Rawhide Mountains WA. The nearest portion of the WA to the SEZ is about 18 mi (29 km) away, and areas of the WA within the viewshed of the SEZ stretch to 28 mi (45 km) from the boundary of the SEZ. While almost 12% of the WA would have a distant view of the SEZ, the level of contrast and detail of solar facilities in the SEZ, and field of view would be so reduced, it is anticipated that there would be no impact on wilderness characteristics.

Areas of Critical Environmental Concern

Harquahala ACEC. The ACEC is a large area that encompasses much of the Harquahala Mountains; it was designated for a variety of resource values, including scenery, primitive landscapes, cultural resources, and unique biological assemblages. The ACEC completely surrounds the Harquahala WA. The portions of the ACEC that are within the viewshed of the SEZ include about 21% of the area and are restricted primarily to the northern and northeastern slopes of the mountains. Areas of the ACEC with visibility of the SEZ range from 13 to 27 mi (21 to 43 km) from the nearest boundary of the SEZ, and only the higher elevation areas closest to the SEZ would have a good view of solar facilities in the SEZ, although the distance would tend to mute the level of contrast and detail of the facilities and the field of view would not be large. The farther distances would have decreasing views of the facilities in the SEZ to the point that they would be largely inconsequential. The ACEC overlooks a wide area with a 360° view, and the SEZ would make up only a small percentage of the overall panorama. Overall, it is anticipated that there would be minimal impact on the scenic values of the ACEC. The other resource values present in the ACEC would not be affected.

Three Rivers Riparian ACEC and Poachie Desert Tortoise Habitat ACEC. These ACECs are designated to protect a range of resource values, including scenery, recreation, riparian habitat, and desert tortoise and threatened and endangered species habitat. The portions of these ACECs that are within the viewshed of the SEZ are almost completely located between 15 and 25 mi (24 and 40 km) from the SEZ, and the acreage of each ACEC that is within the viewshed of the SEZ is about 5% of the total acreage. There are portions of the areas that could have a view of solar facilities in the SEZ; however, because of the distance, reduced contrast and lack of visible detail of the facilities in the SEZ, and the presence of screening vegetation in some of the riparian areas, it is anticipated that there would be no impact on the visual resources within these ACECs. Other resource values present in the ACEC would not be affected.

Scenic Roads

The Joshua Forest Scenic Road, U.S. 93, is located northeast of the SEZ, and visitors traveling the road would be within 5.5 to 10 mi (9 to 16 km) of the SEZ along about a 14-mi (23-km) segment of the road. The road is located at an elevation about 250 ft (76 m) higher than the SEZ, and solar facilities within the SEZ would be visible from the road. Because of the distance to the SEZ and the nature of highway travel, however, it is not anticipated that there would be a significant adverse impact on the use of the scenic highway. While some highway travelers might find the view of solar facilities in the SEZ objectionable, it is also possible that some might find the solar energy development a point of interest.

Viewshed analysis of this area shows that there would be a large reduction in the road mileage that would have visibility of facilities in the SEZ if solar technologies employing shorter facilities were utilized.

8.2.3.2.2 Transmission Facilities and Other Off-Site Infrastructure

For analysis purposes, it is assumed that a new 5-mi (8-km) transmission line to transmit solar power generated at the SEZ to the regional grid would be constructed from the northeastern corner of the SEZ to an existing 500-kV transmission line located 5 mi (8 km) northeast of the SEZ. Construction of this line would result in the disturbance of about 152 acres (0.6 km^2), and the new line would be visible from the Tres Alamos WA. The new transmission line would come within 5 mi (8 km) of the WA and would be at the edge of the distance zone that is considered to be most visually sensitive; thus it is possible that there could be some additional adverse impact on wilderness characteristics in this WA caused by construction of this line.

It also is assumed that a new road connecting the SEZ to State Route 71, southeast of the SEZ, would be constructed and that this construction would disturb 36 acres (0.1 km^2). This road would likely be visible from the Tres Alamos, Harcuvar Mountains, and Harquahala Mountains WAs and from the Harquahala ACEC at distances ranging from 8 to 16 mi (13 to 26 km). The distances are far enough away to minimize the visual impact of the road, and it is anticipated that there would be no additional impacts on wilderness or scenic values associated with this road.

Roads and transmission lines would be constructed within the SEZ as part of the development of the area and would contribute to the impact of solar facilities on surrounding areas.

8.2.3.3 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 proposed Solar Energy Program would provide adequate mitigation for some identified impacts. However, the Tres Alamos WA would incur adverse impacts on wilderness characteristics.

Proposed design features specific to the proposed SEZ include the following:

- The Tres Alamos WA would incur adverse impacts on wilderness characteristics. Consideration should be given to restricting development of solar facilities within 5 mi (8 km) of the WA to avoid the most serious impacts to the WA.

- Consideration also should be given to restricting solar facilities within the SEZ to lower profile facilities. Both the Tres Alamos WA and the Joshua Forest Scenic Road would experience relatively large reductions in potential impacts on visual and wilderness resources if shorter solar energy facilities were required.

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8.2.4 Rangeland Resources

Rangeland resources include livestock grazing and wild horses and burros, both of which are managed by the BLM. These resources and possible impacts on them from solar development within the proposed Bullard Wash SEZ are discussed in Sections 8.2.4.1 and 8.2.4.2.

8.2.4.1 Livestock Grazing

8.2.4.1.1 Affected Environment

The proposed Bullard Wash SEZ includes portions of three perennial grazing allotments, including the Pipeline Ranch, Forepaugh Cattle, and Central Arizona Ranch Company allotments. In years with good spring rainfall, additional ephemeral grazing use may be authorized to utilize above-average amounts of annual forage in addition to the base perennial authorization. A number of water supplies occur in and around the SEZ, with at least two within the SEZ boundaries. The Pipeline allotment is administered by the BLM Kingman Field Office, and the other two allotments are administered by the Hassayampa Field Office. Table 8.2.4.1-1 summarizes key information regarding these allotments.

8.2.4.1.2 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

TABLE 8.2.4.1-1 Grazing Allotments within the Proposed Bullard Wash SEZ

Allotment	Total Acres[a]	% of Acres in SEZ[b]	Active BLM AUMs	No. of Permittees
Pipeline Ranch	28,401	12	1,838	1
Forepaugh Cattle	30,411	4	888	1
Central Arizona Ranch Company	39,357	7	2,329	1

[a] Includes public, private, and state lands included in the allotment based on the Allotment Master Reports included in the BLM's Rangeland Administration System (BLM 2009a) and personal communication with BLM staff (Holden 2010).

[b] This is the percentage of the total allotment acreage of the public lands located in the SEZ.

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.

The Forepaugh Cattle allotment contains 9,199 acres (37 km^2) of public land and 21,212 acres (86 km^2) of state land. The total amount of authorized grazing use on the public land portion of the allotment is 888 AUMs. Approximately 1,280 acres (5 km^2) (14%) of the public land in the allotment is located within the boundaries of the SEZ and would be lost to grazing should full solar development occur. Assuming that the percentage reduction in authorized AUMs would be the same as the percentage reduction in total area available for grazing, the Forepaugh allotment could lose 124 AUMs from the public lands. Given the overall size of the allotment, this is anticipated to be a small impact on the overall grazing operation.

The Central Arizona Ranch Company allotment has about 2,639 acres (10 km^2) of public lands included within the boundary of the proposed SEZ. If the same assumption is used that the percentage reduction of AUMs would be the same as the percentage reduction in available public land for grazing, the BLM authorized grazing permit would be reduced by about 7% or 163 AUMs. This is anticipated to result in a small impact on the grazing permittee.

There are about 3,352 acres (14 km^2) or 12% of the Pipeline Ranch allotment within the boundaries of the SEZ. With full solar development of the SEZ, it is anticipated that 220 AUMs would be lost. This is anticipated to result in a small impact on the grazing permittee.

Quantification of the impact on the grazing permittees would require a specific analysis involving, at a minimum, the three factors identified above. For the purposes of this PEIS, and assuming a loss of AUMs as described previously, there would be a minimal impact on overall livestock forage use within the two field offices from the designation and development of the Bullard Wash SEZ. This conclusion is derived from comparing the projected loss of the 507 AUMs with the total BLM-authorized AUMs in the two offices for grazing year 2009 which totaled 117,273 AUMs. This represents a loss of about 0.4%. The actual impact on the three permittees could also be affected by any mitigation of the loss (e.g., through installation of new range improvements) that could be accomplished on the remaining public lands in the allotments.

Transmission Facilities and Other Off-Site Infrastructure

For analysis purposes, it is assumed that the initial connection to the regional electric grid would be accomplished by constructing a new transmission line from the SEZ to the existing 500-kV transmission line that is located 5 mi (8 km) northeast of the SEZ. Construction of this line, assuming landowner approval, would largely be on state land and would result in the disturbance of about 152 acres (0.6 km^2) of land currently used for grazing. This level of disturbance would not cause a significant additional loss of livestock grazing.

Also for purposes of analysis, it is assumed that a new road connecting the SEZ to State Route 71, southeast of the SEZ, would be constructed on state lands located in the Forepaugh allotment, and that this construction would disturb an additional 36 acres (0.1 km^2). It is not anticipated that this would create a significant additional loss of livestock grazing within the Forepaugh allotment.

8.2.4.1.3 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 proposed Solar Energy Program, would provide adequate mitigation for some identified impacts.

A proposed design feature specific to the proposed SEZ includes the following:

Development of additional range improvements within the allotments should be considered to reduce the expected loss of livestock forage.

8.2.4.2 Wild Horses and Burros

8.2.4.2.1 Affected Environment

Section 4.4.2 discusses wild horses (*Equus caballus*) and burros (*E. asinus*) that occur within the six-state study area. Seven wild horse and burro HMAs occur within Arizona (BLM 2010c); portions of four of them (Alamo, Big Sandy, Havasu, and Lake Pleasant HMAs) occur within the 50-mi (80-km) SEZ region for the proposed Bullard Wash SEZ (Figure 8.2.4.2-1). None of the HMAs occur within the SEZ or indirect impact area of the SEZ.

In addition to the HMAs managed by the BLM, the USFS has wild horse and burro territories in Arizona, California, Nevada, New Mexico, and Utah, and is the lead management agency that administers 37 of the territories (Giffen 2009; USFS 2007). None of the territories occurs within the SEZ region.

8.2.4.2.2 Impacts

Because the proposed Bullard Wash SEZ is about 7 mi (11 km) or more from any wild horse and burro HMA managed by the BLM and more than 50 mi (80 km) from any wild horse and burro territory administered by the USFS, solar energy development within the SEZ would not directly affect wild horses and burros that are managed by these agencies.

FIGURE 8.2.4.2-1 Wild Horse and Burro Herd Management Areas and Territories within the Analysis Area for the Proposed Bullard Wash SEZ (Source: BLM 2010c)

8.2.4.2.3 SEZ-Specific Design Features and Design Feature Effectiveness

No SEZ-specific design features for solar facilities within the proposed Bullard Wash SEZ would be necessary to protect or minimize impacts on wild horses and burros.

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8.2.5 Recreation

8.2.5.1 Affected Environment

The proposed Bullard Wash SEZ is a well-vegetated area and is located just south of the old Alamo Road, which provides good access to the area. While the area is generally flat, numerous drainages cross the area and provide some topographic relief and there are Joshua Trees present throughout the area. No visitor use data exist for the area, but a low level of backcountry driving, OHV use, hunting, photography, and rockhounding are the most likely recreational uses of the area. The area is included within the Bradshaw–Harquahala Resource Management Plan area, and the whole planning area has been classified for eventual designation of OHV uses as "limited to designated routes." Pending completion of the formal route planning process, road use is limited to travel on inventoried routes. The route inventory for the area of the SEZ shows seven inventoried routes within the area of the SEZ (Baker and Bickauskas 2010).

8.2.5.2 Impacts

8.2.5.2.1 Construction and Operations

Recreational users would lose the use of any portions of the SEZ developed for solar energy production, but this loss is anticipated to be minimal. Any inventoried routes that pass through areas developed for solar power production could be closed or rerouted, although the existing Alamo Road would continue to provide general east—west access.

The Tres Alamos WA is within 3.5 mi (6 km) of the SEZ, and solar development within the SEZ would be very visible from areas within the WA. Whether the presence of solar development in the SEZ would affect recreational use of the WA is unknown, but a large percentage of the area is located within the most sensitive visual zone surrounding the proposed SEZ. It is anticipated that some current and potential users of portions of the WA may choose to relocate their activities in the WA farther away from solar energy facilities.

Travelers along the Joshua Forest Scenic Road would have a substantial view of solar development within the SEZ over about 14 mi (23 km), but because the SEZ is located more than 5 mi (8 km) from the highway, it is not likely that there would be any significant impact on the use of the scenic road.

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 redesignated as closed (see Section 5.5.1 for more details on how routes coinciding with proposed solar facilities would be treated).

8.2.5.2.2 Transmission Facilities and Other Off-Site Infrastructure

The new 5-mi (8-km) transmission line connecting solar energy produced in the SEZ to the regional grid would be visible from the Tres Alamos WA and the Joshua Forest Scenic Road. The transmission line would converge with two existing transmission lines that are currently visible from the scenic road, and for that reason, it is not anticipated that there would be any additional impact on travelers on the road from the construction of the new line. Since the new transmission line comes within 5 mi (8 km) of the WA, there is potential for the line to contribute to the adverse impact on wilderness characteristics and a potential subsequent reduction in recreational use within the WA. It is not anticipated that any additional impact caused by the construction of the transmission line would be significant when compared with the adverse impact on the WA already included in Section 8.2.3.2.1.

The new road that has been assumed to be necessary to connect the SEZ to State Route 71, southeast of the SEZ, would not be close enough to any specially designated areas to have an adverse effect on recreational use of those areas.

8.2.5.3 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 proposed Solar Energy Program, would provide mitigation for some impacts on recreation. However, some recreational use within the SEZ would be lost. No SEZ-specific design features for solar facilities within the proposed Bullard Wash SEZ are recommended.

8.2.6 Military and Civilian Aviation

8.2.6.1 Affected Environment

The SEZ is located within an extensive web of MTRs, and the entire SEZ is covered by a combination of two MTRs with 300-ft (91-m) AGL operating limits. One of these routes is used as a VFR corridor and one is an IFR corridor. The SEZ is located 57 mi (92 km) northwest of Luke Air Force Base.

The closest public airport to the SEZ is the Wickenberg Municipal Airport located 25 mi (40 km) to the southeast. This airport does not have regularly scheduled passenger or freight service.

8.2.6.2 Impacts

The military has indicated that construction of solar or transmission facilities in excess of 250 ft (76 m) tall would adversely affect the use of both of the MTRs.

The Wickenberg Municipal Airport is located far enough away from the proposed SEZ that there would be no effect on airport operations.

8.2.6.3 SEZ-Specific Design Features and Design Feature Effectiveness

No SEZ-specific design features for solar development within the proposed Bullard Wash SEZ would be necessary to protect impacts on military and civilian aviation. 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, the potential impacts on the use of MTRs.

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8.2.7 Geologic Setting and Soil Resources

8.2.7.1 Affected Environment

8.2.7.1.1 Geologic Setting

Regional Setting

The proposed Bullard Wash SEZ is located in Date Creek basin, an alluvial basin within the Basin and Range physiographic province in west-central Arizona. The basin is near the transition zone that marks the boundary between the eastern margin of the Basin and Range province and the Colorado Plateau to the northeast. It has a northwest–southeast trend and is bounded to the southwest by the Harcuvar, Buckskin, and Rawhide Mountains and to the northeast by the Poachie Range, Black, and Date Creek Mountains. Low bedrock ridges and hills separate the Date Creek basin from Aguila Valley to the south and Congress Basin to the east (Figure 8.2.7.1-1). The basin straddles two structurally distinct areas: the western part of the basin, which is cut by northwest-trending extensional faults (of Tertiary age) and large vertical displacements of Tertiary rock; and the eastern part of the basin, where rocks are flat-lying and unfaulted (Otton and Brooks 1978).

Boreholes drilled in the eastern part of Date Creek basin in the 1970s showed that the basin-fill sediments were about 5,620 ft (1,720 m) deep; beyond this depth, basement rocks of gneiss were encountered. Unconsolidated alluvial, eolian, and lacustrine sediments of Quaternary age overlie the Chapin Wash Formation (Tertiary), occurring at a depth of about 1,130 ft (350 m). The Chapin Wash Formation is at least 2,700 ft (830 m) thick and is composed of sandy conglomerates, sandstone, fluvial-lacustrine rocks (facies), and some volcanics (tuffs, andesite, and basalt). The lacustrine facies in the Chapin Wash Formation disappear to the west where thin fluvial facies predominate (Otton and Wynn 1978; Bisdorf 1982).

Exposed sediments in the center of Date Creek basin are predominantly young (<10,000 yr) alluvial deposits of gravel and sand (stream channels) and silt and clay (floodplains and playas) and eolian sands (Qy); sedimentary rocks of conglomerate and sandstone of Tertiary age (Tsy) form prominent bluffs along its margins, especially northwest of the Bullard Wash SEZ (Figure 8.2.7.1-2). In the surrounding mountains, exposures are predominantly composed of Tertiary volcanics and Tertiary-Cretaceous intrusives. The oldest rocks in the region are the Precambrian to Mesozoic metamorphic and intrusive rocks (granites) that occur in the Buckskin and Harcuvar Mountains to the west and southwest and the Date Creek and Weaver Mountains to the northwest (Otton and Wynn 1978).

Topography

The Date Creek basin is an elongated basin that predominantly slopes to the northwest. Elevations in the eastern part of the basin range from about 3,200 ft (980 m) at the base of the

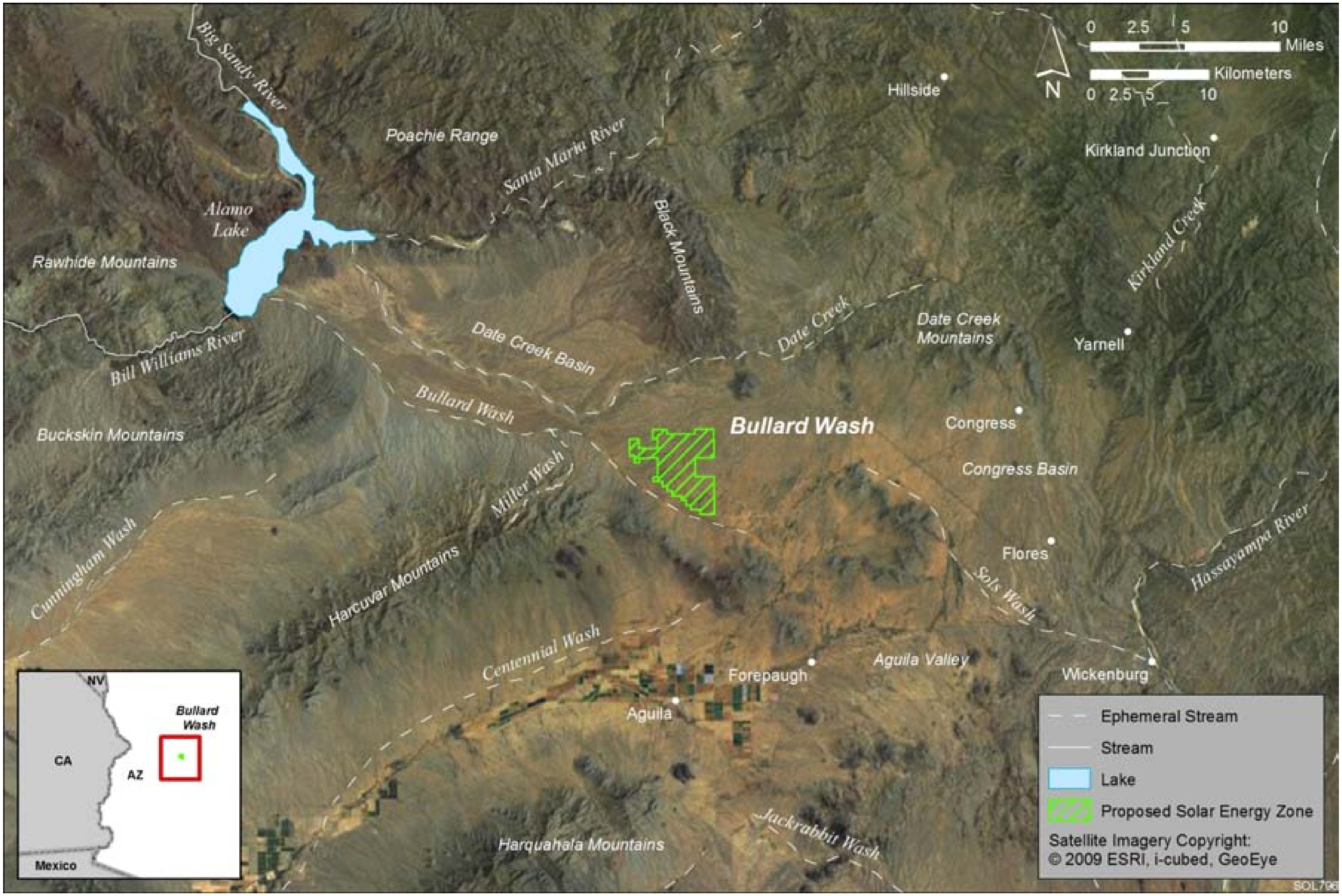

FIGURE 8.2.7.1-1 Physiographic Features of the Date Creek Basin Region

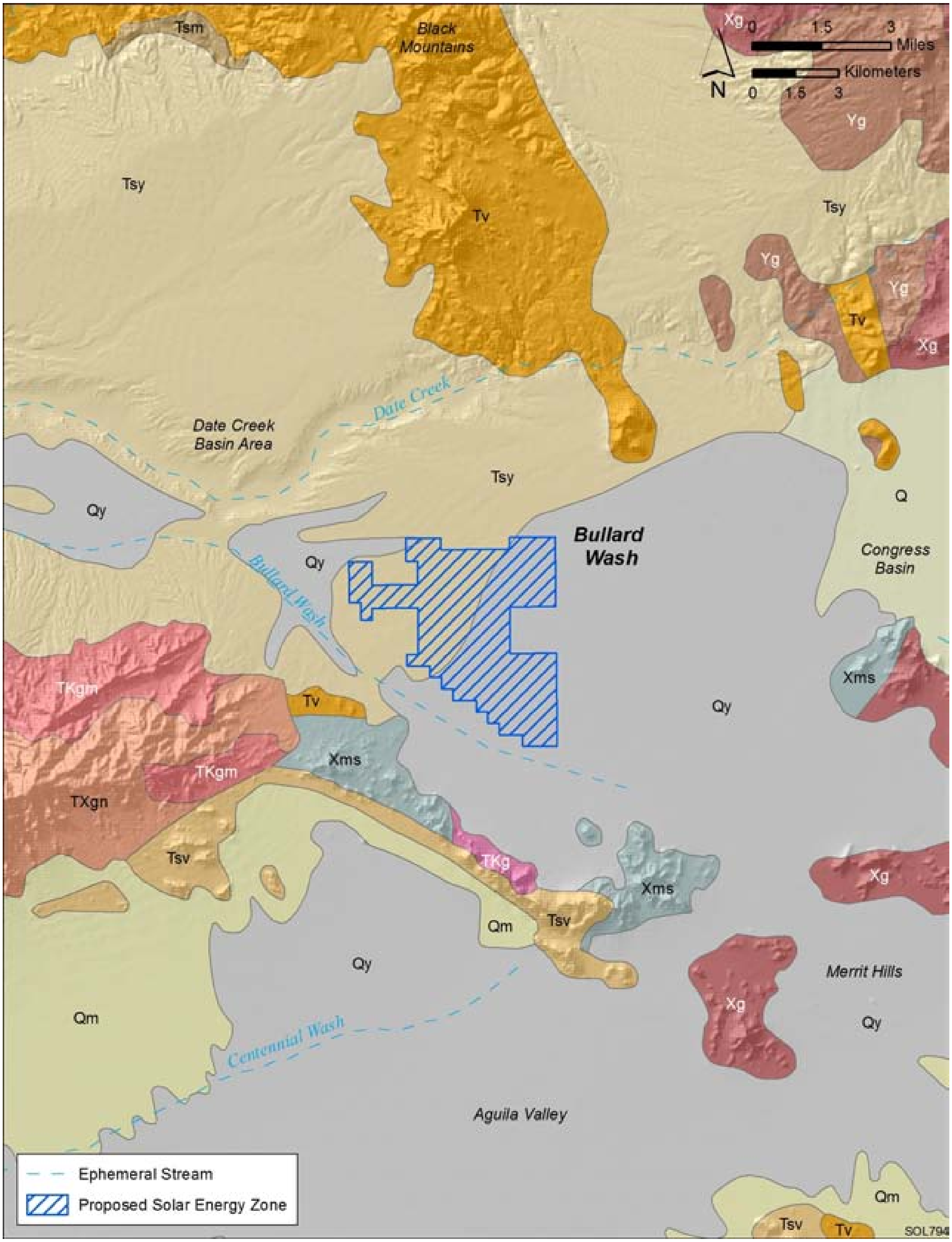

FIGURE 8.2.7.1-2 Geologic Map of the Date Creek Basin Region (adapted from Ludington et al. [2007] and Richard et al. [2000])

Cenozoic (Quaternary, Tertiary)

- Qy — Young alluvium in stream channels and on flood plains and playas (0 to 10,000 yr)
- Q — Surficial deposits, including wind-blown sand (0 to 2 m.y.)
- Qm — Surficial deposits (10,000 to 750,000 yr)
- Tsy — Consolidated conglomerate and sandstone
- Tsv — Volcanic and sedimentary rocks, undivided
- Tsm — Sedimentary rocks
- Tv — Volcanic rocks
- TXgn — Gneissic rocks (Early Proterozoic to Tertiary)
- TKgm — Muscovite-bearing granitic rocks (associated with abundant pegmatite dikes)
- TKg — Granitic rocks

Precambrian

- Yg — Granitic rocks (1,400 to 1,450 m.y.)
- Xg — Granitic rocks (1,600 to 1,800 m.y.)
- Xms — Metasedimentary rocks

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FIGURE 8.2.7.1-2 (Cont.)

Date Creek Mountains to about 2,400 ft (730 m) along Bullard Wash (Figure 8.2.7.1-1). In the western part of the basin, elevations range from about 2,140 ft (650 m), where Miller Wash joins Bullard Wash near the center of the basin to about 1,200 ft (370 m), where Bullard Wash discharges to Alamo Lake. The basin is also drained by Date Creek, which flows northwest to the Santa Maria River. The Santa Maria River joins with the Big Sandy River just upstream of Alamo Lake.

The proposed Bullard Wash SEZ is located in the eastern part of Date Creek basin, between the Harcuvar Mountains to the southwest and the Date Creek Mountains to the northeast. Date Creek, located north of the SEZ, flows northwest to the Santa Maria River. Bullard Wash, southwest of the SEZ, also flows to the northwest and discharges to Alamo Lake (Figure 8.2.7.1-1). The site terrain slopes gently to the southwest, with elevations ranging from about 2,580 ft (790 m) at the northeastern corner to 2,360 ft (720 m) along the southwest-facing border. Several unnamed drainages enter the SEZ from the northeast and drain to the southwest toward Bullard Wash (Figure 8.2.7.1-3).

Geologic Hazards

The types of geologic hazards that could potentially affect solar project sites and their mitigation are discussed in Section 5.7.3 and 5.7.4. The following sections provide a preliminary assessment of these hazards at the proposed Bullard Wash 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. Most of the seismic activity in Arizona occurs along the northwest-trending boundary (transition zone) between the Basin and Range and Colorado Plateau physiographic provinces north of the three proposed Arizona SEZs (Figure 8.2.7.1-4). Of the Quaternary faults in this zone, the Big Chino Fault, an extensional (normal) fault, is the closest to the proposed Bullard Wash SEZ. It is located along the northeastern edge of Big Chino Valley, about 70 mi (110 km) to the north–northeast of the SEZ. No Quaternary faults have been identified within Date Creek basin (USGS and AZGS 2010); however, older faults of Tertiary age (between 18 and 20 million years ago) with displacements of 980 ft (300 m) have been observed in the western part of the basin (Otton and Brooks 1978). Resistivity data also show faults with vertical offsets in basement rocks, with some displacement of deeper basin fill (Bisdorf 1982).

The Big Chino fault has a northwest trend and extends the length of Big Chino Valley (Figure 8.2.7.1-4). Well-defined scarps along most of the fault trace indicate that middle to late Quaternary sediments are offset by 65 to 80 ft (20 to 25 m); younger sediments are offset by about 23 to 26 ft (7 to 8 m). These offsets place the most recent movement along the fault at less than 15,000 years ago (perhaps as recent as 10,000 years ago). The slip rate along this fault is estimated to be less than 0.2 mm/yr. Recurrence intervals are estimated to be on the order of 25,000 to 50,000 years for the past 100,000 years (Pearthree 1998).

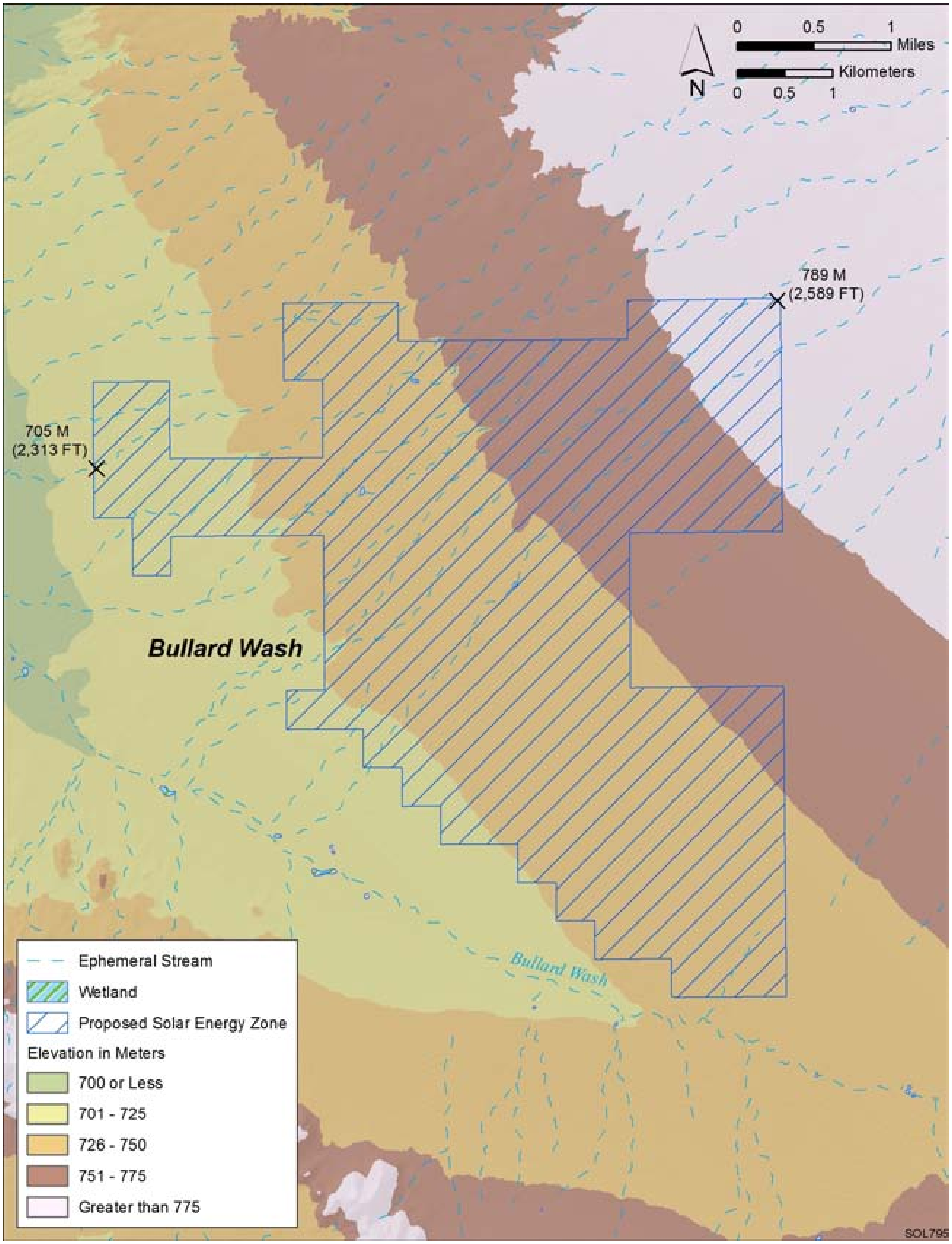

FIGURE 8.2.7.1-3 General Terrain of the Proposed Bullard Wash SEZ

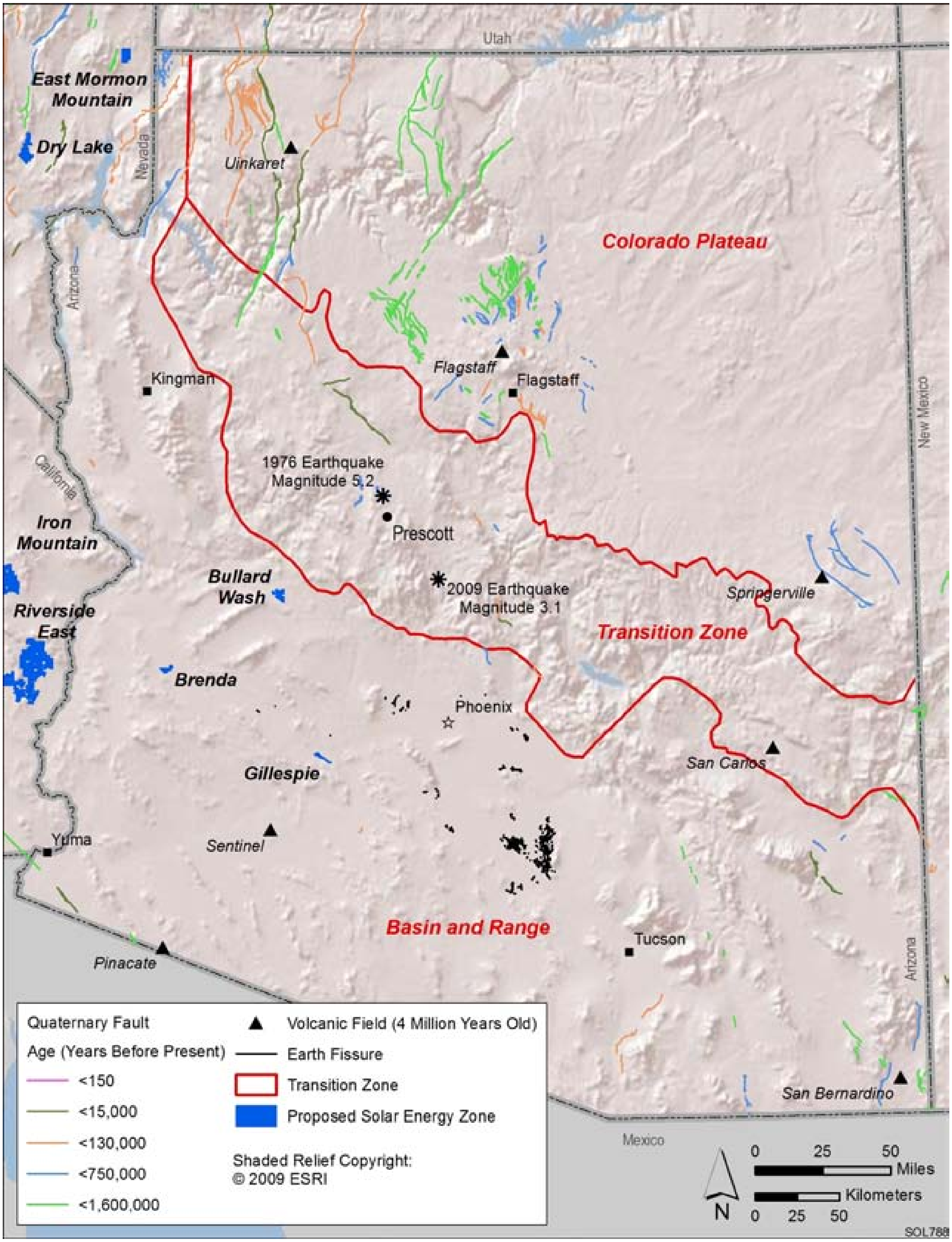

FIGURE 8.2.7.1-4 Quaternary Faults, Volcanic Fields, and Earth Fissures in Arizona (USGS and AZGS 2010; USGS 2010a)

From June 1, 2000, to May 31, 2010, only one earthquake was recorded within a 61-mi (100-km) radius of the proposed Bullard Wash SEZ (USGS 2010b). The earthquake occurred on May 9, 2009. It was located about 60 mi (100 km) east–northeast of the SEZ in Black Canyon, just east of the Bradshaw Mountains, and registered a Richter magnitude of 3.1 (Figure 8.2.7.1-4). The largest earthquake in the region occurred on February 4, 1976, near Prescott, Arizona, about 50 mi (80 km) northeast of the Bullard Wash SEZ (Figure 8.2.7.1-4). The earthquake registered a magnitude (ML[1]) of 5.2 (USGS 2010a).

Liquefaction. The proposed Bullard Wash SEZ lies within an area where the peak horizontal acceleration with a 10% probability of exceedance in 50 years is between 0.03 and 0.04 g. Shaking associated with this level of acceleration is generally perceived as light to moderate; the potential damage to structures is very light (USGS 2008). Given the low incidence of earthquakes within a 61-mi (100-km) radius of the Bullard Wash SEZ and the very low intensity of ground shaking estimated for the area, the potential for liquefaction in valley sediments also is likely to be very low.

Volcanic Hazards. Extensive volcanic activity occurred in Arizona throughout the Tertiary period, with the most recent activity occurring less than 4 million years ago, mainly along the edge of the Colorado Plateau in northeastern Arizona (Figure 8.2.7.1-4). Over the past 15 million years, eruptions were predominantly composed of basalt. The nearest volcanic center is the Sentinel volcanic field, about 105 mi (170 km) south–southeast of the proposed Bullard Wash SEZ; basaltic lava flows erupted from volcanic vents in this area from about 3.3 to 1.3 million years ago (Wood and Kienle 1992). Currently, there is no evidence of volcanic activity or unrest in southern Arizona (Fellows 2000). Lynch (1982) suggests that the next eruption in Arizona would most likely occur in the San Francisco Mountain, Uinkaret, or Pinacate volcanic fields and, because it likely would be of the strombolian type (basaltic lava from a single vent with intermittent explosions), would cause little damage or disruption.

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 like the Date Creek basin, if they are located at the base of steep slopes. The risk of rock falls and slope failures decreases toward the flat valley center.

The Arizona Geological Survey has reviewed aerial and satellite imagery and conducted on-the-ground investigations at 23 study areas to identify and map earth fissures with surface expression. The study areas are within four Arizona counties (Pinal, Maricopa, Cochise, and Pima) that are prone to fissuring (Shipman and Diaz 2008). Earth fissures and subsidence of about 0.6 ft (0.2 m) have been identified within the Harquahala Plain (Maricopa County), about

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[1] Richter scale magnitude (ML) was the original magnitude defined by Richter and Gutenberg for local earthquakes in 1935. It was based on the maximum amplitude recorded on a Wood-Anderson torsion seismograph but is currently calculated for earthquakes with magnitudes ranging from 2 to 6, using modern instruments with adjustments (USGS 2010b).

40 mi (64 km) due south of the proposed Bullard Wash SEZ (AGS 2010; Galloway et al. 1999) (Figure 8.2.7.1-4). The fissures are the result of ground subsidence due to groundwater overdrafts in the basin that have caused differential compaction in the underlying aquifer. Land failure caused by subsidence and fissures in parts of Arizona has been significant enough to damage buildings, roads, railroads, and sewer lines and necessitate changes in the planned route of the Central Arizona Project aqueduct (Galloway et al. 1999). Subsidence in Date Creek basin also is likely because of marked declines in groundwater levels since 1948 (by as much as 300 ft [90 m] near Goodyear, according to Ninyo and Moore [2007]) as a result of the high rates of irrigation pumpage in the basin.

Other Hazards. Other potential hazards at the proposed Bullard Wash 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 may increase the likelihood of soil erosion by wind.

Alluvial fan surfaces, such as those found within the Date Creek basin, 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 8.2.9.1.1 provides further discussion of flood risks within the Bullard Wash SEZ.

8.2.7.1.2 Soil Resources

Soils within the proposed Bullard Wash SEZ are sandy loams and gravelly sandy loams typical of alluvial fan settings (Figure 8.2.7.1-5). Soil map units within the Bullard Wash SEZ are described in Table 8.2.7.1-1. Parent material consists of fan alluvium from mixed sources. Soils are characterized as deep and well-drained with moderate to high surface-runoff potential and moderate to moderately rapid permeability. The natural soil surface is moderately suited for roads, with a slight to moderate water erosion hazard when used as roads or trails. The susceptibility to wind erosion is moderate, with as much as 86 tons (78 metric tons) of soil per acre eroded by wind each year (NRCS 2010).

None of the soils within the Bullard Wash SEZ is rated as hydric.[2] Flooding of soils at the site is not likely and occurs with a frequency of less than once in 500 years. Most of the soils are not suitable for cultivation unless irrigated; only the Mohave sandy loam (covering about 19% of the site) is classified as prime farmland. The major crop in the region is alfalfa (forage) (USDA 2010a; NRCS 2010).

[2] A hydric soil is a soil that formed under conditions of saturation, flooding, or ponding (NRCS 2010).

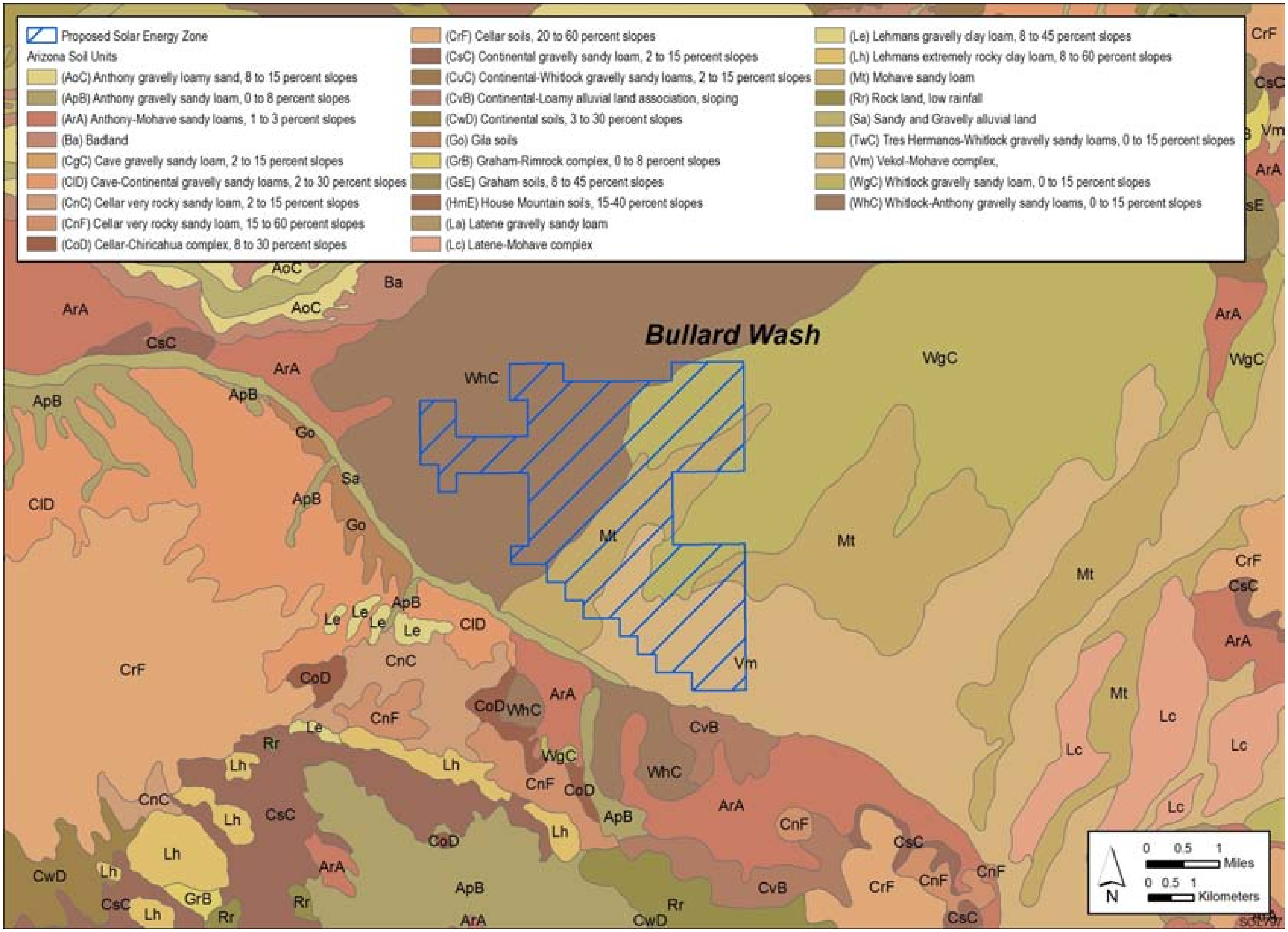

FIGURE 8.2.7.1-5 Soil Map for the Proposed Bullard Wash SEZ (NRCS 2008)

TABLE 8.2.7.1-1 Summary of Soil Map Units within the Proposed Bullard Wash SEZ

Map Unit Symbol	Map Unit Name	Water Erosion Potential[a]	Wind Erosion Potential	Description	Area in Acres[b] (% of SEZ)
WgC	Whitlock-Anthony gravelly sandy loams (0 to 15% slopes)	Slight	Moderate (WEG 3)[c]	Consists of 60% Whitlock gravelly sandy loam and 30% Anthony gravelly sandy loam. Level to sloping soils on alluvial fans. Parent material is fan alluvium from mixed sources. Soils are very deep and well drained, with moderate surface runoff potential and moderate to moderately rapid permeability. Available water capacity is low to moderate. Moderate rutting hazard. Used for rangeland, wildlife habitat, and irrigated cropland.	2,744 (38)
Vm	Vekol-Mohave complex (0 to 3% slopes)	Moderate	Moderate (WEG 5)	Consists of 55% Vekol gravelly sandy loam, 35% Mojave sandy loam. Level to nearly level soils on alluvial fans and swales. Parent material is alluvium derived from granite and other sources. Soils are very deep and well drained, with high surface runoff potential (very slow infiltration rate) and slow to moderately slow permeability. Available water capacity is moderate to high. Severe rutting hazard. Used for rangeland, wildlife habitat, and irrigated cropland.	1,576 (22)
WgC	Whitlock gravelly sandy loam (0 to 15% slopes)	Slight	Moderate (WEG 5)	Level to sloping soils on alluvial fans. Parent material is alluvium from mixed sources. Soils are deep and well drained, with moderate surface runoff potential and moderate permeability. Available water capacity is low. Moderate rutting hazard. Used for rangeland, wildlife habitat, and irrigated cropland.	1,534 (21)
Mt	Mohave sandy loam (0 to 8% slopes)	Slight	Moderate (WEG 3)	Level to nearly level soils on alluvial fan terraces. Parent material is fan alluvium from mixed sources. Soils are very deep and well drained, with moderate surface runoff potential and moderately slow permeability. Available water capacity is high. Moderate rutting hazard. Used mainly for livestock grazing, wildlife habitat, and irrigated cropland. Prime farmland if irrigated.[d]	1,386 (19)

Footnotes on next page.

TABLE 8.2.7.1-1 (Cont.)

[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 (whole soil; doesn't account for the presence of rock fragments) and represent soil loss caused by sheet or rill erosion where 50 to 75 percent 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 "severe" indicates that erosion is expected; loss of soil productivity and damage are likely and erosion control measures may be costly or 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 3, 86 tons per acre per year; and WEG 5, 56 tons per acre per year.

[d] Prime farmland is land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops and that is available for these uses.

Source: NRCS (2010).

8.2.7.2 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 activities 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 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 time frame.

8.2.7.3 SEZ-Specific Design Features and Design Feature Effectiveness

No SEZ-specific design features were identified for soil resources at the proposed Bullard Wash SEZ. Implementing the programmatic design features described under both Soils and Air Quality in Appendix A, Section A.2.2., as required under BLM's proposed Solar Energy Program, would reduce the potential for soil impacts during all project phases.

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8.2.8 Minerals (Fluids, Solids, and Geothermal Resources)

8.2.8.1 Affected Environment

As of July 27, 2010, there are no locatable mining claims within the proposed Bullard Wash SEZ, although there are numerous historical lode and placer claims that have been closed within the SEZ (BLM and USFS 2010a). The public land within the SEZ has been closed to locatable mineral entry since June 2009, pending the outcome of this solar energy PEIS. There are no active oil and gas leases in the area. However, most of the area in and around the SEZ has been leased in the past, but the leases have expired (BLM and USFS 2010b). The area remains open for discretionary mineral leasing for oil and gas and other leasable minerals, and for disposal of salable minerals. There is no active geothermal leasing or development in or near the SEZ, nor has the area been leased previously (BLM and USFS 2010b).

8.2.8.2 Impacts

If the area is identified as a solar energy zone, it would continue to be closed to all incompatible forms of mineral development. For the purpose of this analysis, it was assumed that future development of oil and gas resources, should any be found, would continue to be possible, since such development could occur with directional drilling from outside the SEZ. Since the SEZ does not contain existing mining claims, it was also assumed that there would be no future loss of locatable mineral production. The production of common minerals, such as sand and gravel and mineral materials used for road construction or other purposes, might take place in areas not directly developed for solar energy production.

The SEZ has had no history of development of geothermal resources. For that reason, it is not anticipated that solar development would adversely affect the development of geothermal resources.

8.2.8.3 SEZ-Specific Design Features and Design Feature Effectiveness

No SEZ-specific design features are required to protect mineral resources. Implementing the programmatic design features described in Appendix A, Section A.2.2, as required under BLM's proposed Solar Energy Program, would provide adequate mitigation for impacts on mineral resources.

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8.2.9 Water Resources

8.2.9.1 Affected Environment

The proposed Bullard Wash SEZ is located within the Bill Williams River Basin subbasin of the Lower Colorado Hydrologic Region (USGS 2010a) and the Basin and Range characterized by intermittent mountain ranges and desert valleys (Robson and Banta 1995). The proposed SEZ has surface elevations ranging between 2,320 and 2,590 ft (707 and 789 m). The proposed Bullard Wash SEZ is located in a valley bounded by several mountain ranges, including the Black Mountains to the north, the Date Creek Mountains to the northeast, and the Harcuvar Mountains to the southwest (Figure 8.2.9.1-1). Annual average precipitation is estimated to be 10 to 14 in./yr (25 to 36 cm/yr) in the vicinity of the Bullard Wash SEZ and varies between 6 and 22 in./yr (15 and 56 cm/yr) in other parts of the basin, with higher precipitation occurring at higher elevations (ADWR 2010a). Average evaporation rates are estimated to be 105 in./yr (267 cm/yr) (Cowherd et al. 1988).

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

There are no perennial surface water bodies on the proposed Bullard Wash SEZ. Bullard Wash flows to the northwest along the southwest side of the SEZ and ends at Alamo Lake (Figure 8.2.9.1-1). The proposed SEZ is located entirely within the Bullard Wash watershed. Date Creek is north of the SEZ and flows to the east and northeast toward the Santa Maria River, which also flows into Alamo Lake. Both Bullard Wash and Date Creek are ephemeral streams that convey runoff in response to large rainfall events in the vicinity of the SEZ. Numerous ephemeral dry washes occur within the SEZ, generally flowing to the southwest, to Bullard Wash. These dry washes typically contain water for short periods during or following precipitation events and include temporarily flooded areas. Portions of Date Creek upstream of the SEZ are known to be intermittent. Date Creek was gauged from 1939 to 1943 just north of the SEZ, encompassing a drainage area of 81,280 acres (329 km^2). The largest daily flow recorded was 589 cfs (16.7 m^3/s), and the largest annual flow was 7,674 ac-ft (9.4 million m^3) (in 1941); in 1942, no flow was recorded at the gauge. Alamo Lake is a reservoir located upstream of the Alamo Dam, operated by the U.S. Army Corps of Engineers. The maximum storage capacity of Alamo Lake is 1.4 million ac-ft (1.7 billion m^3), and it has an area of 12,096 acres (49 km^2). In addition to Bullard Wash, the Santa Maria River and the Sandy River flow into Alamo Lake. The Bill Williams River is a perennial stream that flows downstream of Alamo Lake and drains into the Colorado River approximately 31 mi (50 km) west of Alamo Lake.

Flood hazards within the SEZ include areas within the 100-year floodplain (Zone A) and the 100 to 500–year floodplain (Zone X) (FEMA 2009). The 100-year flood zones are within four tributary washes that extend northeast from Bullard Wash. The rest of the SEZ is within the 100 to 500–year floodplain area. Within the flood zones, intermittent flooding may occur with temporary ponding and erosion. Three small, isolated wetland areas have been identified within the SEZ (USFWS 2009). A number of other small wetland areas in the vicinity of the SEZ have been mapped, see Section 8.2.10 for more information.

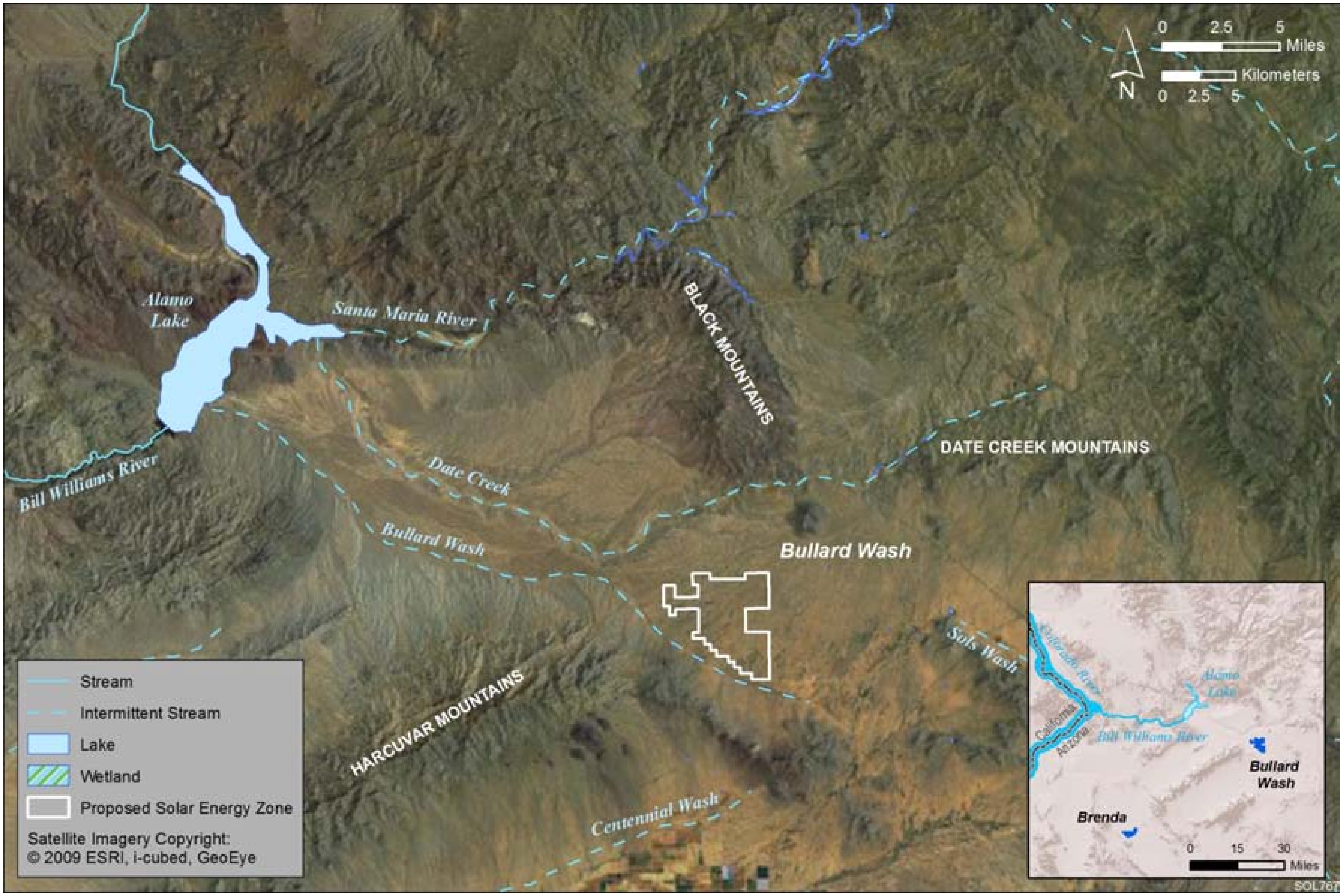

FIGURE 8.2.9.1-1 Surface Water Features near the Proposed Bullard Wash SEZ

8.2.9.1.2 Groundwater

The proposed Bullard Wash SEZ is located within the Date Creek subbasin of the Bill Williams groundwater basin. Groundwater in the Bill Williams basin occurs primarily in alluvial deposits, volcanic rocks, and basin-fill deposits (ADWR 2010a). Bill Williams basin is broken up into the following planning-area subbasins by the ADWR: Clara Peak, Alamo Reservoir, Burro Creek, Santa Maria, and Skull Valley. The Bullard Wash SEZ is located in the southeastern portion of the Alamo Reservoir subbasin (termed Date Creek subbasin by USGS reports), where groundwater flows from the south to the northwest toward the Bill Williams River drainage (ADWR 2010a). The main water-bearing unit near the Bullard Wash SEZ is the basin fill, which has been estimated to be more than 5,000 ft thick in the area (ADWR 2010b). In the Date Creek subbasin of the Bill Williams basin, groundwater surface elevations range from 1,785 to 1,790 ft (544 to 545 m) (USGS 2010b; well numbers 340852113122501, 341508113203801, 340340113364201, and 340333113363701). Depth to water measurements taken between 1974 and 2006 range from 508 to 649 ft (155 to 198 m) below ground surface (USGS 2010b; well numbers 340852113122501, 341508113203801, 340340113364201, and 340333113363701).

The ADWR has estimated that there are between 10 million and 23 million ac-ft (12 billion to 28 billion m^3) of stored water available in the entire Bill Williams basin; in the Date Creek subbasin, where the Bullard Wash SEZ is located, the estimated amount of water stored in a predevelopment condition was 8 million ac-ft (9.9 billion m^3) (ADWR 2010a; Freethy and Anderson 1986). Groundwater recharge has been estimated to be 32,000 ac-ft/yr (39 million m^3/yr) from recharge from stream flow and mountain front precipitation within the entire Bill Williams basin, but only 10,000 ac-ft/yr (12 million m^3/yr) in the Date Creek subbasin (ADWR 2010a; Freethy and Anderson 1986). Recharge from precipitation on the basin floor is expected to be small because of low precipitation (ADWR 2010a). In a predevelopment condition, it was estimated that over half of the recharge was lost to evapotranspiration in the basin and the rest was estimated to provide base flow to streams in the basin (Freethy and Anderson 1986).

Groundwater inflows from the adjacent Big Sandy basin to the north to the Date Creek subbasin are estimated to be less than 1,000 ac-ft/yr (1.2 million m^3/yr) and are on the same order as estimated outflows to the adjacent Havasu Lake basin to the west (Freethy and Anderson 1986). In a comprehensive report about the regional aquifer system in south-central Arizona, Anderson (1995) indicated that groundwater was not the primary method of water flow into the Havasu Lake basin, which contains the Bill Williams River. Interbasin flow in this area is estimated to occur as surface water flow (Anderson 1995). Accordingly, the aquifer in this area is not considered part of the Colorado River flow system (Anderson 1995).

Data collected from 1974 to 2006 indicate that groundwater levels have fluctuated but generally increased in the Date Creek subbasin because of decreased pumping in the basin since the late 1980s, when pumping rates started to decline (ADWR 2010a). A rebound of water levels ranging from 5.5 to 53 ft (1.7 to 16 m) has occurred in four of the five wells analyzed in the vicinity of the proposed Bullard Wash SEZ (USGS 2010b; wells 341508113203801, 340852113122501, 341153113412301, 340333113363701, and 342835113391301).

Groundwater quality samples reported for the Bill Williams basin in the vicinity of the proposed Bullard Wash SEZ have found total dissolved solids (TDS) concentrations to be between 230 and 250 mg/L within the basin-fill (USGS 2010b; wells 340852113122501, 341151113101201, 341227113052901, and 40955113235401). Concentrations of arsenic and fluoride that exceed drinking water quality standards (EPA 2009d) have been found in samples taken in the northwestern part of the Alamo Reservoir subbasin of the Bill Williams basin. Samples in the vicinity of the Bullard Wash SEZ have been found to have low concentrations of fluoride, but have not been tested for arsenic concentrations (USGS 2010b; wells 340852113122501, and 341227113052901). Throughout the Bill Williams basin, water quality samples taken between 1979 and 2003 from mines, wells, and springs indicated that constituents in a total of 60 samples exceeded drinking water standards; specifically, concentrations of arsenic, cadmium, fluoride, lead, mercury, nitrate, TDS, and radionuclides were found to exceed drinking water standards in various locations throughout the basin (ADWR 2010a).

8.2.9.1.3 Water Use and Water Rights Management

In 2005, water withdrawals from surface waters and groundwater in Maricopa County were 1,577,316 ac-ft/yr (1.9 billion m^3/yr), of which 84% came from groundwater and 16% came from surface water. The largest water use category was irrigation (81%), at 1,271,515 ac-ft/yr (1.56 billion m^3/yr). Public supply/domestic water uses accounted for 258,197 ac-ft/yr (318 million m^3/yr), with thermoelectric water uses on the order of 26,431 ac-ft/yr (32 million m^3/yr), aquaculture accounting for 1,816 ac-ft/yr (2.2 million m^3/yr), livestock at 5324 ac-ft/yr (6.5 million m^3/yr), and mining with 7,857 ac-ft/yr (9.6 million m^3/yr) (Kenny et al. 2009). Between 2001 and 2005, 5,650 ac-ft/yr (7 million m^3/yr) of water was used in the Bill Williams basin, of which 91% came from groundwater and 9% came from surface water (ADWR 2010a). The primary use for groundwater in the basin is irrigation (80%), with smaller amounts used for public supply (12%) and for industrial purposes (6%) (ADWR 2010a). Surface water diversions are from the Bill Williams River and are used primarily for municipal supply (ADWR 2010a).

Arizona water law is based on the doctrine of prior appropriation. However, water laws in Arizona are based on a bifurcated system in which surface water and groundwater rights are administered and assessed separately. The state of Arizona has four main sources of water: Colorado River water, surface water separate from the Colorado River, groundwater, and treated effluent. Rights for these four sources are assessed and administered separately: Colorado River water is regulated under the Law of the River; surface water is based on prior appropriation; and groundwater rights are handled on a region-by-region basis (BLM 2001). Effluent is not available for use until it takes on the characteristics of surface water through treatment (ADWR 2010e). The ADWR is the agency responsible for the conservation and distribution of water in the state. It is also responsible for the administration and assessment of novel water rights and transfer of existing water rights and applications. The agency's broad goal is the security of long-term dependable water supplies for the state, which is the main factor in the assessment of water right applications (ADWR 2010f).

Upon completion of an application for water rights, the ADWR has three main criteria for assessing the application: whether the proposed water right will conflict with more senior water rights, whether the proposed right will pose a threat to public safety, and whether the proposed right will be detrimental to the interests and welfare of the general public (BLM 2001). In general, surface water rights are assessed solely upon the criteria above, but they may also be subject to certain management plans in specific areas put into effect by the ADWR. Unlike the majority of groundwater rights that are bound to the land they occupy, users of surface water rights have the option to change location of the water right but not the beneficial use (a change of beneficial use application would need to be submitted). In order to change a surface water right's location a "sever and transfer" permit needs to be approved by the ADWR and the governing body of the irrigation district or water users council of the proposed new location of the surface water right. Evaluations of "sever and transfer" permits follow the same general evaluation guidelines as new surface water rights, and the proposed new location of the right after the transfer is treated as a new surface water right. The new surface water right must not exceed the old one in annual water use (ADWR 2010e).

Arizona has rights to 2.8 million ac-ft of Colorado River water annually, which is further subdivided into allocations for both general Colorado River water users and Central Arizona Project (CAP) users (ADWR 2010h). CAP is a system of water delivery canals, aqueducts, and pumping stations that deliver 1.5 million ac-ft/yr of Colorado River water from Lake Havasu to Pima, Pinal and Maricopa counties annually (CAP 2010). The flows of the Colorado River are variable and thus the water resource availability is variable from year to year.

Because of historic groundwater overdraft, where groundwater recharge is exceeded by discharge (in some places groundwater overdraft is in excess of 700,000 ac-ft/yr [863 million m^3/yr]), the Ground Water Management Code was put into effect in 1980 (ADWR 2010i; ADWR 1999). The Code describes three main goals for the state regarding the management of groundwater: control of severe overdraft, allocation of the limited water resources of the state, and enhancement of the state's groundwater resources using water supply development (BLM 2001). Arizona's groundwater management laws are separated by using a three-tier system based on the Code, in which proposed applications are evaluated with an increasing level of scrutiny. The lowest level of management includes provisions that apply statewide; INAs have an intermediate level of management; and Active Management Areas (AMAs) have the highest level of management with the most restrictions and provisions. Within an AMA or INA, a groundwater permit is required (BLM 2001). There are currently five AMAs and three INAs in the state, each of which has its own specific rules and regulations regarding the appropriation of groundwater (ADWR 2010g). In locations outside of designated AMAs and INAs, a permit is not necessary to withdraw groundwater (BLM 2001). Use of this groundwater, however, requires the filing of a notice of intent to drill with the ADWR.

Recently, the ADWR (2010e) created guidelines regarding the appropriation of water for solar generating facilities, specifically detailing what information needs to be submitted for permit evaluation. Information that is required to be submitted includes the proposed method of power generation, the proposed amount of water to be consumed, the point of diversion, and to what or whom the power is to be distributed. To secure water rights for a solar facility to be located within an AMA, the applicant must demonstrate that there is an "assured water supply" for the life of the project. The ADWR then makes a decision based on whether the proposed water right will be detrimental to public welfare and general conservation of water (ADWR 2010e).

Groundwater within the Bullard SEZ is located in the Bill Williams basin, which is part of the Upper Colorado River Planning Area (ADWR 2010a). The Colorado River is over-allocated and likely would not contribute to surface water resources available for use by solar development for the Bullard Wash SEZ (Lavelle 2006). Since the Bill Williams basin is not included in either an AMA or INA, it is legal to pump groundwater without a permit; however a Notice of Intent to Drill must be reported with the ADWR (ADWR 2010c).

8.2.9.2 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, and 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, 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 excessive withdrawal from aquifers).

8.2.9.2.1 Land Disturbance Impacts on Water Resources

Impacts related to land disturbance activities are common to all utility-scale solar energy developments, which are described in more detail for the four phases of development in Section 5.9.1; these impacts will be minimized through the implementation of programmatic design features described in Appendix A, Section A.2.2. Land disturbance impacts in the vicinity of the Bullard Wash SEZ could potentially affect natural groundwater recharge and discharge properties. Tributary washes within the Bullard Wash SEZ convey runoff to Bullard Wash during major storm events, as evident from channel erosion and sedimentation patterns. Alterations to these systems could enhance erosion processes, disrupt groundwater recharge, change flow quantities to Bullard Wash, and negatively affect plant and animal habitats associated with the ephemeral channels.

8.2.9.2.2 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 Bullard Wash SEZ include the following:

- On the basis of a total area of 7,239 acres (29.2 km^2), it is assumed that 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, results in the potential to disturb up to 41% 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 controlling fugitive dust and for providing the workforce potable water supply. Impacts on water resources during this phase of development are expected to be negligible since 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 the workforce potable water supply. Because there are no significant surface water bodies on the proposed Bullard Wash SEZ, the water requirements for construction activities could be met by either trucking water to the sites or using on-site groundwater resources.

Water requirements for dust suppression and potable water supply during the peak construction year are shown in Table 8.2.9.2-1 and could be as high as 1,816 ac-ft (2.2 million m^3). The assumptions underlying these estimates for each solar energy technology are described in Appendix M. Groundwater wells would have to yield up to an estimated

TABLE 8.2.9.2-1 Estimated Water Requirements during the Peak Construction Year for the Proposed Bullard Wash SEZ

Activity	Parabolic Trough	Power Tower	Dish Engine	PV
Water use requirements[a]				
Fugitive dust control (ac-ft)[b,c]	1,199	1,798	1,798	1,798
Potable supply for workforce (ac-ft)	74	45	19	9
Total water use requirements (ac-ft)	1,228	1,816	1,805	1,802
Wastewater generated				
Sanitary wastewater (ac-ft)	74	45	19	9

[a] Assumptions of water use for fugitive dust control, potable supply for workforce, and wastewater generation are presented in Table M.9-1 (Appendix M).

[b] Fugitive dust control estimation assumes a local pan evaporation rate of 105 in./yr (267 cm/yr) (Cowherd et al. 1988).

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

1,140 gal/min (4,320 L/min) to meet the estimated construction water requirements. This yield is within the range of producing wells in the Bill Williams basin and is typical of well yields of small- to medium-sized farms in Arizona (ADWR 2010a; USDA 2009b). The availability of groundwater and the impacts of groundwater withdrawal would need to be assessed during the site characterization phase of a solar development project. In addition to groundwater withdrawals, up to 74 ac-ft (92,000 m^3) of sanitary wastewater would be generated annually and would need to be either treated on-site or sent to an off-site facility. Groundwater quality in the vicinity of the SEZ would need to be tested to verify the quality would comply with drinking water standards.

Operations

Water would be required for mirror/panel washing, the workforce potable water supply, and cooling during operations. Cooling water is required only for the parabolic trough and power tower technologies. Water needs for cooling are a function of the type of cooling used (dry, wet, hybrid). Further refinements to water requirements for cooling would result from the percentage of time the option was employed (30 to 60% range assumed) and the power of the system. The differences between the water requirements reported in Table 8.2.9.2-2 for the parabolic trough and power tower technologies are attributable to the assumptions of acreage per megawatt. 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.

Water use requirements among the solar energy technologies are a factor of the full build-out capacity for the SEZ, as well as assumptions on water use and technology operations discussed in Appendix M. Table 8.2.9.2-2 lists the quantities of water needed for mirror/panel

TABLE 8.2.9.2-2 Estimated Water Requirements during Operations at the Proposed Bullard Wash SEZ

Activity	Parabolic Trough	Power Tower	Dish Engine	PV
Full build-out capacity (MW)[a,b]	1,158	643	643	643
Water use requirements				
Mirror/panel washing (ac-ft/yr)[c,d]	579	322	322	32
Potable supply for workforce (ac-ft/yr)	16	7	7	0.7
Dry cooling (ac-ft/yr)[e]	232–1,158	129–643	NA[f]	NA
Wet cooling (ac-ft/yr)[e]	5,212–16,794	2,896–9,330	NA	NA
Total water use requirements				
Non-cooled technologies (ac-ft/yr)	NA	NA	329	33
Dry-cooled technologies (ac-ft/yr)	827–1,754	458–972	NA	NA
Wet-cooled technologies (ac-ft/yr)	5,807–17,390	3,225–9,659	NA	NA
Wastewater generated				
Blowdown (ac-ft/yr)[g]	329	183	NA	NA
Sanitary wastewater (ac-ft/yr)	16	7	7	0.7

[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 per MW and wet-cooling value assumes 4.5 to 14.5 ac-ft/yr per 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.

washing, potable water supply, and cooling activities for each solar energy technology. At full build-out capacity, the estimated total water use requirements for non-cooling technologies (i.e., technologies that do not use water for cooling) during operations are 33 and 329 ac-ft/yr (40,700 and 406,000 m^3/yr) for the PV and dish engine technologies, respectively. For technologies that use water for cooling (i.e., parabolic trough and power tower), total water needs range from 458 ac-ft/yr (0.6 million m^3/yr) (power tower for an operating time of 30% and using dry cooling) to 17,390 ac-ft/yr (21.5 million m^3/yr) (parabolic trough for an operating time of 60% and using wet cooling). Operations would generate up to 16 ac-ft/yr (20,000 m^3/yr) of sanitary wastewater; in addition, for wet-cooled technologies, 183 to 329 ac-ft/yr (226,000 to 406,000 m^3/yr) of cooling system blowdown water would need to be either treated on-site or sent to an off-site facility. Any on-site treatment of wastewater would have to ensure that treatment ponds are effectively lined in order to prevent any groundwater contamination.

Water demands during operations would most likely be met by withdrawing groundwater from wells constructed on-site. Non-cooled technologies (i.e., PV system and dish engine) would require 21 gal/min (77 L/min) and 200 gal/min (760 L/min), respectively. Cooled technologies (i.e., parabolic trough and power tower) would require well yields between 280 and 1,100 gal/min (1,100 and 4,100 L/min) for dry cooling, and between 2,000 and 11,000 gal/min (7,600 and 41,000 L/min) for wet cooling. The required well yields for dry cooling are within the range of well yields within the Bill Williams basin; wet-cooling water demands would mostly exceed the average annual yield for a single well within the basin. For wet cooling, multiple wells could be used. Water demands for non-cooled technologies are substantially less than those for cooled technologies.

Water demands for technologies that require wet cooling are significant compared to water use in the Bill Williams basin. For the Bullard Wash SEZ, estimated water requirements for wet cooling are equivalent to a factor of 1 to 4 times the annual water withdrawal from the basin (ADWR 2010a). The estimated recharge in the basin (32,000 ac-ft/yr [39 million m^3/yr]) is much larger than the water demand, but the portion of the basin that contains the SEZ was estimated to have a recharge of only 10,000 ac-ft/yr (12 million m^3/yr). The estimated water requirements for wet cooling are equivalent to 29 to 170% of the annual recharge for the Date Creek portion of the Bill Williams basin. Based on the information presented here, wet cooling for the full build-out scenario is not deemed feasible for the Bullard Wash SEZ. To the extent possible, facilities using dry cooling should implement water conservation practices to limit water needs.

The availability of water rights and the impacts associated 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 by using water use factors described in Appendix M.9.

In addition, the sustainable yield has not been assessed for the basin, and thus the impacts of groundwater withdrawals on aquifer drawdown and potentially on land subsidence would need to be investigated. These indirect impacts could disturb regional groundwater flow patterns and recharge patterns, potentially affecting ecological habitats (see discussion in Section 8.2.10). Groundwater quality in the vicinity of the SEZ would need to be tested to verify the quality would comply with drinking water standards.

Decommissioning/Reclamation

During decommissioning/reclamation, all surface structures associated with the solar project would be dismantled, and the Bullard Wash SEZ would be reclaimed to its pre-construction state. Activities and water needs during this phase would be similar to those during the construction phase (dust suppression and 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 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.

8.2.9.2.3 Off-Site Impacts: Roads and Transmission Lines

The proposed Bullard Wash SEZ is located approximately 5 mi (8 km) from existing transmission lines and 5 mi (8 km) from an existing road (State Route 71), as described in Section 8.2.1.2. 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 on 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 use impacts 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.

8.2.9.2.4 Summary of Impacts on Water Resources

The impacts on water resources associated with developing a utility-scale solar facility in the proposed Bullard Wash SEZ are associated with land disturbance effects on hydrology, water use requirements for the various solar energy technologies, and water quality issues. Impacts relating to water use requirements vary depending on the type of solar technology built and, for technologies using cooling systems, the type of cooling (wet, dry, or hybrid) employed. Water requirements would be greatest for wet-cooled parabolic trough and power tower facilities. Dry cooling reduces water use requirements by approximately a factor of 10 compared with wet cooling. PV requires the least amount of water among the solar energy technologies. The estimates of groundwater recharge, discharge, underflow from adjacent basins, and historical data on groundwater extractions and groundwater surface elevations suggest that there is not enough water available to support the water-intensive technologies, such as those using wet cooling for the full build-out scenario.

Because the Bullard Wash SEZ is not located within a designated AMA or INA, no groundwater permit would be required for groundwater supply wells. However, an application to drill would have to be submitted to the state, and its groundwater extraction plans would have to be approved by the ADWR. The portion of the basin that contains the SEZ (the Date Creek basin) was estimated to have a recharge of only 10,000 ac-ft/yr (12 million m^3/yr). In addition, the sustainable yield has not been assessed for the basin, and thus impacts of groundwater withdrawals on aquifer drawdown and potentially land subsidence would need to be investigated. If groundwater in the local Date Creek basin is not well connected to the rest of the Bill Williams basin, local groundwater extraction could significantly lower the water table, decrease the volume of stored water, change the direction of groundwater flow, and produce land subsidence. Land subsidence in the basins of Arizona is generally caused by compaction of the alluvium caused by a lowering of the water table. As the water table declines, pores in the alluvium once held open by water pressure are no longer supported and collapse. Measurements of land subsidence in the Bill Williams basin are not currently available.

Land disturbance activities can cause localized erosion and sedimentation issues, as well as altering groundwater recharge and discharge processes. It is likely that Bullard Wash and its tributaries provide significant recharge to the basin in the vicinity of the SEZ and land disturbance activity could significantly impact groundwater recharge in the basin. Land disturbance within the SEZ could impact channel erosion and sedimentation patterns in Bullard Wash and the ephemeral washes that are present within the SEZ.

8.2.9.3 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 proposed Solar Energy Program, will mitigate some impacts on water resources. Programmatic design features would focus on coordinating 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 conducting 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 Bullard Wash SEZ include the following:

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

- 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;

- Before a new well is drilled within the Bill Williams basin, a Notice of Intent to Drill must be filed with the ADWR, and any groundwater rights policy of the ADWR must be followed (ADWR 2010c);

- Groundwater monitoring and production wells should be constructed in accordance with state standards (ADWR 2010d);

- Stormwater management plans and best management practices should comply with standards developed by the Arizona Department of Environmental Quality (ADEQ 2010);

- Water for potable uses would have to meet or be treated to meet drinking water quality standards; and

- Land disturbance and operations activities should prevent erosion and sedimentation in the vicinity of the ephemeral washes present on the site and downstream in Bullard Wash.

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8.2.10 Vegetation

This section addresses vegetation that could occur or is known to occur within the potentially affected area of the proposed Bullard Wash SEZ. The affected area considered in this assessment includes the areas of direct and indirect effects. The area of direct effects is defined as the area that would be physically modified during project development (i.e., where ground-disturbing activities would occur) and includes the SEZ, a 250-ft (76-m) wide portion of an assumed transmission line corridor, and a 60-ft (18-m) wide portion of an assumed access road corridor. The area of indirect effects was defined as the area within 5 mi (8 km) of the SEZ boundary, within the 1-mi (1.6-km) wide assumed transmission line corridor, and within the 1-mi (1.6-km) wide assumed access road corridor, where ground-disturbing activities would not occur but that could be indirectly affected by activities in the area of direct effects.

Indirect effects considered in the assessment included effects from surface runoff, dust, and accidental spills from the SEZ, but did not include ground-disturbing activities. The potential degree of indirect effects would decrease with increasing distance from the SEZ. This area of indirect effects 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. These areas are defined and the impact assessment approach is described in Appendix M.

8.2.10.1 Affected Environment

The proposed Bullard Wash SEZ is located within the Sonoran Basin and Range Level III ecoregion (EPA 2007), which supports creosotebush (*Larrea tridentata)*-white bursage (*Ambrosia dumosa*) plant communities with large areas of palo verde (*Parkinsonia microphylla*)-cactus shrub and saguaro cactus (*Carnegiea gigantea*) communities (EPA 2002). The dominant species of the Lower Colorado River Valley subdivision of the Sonoran Desert are primarily creosotebush, white bursage, and all-scale (*Atriplex polycarpa*), with big galleta (*Pleuraphis rigida*), Palmer alkali heath (*Frankenia palmeri*), brittlebush (*Encelia farinosa*), and western honey mesquite (*Prosopis glandulosa* var. *torreyana*) dominant in some areas (Turner and Brown 1994). Larger drainageways and washes support species of small trees and shrubs that may also occur in adjacent areas, such as western honey mesquite, ironwood (*Olneya tesota*), and blue palo verde (*Parkinsonia florida*) as well as species such as smoketree (*Psorothamnus spinosus*), which are mostly restricted to drainageways. Shrub species found in minor drainages include cat-claw acacia (*Acacia greggii*), burrobrush (*Hymenoclea salsola* var. *pentalepis*), Anderson thornbush (*Lycium andersonii*), and desert broom (*Baccharis sarothroides*). The proposed Bullard Wash SEZ is located in an area transitional to the Arizona Upland subdivision, which includes Sonoran Paloverde-Mixed Cacti Desert Scrub communities, and Mojave desert scrub, which includes Joshua tree (*Yucca brevifolia*)–creosotebush communities. Annual precipitation in the Sonoran Desert occurs in winter and summer (Turner and Brown 1994) and is low in the area of the SEZ, averaging about 8.5 in. (21.5 cm) at Aguila, Arizona (see Section 8.2.13).

Land cover types, described and mapped under SWReGAP (USGS 2005a) 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 Bullard Wash SEZ are shown in Figure 8.2.10.1-1. Table 8.2.10.1-1 provides the surface area of each cover type within the potentially affected area.

Lands within the proposed Bullard Wash SEZ are classified primarily as Sonora–Mojave Creosotebush–White Bursage Desert Scrub. Additional cover types within the SEZ are given in Table 8.2.10.1-1. During a September 2009 visit to the site, dominant species observed in the desert scrub communities present within the SEZ included creosotebush, Joshua tree, ocotillo (*Fouquieria splendens*), and saguaro cactus. Much of the SEZ supports a Joshua tree–creosotebush community. Saguaro cactus and ocotillo are characteristic Sonoran Desert species, while Joshua tree is a characteristic Mojave Desert species. Cacti species observed within the SEZ were saguaro cactus, cholla (*Opuntia* spp.), and barrel cactus (*Ferocactus* sp.). Sensitive habitats on the SEZ include desert dry washes, dry wash woodlands, and desert riparian mesquite bosque, which is dependent on accessible groundwater. Cryptogrammic soil crusts occur in some areas of the SEZ. Much of the SEZ supports a high-quality, diverse, Sonoran-Mojave desert scrub community. The area has a history of livestock grazing, and the plant communities on the SEZ have likely been affected by grazing.

The area of indirect effects, including the area within 5 mi (8 km) around the SEZ, the assumed access road corridor, and the assumed transmission line corridor, includes 12 cover types, which are listed in Table 8.2.10.1-1. The predominant cover types are Sonora–Mojave Creosotebush–White Bursage Desert Scrub and Sonoran Paloverde-Mixed Cacti Desert Scrub.

Three small wetlands mapped by the NWI occur in the Bullard Wash SEZ (USFWS 2009) (Figure 8.2.10.1-2). NWI maps are produced from high-altitude imagery and are subject to uncertainties inherent in image interpretation (USFWS 2009). These wetlands occur along dry washes and are classified as intermittently flooded palustrine wetlands with sparse plant communities (less than 30% vegetation cover). They range in size from 0.4 to 0.8 acres (0.002 to 0.003 km^2) and total 1.7 acres (0.007 km^2). One or more of these wetlands is developed for a livestock watering area. Numerous ephemeral dry washes occur within the SEZ, generally flowing to the southwest, to Bullard Wash. These dry washes typically contain water for short periods during or following precipitation events and include temporarily flooded areas. Although these washes generally do not support wetland or riparian habitats, woodlands occur along the margins of a number of the larger washes. Several areas within the SEZ are mapped as North American Warm Desert Riparian Mesquite Bosque. A total of 35 wetlands, ranging in size from 0.1 to 3.0 acres (0.0004 to 0.01 km^2), are mapped in the area of indirect effects within 5 mi (8 km) of the SEZ. These wetlands are classified primarily as intermittently flooded to temporarily flooded palustrine wetlands with sparse plant communities. A number of these wetlands occur near Bullard Wash, including two riverine wetlands, 2.0 and 3.0 acres (0.008 and 0.01 km^2) in size, which occur within the channel. One 0.3-acre (0.001-km^2) palustrine wetland with a scrub-shrub plant community occurs southwest of Bullard Wash. A number of areas in the area of indirect effects within 5 mi (8 km) of the SEZ are mapped as North American Warm Desert Wash, North American Warm Desert Riparian Mesquite Bosque, and North American Warm Desert Riparian Woodland and Shrubland. The assumed access road corridor and transmission line corridor include areas mapped as North American Warm Desert Riparian

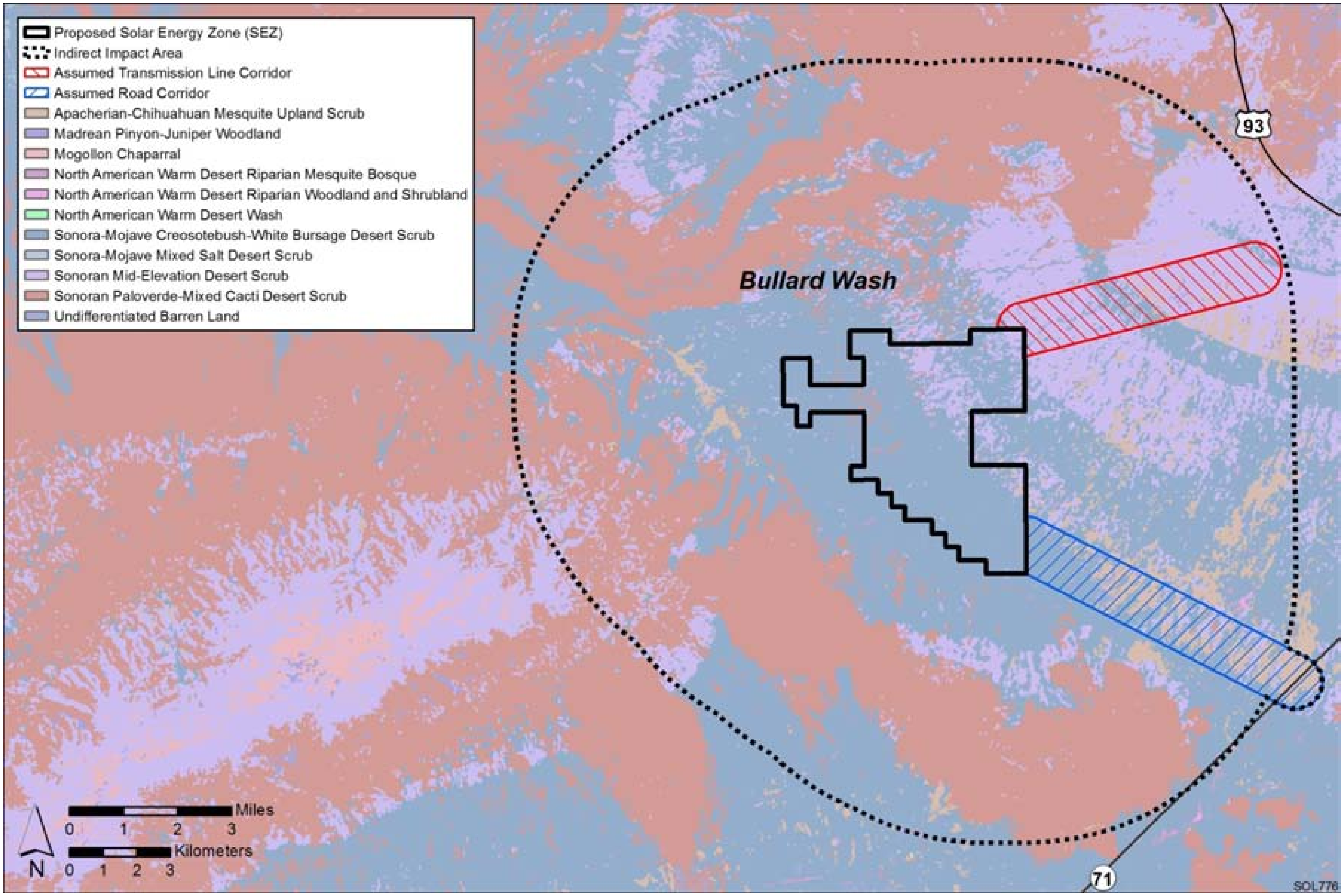

FIGURE 8.2.10.1-1 Land Cover Types within the Proposed Bullard Wash SEZ (Source: USGS 2004)

TABLE 8.2.10.1-1 Land Cover Types within the Potentially Affected Area of the Proposed Bullard Wash SEZ and Potential Impacts

	Area of Cover Type Affected (acres)[b]				
Land Cover Type[a]	Within SEZ (Direct Effects)[c]	Assumed Access Road (Direct Effects)[d]	Assumed Transmission Line (Direct Effects)[e]	Corridors and Outside SEZ (Indirect Effects)[f]	Overall Impact Magnitude[g]
Sonora–Mojave Creosotebush–White Bursage Desert Scrub: Occurs in broad valleys, lower bajadas, plains, and low hills in the Mojave and Sonoran deserts. Shrubs form a sparse to moderately dense cover (2 to 50%), although the ground surface may be mostly barren. The dominant species are typically creosotebush (*Larrea tridentata*) and white bursage (*Ambrosia dumosa*). Other shrubs, dwarf-shrubs, and cacti may also be dominant or form sparse understories. Herbaceous species are typically sparse, but may be seasonally abundant.	6,147 acres[h] (0.6%, 1.3%)	21 acres (<0.1%)	24 acres (<0.1%)	40,401 acres (3.7%)	Small
Sonoran Mid-Elevation Desert Scrub: Occurs on lower slopes along the northern edge of the Sonoran Desert. Generally consists of an open shrub layer and a generally sparse herbaceous layer.	886 acres (0.4%, 0.7%)	4 acres (<0.1 %)	118 acres (0.1%)	18,346 acres (8.1%),	Small
Sonoran Paloverde-Mixed Cacti Desert Scrub: Occurs on hillsides, mesas, and upper bajadas. The tall shrubs yellow palo verde (*Parkinsonia microphylla*) and creosotebush (*Larrea tridentata*), which are sparse to moderately dense, and/or sparse saguaro cactus (*Carnegia gigantea*) characterize the vegetation. Other shrubs and cacti are typically present. Perennial grasses and forbs are sparse. Annual species are seasonally present and may be abundant.	135 acres (<0.1%, 0.1%)	<1 acre (<0.1%)	<1 acre (<0.1%)	38,717 acres (1.8%)	Small
Apacherian-Chihuahuan Mesquite Upland Scrub: Occurs on foothills where deeper soil layers store winter precipitation. Dominant species are western honey mesquite (*Prosopis glandulosa*) or velvet mesquite (*P. velutina*) along with succulents and other deep-rooted shrubs. Cover of grasses is low.	36 acres (<0.1%, 0.1%)	11 acres (<0.1%)	10 acres (<0.1%)	4,797 acres (1.6%)	Small

TABLE 8.2.10.1-1 (Cont.)

	Area of Cover Type Affected (acres)[b]				
Land Cover Type[a]	Within SEZ (Direct Effects)[c]	Assumed Access Road (Direct Effects)[d]	Assumed Transmission Line (Direct Effects)[e]	Corridors and Outside SEZ (Indirect Effects)[f]	Overall Impact Magnitude[g]
North American Warm Desert Riparian Mesquite Bosque: Occurs along perennial and intermittent streams as relatively dense riparian corridors composed of trees and shrubs. Honey mesquite (*Prosopis glandulosa*) and velvet mesquite (*P. velutina*) are the dominant trees. Vegetation is supported by groundwater when surface water is absent.	15 acres (0.3%, 1.5%)	<1 acre (<0.1%)	<1 acre (<0.1%)	110 acres (2.3%)	Small
Barren lands nonspecific: Includes a variety of barren areas, generally with less than 15% cover of vegetation.	8 acres (0.1%, <0.4%)	1 acre (<0.1%)	<1 acre (<0.1%)	161 acres (2.5%)	Small
North American Warm Desert Riparian Woodland and Shrubland: Occurs along medium to large perennial streams in canyons and desert valleys. Consists of a mix of riparian woodlands and shrublands. Vegetation is dependent upon annual or periodic flooding, along with substrate scouring, and/or a seasonally shallow water table.	0 acres	<1 acre (<0.1%)	0 acres	31 acres (0.5%)	Small
Madrean Pinyon-Juniper Woodland: Occurs on foothills, mountains, and plateaus. Mexican pinyon (*Pinus cembroides*), border pinyon (*P. discolor*), or other trees and shrubs of the Sierra Madres are present. Dominant species may include redberry juniper (*Juniperus coahuilensis*), alligator juniper (*J. deppeana*), Pinchot's juniper (*J. pinchotii*), oneseed juniper (*J. monosperma*), or twoneedle pinyon (*P. edulis*). Oaks (*Quercus* sp.) may be codominant. Understory shrub or graminoid layers may be present.	0 acres	0 acres	2 acres (<0.1%)	123 acres (<0.1%)	Small

TABLE 8.2.10.1-1 (Cont.)

	Area of Cover Type Affected (acres)[b]				
Land Cover Type[a]	Within SEZ (Direct Effects)[c]	Assumed Access Road (Direct Effects)[d]	Assumed Transmission Line (Direct Effects)[e]	Corridors and Outside SEZ (Indirect Effects)[f]	Overall Impact Magnitude[g]
North American Warm Desert Wash: Consists of intermittently flooded linear or braided strips within desert scrub or grassland landscapes on bajadas, mesas, plains, and basin floors. Although often dry, washes are associated with rapid sheet and gully flow. The vegetation varies from sparse and patchy to moderately dense and typically occurs along the banks, but may occur within the channel. Shrubs and small trees are typically intermittent to open. Common upland shrubs often occur along the edges.	0 acres	0 acres	0 acres	4 acres (0.1%)	Small
Sonora-Mojave Mixed Salt Desert Scrub: Extensive open-canopied shrublands in the Mojave and Sonoran Deserts, usually occurring around playas and in valley bottoms or basins with saline soils. Vegetation is typically composed of one or more *Atriplex* species; other salt-tolerant plants are often present or even codominant. Grasses occur at varying densities.	0 acres	0 acres	0 acres	1 acre (<0.1%)	Small

a Land cover descriptions are from USGS (2005a). Full descriptions of land cover types, including plant species, can be found in Appendix I.

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.

d For access road development, direct effects were estimated within a 5-mi (8-km) long, 60-ft (18-m) wide road ROW from the SEZ to the nearest state highway. Direct impacts within this area were determined from the proportion of the cover type within the 1-mi (1.6-km) wide road corridor. Impacts are for the area of the cover type within the assumed ROW, and the percentage that area represents of all occurrences of that cover type within the SEZ region.

Footnotes continued on next page.

TABLE 8.2.10.1-1 (Cont.)

[e] For transmission development, direct effects were estimated within a 5-mi (8-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, and the percentage that area represents of all occurrences of that cover type within the SEZ region.

[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 portions of the 1-mi (1.6-km) wide road and transmission corridors 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.

[g] 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.

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

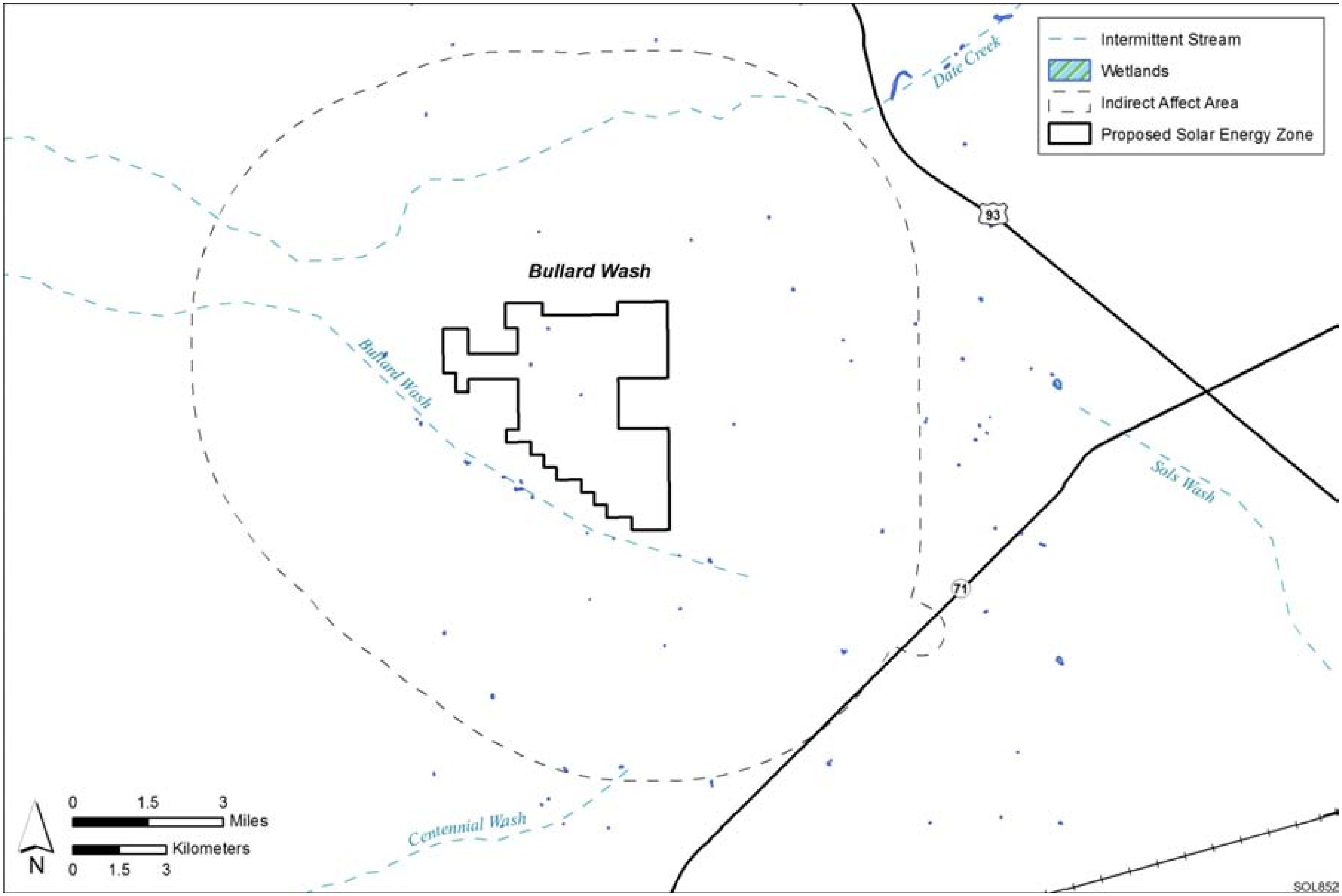

FIGURE 8.2.10.1-2 Wetlands within the Proposed Bullard Wash SEZ (Source: USFWS 2009)

Mesquite Bosque, and North American Warm Desert Riparian Woodland and Shrubland occurs in the road corridor. Tres Alamos Spring, northwest of the SEZ, and Yerba Mansa Spring, north of the SEZ, support riparian habitat. Riparian habitats along the Santa Maria River may also be supported by groundwater discharge.

The State of Arizona maintains an official list of weed species that are designated noxious species (AZDA 2010). Table 8.2.10.1-2 provides a summary of the noxious weed species regulated in Arizona that are known to occur in Yavapai County (USDA 2010b), which includes the proposed Bullard Wash SEZ. No species included in Table 8.2.10.1-2 were observed on the SEZ during a site visit in September 2009.

The Arizona Department of Agriculture classifies noxious weeds into one of three categories (AZDA 2010):

- "Prohibited: Noxious weeds (includes plants, stolons, rhizomes, cuttings, and seed) that are prohibited from entry into the state."
- "Regulated: Noxious weeds that are regulated (includes plants, stolons, rhizomes, cuttings, and seed) and if found within the state may be controlled or quarantined to prevent further infestation or contamination."
- "Restricted: Noxious weeds that are restricted (includes plants, stolons, rhizomes, cuttings, and seed) and if found within the state shall be quarantined to prevent further infestation or contamination."

TABLE 8.2.10.1-2 Designated Noxious Weeds of Arizona Occurring in Yavapai County

Common Name	Scientific Name	Category
Burclover	*Medicago polymorpha*	Regulated, prohibited
Canada thistle	*Cirsium arvense*	Prohibited
Common purslane	*Portulaca oleracea*	Regulated, prohibited
Dalmatian toadflax	*Linaria genistifolia* ssp. *dalmatica*	Restricted, prohibited
Dodder	*Cuscuta* spp.	Restricted, prohibited
Field bindweed	*Convolvulus arvensis*	Regulated, prohibited
Field sandbur	*Cenchrus incertus*	Regulated, prohibited
Jointed goatgrass	*Aegilops cylindrica*	Restricted, prohibited
Morning glory	*Ipomoea* spp.	Prohibited
Puncture vine	*Tribulus terrestris*	Regulated, prohibited
Russian knapweed	*Acroptilon repens*	Restricted, prohibited
Scotch thistle	*Onopordum acanthium*	Restricted, prohibited
Sweet resinbush	*Euryops subcarnosus* ssp. *vulgaris*	Restricted
Whitetop	*Cardaria draba*	Restricted, prohibited

Sources: AZDA (2010); USDA (2010b).

Table 8.2.10.1-3 presents a listing of invasive plant species that are known to occur in the BLM Bradshaw-Harquahala Planning Area (BLM 2010d), which includes the proposed Bullard Wash SEZ. No species listed in Table 8.2.10.1-3 was observed on the SEZ in August 2009.

8.2.10.2 Impacts

The construction of solar energy facilities within the proposed Bullard Wash 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 (5,791 acres [23.4 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, e.g., 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 by another. The proper implementation of programmatic design features, however, would reduce indirect effects to a minor or small level of impact.

Possible impacts from solar energy facilities on vegetation encountered within the SEZ, as well as general mitigation measures, are described in more detail in Section 5.10.4. Any such impacts would be minimized through implementation of required programmatic design features described in Appendix A, Section A.2.2 (selected from the general mitigation measures) and application of any additional mitigation measures.

TABLE 8.2.10.1-3 Invasive Plant Species Occurring in the Bradshaw-Harquahala Planning Area

Common Name	Scientific Name
African mustard	*Brassica tournefortii*
Fountain grass	*Pennisetum alopecuroides*
Bufflegrass	*Cenchrus ciliaris*
Wild oats	*Avena fatua*
Saltcedar	*Tamarix ramosissima*

Sources: BLM (2010d).

8.2.10.2.1 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); moderate (>1 but <10%) if the impact could affect an intermediate proportion of cover type; and large if the impact could affect more than 10% of a cover type.

Solar facility construction and operation in the proposed Bullard Wash SEZ would primarily affect communities of the Sonora–Mojave Creosotebush–White Bursage Desert Scrub cover type. Additional cover types that would be affected within the SEZ include Sonoran Mid-Elevation Desert Scrub, Sonoran Paloverde-Mixed Cacti Desert Scrub, Apacherian-Chihuahuan Mesquite Upland Scrub, North American Warm Desert Riparian Mesquite Bosque, and Barren Lands Non-specific. Table 8.2.10.1-1 summarizes the potential impacts on land cover types resulting from solar energy facilities in the proposed Bullard Wash SEZ. Most of these cover types are relatively common in the SEZ region; however, several are relatively uncommon, representing 1% or less of the land area within the SEZ region: North American Warm Desert Riparian Mesquite Bosque (0.09%), Barren Lands Non-specific (0.1%). In addition, North American Warm Desert Riparian Woodland and Shrubland (0.1%) would potentially be affected by the access road ROW. Desert dry wash, dry wash woodlands, and mesquite bosque are important sensitive habitats in the region.

The construction, operation, and decommissioning of solar projects within the proposed Bullard Wash SEZ would result in small impacts on all cover types in the affected area.

Because of the arid conditions, reestablishment of desert scrub communities in temporarily disturbed areas would likely be very difficult and might 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. Cryptogamic soil crusts occur in many of the shrubland communities in the region and likely occur on the SEZ. Damage to these crusts, by the operation of heavy equipment or other vehicles, can alter important soil characteristics, such as nutrient cycling and availability, and affect plant community characteristics (Lovich and Bainbridge 1999).

The deposition of fugitive dust from large areas of disturbed soil onto habitats outside a solar energy project site could result in reduced productivity or changes in plant community composition. Fugitive dust deposition could affect plant communities of each of the cover types occurring within the area of indirect effects identified in Table 8.2.10.1-1.

The construction of access roads or transmission lines could result in impacts on woodland communities. Small areas of North American Warm Desert Riparian Woodland and Shrubland occur within the access road corridor, and small areas of Madrean Pinyon-Juniper Woodland occur in the transmission line corridor. Woodland habitat within the ROWs would likely be converted to shrub- or grass-dominated habitat. Clearing of woodland along the ROWs during construction would contribute to fragmentation of these habitats and changes in characteristics in adjacent areas, such as light and soil moisture conditions. As a result, woodland communities along the ROWs could be degraded. ROW management would maintain altered habitat conditions within and adjacent to the ROWs.

Approximately 1.7 acres (0.007 km^2) of wetlands occurs within the SEZ. Grading could result in direct impacts on these wetlands if fill material is placed there. Grading near the wetlands in 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 the SEZ, such as those in or near Bullard Wash.

Grading could also affect dry washes within the SEZ, assumed access road corridor, and assumed transmission line corridor. Desert dry washes in the SEZ and corridors support woodland communities. 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. Communities associated with intermittently flooded areas downgradient from solar projects in the SEZ could be affected by ground-disturbing activities. Site clearing and grading could result in hydrologic changes and could potentially alter plant communities and affect community function. Increases in surface runoff from a solar energy project site could also affect hydrologic characteristics of these communities. The introduction of contaminants into these habitats could result from spills of fuels or other materials used on a project site. Soil disturbance could result in sedimentation in these areas, which could degrade or eliminate sensitive plant communities. Direct impacts on wetlands and desert washes that are waters of the United States would require permitting from the U.S. Army Corps of Engineers under Section 404 of the Clean Water Act. See Section 8.2.9 for further discussion of impacts on washes.

The construction of access roads or transmission lines in ROWs outside of the SEZ could potentially result in direct impacts on riparian habitat that occurs in or near the ROWs. Small areas of North American Warm Desert Riparian Woodland and Shrubland occur within the assumed access road corridor, and small areas of North American Warm Desert Riparian Mesquite Bosque occur within the assumed access road and transmission line corridors. These riparian habitats could also be indirectly affected by access road or transmission line construction or operation.

Although the use of groundwater within the Bullard Wash SEZ by technologies with high water requirements, such as wet-cooling systems, may be unlikely, groundwater withdrawals for such systems could reduce groundwater elevations. Communities in the vicinity of the SEZ that depend on accessible groundwater, such as mesquite bosque communities or communities associated with springs, such as Tres Alamos Spring or Yerba Mansa Spring, could become degraded or lost as a result of lowered groundwater levels. Riparian habitats along the Santa Maria River also may be affected.

8.2.10.2.2 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, provide for their control, and minimize their economic, ecological, and human health impacts (*Federal Register*, Volume 64, page 6183, Feb. 8, 1999). Potential impacts of noxious weeds and invasive plant species resulting from solar energy facilities 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 the affected area of the proposed Bullard Wash SEZ, such that 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.

Species designated as noxious weeds in Arizona and known to occur in Yavapai County are given in Table 8.2.10.1-2; species designated as invasive species, and known to occur in the Bradshaw-Harquahala Planning Area, are listed in Table 8.2.10.1-3. Past or present land uses may affect the susceptibility of plant communities to the establishment of noxious weeds and invasive species. Existing roads, grazing, and recreational OHV use within the SEZ area of potential impact also likely contribute to the susceptibility of plant communities to the establishment and spread of noxious weeds and invasive species.

8.2.10.3 SEZ-Specific Design Features and Design Feature Effectiveness

In addition to programmatic design features, SEZ-specific design features would reduce the potential for impacts on plant communities. While specific practices are best established when project details are considered, some measures can be identified at this time, as follows.

- 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 creosotebush-white bursage desert scrub communities and other affected habitats and to minimize the potential for the spread of noxious weeds or invasive species, such as those occurring in Yavapai County or the Bradshaw-Harquahala Planning Area, that could be introduced as a result of solar energy project activities (see Section 8.2.10.2.2). Invasive species control should focus on biological and mechanical methods where possible to reduce the use of herbicides.

- All wetland, dry wash, woodland, mesquite bosque, riparian, Joshua tree, and saguaro cactus communities within the SEZ or corridors should be avoided to the extent practicable and any impacts minimized and mitigated. Any Joshua trees or cacti that cannot be avoided should be salvaged. A buffer area should be maintained around wetland, dry washes, dry wash woodland, mesquite bosque habitats, and riparian habitats to reduce the potential for impacts. Transmission line towers should be sited and constructed to minimize impacts on these habitats and to span them whenever practicable.

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

- Groundwater withdrawals should be limited to reduce the potential for indirect impacts on groundwater-dependent communities, such as mesquite bosque communities, or riparian communities associated with springs, such as Yerba Mansa Spring or Tres Alamos Spring, or along the Santa Maria River.

If these SEZ-specific design features are implemented in addition to programmatic design features, it is anticipated that a high potential for impacts from invasive species and potential impacts on wetland, dry wash, dry wash woodland, mesquite bosque, riparian habitats, Joshua tree, and saguaro cactus communities would be reduced to a minimal potential for impacts.

8.2.11 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 Bullard Wash SEZ. Wildlife known to occur within 50 mi (80 km) of the SEZ (i.e., the SEZ region) were determined from Arizona Field Ornithologists (2010), Brennan (2008), Hoffmeister (1986), and SWReGAP (USGS 2007). Land cover types suitable for each species were determined from SWReGAP (USGS 2004, 2005a, 2007). The amount of aquatic habitat within the SEZ region was determined by estimating the length of linear perennial stream 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, a 250-ft (76-m) wide portion of an assumed 5-mi (8-km) long transmission line corridor and a 60-ft (18-m) wide portion of an assumed 5-mi (8-km) long access road. The maximum developed area within the SEZ would be 5,791 acres (23.4 km^2) and the maximum developed area within the transmission line and access road would be 151 acres (0.6 km^2) and 36 acres (0.15 km^2), respectively.

The area of indirect effects was defined as the area within 5 mi (8 km) of the SEZ boundary and within the 1.0-mi (1.6-km) wide assumed transmission line and access road corridors where ground-disturbing activities would not occur, but that could be indirectly affected by activities in the area of direct effect (e.g., surface runoff, dust, noise, lighting, and accidental spills in the SEZ or transmission line and access road construction areas). Potentially suitable habitat for a species within the SEZ greater than the maximum of 5,791 acres (23.4 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.

The primary land cover habitat types within the affected area are Sonora–Mojave creosotebush–white bursage desert scrub, Sonoran Paloverde-Mixed Cacti Desert Scrub, and Sonoran mid-elevation desert scrub (see Section 8.2.10). Bullard Wash, an intermittent streambed that exists along the southwestern boundary of the SEZ within the area of indirect impacts, is the only potential aquatic habitat within the affected area. Several isolated wetlands within the SEZ and area of indirect impacts could also contain standing water on an intermittent basis. Other washes, Bill Williams River, and Alamo Lake occur within the SEZ region (Figure 8.2.9.1-1).

8.2.11.1 Amphibians and Reptiles

8.2.11.1.1 Affected Environment

This section addresses amphibian and reptile species that are known to occur, or for which potentially suitable habitat occurs, on or within the potentially affected area of the proposed Bullard Wash SEZ. The list of amphibian and reptile species potentially present in the SEZ area was determined from species lists available from Brennan (2008) and range maps and habitat information available from the SWReGAP (USGS 2007). Land cover types suitable for each species were determined from SWReGAP (USGS 2004, 2005a, 2007). See Appendix M for additional information on the approach used.

Based on species distributions within the area of the SEZ and habitat preferences of the amphibian species, the Great Basin spadefoot (*Spea intermontana*) and red-spotted toad (*Bufo punctatus*) would be expected to occur within the SEZ (Brennan 2008; USGS 2007; Stebbins 2003). These species could breed within the isolated wetlands when standing water is available.

More than 30 reptile species occur within the area that encompasses the proposed Bullard Wash SEZ (Brennan 2008; USGS 2007; Stebbins 2003). The desert tortoise (*Gopherus agassizii*) is a federal and state listed threatened species and is discussed in Section 8.2.12. Lizard species expected to occur within the SEZ include the desert horned lizard (*Phrynosoma platyrhinos*), Great Basin collared lizard (*Crotaphytus bicinctores*), side-blotched lizard (*Uta stansburiana*), western whiptail (*Cnemidophorus tigris*), and zebra-tailed lizard (*Callisaurus draconoides*).

Snake species expected to occur within the SEZ include the coachwhip (*Masticophis flagellum*), common kingsnake (*Lampropeltis gentula*), glossy snake (*Arizona elegans*), gophersnake (*Pituophis catenifer*), groundsnake (*Sonora semiannulata*), and nightsnake (*Hypsiglena torquata*). The Mohave rattlesnake (*Crotalus scutulatus*), sidewinder (*C. cerastes*), and western diamond-backed rattlesnake (*C. atrox*) would be the most common poisonous snake species expected to occur on the SEZ.

Table 8.2.11.1-1 provides habitat information for representative amphibian and reptile species that could occur within the proposed Bullard Wash SEZ.

8.2.11.1.2 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 application of additional mitigation applied. Section 8.2.11.1.3, below, identifies SEZ-specific design features of particular relevance to the proposed Bullard Wash SEZ.

TABLE 8.2.11.1-1 Habitats, Potential Impacts, and Potential Mitigation for Representative Amphibian and Reptile Species That Could Occur on or in the Affected Area of the Proposed Bullard Wash 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]	Within Access Road Corridor (Indirect and Direct Effects)[f]	Overall Impact Magnitude[g] and Species-Specific Mitigation[h]
Amphibians						
Great Basin spadefoot (*Spea intermontana*)	Sagebrush flats, semidesert shrublands, pinyon-juniper woodlands, and spruce-fir forests. Breeds in temporary and permanent waters including rain pools, pools in intermittent streams, and flooded areas along streams. About 1,162,900 acres[i] of potentially suitable habitat occurs within the SEZ region.	5,791 acres of potentially suitable habitat lost (0.5% of available potentially suitable habitat) during construction and operations	38,299 acres of potentially suitable habitat (3.3% of available potentially suitable habitat)	23 acres of potentially suitable habitat lost (0.002% of available potentially suitable habitat) and 469 acres in area of indirect effect	24 acres of potentially suitable habitat lost (0.002% of available potentially suitable habitat) and 2,113 acres in area of indirect effect	Small overall impact. Avoid wetland habitats. No other species-specific mitigation of direct effects is feasible because suitable habitat is widespread in the area of direct effects.
Red-spotted toad (*Bufo punctatus*)	Dry, rocky areas at lower elevations near desert springs and persistent pools along rocky arroyos, desert streams and oases, open grassland, scrubland oaks, and dry woodlands. About 4,177,800 acres of potentially suitable habitat occurs within the SEZ region.	5,791 acres of potentially suitable habitat lost (0.1% of available potentially suitable habitat) during construction and operations	97,323 acres of potentially suitable habitat (2.3% of available potentially suitable habitat)	151 acres of potentially suitable habitat lost (0.004% of available potentially suitable habitat) and 3,043 acres in area of indirect effect	36 acres of potentially suitable habitat lost (0.001% of available potentially suitable habitat) and 3,434 acres in area of indirect effect	Small overall impact. Avoid wetland habitats. No other species-specific mitigation of direct effects is feasible because suitable habitat is widespread in the area of direct effects.

TABLE 8.2.11.1-1 (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]	Within Access Road Corridor (Indirect and Direct Effects)[f]	Overall Impact Magnitude[g] and Species-Specific Mitigation[h]
Lizards						
Desert horned lizard (*Phrynosoma platyrhinos*)	Deserts dominated by sagebrush, creosotebush, greasewood, or cactus. Occurs on sandy flats, alluvial fans, washes, and edges of dunes. Burrows in soil during periods of inactivity. About 3,538,400 acres of potentially suitable habitat occurs in the SEZ region.	5,791 acres of potentially suitable habitat lost (0.2% of available potentially suitable habitat) during construction and operations	92,903 acres of potentially suitable habitat (2.6% of available potentially suitable habitat)	140 acres of potentially suitable habitat lost (0.004% of available potentially suitable habitat) and 2,821 acres in area of indirect effect	36 acres of potentially suitable habitat lost (0.001% of available potentially suitable habitat) and 3,244 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 effects.
Great Basin collared lizard (*Crotaphytus bicinctores*)	Usually inhabits alluvia, lava flows, mountain slopes, canyons, buttes, rock outcrops, washes, and rocky plains. Limiting factors are the presence of large boulders and open/sparse vegetation. About 3,524,100 acres of potentially suitable habitat occurs in the SEZ region.	5,791 acres of potentially suitable habitat lost (0.2% of available potentially suitable habitat) during construction and operations	92,773 acres of potentially suitable habitat (2.6% of available potentially suitable habitat)	140 acres of potentially suitable habitat lost (0.004% of available potentially suitable habitat) and 2,820 acres in area of indirect effect	36 acres of potentially suitable habitat lost (0.001% of available potentially suitable habitat) and 3,245 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 effects.

TABLE 8.2.11.1-1 (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]	Within Access Road Corridor (Indirect and Direct Effects)[f]	Overall Impact Magnitude[g] and Species-Specific Mitigation[h]
Lizards (Cont.)						
Side-blotched lizard (*Uta stansburiana*)	Low to moderate elevations in washes, arroyos, boulder-strewn ravines, rocky cliff bases, and flat shrubby areas in canyon bottoms. Often along sandy washes. Usually in areas with a lot of bare ground. About 4,035,000 acres of potentially suitable habitat occurs within the SEZ region.	5,791 acres of potentially suitable habitat lost (0.1% of available potentially suitable habitat) during construction and operations	80,733 acres of potentially suitable habitat (2.0% of available potentially suitable habitat)	35 acres of potentially suitable habitat lost (<0.001% of available potentially suitable habitat) and 698 acres in area of indirect effect	36 acres of potentially suitable habitat lost (<0.001% of available potentially suitable habitat) and 3,136 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 effects.
Western whiptail (*Cnemidophorus tigris*)	Arid and semiarid habitats with sparse plant cover. About 4,690,600 acres of potentially suitable habitat occurs within the SEZ region.	5,791 acres of potentially suitable habitat lost (0.1% of available potentially suitable habitat) during construction and operations	97,456 acres of potentially suitable habitat (2.1% of available potentially suitable habitat)	151 acres of potentially suitable habitat lost (0.003% of available potentially suitable habitat) and 3,044 acres in area of indirect effect	36 acres of potentially suitable habitat lost (<0.001% of available potentially suitable habitat) and 3,458 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 effects.

TABLE 8.2.11.1-1 (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]	Within Access Road Corridor (Indirect and Direct Effects)[f]	Overall Impact Magnitude[g] and Species-Specific Mitigation[h]
Lizards (Cont.)						
Zebra-tailed lizard (*Callisaurus draconoides*)	Open, warm-desert habitats, especially dry washes and canyons with fine gravel and sand. About 3,605,600 acres of potentially suitable habitat occurs in the SEZ region.	5,791 acres of potentially suitable habitat lost (0.2% of available potentially suitable habitat) during construction and operations	80,775 acres of potentially suitable habitat (2.2% of available potentially suitable habitat)	33 acres of potentially suitable habitat lost (0.001% of available potentially suitable habitat) and 665 acres in area of indirect effect	36 acres of potentially suitable habitat lost (0.001% of available potentially suitable habitat) and 3,161 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 effects.
Snakes						
Coachwhip (*Masticophis flagellum*)	Creosotebush desert, shortgrass prairie, shrub-covered flats and hills. Sandy to rocky substrates. Avoids dense vegetation. About 4,009,200 acres of potentially suitable habitat occurs within the SEZ region.	5,791 acres of potentially suitable habitat lost (0.1% of available potentially suitable habitat) during construction and operations	80,729 acres of potentially suitable habitat (2.0% of available potentially suitable habitat)	35 acres of potentially suitable habitat lost (<0.001% of available potentially suitable habitat) and 698 acres in area of indirect effect	36 acres of potentially suitable habitat lost (<0.001% of available potentially suitable habitat) and 3,136 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 effects.

TABLE 8.2.11.1-1 (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]	Within Access Road Corridor (Indirect and Direct Effects)[f]	Overall Impact Magnitude[g] and Species-Specific Mitigation[h]
Snakes (Cont.)						
Common kingsnake (*Lampropeltis getula*)	Coniferous forests, woodlands, swampland, coastal marshes, river bottoms, farmlands, prairies, chaparral, and deserts. Uses rock outcrops and rodent burrows for cover. About 4,967,600 acres of potentially suitable habitat occurs within the SEZ region.	5,791 acres of potentially suitable habitat lost (0.1% of available potentially suitable habitat) during construction and operations	97,457 acres of potentially suitable habitat (2.0% of available potentially suitable habitat)	151 acres of potentially suitable habitat lost (0.003% of available potentially suitable habitat) and 3,044 acres in area of indirect effect	36 acres of potentially suitable habitat lost (<0.001% of available potentially suitable habitat) and 3,458 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 effects.
Glossy snake (*Arizona elegans*)	Light shrubby to barren deserts, sagebrush flats, grasslands, and chaparral-covered slopes and woodlands. Prefers sandy grasslands, shrublands and woodlands. About 3,601,400 acres of potentially suitable habitat occurs within the SEZ region.	5,791 acres of potentially suitable habitat lost (0.2% of available potentially suitable habitat) during construction and operations	80,750 acres of potentially suitable habitat (2.2% of available potentially suitable habitat)	33 acres of potentially suitable habitat lost (0.001% of available potentially suitable habitat) and 665 acres in area of indirect effect	36 acres of potentially suitable habitat lost (0.001% of available potentially suitable habitat) and 3,154 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 effects.

TABLE 8.2.11.1-1 (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]	Within Access Road Corridor (Indirect and Direct Effects)[f]	Overall Impact Magnitude[g] and Species-Specific Mitigation[h]
Snakes (Cont.)						
Gophersnake (*Pituophis catenifer*)	Plains grasslands, sand hills, 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 4,927,100 acres of potentially suitable habitat occurs in the SEZ region.	5,791 acres of potentially suitable habitat lost (0.1% of available potentially suitable habitat) during construction and operations	97,457 acres of potentially suitable habitat (2.0% of available potentially suitable habitat)	151 acres of potentially suitable habitat lost (0.003% of available potentially suitable habitat) and 3,044 acres in area of indirect effect	36 acres of potentially suitable habitat lost (<0.001% of available potentially suitable habitat) and 3,458 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 effects.
Groundsnake (*Sonora semiannulata*)	Arid and semiarid regions with rocky to sandy soils. River bottoms, desert flats, sand hummocks, and rocky hillsides. About 4,273,300 acres of potentially suitable habitat occurs in the SEZ region.	5,791 acres of potentially suitable habitat lost (0.1% of available potentially suitable habitat) during construction and operations	97,452 acres of potentially suitable habitat (2.2% of available potentially suitable habitat)	151 acres of potentially suitable habitat lost (0.004% of available potentially suitable habitat) and 3,044 acres in area of indirect effect	36 acres of potentially suitable habitat lost (0.001% of available potentially suitable habitat) and 3,458 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 effects.

TABLE 8.2.11.1-1 (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]	Within Access Road Corridor (Indirect and Direct Effects)[f]	Overall Impact Magnitude[g] and Species-Specific Mitigation[h]
Snakes (Cont.)						
Mohave rattlesnake (*Crotalus scutulatus*)	Upland desert and lower mountain slopes including barren desert, grassland, open juniper woodland, and scrubland. Especially common in areas of scattered scrubby growth such as creosote and mesquite. About 5,017,700 acres of potentially suitable habitat occurs in the SEZ region.	5,791 acres of potentially suitable habitat lost (0.1% of available potentially suitable habitat) during construction and operations	97,592 acres of potentially suitable habitat (1.9% of available potentially suitable habitat)	151 acres of potentially suitable habitat lost (0.003% of available potentially suitable habitat) and 3,044 acres in area of indirect effect	36 acres of potentially suitable habitat lost (<0.001% of available potentially suitable habitat) and 3,493 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 effects.
Nightsnake (*Hypsiglena torquata*)	Arid and semiarid desert flats, plains, and woodlands; areas with rocky and sandy soils are preferred. During cold periods of the year, it seeks refuge underground, in crevices, or under rocks. About 4,535,800 acres of potentially suitable habitat occurs within the SEZ region.	5,791 acres of potentially suitable habitat lost (0.1% of available potentially suitable habitat) during construction and operations	80,729 acres of potentially suitable habitat (1.8% of available potentially suitable habitat)	35 acres of potentially suitable habitat lost (<0.001% of available potentially suitable habitat) and 698 acres in area of indirect effect	36 acres of potentially suitable habitat lost (<0.001% of available potentially suitable habitat) and 3,136 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 effects.

TABLE 8.2.11.1-1 (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]	Within Access Road Corridor (Indirect and Direct Effects)[f]	Overall Impact Magnitude[g] and Species-Specific Mitigation[h]
Snakes (Cont.)						
Sidewinder (*Crotalus cerastes*)	Windblown sand habitats near rodent burrows. Most common in areas of sand hummocks topped with creosote, mesquite, or other desert plants. About 3,294,800 acres of potentially suitable habitat occurs within the SEZ region.	5,791 acres of potentially suitable habitat lost (0.2% of available potentially suitable habitat) during construction and operations	76,199 acres of potentially suitable habitat (2.3% of available potentially suitable habitat)	24 acres of potentially suitable habitat lost (<0.001% of available potentially suitable habitat) and 475 acres in area of indirect effect	34 acres of potentially suitable habitat lost (0.001% of available potentially suitable habitat) and 2,954 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 effects.
Western diamond-backed rattlesnake (*Crotalus atrox*)	Dry and semi-dry lowland areas. Usually found in brush-covered plains, dry washes, rock outcrops, and desert foothills. About 4,853,600 acres of potentially suitable habitat occurs within the SEZ region.	5,791 acres of potentially suitable habitat lost (0.1% of available potentially suitable habitat) during construction and operations	97,457 acres of potentially suitable habitat (2.0% of available potentially suitable habitat)	151 acres of potentially suitable habitat lost (0.003% of available potentially suitable habitat) and 3,044 acres in area of indirect effect	36 acres of potentially suitable habitat lost (<0.001% of available potentially suitable habitat) and 3,458 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 effects.

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TABLE 8.2.11.1-1 (Cont.)

[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. A maximum of 5,791 acres of direct effect within the SEZ was assumed.

[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.

[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 5,791 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 5-mi (8-km) long, 250-ft (76-m) wide transmission line ROW from the SEZ to the nearest existing transmission 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.

[f] For access road development, direct effects were estimated within a 5-mi (8-km) long, 60-ft (18-m) access road ROW from the SEZ to the nearest existing state route, U.S. highway, or interstate. Indirect effects were estimated within a 1-mi (1.6-km) wide access road corridor to the existing road, less the assumed area of direct effects.

[g] 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.

[h] 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.

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

Sources: Brennan (2008); CDFG (2008); NatureServe (2010); USGS (2004, 2005a, 2007).

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 8.2.11.1.1 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 required actions to avoid or mitigate impacts on amphibians and reptiles (see Section 8.2.11.1.3).

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 magnitude of impacts on amphibians and reptiles summarized in Table 8.2.11.1-1, direct impacts on representative amphibian and reptile species would be small, ranging from a high of 0.5% for the Great Basin spadefoot to 0.1 to 0.2% for all other species (Table 8.2.11.1-1). Larger areas of potentially suitable habitats for the amphibian and reptile species occur within the area of potential indirect effects (e.g., up to 3.3% of available habitat for the Great Basin spadefoot and 1.8 to 2.6% for all other species). 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 after operations cease could result in short-term negative impacts on individuals and habitats within and adjacent to the SEZ. The negative impacts of decommissioning would be reduced or eliminated as reclamation proceeds. Potentially long-term benefits could accrue as habitats are 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 desert scrub and wash habitats.

8.2.11.1.3 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 amphibians and reptiles, especially for those species that utilize habitat types that can be avoided (e.g., washes). 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 SEZ-specific design features are best established when project details are being considered, there is one design feature that can be identified at this time:

- Isolated wetlands should be avoided.

If this SEZ-specific design feature is implemented in addition to other programmatic design features, impacts on amphibian and reptile species could be reduced. However, as potentially suitable habitats for the representative 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.

8.2.11.2 Birds

8.2.11.2.1 Affected Environment

> **Desert Focal Bird Species**
>
> Bird species whose requirements define spatial attributes, habitat characteristics, and management regimes representative of a healthy desert system (Chase and Geupel 2005).

This section addresses bird species that are known to occur, or for which potentially suitable habitat occurs, on or within the potentially affected area of the proposed Bullard Wash SEZ. The list of bird species potentially present in the SEZ area was determined from the Arizona Field Ornithologists (2010) and range maps and habitat information available from SWReGAP (USGS 2007). Land cover types suitable for each species were determined from SWReGAP (USGS 2004, 2005a, 2007). See Appendix M for additional information on the approach used.

Fourteen of the bird species that could occur on or in the affected area of the SEZ are considered focal species in the *Desert Bird Conservation Plan* (CalPIF 2009): ash-throated flycatcher (*Myiarchus cinerascens*), black-tailed gnatcatcher (*Polioptila melanura*), black-throated sparrow (*Amphispiza bilineata*), burrowing owl (*Athene cunicularia*), common raven (*Corvus corax*), Costa's hummingbird (*Calypte costae*), crissal thrasher (*Toxostoma crissale*), Gila woodpecker (*Melanerpes uropygialis*), ladder-backed woodpecker (*Picoides scalaris*), Le Conte's thrasher (*Toxostoma lecontei*), Lucy's warbler (*Vermivora luciae*), phainopepla (*Phainopepla nitens*), Scott's oriole (*Icterus parisorum*), and verdin (*Auriparus flaviceps*). Habitats for most of these species are described in Table 8.2.11.2-1. Due to its special species status, the burrowing owl is discussed in Section 8.2.12.1.

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 solar study area. However, within the proposed Bullard Wash SEZ, waterfowl, wading birds, and shorebird species would be mostly absent to uncommon. Bullard Wash, within the area of indirect effects, and the isolated wetlands within the affected area may occasionally attract shorebird species such as the killdeer (*Charadrius vociferus*) and least sandpiper (*Calidris minutilla*). The Bill Williams River and Alamo Lake, which occur within the 50-mi (80-km) SEZ region would provide more viable habitat for this group of birds.

Neotropical Migrants

As discussed in Section 4.10.2.2.3, neotropical migrants represent the most diverse category of birds within the six-state solar energy study area. Species expected to occur within the proposed Bullard Wash SEZ include the ash-throated flycatcher, black-tailed gnatcatcher, black-throated sparrow, Brewer's sparrow (*Spizella breweri*), cactus wren (*Campylorhynchus brunneicapillus*), common poorwill (*Phalaenoptilus nuttallii*), common raven, Costa's hummingbird, crissal thrasher, Gila woodpecker, greater roadrunner (*Geococcyx californianus*), horned lark (*Eremophila alpestris*), ladder-backed woodpecker, Le Conte's thrasher, lesser nighthawk (*Chordeiles acutipennis*), loggerhead shrike (*Lanius ludovicianus*), Lucy's warbler, phainopepla, Say's phoebe (*Sayornis saya*), Scott's oriole, and verdin (Arizona Field Ornithologists 2010; CalPIF 2009; USGS 2007).

Birds of Prey

Section 4.10.2.2.4 provided an overview of the birds of prey (raptors, owls, and vultures) within the six-state solar study area. Raptor species that could occur within the proposed Bullard Wash SEZ include the American kestrel (*Falco sparverius*), golden eagle (*Aquila chrysaetos*), prairie falcon (*Falco mexicanus*), red-tailed hawk (*Buteo jamaicensis*), and turkey vulture (*Cathartes aura*) (Arizona Field Ornithologists 2010; USGS 2007). Several other special status birds of prey are discussed in Section 8.2.12. These include the American peregrine falcon (*Falco peregrinus anatum*), bald eagle (*Haliaeetus leucocephalus*), ferruginous hawk (*Buteo regalis*), long-eared owl (*Asio otus*), and burrowing owl.

Upland Game Birds

Section 4.10.2.2.5 provided an overview of the upland game birds (primarily pheasants, grouse, quail, and doves) that occur within the six-state solar study area. Upland game species that could occur within the proposed Bullard Wash SEZ include Gambel's quail (*Callipepla gambelii*), mourning dove (*Zenaida macroura*), and white-winged dove (*Zenaida asiatica*) (Arizona Field Ornithologists 2010; USGS 2007).

8.2.11.2.2 Impacts

The types of impacts 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 application of any additional mitigation. Section 8.2.11.2.3, below, identifies design features of particular relevance to the proposed Bullard Wash 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 8.2.11.2.1, 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 8.2.11.2.3).

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 8.2.11.2-1 summarizes the magnitude of potential impacts on representative bird species resulting from solar energy development in the proposed Bullard Wash SEZ. On the basis of the impacts on birds summarized in Table 8.2.11.2-1, direct impacts on representative bird species would be small for all bird species (ranging from a high of 0.5% for the horned lark to a low of 0.002% for the crissal thrasher (Table 8.2.11.2-1). Larger areas of potentially suitable habitats for the bird species occur within the area of potential indirect effects (e.g., up to 3.1% of available habitat for the horned lark and Say's phoebe). Indirect impacts on birds could result from surface water and sediment runoff from disturbed areas, fugitive dust generated by project activities, accidental spills, and harassment. These indirect impacts are expected to be negligible with implementation of programmatic design features.

Decommissioning after operations cease could result in short-term negative impacts on individuals and habitats within and adjacent to the SEZ. The negative impacts of decommissioning would be reduced or eliminated as reclamation proceeds. Potentially long-term benefits could accrue as habitats are 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 desert scrub, playa, and wash habitats.

8.2.11.2.3 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 birds. 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 SEZ-specific design features important for reducing impacts on birds are best established when project details are considered, one design feature can be identified at this time, as follows:

- For solar energy facilities 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.

- 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 Arizona Game and Fish Department. A permit may be required under the Bald and Golden Eagle Protection Act.

TABLE 8.2.11.2-1 Habitats, Potential Impacts, and Potential Mitigation for Representative Bird Species That Could Occur on or in the Affected Area of the Proposed Bullard Wash 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]	Within Access Road Corridor (Indirect and Direct Effects)[f]	Overall Impact Magnitude[g] and Species-Specific Mitigation[h]
Neotropical Migrants						
Ash-throated flycatcher (*Myiarchus cinerascens*)	Common in scrub and woodland habitats including desert riparian and desert washes. Requires hole/cavity for nesting. Uses shrubs or small trees for foraging perches. About 4,804,300 acres[i] of potentially suitable habitat occurs within the SEZ region.	5,791 acres of potentially suitable habitat lost (0.1% of available potentially suitable habitat) during construction and operations	97,457 acres of potentially suitable habitat (2.0% of available potentially suitable habitat)	151 acres of potentially suitable habitat lost (0.003% of available potentially suitable habitat) and 3,044 acres in area of indirect effect	36 acres of potentially suitable habitat lost (<0.001% of available potentially suitable habitat) and 3,458 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 effects. Some measure of mitigation provided by the requirements of the Migratory Bird Treaty Act.
Black-tailed gnatcatcher (*Polioptila melanura*)	Nests in bushes mainly in wooded desert washes with dense mesquite, palo verde, ironwood, and acacia. Also occurs in desert scrub habitat. About 3,601,400 acres of potentially suitable habitat occurs in the SEZ region.	5,791 acres of potentially suitable habitat lost (0.2% of available potentially suitable habitat) during construction and operations	80,750 acres of potentially suitable habitat (2.2% of available potentially suitable habitat)	33 acres of potentially suitable habitat lost (0.001% of available potentially suitable habitat) and 665 acres in area of indirect effect	36 acres of potentially suitable habitat lost (0.001% of available potentially suitable habitat) and 3,154 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 effects. Some measure of mitigation provided by the requirements of the Migratory Bird Treaty Act.

TABLE 8.2.11.2-1 (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]	Within Access Road Corridor (Indirect and Direct Effects)[f]	Overall Impact Magnitude[g] and Species-Specific Mitigation[h]
Neotropical Migrants (Cont.)						
Black-throated sparrow (*Amphispiza bilineata*)	Chaparral and desertscrub habitats with sparse to open stands of shrubs. Often in areas with scattered Joshua trees. Nests in thorny shrubs or cactus. About 4,473,400 acres of potentially suitable habitat occurs within the SEZ region.	5,791 acres of potentially suitable habitat lost (0.1% of available potentially suitable habitat) during construction and operations	80,835 acres of potentially suitable habitat (1.8% of available potentially suitable habitat)	35 acres of potentially suitable habitat lost (<0.001% of available potentially suitable habitat) and 699 acres in area of indirect effect	36 acres of potentially suitable habitat lost (<0.001% of available potentially suitable habitat) and 3,154 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 effects. Some measure of mitigation provided by the requirements of the Migratory Bird Treaty Act.
Brewer's sparrow (*Spizella breweri*)	Common in Mojave and Colorado deserts during winter. Occupies open desert scrub and cropland habitats. About 1,461,300 acres of potentially suitable habitat occurs in the SEZ region.	5,791 acres of potentially suitable habitat lost (0.4% of available potentially suitable habitat) during construction and operations	42,681 acres of potentially suitable habitat (2.9% of available potentially suitable habitat)	33 acres of potentially suitable habitat lost (0.002% of available potentially suitable habitat) and 656 acres in area of indirect effect	26 acres of potentially suitable habitat lost (0.002% of available potentially suitable habitat) and 2,291 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 effects. Some measure of mitigation provided by the requirements of the Migratory Bird Treaty Act.

TABLE 8.2.11.2-1 (Cont.)

Common Name (Scientific Name)	Habitat[a]	Maximum Area of Potential Habitat Affected[b]				Overall Impact Magnitude[g] and Species-Specific Mitigation[h]
		Within SEZ (Direct Effects)[c]	Outside SEZ (Indirect Effects)[d]	Within Transmission Line Corridor (Indirect and Direct Effects)[e]	Within Access Road Corridor (Indirect and Direct Effects)[f]	
Neotropical Migrants (Cont.)						
Cactus wren (*Campylorhynchus brunneicapillus*)	Desert (especially areas with cholla cactus or yucca), mesquite, arid scrub, coastal sage scrub, and trees in towns in arid regions. Nests in *Opuntia* spp.; twiggy, thorny trees and shrubs; and sometimes in buildings. Nests may be used as winter roost. About 2,995,900 acres of potentially suitable habitat occurs within the SEZ region.	1,021 acres of potentially suitable habitat lost (0.03% of available potentially suitable habitat) during construction and operations	53,583 acres of potentially suitable habitat (1.8% of available potentially suitable habitat)	117 acres of potentially suitable habitat lost (0.004% of available potentially suitable habitat) and 2,352 acres in area of indirect effect	13 acres of potentially suitable habitat lost (<0.001% of available potentially suitable habitat) and 1,157 acres in area of indirect effect	Small overall impact. Some measure of mitigation provided by the requirements of the Migratory Bird Treaty Act.
Common poorwill (*Phalaenoptilus nuttallii*)	Scrubby and brushy areas, prairie, desert, rocky canyons, open woodlands, and broken forests. Mostly in arid and semiarid habitats. Nests in open areas on a bare site. About 4,256,400 acres of potentially suitable habitat occurs within the SEZ region.	5,791 acres of potentially suitable habitat lost (0.1% of available potentially suitable habitat) during construction and operations	76,293 acres of potentially suitable habitat (1.8% of available potentially suitable habitat)	25 acres of potentially suitable habitat lost (<0.001% of available potentially suitable habitat) and 510 acres in area of indirect effect	34 acres of potentially suitable habitat lost (<0.001% of available potentially suitable habitat) and 2,954 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 effects. Some measure of mitigation provided by the requirements of the Migratory Bird Treaty Act.

TABLE 8.2.11.2-1 (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]	Within Access Road Corridor (Indirect and Direct Effects)[f]	Overall Impact Magnitude[g] and Species-Specific Mitigation[h]
Neotropical Migrants (Cont.)						
Common raven (*Corvus corax*)	Occurs in most habitats. Trees and cliffs provide cover. Roosts primarily in trees. Nests on cliffs, bluffs, tall trees, or man-made structures. Forages in sparse, open terrain. About 4,995,000 acres of potentially suitable habitat occurs in the SEZ region.	5,791 acres of potentially suitable habitat lost (0.1% of available potentially suitable habitat) during construction and operations	97,453 acres of potentially suitable habitat (2.0% of available potentially suitable habitat)	151acres of potentially suitable habitat lost (0.003% of available potentially suitable habitat) and 3,044 acres in area of indirect effect	36 acres of potentially suitable habitat lost (<0.001% of available potentially suitable habitat) and 3,458 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 effects. Some measure of mitigation provided by the requirements of the Migratory Bird Treaty Act.
Costa's hummingbird (*Calypte costae*)	Desert and semidesert areas, arid brushy foothills, and chaparral. Main habitats are desert washes, edges of desert riparian and valley foothill riparian areas, coastal shrub, desert scrub, desert succulent shrub, lower-elevation chaparral, and palm oasis. Also in mountains, meadows, and gardens during migration and winter. Most common in canyons and washes when nesting. Nests are located in trees, shrubs, vines, or cacti. About 4,226,400 acres of potentially suitable habitat occurs within the SEZ region.	5,791 acres of potentially suitable habitat lost (0.1% of available potentially suitable habitat) during construction and operations	97,457 acres of potentially suitable habitat (2.3% of available potentially suitable habitat)	151 acres of potentially suitable habitat lost (0.004% of available potentially suitable habitat) and 3,044 acres in area of indirect effect	36 acres of potentially suitable habitat lost (0.001% of available potentially suitable habitat) and 3,458 acres in area of indirect effect	Small overall impact. Avoid wash habitats. No other mitigation of direct effects is feasible because suitable habitat is widespread in the area of direct effects. Some measure of mitigation provided by the requirements of the Migratory Bird Treaty Act.

TABLE 8.2.11.2-1 (Cont.)

Common Name (Scientific Name)	Habitat[a]	Maximum Area of Potential Habitat Affected[b]				Overall Impact Magnitude[g] and Species-Specific Mitigation[h]
		Within SEZ (Direct Effects)[c]	Outside SEZ (Indirect Effects)[d]	Within Transmission Line Corridor (Indirect and Direct Effects)[e]	Within Access Road Corridor (Indirect and Direct Effects)[f]	
Neotropical Migrants (Cont.)						
Crissal thrasher (*Toxostoma crissale*)	Desert and semidesert areas, arid brushy foothills, and chaparral. Main habitats are desert washes, edges of desert riparian and valley foothill riparian areas, coastal shrub, desert scrub, desert succulent shrub, lower-elevation chaparral, and palm oasis. Also in mountains, meadows, and gardens during migration and winter. Most common in canyons and washes when nesting. Nests are located in trees, shrubs, vines, or cacti. About 903,400 acres of potentially suitable habitat occurs within the SEZ region.	15 acres of potentially suitable habitat lost (0.002% of available potentially suitable habitat) during construction and operations	208 acres of potentially suitable habitat (0.02% of available potentially suitable habitat)	2 acres of potentially suitable habitat lost (<0.001% of available potentially suitable habitat) and 39 acres in area of indirect effect	0.3 acres of potentially suitable habitat lost (<0.001% of available potentially suitable habitat) and 24.7 acres in area of indirect effect	Small overall impact. Some measure of mitigation provided by the requirements of the Migratory Bird Treaty Act.
Gila woodpecker (*Melanerpes uropygialis*)	Prefers sparsely covered desert habitats containing large saguaro cacti. About 2,447,200 acres of potentially suitable habitat occurs within the SEZ region.	1,036 acres of potentially suitable habitat lost (0.04% of available potentially suitable habitat) during construction and operations	53,670 acres of potentially suitable habitat (2.2% of available potentially suitable habitat)	117 acres of potentially suitable habitat lost (0.005% of available potentially suitable habitat) and 2,353 acres in area of indirect effect	13 acres of potentially suitable habitat lost (<0.001% of available potentially suitable habitat) and 1,175 acres in area of indirect effect	Small overall impact. Some measure of mitigation provided by the requirements of the Migratory Bird Treaty Act.

TABLE 8.2.11.2-1 (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]	Within Access Road Corridor (Indirect and Direct Effects)[f]	Overall Impact Magnitude[g] and Species-Specific Mitigation[h]
Neotropical Migrants (Cont.)						
Greater roadrunner (*Geococcyx californianus*)	Desert scrub, chaparral, edges of cultivated lands, and arid open areas with scattered brush. Fairly common in desert habitats. Requires thickets, large bushes, or small trees for shade, refuge, and roosting. Usually nests low in trees, shrubs, or clumps of cactus. Rarely nests on ground. About 4,925,700 acres of potentially suitable habitat occurs in the SEZ region.	5,791 acres of potentially suitable habitat lost (0.1% of available potentially suitable habitat) during construction and operations	97,433 acres of potentially suitable habitat (2.0% of available potentially suitable habitat)	151 acres of potentially suitable habitat lost (0.003% of available potentially suitable habitat) and 3,044 acres in area of indirect effect	36 acres of potentially suitable habitat lost (<0.001% of available potentially suitable habitat) and 3,451 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 effects. Some measure of mitigation provided by the requirements of the Migratory Bird Treaty Act.
Horned lark (*Eremophila alpestris*)	Common to abundant resident in a variety of open habitats. Breeds in grasslands, sagebrush, semidesert shrublands, and alpine tundra. During migration and winter, inhabits the same habitats other than tundra, and occurs in agricultural areas. Usually occurs where plant density is low and there are exposed soils. About 1,239,800 acres of potentially suitable habitat occurs in the SEZ region.	5,791 acres of potentially suitable habitat lost (0.5% of available potentially suitable habitat) during construction and operations	38,328 acres of potentially suitable habitat (3.1% of available potentially suitable habitat)	23 acres of potentially suitable habitat lost (0.002% of available potentially suitable habitat) and 468 acres in area of indirect effect	24 acres of potentially suitable habitat lost (0.002% of available potentially suitable habitat) and 2,130 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 effects. Some measure of mitigation provided by the requirements of the Migratory Bird Treaty Act.

TABLE 8.2.11.2-1 (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]	Within Access Road Corridor (Indirect and Direct Effects)[f]	Overall Impact Magnitude[g] and Species-Specific Mitigation[h]
Neotropical Migrants (Cont.)						
Ladder-backed woodpecker (*Picoides scalaris*)	Fairly common in Mojave and Colorado Deserts. Variety of habitats, including deserts, arid scrub, riparian woodlands, mesquite, scrub oak, pinyon-juniper woodlands. Digs nest hole in rotted stub or dead or dying branches of various trees. Also nests in saguaro, agave, yucca, fence posts, and utility poles. Nests on ledges; branches of trees, shrubs, and cactus; and holes in trees or walls. About 4,813,200 acres of potentially suitable habitat occurs within the SEZ region.	5,791 acres of potentially suitable habitat lost (0.1% of available potentially suitable habitat) during construction and operations	97,457 acres of potentially suitable habitat (2.0% of available potentially suitable habitat)	151 acres of potentially suitable habitat lost (0.003% of available potentially suitable habitat) and 3,044 acres in area of indirect effect	36 acres of potentially suitable habitat lost (<0.001% of available potentially suitable habitat) and 3,458 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 effects. Some measure of mitigation provided by the requirements of the Migratory Bird Treaty Act.

TABLE 8.2.11.2-1 (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]	Within Access Road Corridor (Indirect and Direct Effects)[f]	Overall Impact Magnitude[g] and Species-Specific Mitigation[h]
Neotropical Migrants (Cont.)						
Le Conte's thrasher (*Toxostoma lecontei*)	Open desert wash, alkali desert scrub, and desert succulent shrub habitats. Prefers to nest and forage in arroyos and washes lined with dense stands of creosotebush and salt bush. About 3,589,700 acres of potentially suitable habitat occurs in the SEZ region.	5,791 acres of potentially suitable habitat lost (0.2% of available potentially suitable habitat) during construction and operations	80,750 acres of potentially suitable habitat (2.2% of available potentially suitable habitat)	33 acres of potentially suitable habitat lost (0.001% of available potentially suitable habitat) and 665 acres in area of indirect effect	36 acres of potentially suitable habitat lost (0.001% of available potentially suitable habitat) and 3,154 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 effects. Some measure of mitigation provided by the requirements of the Migratory Bird Treaty Act.
Lesser nighthawk (*Chordeiles acutipennis*)	Open country, desert regions, scrub, savanna, and cultivated areas. Usually near water, including open marshes, salt ponds, large rivers, rice paddies, and beaches. Roosts on low perches or the ground. Nests in the open on bare sites. About 4,385,700 acres of potentially suitable habitat occurs within the SEZ region.	5,791 acres of potentially suitable habitat lost (0.1% of available potentially suitable habitat) during construction and operations	97,344 acres of potentially suitable habitat (2.2% of available potentially suitable habitat)	150 acres of potentially suitable habitat lost (0.003% of available potentially suitable habitat) and 3,009 acres in area of indirect effect	36 acres of potentially suitable habitat lost (<0.001% of available potentially suitable habitat) and 3,458 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. Some measure of mitigation provided by the requirements of the Migratory Bird Treaty Act.

TABLE 8.2.11.2-1 (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]	Within Access Road Corridor (Indirect and Direct Effects)[f]	Overall Impact Magnitude[g] and Species-Specific Mitigation[h]
Neotropical Migrants (Cont.)						
Loggerhead shrike (*Lanius ludovicianus*)	Open country with scattered trees and shrubs, savanna, desert scrub, desert riparian, Joshua tree, and occasionally open woodland habitats. Perches on poles, wires, or fence posts (suitable hunting perches are important aspect of habitat). Nests in shrubs and small trees. About 4,938,000 acres of potentially suitable habitat occurs in the SEZ region.	5,791 acres of potentially suitable habitat lost (0.1% of available potentially suitable habitat) during construction and operations	97,457 acres of potentially suitable habitat (2.0% of available potentially suitable habitat)	151 acres of potentially suitable habitat lost (0.003% of available potentially suitable habitat) and 3,044 acres in area of indirect effect	36 acres of potentially suitable habitat lost (<0.001% of available potentially suitable habitat) and 3,458 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 effects. Some measure of mitigation provided by the requirements of the Migratory Bird Treaty Act.
Lucy's warbler (*Vermivora luciae*)	Breeds most often in dense lowland riparian mesquite woodlands. Inhabits dry washes, riparian forests, and thorn forests during winter and migration. About 2,921,700 acres of potentially suitable habitat occurs within the SEZ region.	186 acres of potentially suitable habitat lost (0.006% of available potentially suitable habitat) during construction and operations	42,485 acres of potentially suitable habitat (1.5% of available potentially suitable habitat)	12 acres of potentially suitable habitat lost (<0.001% of available potentially suitable habitat) and 232 acres in area of indirect effect	12 acres of potentially suitable habitat lost (<0.001% of available potentially suitable habitat) and 1,066 acres in area of indirect effect	Small overall impact. Some measure of mitigation provided by the requirements of the Migratory Bird Treaty Act.

TABLE 8.2.11.2-1 (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]	Within Access Road Corridor (Indirect and Direct Effects)[f]	Overall Impact Magnitude[g] and Species-Specific Mitigation[h]
Neotropical Migrants (Cont.)						
Phainopepla (*Phainopepla nitens*)	Common in Mojave and Colorado deserts. Desert scrub, mesquite, juniper and oak woodlands, tall brush, washes, riparian woodlands, and orchards. Nests in dense foliage of large shrubs or trees, sometimes in a clump of mistletoe. About 3,550,500 acres of potentially suitable habitat occurs in the SEZ region.	186 acres of potentially suitable habitat lost (0.005% of available potentially suitable habitat) during construction and operations	42,485 acres of potentially suitable habitat (1.2% of available potentially suitable habitat)	12 acres of potentially suitable habitat lost (<0.001% of available potentially suitable habitat) and 231 acres in area of indirect effect	12 acres of potentially suitable habitat lost (<0.001% of available potentially suitable habitat) and 1,066 acres in area of indirect effect	Small overall impact. Some measure of mitigation provided by the requirements of the Migratory Bird Treaty Act.
Say's phoebe (*Sayornis saya*)	Arid open country, deserts, sagebrush plains, dry barren foothills, canyons, cliffs, ranches, and rural homes. Nests in cliff crevices, holes in banks, sheltered ledges, tree cavities, under bridges and roofs, and in mines. About 1,251,400 acres of potentially suitable habitat occurs within the SEZ region.	5,791 acres of potentially suitable habitat lost (0.5% of available potentially suitable habitat) during construction and operations	38,193 acres of potentially suitable habitat (3.1% of available potentially suitable habitat)	23 acres of potentially suitable habitat lost (0.002% of available potentially suitable habitat) and 468 acres in area of indirect effect	24 acres of potentially suitable habitat lost (0.002% of available potentially suitable habitat) and 2,095 acres in area of indirect effect	Small overall impact. No mitigation of direct effects is feasible because suitable habitat is widespread in the area of direct effects. Some measure of mitigation provided by the requirements of the Migratory Bird Treaty Act.

TABLE 8.2.11.2-1 (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]	Within Access Road Corridor (Indirect and Direct Effects)[f]	Overall Impact Magnitude[g] and Species-Specific Mitigation[h]
Neotropical Migrants (Cont.)						
Scott's oriole (*Icterus parisorum*)	Desert-facing slopes of mountains or semiarid plains between mountain ranges. Nests in trees or yuccas. About 1,217,200 acres of potentially suitable habitat occurs within the SEZ region.	36 acres of potentially suitable habitat lost (0.003% of available potentially suitable habitat) during construction and operations	4,518 acres of potentially suitable habitat (0.4% of available potentially suitable habitat)	11 acres of potentially suitable habitat lost (0.001% of available potentially suitable habitat) and 223 acres in area of indirect effect	2 acres of potentially suitable habitat lost (<0.001% of available potentially suitable habitat) and 189 acres in area of indirect effect	Small overall impact. Some measure of mitigation provided by the requirements of the Migratory Bird Treaty Act.
Verdin (*Auriparus flaviceps*)	Desert riparian, desert wash, desert scrub, and alkali desert scrub areas with large shrubs and small trees. Nests in shrubs, small trees, or cactus. About 4,102,700 acres of potentially suitable habitat occurs within the SEZ region.	5,791 acres of potentially suitable habitat lost (0.1% of available potentially suitable habitat) during construction and operations	80,863 acres of potentially suitable habitat (2.0% of available potentially suitable habitat)	35 acres of potentially suitable habitat lost (<0.001% of available potentially suitable habitat) and 699 acres in area of indirect effect	36 acres of potentially suitable habitat lost (<0.001% of available potentially suitable habitat) and 3,161 acres in area of indirect effect	Small overall impact. Avoid wash habitats. No other mitigation of direct effects is feasible because suitable habitat is widespread in the area of direct effects. Some measure of mitigation provided by the requirements of the Migratory Bird Treaty Act.

TABLE 8.2.11.2-1 (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]	Within Access Road Corridor (Indirect and Direct Effects)[f]	Overall Impact Magnitude[g] and Species-Specific Mitigation[h]
Birds of Prey						
American kestrel (*Falco sparverius*)	Occurs in most open habitats, in various shrub and early successional forest habitats, forest openings, and various ecotones. Perches on trees, snags, rocks, utility poles and wires, and fence posts. Uses cavities in trees, snags, rock areas, banks, and buildings for nesting and cover. About 3,380,400 acres of potentially suitable habitat occurs in the SEZ region.	1,072 acres of potentially suitable habitat lost (0.03% of available potentially suitable habitat) during construction and operations	58,189 acres of potentially suitable habitat (1.7% of available potentially suitable habitat)	128 acres of potentially suitable habitat lost (0.004% of available potentially suitable habitat) and 2,576 acres in area of indirect effect	16 acres of potentially suitable habitat lost (<0.001% of available potentially suitable habitat) and 1,363 acres in area of indirect effect	Small overall impact.
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 3,351,600 acres of potentially suitable habitat occurs in the SEZ region.	1,072 acres of potentially suitable habitat lost (0.03% of available potentially suitable habitat) during construction and operations	58,193 acres of potentially suitable habitat (1.7% of available potentially suitable habitat)	128 acres of potentially suitable habitat lost (0.004% of available potentially suitable habitat) and 2,576 acres in area of indirect effect	16 acres of potentially suitable habitat lost (<0.001% of available potentially suitable habitat) and 1,363 acres in area of indirect effect	Small overall impact. Some measure of mitigation provided by the requirements of the Bald and Golden Eagle Protection Act.

TABLE 8.2.11.2-1 (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]	Within Access Road Corridor (Indirect and Direct Effects)[f]	Overall Impact Magnitude[g] and Species-Specific Mitigation[h]
Birds of Prey (Cont.)						
Prairie falcon (*Falco mexicanus*)	Open habitats adjacent to cliffs or bluffs. Occurs mainly in desert grassland, chaparral, and creosotebush-bursage habitats. About 5,017,700 acres of potentially suitable habitat occurs within the SEZ region.	5,791 acres of potentially suitable habitat lost (0.1% of available potentially suitable habitat) during construction and operations	97,592 acres of potentially suitable habitat (1.9% of available potentially suitable habitat)	151 acres of potentially suitable habitat lost (0.003% of available potentially suitable habitat) and 3,044 acres in area of indirect effect	36 acres of potentially suitable habitat lost (<0.001% of available potentially suitable habitat) and 3,493 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 effects.
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 2,927,900 acres of potentially suitable habitat occurs in the SEZ region.	1,057 acres of potentially suitable habitat lost (0.04% of available potentially suitable habitat) during construction and operations	57,985 acres of potentially suitable habitat (2.0% of available potentially suitable habitat)	126 acres of potentially suitable habitat lost (0.004% of available potentially suitable habitat) and 2,541 acres in area of indirect effect	15 acres of potentially suitable habitat lost (<0.001% of available potentially suitable habitat) and 1,339 acres in area of indirect effect	Small overall impact.

TABLE 8.2.11.2-1 (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]	Within Access Road Corridor (Indirect and Direct Effects)[f]	Overall Impact Magnitude[g] and Species-Specific Mitigation[h]
Birds of Prey (Cont.)						
Turkey vulture (*Cathartes aura*)	Occurs in open stages of most habitats that provide adequate cliffs or large trees for nesting, roosting, and resting. Migrates and forages over most open habitats. Will roost communally in trees, exposed boulders, and occasionally transmission line support towers. About 1,598,700 acres of potentially suitable habitat occurs in the SEZ region.	5,791 acres of potentially suitable habitat lost (0.4% of available potentially suitable habitat) during construction and operations	42,788 acres of potentially suitable habitat (2.7% of available potentially suitable habitat)	33 acres of potentially suitable habitat lost (0.002% of available potentially suitable habitat) and 657 acres in area of indirect effect	27 acres of potentially suitable habitat lost (0.002% of available potentially suitable habitat) and 2,308 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 effects.
Upland Game Birds						
Gambel's quail (*Callipepla gambelii*)	Deserts, especially in areas with brushy or thorny growth, and adjacent cultivated areas. Usually occurs near water. Nests on the ground under cover of small trees, shrubs, and grass tufts. About 4,807,800 acres of potentially suitable habitat occurs within the SEZ region.	5,791 acres of potentially suitable habitat lost (0.1% of available potentially suitable habitat) during construction and operations	97,457 acres of potentially suitable habitat (2.0% of available potentially suitable habitat)	151 acres of potentially suitable habitat lost (0.003% of available potentially suitable habitat) and 3,044 acres in area of indirect effect	36 acres of potentially suitable habitat lost (<0.001% of available potentially suitable habitat) and 3,458 acres in area of indirect effect	Small overall impact. Avoid isolated wetlands. No other species-specific mitigation of direct effects is feasible because suitable habitat is widespread in the area of direct effects.

TABLE 8.2.11.2-1 (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]	Within Access Road Corridor (Indirect and Direct Effects)[f]	Overall Impact Magnitude[g] and Species-Specific Mitigation[h]
Upland Game Birds (Cont.)						
Mourning dove (*Zenaida macroura*)	Habitat generalist, occurring in grasslands, shrublands, croplands, lowland and foothill riparian forests, ponderosa pine forests, deserts, 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 5,000,500 acres of potentially suitable habitat occurs in the SEZ region.	5,791 acres of potentially suitable habitat lost (0.1% of available potentially suitable habitat) during construction and operations	97,457 acres of potentially suitable habitat (1.9% of available potentially suitable habitat)	151 acres of potentially suitable habitat lost (0.003% of available potentially suitable habitat) and 3,044 acres in area of indirect effect	36 acres of potentially suitable habitat lost (<0.001% of available potentially suitable habitat) and 3,458 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 effects.
White-winged dove (*Zenaida asiatica*)	Nests in low to medium height trees with dense foliage and fairly open ground cover. Feeds on wild seeds, grains, and fruit. About 3,860,200 acres of potentially suitable habitat occurs within the SEZ region.	5,791 acres of potentially suitable habitat lost (0.15% of available potentially suitable habitat) during construction and operations	97,344 acres of potentially suitable habitat (2.5% of available potentially suitable habitat)	150 acres of potentially suitable habitat lost (0.004% of available potentially suitable habitat) and 3,009 acres in area of indirect effect	36 acres of potentially suitable habitat lost (0.001% of available potentially suitable habitat) and 3,451 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 effects.

Footnotes on next page.

TABLE 8.2.11.2-1 (Cont.)

[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 using SWReGAP habitat suitability and land cover models. This approach probably overestimates the amount of suitable habitat in the project area. A maximum of 5,791 acres of direct effect within the SEZ was assumed.

[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.

[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 5,791 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 5-mi (8-km) long, 250-ft (76-m) wide transmission line ROW from the SEZ to the nearest existing transmission 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.

[f] For access road development, direct effects were estimated within a 5-mi (8-km) long, 60-ft (18-m) access road ROW from the SEZ to the nearest existing state route, U.S. highway, or interstate. Indirect effects were estimated within a 1-mi (1.6-km) wide access road corridor to the existing road, less the assumed area of direct effects.

[g] 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.

[h] 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.

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

Sources: Arizona Field Ornithologists (2010); NatureServe (2010); CalPIF (2009); CDFG (2008); USGS (2004, 2005a, 2007).

- Wetland habitats, which could provide occasional watering and feeding sites for some bird species, should be avoided

If SEZ-specific design features are implemented in addition to programmatic design features, impacts on bird species could be reduced. However, as potentially suitable habitats for most 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.

8.2.11.3 Mammals

8.2.11.3.1 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 Bullard Wash SEZ. The list of mammal species potentially present in the SEZ area was determined from Hoffmeister (1986) and range maps and habitat information available from SWReGAP (USGS 2007). Land cover types suitable for each species were determined from SWReGAP (USGS 2004, 2005a, 2007). See Appendix M for additional information on the approach used. About 45 species of mammals have ranges that encompass the area of the proposed Bullard Wash SEZ (Hoffmeister 1986; USGS 2007); however, suitable habitats for a number of these species are limited or nonexistent within the SEZ (USGS 2007). Similar to the overview of mammals provided for the six-state solar energy study area (Section 4.10.2.3), the following discussion for the SEZ 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 important habitats.

Big Game

The big game species that could occur within the affected area of the proposed Bullard Wash SEZ include cougar (*Puma concolor*) and mule deer (*Odocoileus hemionus*) (Hoffmeister 1986; USGS 2007). Due to its special species status, the Nelson's bighorn sheep is addressed in Section 8.2.12.

Other Mammals

A number of small game and furbearer species occur within the area of the proposed Bullard Wash SEZ. Species that could occur within the area of the SEZ would include the American badger (*Taxidea taxus*), black-tailed jackrabbit (*Lepus californicus*), bobcat (*Lynx rufus*), coyote (*Canis latrans*), desert cottontail (*Sylvilagus audubonii*), gray fox (*Urocyon cinereoargenieus*), javelina or spotted peccary (*Pecari tajacu*), kit fox (*Vulpes macrotis*), ringtail (*Bassariscus astutus*), and striped skunk (*Mephitis mephitis*) (USGS 2007).

The nongame (small) mammal species generally include smaller-sized mammals such as rodents, bats, and shrews. Species for which potentially suitable habitat occurs within the SEZ include the Arizona pocket mouse (*Perognathus amplus*), Botta's pocket gopher (*Thomomys bottae*), cactus mouse (*Peromyscus eremicus*), canyon mouse (*P. crinitis*), deer mouse (*P. maniculatus*), desert pocket mouse (*Chaetodipus penicillatus*), desert shrew (*Notiosorex crawfordi*), desert woodrat (*Neotoma lepida*), Merriam's pocket mouse (*Dipodomys merriami*), round-tailed ground squirrel (*Spermophilus tereticaudus*), southern grasshopper mouse (*Onychomys torridus*), and white-tailed antelope squirrel (*Ammospermophilus leucurus*) (Hoffmeister 1986; USGS 2007). Bat species that may occur within the area of the SEZ include the big brown bat (*Eptesicus fuscus*), Brazilian free-tailed bat (*Tadarida brasiliensis*), California myotis (*Myotis californicus*), silver-haired bat (*Lasionycteris noctivagans*), spotted bat (*Euderma maculatum*), and western pipistrelle (*Pipistrellus hesperus*) (Hoffmeister 1986; USGS 2007). However, roost sites for the bat species (e.g., caves, hollow trees, rock crevices, or buildings) would be limited to absent within the SEZ. Several other special status bat species that could occur within the SEZ area are addressed in Section 8.2.12.1.

Table 8.2.11.3-1 provides habitat information for representative mammal species that could occur within the proposed Bullard Wash SEZ.

8.2.11.3.2 Impacts

The types of impacts 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 application of any additional mitigation. Section 8.2.11.3.3, below, identifies design features of particular relevance to mammals for the proposed Bullard Wash 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 8.2.11.3.1 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 8.2.11.3.3).

Table 8.2.11.3-1 summarizes the magnitude of potential impacts on select mammal species resulting from solar energy development (with the inclusion of programmatic design features) in the proposed Bullard Wash SEZ.

Cougar

Up to 5,791 acres (23.4 km^2) of potentially suitable cougar habitat could be lost through solar energy development within the proposed Bullard Wash SEZ. An additional 187 acres (0.8 km^2) could be lost by transmission line and access road development. Together, these

TABLE 8.2.11.3-1 Habitats, Potential Impacts, and Potential Mitigation for Representative Mammal Species That Could Occur on or in the Affected Area of the Proposed Bullard Wash 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]	Within Access Road Corridor (Indirect and Direct Effects)[f]	Overall Impact Magnitude[g] and Species-Specific Mitigation[h]
Big Game						
Cougar (*Puma concolor*)	Most common in rough, broken foothills and canyon country, often in association with montane forests, shrublands, and pinyon-juniper woodlands. About 4,852,500 acres[i] of potentially suitable habitat occurs in the SEZ region.	5,791 acres of potentially suitable habitat lost (0.1% of available potentially suitable habitat) during construction and operations	97,453 acres of potentially suitable habitat (2.0% of available potentially suitable habitat)	151 acres of potentially suitable habitat lost (0.003% of available potentially suitable habitat) and 3,044 acres in area of indirect effect	36 acres of potentially suitable habitat lost (<0.001% of available potentially suitable habitat) and 3,458 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 effects.
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. About 4,963,900 acres of potentially suitable habitat occurs in the SEZ region.	5,791 acres of potentially suitable habitat lost (0.1% of available potentially suitable habitat) during construction and operations	97,456 acres of potentially suitable habitat (2.0% of available potentially suitable habitat)	151 acres of potentially suitable habitat lost (0.003% of available potentially suitable habitat) and 3,044 acres in area of indirect effect	36 acres of potentially suitable habitat lost (<0.001% of available potentially suitable habitat) and 3,458 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 effects.

TABLE 8.2.11.3-1 (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]	Within Access Road Corridor (Indirect and Direct Effects)[f]	Overall Impact Magnitude[g] and Species-Specific Mitigation[h]
Small Game and Furbearers						
American badger (*Taxidea taxus*)	Open grasslands and deserts, meadows in subalpine and montane forests, alpine tundra. Digs burrows in friable soils. Most common in areas with abundant populations of ground squirrels, prairie dogs, and pocket gophers. About 4,088,600 acres of potentially suitable habitat occurs in the SEZ region.	5,791 acres of potentially suitable habitat lost (0.1% of available potentially suitable habitat) during construction and operations	80,859 acres of potentially suitable habitat (2.0% of available potentially suitable habitat)	35 acres of potentially suitable habitat lost (<0.001% of available potentially suitable habitat) and 699 acres in area of indirect effect	36 acres of potentially suitable habitat lost (<0.001% of available potentially suitable habitat) and 3,161 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 effects.
Black-tailed jackrabbit (*Lepus californicus*)	Open plains, fields, and deserts with scattered thickets or patches of shrubs. Also open, early stages of forests and chaparral habitats. Rests during the day in shallow depressions, and uses shrubs for cover. About 2,573,300 acres of potentially suitable habitat occurs in the SEZ region.	5,791 acres of potentially suitable habitat lost (0.2% of available potentially suitable habitat) during construction and operations	43,015 acres of potentially suitable habitat (1.7% of available potentially suitable habitat)	34 acres of potentially suitable habitat lost (0.001% of available potentially suitable habitat) and 692 acres in area of indirect effect	32 acres of potentially suitable habitat lost (0.001% of available potentially suitable habitat) and 2,336 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 effects.

TABLE 8.2.11.3-1 (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]	Within Access Road Corridor (Indirect and Direct Effects)[f]	Overall Impact Magnitude[g] and Species-Specific Mitigation[h]
Small Game and Furbearers (Cont.)						
Bobcat (*Lynx rufus*)	Most habitats except subalpine coniferous forest and montane meadow grasslands. Most common in rocky country from deserts through ponderosa forests. About 2,456,400 acres of potentially suitable habitat occurs in the SEZ region.	5,791 acres of potentially suitable habitat lost (0.2% of available potentially suitable habitat) during construction and operations	42,880 acres of potentially suitable habitat (1.7% of available potentially suitable habitat)	34 acres of potentially suitable habitat lost (0.001% of available potentially suitable habitat) and 692 acres in area of indirect effect	27 acres of potentially suitable habitat lost (0.001% of available potentially suitable habitat) and 2,308 acres in area of indirect effect	Small overall impact. Avoid wash habitats. No other species-specific mitigation of direct effects is feasible because suitable habitat is widespread in the area of direct effects.
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 4,487,200 acres of potentially suitable habitat occurs in the SEZ region.	5,791 acres of potentially suitable habitat lost (0.1% of available potentially suitable habitat) during construction and operations	80,886 acres of potentially suitable habitat (1.8% of available potentially suitable habitat)	33 acres of potentially suitable habitat lost (<0.001% of available potentially suitable habitat) and 665 acres in area of indirect effect	36 acres of potentially suitable habitat lost (<0.001% of available potentially suitable habitat) and 3,188 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 effects.

TABLE 8.2.11.3-1 (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]	Within Access Road Corridor (Indirect and Direct Effects)[f]	Overall Impact Magnitude[g] and Species-Specific Mitigation[h]
Small Game and Furbearers (Cont.)						
Desert cottontail (*Sylvilagus audubonii*)	Abundant to common in grasslands, open forests, and desert shrub habitats. Can occur in areas with minimal vegetation as long as adequate cover (e.g., rock piles, fallen logs, fence rows) is present. Thickets and patches of shrubs, vines, and brush also used as cover. About 4,714,100 acres of potentially suitable habitat occurs in the SEZ region.	5,791 acres of potentially suitable habitat lost (0.1% of available potentially suitable habitat) during construction and operations	80,974 acres of potentially suitable habitat (1.7% of available potentially suitable habitat)	35 acres of potentially suitable habitat lost (<0.001% of available potentially suitable habitat) and 699 acres in area of indirect effect	36 acres of potentially suitable habitat lost (<0.001% of available potentially suitable habitat) and 3,188 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 effects.
Gray fox (*Urocyon cinereoargenteus*)	Deserts, open forests, and brush. Prefers wooded areas, broken country, brushlands, and rocky areas. Tolerant of low levels of residential development. About 4,696,800 acres of potentially suitable habitat occurs in the SEZ region.	5,791 acres of potentially suitable habitat lost (0.1% of available potentially suitable habitat) during construction and operations	80,839 acres of potentially suitable habitat (1.7% of available potentially suitable habitat)	13 acres of potentially suitable habitat lost (<0.001% of available potentially suitable habitat) and 721 acres in area of indirect effect	36 acres of potentially suitable habitat lost (<0.001% of available potentially suitable habitat) and 3,154 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 effects.

TABLE 8.2.11.3-1 (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]	Within Access Road Corridor (Indirect and Direct Effects)[f]	Overall Impact Magnitude[g] and Species-Specific Mitigation[h]
Small Game and Furbearers (Cont.)						
Javelina (spotted peccary) (*Pecari tajacu*)	Often in thickets along creeks and washes. Beds in caves, mines, boulder fields, and dense stands of brush. May visit a water hole on a daily basis. About 4,739,100 acres of potentially suitable habitat occurs in the SEZ region.	5,791 acres of potentially suitable habitat lost (0.1% of available potentially suitable habitat) during construction and operations	97,457 acres of potentially suitable habitat (2.1% of available potentially suitable habitat)	151 acres of potentially suitable habitat lost (0.003% of available potentially suitable habitat) and 3,044 acres in area of indirect effect	36 acres of potentially suitable habitat lost (<0.001% of available potentially suitable habitat) and 3,458 acres in area of indirect effect	Small overall impact. Avoid wash habitats. No other species-specific mitigation of direct effects is feasible because suitable habitat is widespread in the area of direct effects.
Kit fox (*Vulpes macrotis*)	Desert and semidesert areas with relatively open vegetative cover and soft soils. Seeks shelter in underground burrows. About 4,392,300 acres of potentially suitable habitat occurs in the SEZ region.	5,791 acres of potentially suitable habitat lost (0.1% of available potentially suitable habitat) during construction and operations	97,238 acres of potentially suitable habitat (2.2% of available potentially suitable habitat)	150 acres of potentially suitable habitat lost (0.003% of available potentially suitable habitat) and 3,008 acres in area of indirect effect	36 acres of potentially suitable habitat lost (<0.001% of available potentially suitable habitat) and 3,434 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 effects.

TABLE 8.2.11.3-1 (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]	Within Access Road Corridor (Indirect and Direct Effects)[f]	Overall Impact Magnitude[g] and Species-Specific Mitigation[h]
Small Game and Furbearers (Cont.)						
Ringtail (*Bassariscus astutus*)	Usually in rocky areas with cliffs or crevices for daytime shelter, desert scrub, chaparral, pine-oak and conifer woodlands. About 4,737,500 acres of potentially suitable habitat occurs in the SEZ region.	5,791 acres of potentially suitable habitat lost (0.1% of available potentially suitable habitat) during construction and operations	80,859 acres of potentially suitable habitat (1.7% of available potentially suitable habitat)	35 acres of potentially suitable habitat lost (<0.001% of available potentially suitable habitat) and 699 acres in area of indirect effect	36 acres of potentially suitable habitat lost (<0.001% of available potentially suitable habitat) and 3,161 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 effects.
Striped skunk (*Mephitis mephitis*)	Prefers semi-open country with woodland and meadows interspersed, brushy areas, bottomland woods. Frequently found in suburban areas. Dens often under rocks, logs, or buildings. About 4,708,700 acres of potentially suitable habitat occurs in the SEZ region.	5,791 acres of potentially suitable habitat lost (0.1% of available potentially suitable habitat) during construction and operations	80,863 acres of potentially suitable habitat (1.7% of available potentially suitable habitat)	35 acres of potentially suitable habitat lost (<0.001% of available potentially suitable habitat) and 699 acres in area of indirect effect	36 acres of potentially suitable habitat lost (<0.001% of available potentially suitable habitat) and 3,161 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 effects.

TABLE 8.2.11.3-1 (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]	Within Access Road Corridor (Indirect and Direct Effects)[f]	Overall Impact Magnitude[g] and Species-Specific Mitigation[h]
Nongame (small) Mammals						
Arizona pocket mouse (*Perognathus amplus*)	Various desert scrub habitats. Sleeps and rears young in underground burrows. About 3,829,700 acres of potentially suitable habitat occurs in the SEZ region.	5,791 acres of potentially suitable habitat lost (0.1% of available potentially suitable habitat) during construction and operations	97,237 acres of potentially suitable habitat (2.5% of available potentially suitable habitat)	150 acres of potentially suitable habitat lost (0.004% of available potentially suitable habitat) and 3,008 acres in area of indirect effect	36 acres of potentially suitable habitat lost (0.001% of available potentially suitable habitat) and 3,119 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 effects.
Big brown bat (*Eptesicus fuscus*)	Most habitats from lowland deserts to timberline meadows. Roosts in hollow trees, rock crevices, mines, tunnels, and buildings. About 4,725,600 acres of potentially suitable habitat occurs in the SEZ region.	5,791 acres of potentially suitable habitat lost (0.1% of available potentially suitable habitat) during construction and operations	80,729 acres of potentially suitable habitat (1.7% of available potentially suitable habitat)	35 acres of potentially suitable habitat lost (<0.001% of available potentially suitable habitat) and 698 acres in area of indirect effect	36 acres of potentially suitable habitat lost (<0.001% of available potentially suitable habitat) and 3,136 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 effects.

TABLE 8.2.11.3-1 (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]	Within Access Road Corridor (Indirect and Direct Effects)[f]	Overall Impact Magnitude[g] and Species-Specific Mitigation[h]
Nongame (small) Mammals (Cont.)						
Botta's pocket gopher (*Thomomys bottae*)	Variety of habitats, including shortgrass plains, oak savanna, agricultural lands, and deserts. Burrows are more common in disturbed areas such as roadways and stream floodplains. About 4,570,900 acres of potentially suitable habitat occurs in the SEZ region.	5,791 acres of potentially suitable habitat lost (0.1% of available potentially suitable habitat) during construction and operations	80,733 acres of potentially suitable habitat (1.8% of available potentially suitable habitat)	35 acres of potentially suitable habitat lost (<0.001% of available potentially suitable habitat) and 698 acres in area of indirect effect	36 acres of potentially suitable habitat lost (<0.001% of available potentially suitable habitat) and 3,136 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 effects.
Brazilian free-tailed bat (*Tadarida brasiliensis*)	Cliffs, deserts, grasslands, old fields, savannas, shrublands, woodlands, and suburban/urban areas. Roosts in buildings, caves, and hollow trees. May roost in rock crevices, bridges, signs, or cliff swallow nests during migration. Large maternity colonies inhabit caves, buildings, culverts, and bridges. About 4,739,700 acres of potentially suitable habitat occurs in the SEZ region.	5,791 acres of potentially suitable habitat lost (0.1% of available potentially suitable habitat) during construction and operations	80,892 acres of potentially suitable habitat (1.7% of available potentially suitable habitat)	35 acres of potentially suitable habitat lost (<0.001% of available potentially suitable habitat) and 698 acres in area of indirect effect	36 acres of potentially suitable habitat lost (<0.001% of available potentially suitable habitat) and 3,177 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 effects.

TABLE 8.2.11.3-1 (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]	Within Access Road Corridor (Indirect and Direct Effects)[f]	Overall Impact Magnitude[g] and Species-Specific Mitigation[h]
Nongame (small) Mammals (Cont.)						
Cactus mouse (*Peromyscus eremicus*)	Variety of areas, including desert scrub, semidesert chaparral, desert wash, semidesert grassland, and cliff and canyon habitats. About 4,286,500 acres of potentially suitable habitat occurs in the SEZ region.	5,791 acres of potentially suitable habitat lost (0.1% of available potentially suitable habitat) during construction and operations	97,457 acres of potentially suitable habitat (2.3% of available potentially suitable habitat)	151 acres of potentially suitable habitat lost (0.004% of available potentially suitable habitat) and 3,044 acres in area of indirect effect	36 acres of potentially suitable habitat lost (0.001% of available potentially suitable habitat) and 3,458 acres in area of indirect effect	Small overall impact. Avoid wash habitats. No other species-specific mitigation of direct effects is feasible because suitable habitat is widespread in the area of direct effects.
California myotis (*Myotis californicus*)	Desertscrub, semidesert shrublands, lowland riparian, swamps, riparian suburban areas, plains grasslands, scrub-grasslands, woodlands, and forests. Roosts in caves, mine tunnels, hollow trees, and loose rocks. About 4,587,600 acres of potentially suitable habitat occurs in the SEZ region.	5,791 acres of potentially suitable habitat lost (0.1% of available potentially suitable habitat) during construction and operations	80,863 acres of potentially suitable habitat (1.8% of available potentially suitable habitat)	35 acres of potentially suitable habitat lost (<0.001% of available potentially suitable habitat) and 699 acres in area of indirect effect	36 acres of potentially suitable habitat lost (<0.001% of available potentially suitable habitat) and 3,161 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 effects.

TABLE 8.2.11.3-1 (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]	Within Access Road Corridor (Indirect and Direct Effects)[f]	Overall Impact Magnitude[g] and Species-Specific Mitigation[h]
Nongame (small) Mammals (Cont.)						
Canyon mouse (*Peromyscus crinitus*)	Associated with rocky substrates in a variety of habitats, including desert scrub, sagebrush shrublands, woodlands, cliffs and canyons, and volcanic rock and cinder lands. Source of free water not required. About 4,184,400 acres of potentially suitable habitat occurs in the SEZ region.	5,791 acres of potentially suitable habitat lost (0.1% of available potentially suitable habitat) during construction and operations	92,793 acres of potentially suitable habitat (2.2% of available potentially suitable habitat)	140 acres of potentially suitable habitat lost (0.003% of available potentially suitable habitat) and 2,820 acres in area of indirect effect	36 acres of potentially suitable habitat lost (<0.001% of available potentially suitable habitat) and 3,252 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 effects.
Deer mouse (*Peromyscus maniculatus*)	Tundra; alpine and subalpine grasslands; plains grasslands; open, sparsely vegetated deserts; warm temperate swamps and riparian forests; and Sonoran desert scrub habitats. About 4,729,900 acres of potentially suitable habitat occurs in the SEZ region.	5,791 acres of potentially suitable habitat lost (0.1% of available potentially suitable habitat) during construction and operations	80,753 acres of potentially suitable habitat (1.7% of available potentially suitable habitat)	35 acres of potentially suitable habitat lost (<0.001% of available potentially suitable habitat) and 698 acres in area of indirect effect	36 acres of potentially suitable habitat lost (<0.001% of available potentially suitable habitat) and 3,143 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 effects.

TABLE 8.2.11.3-1 (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]	Within Access Road Corridor (Indirect and Direct Effects)[f]	Overall Impact Magnitude[g] and Species-Specific Mitigation[h]
Nongame (small) Mammals (Cont.)						
Desert pocket mouse (*Chaetodipus penicillatus*)	Sparsely vegetated sandy deserts. Prefers rock-free bottomland soils along rivers and streams. Sleeps and rears young in underground burrows. About 3,862,100 acres of potentially suitable habitat occurs in the SEZ region.	5,791 acres of potentially suitable habitat lost (0.15% of available potentially suitable habitat) during construction and operations	97,367 acres of potentially suitable habitat (2.5% of available potentially suitable habitat)	150 acres of potentially suitable habitat lost (0.004% of available potentially suitable habitat) and 3,009 acres in area of indirect effect	36 acres of potentially suitable habitat lost (0.001% of available potentially suitable habitat) and 3,458 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 effects.
Desert shrew (*Notiosorex crawfordi*)	Usually in arid areas with adequate cover such as semiarid grasslands, shortgrass plains, desert scrub, chaparral slopes, shortgrass plains, oak savannas and woodlands, and alluvial fans. About 4,433,100 acres of potentially suitable habitat occurs in the SEZ region.	5,791 acres of potentially suitable habitat lost (0.1% of available potentially suitable habitat) during construction and operations	97,457 acres of potentially suitable habitat (2.2% of available potentially suitable habitat)	151 acres of potentially suitable habitat lost (0.003% of available potentially suitable habitat) and 3,044 acres in area of indirect effect	36 acres of potentially suitable habitat lost (<0.001% of available potentially suitable habitat) and 3,458 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 effects.

TABLE 8.2.11.3-1 (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]	Within Access Road Corridor (Indirect and Direct Effects)[f]	Overall Impact Magnitude[g] and Species-Specific Mitigation[h]
Nongame (small) Mammals (Cont.)						
Desert woodrat (*Neotoma lepida*)	Sagebrush scrub; chaparral; deserts and rocky slopes with scattered cactus, yucca, pine-juniper, or other low vegetation; creosotebush desert; Joshua tree woodlands; scrub oak woodlands, pinyon-juniper woodlands; and riparian zones. Most abundant in rocky areas with Joshua trees. Dens built of debris on ground, among cacti or yucca, along cliffs, among rocks, or occasionally in trees. About 4,116,200 acres of potentially suitable habitat occurs in the SEZ region.	5,791 acres of potentially suitable habitat lost (0.1% of available potentially suitable habitat) during construction and operations	92,903 acres of potentially suitable habitat (2.2% of available potentially suitable habitat)	140 acres of potentially suitable habitat lost (0.003% of available potentially suitable habitat) and 2,821 acres in area of indirect effect	36 acres of potentially suitable habitat lost (<0.001% of available potentially suitable habitat) and 3,269 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 effects.
Merriam's kangaroo rat (*Dipodomys merriami*)	Plains grasslands, scrub-grasslands, desertscrub, shortgrass plains, oak and juniper savannahs, mesquite dunes, and creosote flats. About 4,464,600 acres of potentially suitable habitat occurs in the SEZ region.	5,791 acres of potentially suitable habitat lost (0.1% of available potentially suitable habitat) during construction and operations	97,344 acres of potentially suitable habitat (2.2% of available potentially suitable habitat)	150 acres of potentially suitable habitat lost (0.003% of available potentially suitable habitat) and 3,009 acres in area of indirect effect	36 acres of potentially suitable habitat lost (<0.001% of available potentially suitable habitat) and 3,451 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 effects.

TABLE 8.2.11.3-1 (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]	Within Access Road Corridor (Indirect and Direct Effects)[f]	Overall Impact Magnitude[g] and Species-Specific Mitigation[h]
Nongame (small) Mammals (Cont.)						
Round-tailed ground squirrel (*Spermophilus tereticaudus*)	Low flat areas with desert shrubs and usually with sandy soils. Also in areas with coarse hard-packed sand and gravel, alkali sinks, and creosotebush communities. Burrows usually at base of shrubs. Avoids rocky hills. About 3,833,700 acres of potentially suitable habitat occurs in the SEZ region.	5,791 acres of potentially suitable habitat lost (0.15% of available potentially suitable habitat) during construction and operations	97,364 acres of potentially suitable habitat (2.5% of available potentially suitable habitat)	150 acres of potentially suitable habitat lost (0.004% of available potentially suitable habitat) and 3,009 acres in area of indirect effect	36 acres of potentially suitable habitat lost (0.001% of available potentially suitable habitat) and 3,458 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 effects.
Silver-haired bat (*Lasionycteris noctivagans*)	Urban areas, chaparral, alpine and subalpine grasslands, forests, scrub-grassland, oak savannah, and desertscrub habitats. Roosts under bark, and in hollow trees, caves, and mines. Forages over clearings and open water. About 2,154,700 acres of potentially suitable habitat occurs in the SEZ region.	5,791 acres of potentially suitable habitat lost (0.3% of available potentially suitable habitat) during construction and operations	38,305 acres of potentially suitable habitat (1.8% of available potentially suitable habitat)	25 acres of potentially suitable habitat lost (0.001% of available potentially suitable habitat) and 502 acres in area of indirect effect	24 acres of potentially suitable habitat lost (0.001% of available potentially suitable habitat) and 2,102 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 effects.

TABLE 8.2.11.3-1 (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]	Within Access Road Corridor (Indirect and Direct Effects)[f]	Overall Impact Magnitude[g] and Species-Specific Mitigation[h]
Nongame (small) Mammals (Cont.)						
Southern grasshopper mouse (*Onychomys torridus*)	Low, arid, shrub and semiscrub vegetation of deserts. About 3,875,600 acres of potentially suitable habitat occurs within the SEZ region.	5,791 acres of potentially suitable habitat lost (0.15% of available potentially suitable habitat) during construction and operations	97,262 acres of potentially suitable habitat (2.5% of available potentially suitable habitat)	142 acres of potentially suitable habitat lost (0.004% of available potentially suitable habitat) and 3,016 acres in area of indirect effect	28 acres of potentially suitable habitat lost (<0.001% of available potentially suitable habitat) and 3,452 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 effects.
Spotted bat (*Euderma maculatum*)	Various habitats from desert to montane coniferous forests, mostly in open or scrub areas. Roosts in caves and cracks and crevices in cliffs and canyons. About 1,739,000 acres of potentially suitable habitat occurs within the SEZ region.	5,791 acres of potentially suitable habitat lost (0.3% of available potentially suitable habitat) during construction and operations	55,008 acres of potentially suitable habitat (3.2% of available potentially suitable habitat)	142 acres of potentially suitable habitat lost (0.008% of available potentially suitable habitat) and 2,847 acres in area of indirect effect	28 acres of potentially suitable habitat lost (0.002% of available potentially suitable habitat) and 2,417 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 effects.

TABLE 8.2.11.3-1 (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]	Within Access Road Corridor (Indirect and Direct Effects)[f]	Overall Impact Magnitude[g] and Species-Specific Mitigation[h]
Nongame (small) Mammals (Cont.)						
Western pipistrelle (*Parastrellus hesperus*)	Deserts and lowlands, desert mountain ranges, desert scrub flats, and rocky canyons. Roosts mostly in rock crevices, sometimes mines and caves, and rarely in buildings. Suitable roosts occur in rocky canyons and cliffs. Most abundant bat in desert regions. About 4,308,200 acres of potentially suitable habitat occurs in the SEZ region.	5,791 acres of potentially suitable habitat lost (0.1% of available potentially suitable habitat) during construction and operations	76,399 acres of potentially suitable habitat (1.8% of available potentially suitable habitat)	25 acres of potentially suitable habitat lost (<0.001% of available potentially suitable habitat) and 510 acres in area of indirect effect	34 acres of potentially suitable habitat lost (<0.001% of available potentially suitable habitat) and 2,982 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 effects.
White-tailed antelope squirrel (*Ammospermophilus leucurus*)	Low deserts, semidesert and montane shrublands, plateaus, and foothills in areas with sparse vegetation and hard gravelly surfaces. Spends its nights and other periods of inactivity in underground burrows. About 3,889,500 acres of potentially suitable habitat occurs within the SEZ region.	5,791 acres of potentially suitable habitat lost (0.15% of available potentially suitable habitat) during construction and operations	76,179 acres of potentially suitable habitat (2.0% of available potentially suitable habitat)	24 acres of potentially suitable habitat lost (<0.001% of available potentially suitable habitat) and 475 acres in area of indirect effect	34 acres of potentially suitable habitat lost (<0.001% of available potentially suitable habitat) and 2,947 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 effects.

Footnotes on next page.

TABLE 8.2.11.3-1 (Cont.)

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[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 using SWReGAP habitat suitability and land cover models. This approach probably overestimates the amount of suitable habitat in the project area. A maximum of 5,791 acres of direct effect within the SEZ was assumed.

[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.

[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 5,791 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 5-mi (8-km) long, 250-ft (76-m) wide transmission line ROW from the SEZ to the nearest existing transmission 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.

[f] For access road development, direct effects were estimated within a 5-mi (8-km) long, 60-ft (18-m) access road ROW from the SEZ to the nearest existing state route, U.S. highway, or interstate. Indirect effects were estimated within a 1-mi (1.6-km) wide access road corridor to the existing road, less the assumed area of direct effects.

[g] 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.

[h] 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.

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

Sources: CDFG (2008); Hoffmeister (1986); NatureServe (2010); USGS (2004, 2005a, 2007).

represent about 0.1% of potentially suitable cougar habitat within the SEZ region. Over 97,000 acres (392 km^2) of potentially suitable cougar habitat occurs within the area of indirect effect for the SEZ and transmission line. This is about 2.0% of potentially suitable cougar habitat within the SEZ region. Overall, impacts on cougar from solar energy development in the SEZ would be small.

Mule Deer

Up to 5,791 acres (23.4 km^2) of potentially suitable mule deer habitat could be lost through solar energy development within the proposed Bullard Wash SEZ. An additional 187 acres (0.8 km^2) could be lost by transmission line and access road development. Together, these represent about 0.1% of potentially suitable mule deer habitat within the SEZ region. Over 97,900 acres (3,926 km^2) of potentially suitable mule deer habitat occurs within the area of indirect effect for the SEZ and access road. This is about 2.0% of potentially suitable mule deer habitat within the SEZ region. Overall, impacts on mule deer from solar energy development in the SEZ would be small.

Other Mammals

Direct impacts on all other representative mammal species from solar energy development within the proposed Bullard Wash SEZ would be small (Table 8.2.11.3-1). For all of these species, up to 5,791 acres (23.4 km^2) (0.1 to 0.3%) of potentially suitable habitat would be lost. Direct impacts from transmission line and access road development for these species would range from 49 to 187 acres (0.2 to 0.8 km^2) (Table 8.2.11.3-1). Loss of potential habitat to transmission line and access road development would be no more than 0.005% of potentially suitable habitat within the SEZ region for any of these species. Larger areas of potentially suitable habitats for these mammal species occur within the area of potential indirect effects (i.e., from 1.7 to 3.2% of available habitat (Table 8.2.11.3-1).

Summary

Overall, impacts on mammal species would be small (Table 8.2.11.3-1). In addition to habitat loss, other direct impacts on mammals could result from collision with vehicles and infrastructure (e.g., fences). Indirect impacts on mammals could result from surface water and sediment runoff from disturbed areas, fugitive dust generated by project activities, accidental spills, and harassment. These indirect impacts are expected to be negligible with implementation of programmatic design features.

Decommissioning after operations cease could result in short-term negative impacts on individuals and habitats within and adjacent to the SEZ. The negative impacts of decommissioning would be reduced or eliminated as reclamation proceeds. Potentially long-term benefits could accrue as habitats are 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 mammal species would be the restoration of original ground surface contours, soils, and native plant communities associated with desert scrub, playa, and wash habitats.

8.2.11.3.3 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 mammals. Specific mitigation measures particularly important to reducing impacts on mammals are best established when project details are being considered; however, the following SEZ-specific design features can be identified at this time:

- The fencing around solar energy projects should not block the free movement of mammals, particularly big game species.

- Wetland habitats, which could provide occasional watering and feeding sites for some mammal species, should be avoided.

If these SEZ-specific design features are implemented in addition to programmatic design features, impacts on mammals could be reduced. However, potentially suitable habitats for a number of the mammal species occur throughout much of the SEZ; therefore, species-specific mitigation of direct effects for those species would be difficult or infeasible.

8.2.11.4 Aquatic Biota

8.2.11.4.1 Affected Environment

The proposed Bullard Wash SEZ is located in a desert valley where surface waters are typically limited to intermittent washes that only contain water for short periods during or following precipitation. No perennial or intermittent streams or water bodies are present in the proposed Bullard Wash SEZ or within the area of direct effects associated with the proposed new transmission line corridor and presumed new access road. Ephemeral streams cross the northern side of the SEZ, but these drainages only contain water following rainfall and typically do not support wetland or riparian habitats. There are several small wetlands located within the SEZ (USFWS 2009). Although little data are available, desert wetlands are likely to be typically dry except after rainfall and would not be expected to support aquatic habitat. Aquatic habitat and communities are not likely to be present in the proposed Bullard Wash SEZ, although opportunistic crustaceans and aquatic insect larvae adapted to desert conditions may be present even under dry conditions (Levick et al. 2008). However, more detailed site survey data are needed to characterize the aquatic biota, if present, in Bullard Wash SEZ.

No perennial streams or water bodies are present within the area of indirect effects associated with the proposed Bullard Wash SEZ or the presumed new transmission line corridor and access road. In addition, no intermittent surface waters are present within the area of indirect effects associated with the proposed new transmission line corridor or access road. Bullard Wash is an ephemeral stream that runs along the western side of the SEZ, 13 mi (21 km) of which are within the area of indirect effects associated with the SEZ. Bullard Wash contains water only after rainfall and flows into Alamo Lake. Fourteen miles (22 km) of Date Creek are also located in the area of indirect effects. Date Creek is an intermittent stream north of the SEZ that receives both groundwater and rainwater that it conveys to the Santa Maria River. Although typically dry, such ephemeral and intermittent habitat may contain opportunistic crustaceans and aquatic insect larvae. Common aquatic invertebrates in the below Alamo Lake include mayflies (*Baetis*), caddisflies (*Hydroptila*), and chironomids (Shafroth and Beauchamp 2006), but these same species may not be capable of tolerating ephemeral and intermittent conditions. Non-native fish species such as mosquitofish (*Gambusia affinis*), centrachids, and bullhead catfish (*Ictalurus* spp.) are common in Alamo Lake and the Santa Maria River. Native fish species including longfin dace (*Agosia chrysogaster*), speckled dace (*Rhinichthys osculus*), roundtail chub (*Gila robusta*), Gila mountain sucker (*Pantosteus clarki*), and desert sucker (*Catostomus insignis*) are generally restricted to tributaries above Alamo Lake (Shafroth and Beauchamp 2006). Although no data is available, it is possible that these species may also occur in the lower reaches of Date Creek, given sufficient water. There are also several wetlands throughout the area of indirect effects associated with the SEZ. However, only those wetlands receiving groundwater would be expected to contain aquatic habitat.

Outside of the indirect effects area, but within 50 mi (80 km) of the proposed Bullard Wash SEZ, are approximately 48 mi (77 km) of perennial streams and 653 mi (1051 km) of intermittent streams. Approximately 12,095 acres (49 km^2) of Alamo Lake are located in the area of indirect effects more than 15 mi (24 km) from the proposed Bullard Wash SEZ. Yerba Mansa Spring is a constructed wetland in the Bill Williams River drainage upstream of Alamo Lake and contains introduced Gila topminnow (*Poeciliopsis occidentalis*), an endangered species. Intermittent streams are the only surface water feature in the area of direct and indirect effects, and their area represents approximately 4% of the total amount of intermittent stream present in the 50-mi (80-km) SEZ region.

8.2.11.4.2 Impacts

Because surface water habitats are a unique feature in the arid landscape in the vicinity of the proposed Bullard Wash SEZ, the maintenance and protection of such habitats may be important to the survival of aquatic and terrestrial organisms. The types of impacts aquatic habitats and biota could incur from the development of utility-scale solar energy facilities are described in detail in Section 5.10.3. Aquatic habitats present on or near the locations selected for construction of solar energy facilities could be affected 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, streams, or wetlands present within the boundaries of either the proposed Bullard Wash SEZ or the presumed new access road and transmission line corridors, and consequently there would be no direct impacts on aquatic habitats from solar energy development. There are also no perennial surface water features in the area of indirect effects. Of the two intermittent and ephemeral streams present in the area of indirect effects, Bullard Wash may contain aquatic biota when water is present, but it is typically dry and does not support aquatic habitat or communities. However, Date Creek is spring fed and may contain aquatic habitat and biota. Both streams also flow into perennial surface waters. Therefore, disturbance of land areas within the SEZ for solar energy facilities could increase the transport of soil into these streams via water- and airborne pathways, adversely affecting aquatic biota and habitat both locally and further downstream. The introduction of waterborne sediments to Date Creek and Bullard Wash could be minimized using common mitigation measures such as settling basins, silt fences, or directing water draining from the developed areas away from streams. It is unlikely any of the sediment from surface runoff or airborne dust associated with ground disturbance within the SEZ would reach aquatic habitat, given the large distance from the SEZ to the nearest stream (15 mi [24 km]).

In arid environments, reductions in the quantity of water in aquatic habitats are of particular concern. Water quantity in aquatic habitats 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 technologies, were developed at the site; the associated impacts would ultimately depend on the water source used (including groundwater from aquifers at various depths). There are no surface water habitats on the proposed Bullard Wash SEZ that could be used to supply water needs. Water demands during normal operations would most likely be met by withdrawing groundwater from wells constructed on-site, and given that groundwater outflows support streams in the region (8.2.9.1.2), there is the potential that groundwater withdrawals could reduce surface water levels in streams and wetlands outside of the proposed SEZ and area of indirect effects and, as a consequence, potentially reduce habitat size and connectivity and create more adverse environmental conditions for aquatic organisms in those habitats. 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/reclamation of a solar energy facility. However, because construction activities occur at least 0.2 mi (0.3 km) from any surface water features, the potential for introducing contaminants would be small, especially if the appropriate mitigation measures are used.

8.2.11.4.3 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 aquatic biota and aquatic habitats from development and operation of solar energy facilities. While some SEZ-specific design features are best established when project details are being considered, a design feature that can be identified at this time is as follows:

- Any wetlands within the SEZ should be avoided.

If this SEZ-specific design feature is implemented in addition to programmatic design features and if the utilization of water from groundwater or surface water sources is adequately controlled to maintain sufficient water levels in aquatic habitats, the potential impacts on aquatic biota and habitats from solar energy development at the proposed Bullard Wash SEZ would be negligible.

8.2.12 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 Bullard Wash SEZ. Special status species include the following types of species[3]:

- Species listed as threatened or endangered under the ESA;
- Species that are proposed for listing, under review, or are candidates for listing under the ESA;
- Species that are listed by the BLM as sensitive;
- Species that are listed by the State of Arizona[4]; and
- Species that have been ranked by the State of Arizona as S1 or S2, or species of concern by the USFWS; hereafter referred to as "rare" species.

Special status species known to occur within 50 mi (80 km) of the proposed Bullard Wash SEZ center (i.e., the SEZ region) were determined from natural heritage records available through NatureServe Explorer (NatureServe 2010), information provided by the ANHP (Schwartz 2009; ANHP 2010), SWReGAP (USGS 2004, 2005a, 2007), and the USFWS Environmental Conservation Online System (ECOS) (USFWS 2010a). Information reviewed consisted of county-level occurrences as determined from NatureServe, quad-level occurrences provided by the ANHP, 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 La Paz, Maricopa, Mohave, and Yavapai Counties in Arizona. However, the SEZ (and affected area) occurs only in Yavapai County. See Appendix M for additional information on the approach used to identify species that could be affected by development within the SEZ.

8.2.12.1 Affected Environment

The affected area considered in the 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 Bullard Wash SEZ, the area of direct effects included the SEZ and the portions of the assumed access road and transmission corridors where ground-disturbing activities are assumed to occur (refer to Section 8.2.1.2 for development assumptions). The area of indirect effects was defined

[3] 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 in BLM Manual 6840 (BLM 2008c). These species are included here to ensure broad consideration of species that may be most vulnerable to impacts.

[4] State-listed species for the state of Arizona are those plants protected under the Arizona Native Plant Law or wildlife listed by the AZGFD as Wildlife Species of Special Concern (WSC).

as the area within 5 mi (8 km) of the SEZ boundary and portions of the assumed access road and transmission corridors 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, but do not include ground-disturbing activities. For the most part, 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.

In its scoping comments on the proposed Bullard Wash SEZ (Stout 2009), the USFWS expressed concern that groundwater withdrawals associated with solar energy development on the Bullard Wash SEZ may reduce the regional groundwater supply that supports spring-fed aquatic habitats in the SEZ region for the Gila topminnow, a species listed as endangered under the ESA. In particular, the USFWS identified Yerba Mansa Spring along the Santa Maria River near Date Creek Ranch as suitable habitat for this species that may be affected by groundwater withdrawals to serve development on the SEZ. In addition, aquatic habitat in the Tres Alamos Spring system, which occurs approximately 5 mi (8 km) north of the SEZ historically provided habitat for the Gila topminnow and the desert pupfish—another fish species listed as endangered under the ESA. This spring system is within the above-defined area of indirect effects and could also be affected by groundwater withdrawals to serve solar energy development on the SEZ. For these reasons, the analysis in this section includes these spring systems (Figure 8.2.12.1-1). Although the Yerba Mansa Spring system is outside of the affected area as defined above, it is included in this evaluation because of the possible effect of groundwater withdrawals.

The primary land cover habitat type within the affected area is Sonora-Mojave creosote desert scrub (see Section 8.2.10). Potentially unique habitats in the affected area in which special status species may reside include desert washes and associated riparian habitats as well as pinyon-juniper woodlands. There are no aquatic habitats known to occur on the SEZ or anywhere within the area of direct effects. The only aquatic habitats known to occur within the area of indirect effects are Bullard Wash, Date Creek, and Tres Alamos Spring. Bullard Wash occurs south and west of the SEZ; Date Creek occurs north of the SEZ (Figure 8.2.12.1-1).

All special status species that are known to occur within the Bullard Wash SEZ region (i.e., within 50 mi [80 km] of the center of the SEZ) are listed, with their status, nearest recorded occurrence, and habitats in Appendix J. Of these species, there are 39 that could be affected by solar energy development on the SEZ, 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 8.2.12.1-1. For many of the species listed in the table (especially plants), 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 more than 20 mi (32 km) away from the SEZ.

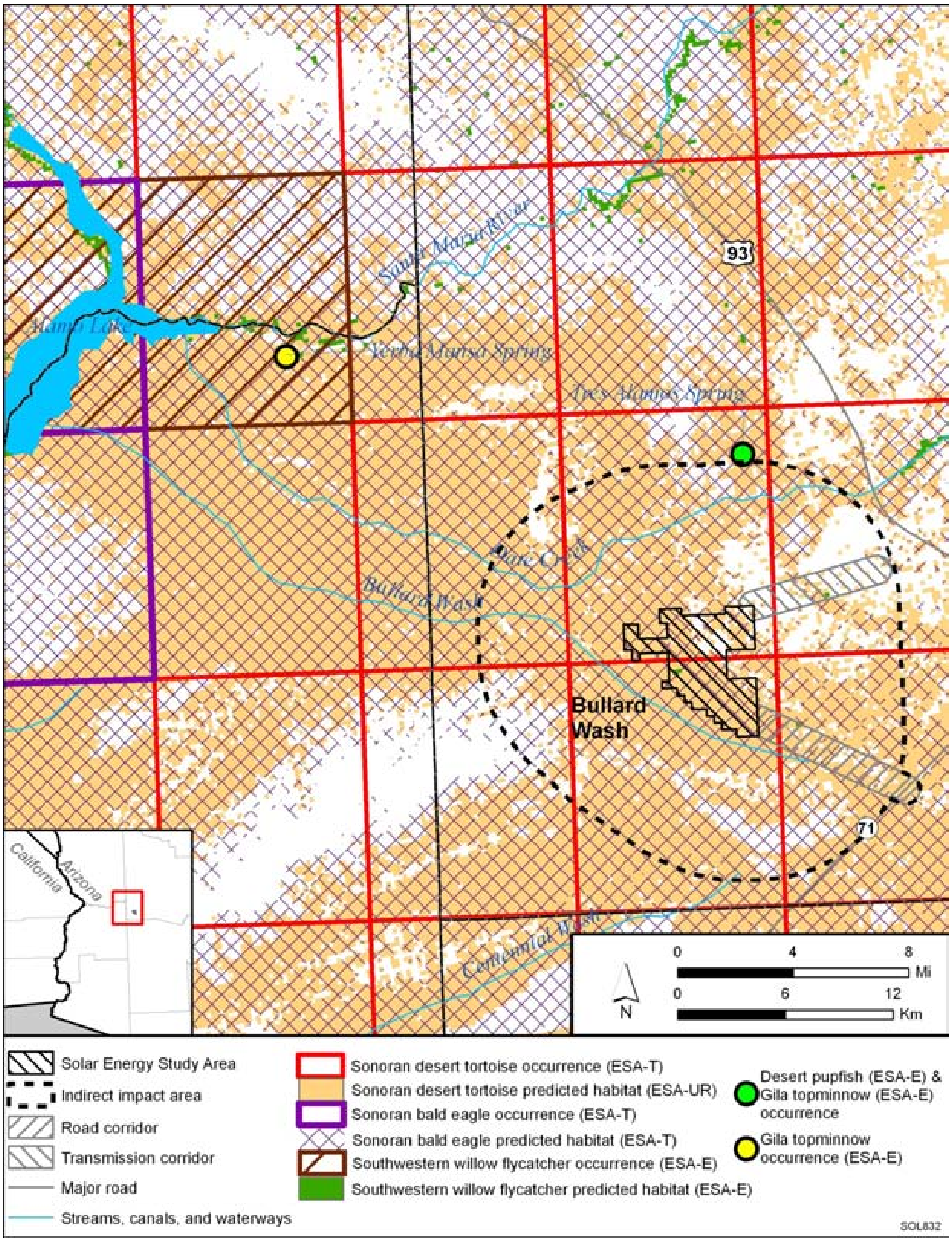

FIGURE 8.2.12.1-1 Known or Potential Occurrences of Species Listed as Endangered or Threatened under the ESA, Candidates for Listing under the ESA, or Species under Review for ESA Listing in the Affected Area of the Proposed Bullard Wash SEZ (Sources: Schwartz 2009; USFWS 2010a; USGS 2007)

TABLE 8.2.12.1-1 Habitats, Potential Impacts, and Potential Mitigation for Special Status Species That Could Be Affected by Solar Energy Development on the Proposed Bullard Wash SEZ

				Maximum Area of Potential Habitat Affected[c]				
Common Name	Scientific Name	Listing Status[a]	Habitat[b]	Within SEZ (Direct Effects)[d]	Access Road (Direct Effects)[e]	Transmission Line ROW (Direct Effects)[e]	Indirect Effects (Outside SEZ)[f]	Overall Impact Magnitude[g] and Species-Specific Mitigation[h]
Plants								
Aravaipa wood fern	*Thelypteris puberula* var. *sonorensis*	BLM-S; AZ-S2	Moist soils in shady canyon regions, riparian habitats such as river banks, seepage areas, and mesic meadow habitats. Elevation ranges between 2,220 and 4,500 ft.[i] Nearest quad-level occurrences are approximately 8 mi[j] northwest of the SEZ. About 21,100 acres[k] of potentially suitable habitat occurs within the SEZ region.	15 acres of potentially suitable riparian habitat lost (<0.1% of available potentially suitable habitat)	0 acres	0 acres	145 acres of potentially suitable riparian habitat (0.7% of available potentially suitable habitat)	Small overall impact. Avoiding or minimizing disturbance to riparian or desert wash habitats in the area of direct effects could reduce impacts. In addition, pre-disturbance surveys and avoiding or minimizing disturbance to occupied habitats in the areas of direct effects; translocation of individuals from areas of direct effects; or compensatory mitigation of direct effects on occupied habitats could reduce impacts.

TABLE 8.2.12.1-1 (Cont.)

Common Name	Scientific Name	Listing Status[a]	Habitat[b]	Maximum Area of Potential Habitat Affected[c]: Within SEZ (Direct Effects)[d]	Access Road (Direct Effects)[e]	Transmission Line ROW (Direct Effects)[e]	Indirect Effects (Outside SEZ)[f]	Overall Impact Magnitude[g] and Species-Specific Mitigation[h]
Plants (Cont.)								
Arid tansy-aster	*Machaeranthera arida*	AZ-S1	Low sand dunes, alkaline flats, riverbanks, and sandy roadsides. Nearest quad-level occurrences are approximately 12 mi northwest of the SEZ. About 53,500 acres of potentially suitable habitat occurs within the SEZ region.	23 acres of potentially suitable riparian and disturbed habitat lost (<0.1% of available potentially suitable habitat)	0 acres	0 acres	306 acres of potentially suitable riparian habitat (0.6% of available potentially suitable habitat)	Small overall impact. Avoiding or minimizing disturbance to riparian or desert wash habitat in the area of direct effects could reduce impacts. In addition, pre-disturbance surveys and avoiding or minimizing disturbance to occupied habitats in the areas of direct effects; translocation of individuals from areas of direct effects; or compensatory mitigation of direct effects on occupied habitats could reduce impacts.

TABLE 8.2.12.1-1 (Cont.)

Common Name	Scientific Name	Listing Status[a]	Habitat[b]	Maximum Area of Potential Habitat Affected[c]: Within SEZ (Direct Effects)[d]	Access Road (Direct Effects)[e]	Transmission Line ROW (Direct Effects)[e]	Indirect Effects (Outside SEZ)[f]	Overall Impact Magnitude[g] and Species-Specific Mitigation[h]
Plants (Cont.)								
Arizona cliff rose	*Purshia subintegra*	ESA-E; AZ-HS; AZ-S1	Endemic to central Arizona near Horseshoe Lake (Maricopa County), Cottonwood (Yavapai County), Burro Creek (Mohave County), and Bylas (Graham County) in rolling, rocky, limestone hills and slopes within the creosotebush-crucifixion thorn habitat. Elevation ranges between 2,100 and 4,000 ft. Nearest quad-level occurrence is near Burro Creek, approximately 24 mi north of the SEZ. About 1,317,500 acres of potentially suitable habitat occurs within the SEZ region.	7,000 acres of potentially suitable habitat lost (0.5% of available potentially suitable habitat)	24 acres of potentially suitable habitat lost (<0.1% of available potentially suitable habitat)	142 acres of potentially suitable habitat lost (<0.1% of available potentially suitable habitat)	58,750 acres of potentially suitable habitat (4.5% of available potentially suitable habitat)	Small overall impact. Pre-disturbance surveys and avoiding or minimizing disturbance of occupied habitats in the area of direct effects, translocation of individuals from areas of direct effects, or compensatory mitigation of direct effects on occupied habitats could reduce impacts. Note that these same potential mitigations apply to all special status plants.
Arizona giant sedge	*Carex ultra*	BLM-S; AZ-S2	Shaded southeast-facing exposures of moist gravelly substrates near perennially wet springs and streams. Elevation ranges between 2,000 and 6,000 ft. Nearest quad-level occurrences are approximately 22 mi east of the SEZ. About 21,100 acres of potentially suitable habitat occurs within the SEZ region.	15 acres of potentially suitable riparian habitat lost (<0.1% of available potentially suitable habitat)	0 acres	0 acres	145 acres of potentially suitable riparian habitat (0.7% of available potentially suitable habitat)	Small overall impact. Avoiding or minimizing disturbance to riparian or desert wash habitats in the area of direct effects could reduce impacts. See Arizona cliff rose for a list of potential mitigations applicable to all special status plant species.

TABLE 8.2.12.1-1 (Cont.)

Common Name	Scientific Name	Listing Status[a]	Habitat[b]	Maximum Area of Potential Habitat Affected[c]: Within SEZ (Direct Effects)[d]	Access Road (Direct Effects)[e]	Transmission Line ROW (Direct Effects)[e]	Indirect Effects (Outside SEZ)[f]	Overall Impact Magnitude[g] and Species-Specific Mitigation[h]
Plants (Cont.)								
Bigelow onion	*Allium bigelovii*	AZ-SR; AZ-S2	Gentle slopes on open, dry rocky soil in grassland, chaparral, and Sonoran–Mohave desert scrub communities. Elevation ranges between 2,000 and 5,000 ft. Nearest quad-level occurrences are from the Black Mountains approximately 10 mi north of the SEZ. About 1,685,400 acres of potentially suitable habitat occurs within the SEZ region.	6,150 acres of potentially suitable habitat lost (0.4% of available potentially suitable habitat)	21 acres of potentially suitable habitat lost (<0.1% of available potentially suitable habitat)	24 acres of potentially suitable habitat lost (<0.1% of available potentially suitable habitat)	40,400 acres of potentially suitable habitat (2.4% of available potentially suitable habitat)	Small overall impact. See Arizona cliff rose for a list of potential mitigations applicable to all special status plant species.
Davidson sage	*Salvia davidsonii*	AZ-S2	Rocky substrates in canyons and in moist soils on wooded slopes, often on bedrock. Elevation ranges between 1,600 and 9,500 ft. Nearest quad-level occurrences are approximately 15 mi north of the SEZ. About 394,000 acres of potentially suitable habitat occurs within the SEZ region.	0 acres	0 acres	0 acres	158 acres of potentially suitable habitat (<0.1% of available potentially suitable habitat)	Small overall impact; no direct effect. No species-specific mitigation is warranted.
Golden barrel cactus	*Ferocactus cylindraceus* var. *eastwoodiae*	AZ-SR; AZ-S1	Endemic to central Arizona on gravelly or rocky hillsides, canyon walls, and wash margins. Elevation ranges between 1,200 and 4,000 ft. Nearest quad-level occurrences are approximately 15 mi north of the SEZ. About 4,250 acres of potentially suitable habitat occurs within the SEZ region.	15 acres of potentially suitable riparian habitat lost (<0.1% of available potentially suitable habitat)	0 acres	0 acres	145 acres of potentially suitable riparian habitat (3.4% of available potentially suitable habitat)	Small overall impact. Avoiding or minimizing disturbance to riparian or desert wash habitat in the area of direct effects could reduce impacts. See Arizona cliff rose for a list of potential mitigations applicable to all special status plant species.

TABLE 8.2.12.1-1 (Cont.)

Common Name	Scientific Name	Listing Status[a]	Habitat[b]	Maximum Area of Potential Habitat Affected[c]: Within SEZ (Direct Effects)[d]	Access Road (Direct Effects)[e]	Transmission Line ROW (Direct Effects)[e]	Indirect Effects (Outside SEZ)[f]	Overall Impact Magnitude[g] and Species-Specific Mitigation[h]
Plants (Cont.)								
Hohokam agave	*Agave murpheyi*	BLM-S; AZ-HS; FWS-SC; AZ-S2	Endemic to Arizona and Sonora, Mexico, on benches or alluvial terraces on gentle bajada slopes above major drainages in desert scrub communities. Elevation ranges between 1,300 and 3,200 ft. Nearest quad-level occurrences are approximately 23 mi east of the SEZ. About 21,100 acres of potentially suitable habitat occurs within the SEZ region.	15 acres of potentially suitable riparian habitat lost (<0.1% of available potentially suitable habitat)	0 acres	0 acres	145 acres of potentially suitable riparian habitat (0.7% of available potentially suitable habitat)	Small overall impact. Avoiding or minimizing disturbance to riparian or desert wash habitat in the area of direct effects could reduce impacts. See Arizona cliff rose for a list of potential mitigations applicable to all special status plant species.
McKelvey's agave	*Agave mckelveyana*	AZ-SR	Endemic to Arizona in dry scrubland between 3,000 and 6,000 ft. Nearest quad-level occurrence is from the vicinity of Smith Canyon, approximately 34 mi northeast of the SEZ. About 3,497,000 acres of potentially suitable habitat occurs within the SEZ region.	7,150 acres of potentially suitable habitat lost (0.2% of available potentially suitable habitat)	33 acres of potentially suitable habitat lost (<0.1% of available potentially suitable habitat)	142 acres of potentially suitable habitat lost (<0.1% of available potentially suitable habitat)	97,450 acres of potentially suitable habitat (2.8% of available potentially suitable habitat)	Small overall impact. See Arizona cliff rose for a list of potential mitigations applicable to all special status plant species.

TABLE 8.2.12.1-1 (Cont.)

Common Name	Scientific Name	Listing Status[a]	Habitat[b]	Maximum Area of Potential Habitat Affected[c]: Within SEZ (Direct Effects)[d]	Access Road (Direct Effects)[e]	Transmission Line ROW (Direct Effects)[e]	Indirect Effects (Outside SEZ)[f]	Overall Impact Magnitude[g] and Species-Specific Mitigation[h]
Plants (Cont.)								
Parish alkali grass	*Puccinellia parishii*	AZ-HS; FWS-SC; AZ-S2	Open saline areas on moist soils near springs. Elevation ranges between 2,780 and 7,350 ft. Nearest quad-level occurrence is approximately 25 mi north of the SEZ. About 21,100 acres of potentially suitable habitat occurs within the SEZ region.	15 acres of potentially suitable riparian habitat lost (<0.1% of available potentially suitable habitat)	0 acres	0 acres	145 acres of potentially suitable riparian habitat (0.7% of available potentially suitable habitat)	Small overall impact. Avoiding or minimizing disturbance to riparian or desert wash habitat in the area of direct effects could reduce impacts. See Arizona cliff rose for a list of potential mitigations applicable to all special status plant species.
Parish's phacelia	*Phacelia parishii*	BLM-S; AZ-S1	Moist to superficially dry, open, flat, mostly barren, salt-crusted silty-clay soils on valley bottoms, lake deposits, and playa edges, often in close proximity to seepage areas surrounded by saltbush scrub vegetation. Elevation ranges between 2,200 and 5,950 ft. Nearest quad-level occurrence is approximately 24 mi north of the SEZ. About 21,100 acres of potentially suitable habitat occurs within the SEZ region.	15 acres of potentially suitable riparian habitat lost (<0.1% of available potentially suitable habitat)	0 acres	0 acres	145 acres of potentially suitable riparian habitat (0.7% of available potentially suitable habitat)	Small overall impact. Avoiding or minimizing disturbance to riparian or desert wash habitat in the area of direct effects could reduce impacts. See Arizona cliff rose for a list of potential mitigations applicable to all special status plant species.

TABLE 8.2.12.1-1 (Cont.)

Common Name	Scientific Name	Listing Status[a]	Habitat[b]	Maximum Area of Potential Habitat Affected[c]: Within SEZ (Direct Effects)[d]	Access Road (Direct Effects)[e]	Transmission Line ROW (Direct Effects)[e]	Indirect Effects (Outside SEZ)[f]	Overall Impact Magnitude[g] and Species-Specific Mitigation[h]
Plants (Cont.)								
Pima Indian mallow	*Abutilon parishii*	BLM-S; AZ-SR; FWS-SC; AZ-S2	Mesic and riparian areas on hillsides, cliff bases, canyon bottoms, rocks and boulders, and washes. Elevation ranges between 1,720 and 4,900 ft. Nearest quad-level occurrence is approximately 24 mi north of the SEZ. About 21,100 acres of potentially suitable habitat occurs within the SEZ region.	15 acres of potentially suitable riparian habitat lost (<0.1% of available potentially suitable habitat)	0 acres	0 acres	145 acres of potentially suitable riparian habitat (0.7% of available potentially suitable habitat)	Small overall impact. Avoiding or minimizing disturbance to riparian or desert wash habitat in the area of direct effects could reduce impacts. See Arizona cliff rose for a list of potential mitigations applicable to all special status plant species.
Straw-top cholla	*Opuntia echinocarpa*	AZ-SR	Sandy or gravelly soil of benches, slopes, mesas, flats, and washes at elevations between 1,000 and 6,700 ft. Nearest quad-level occurrences are approximately 10 mi west of the SEZ. About 21,100 acres of potentially suitable habitat occurs within the SEZ region.	15 acres of potentially suitable riparian habitat lost (<0.1% of available potentially suitable habitat)	0 acres	0 acres	145 acres of potentially suitable riparian habitat (0.7% of available potentially suitable habitat)	Small overall impact. Avoiding or minimizing disturbance to riparian or desert wash habitat in the area of direct effects could reduce impacts. See Arizona cliff rose for a list of potential mitigations applicable to all special status plant species.

TABLE 8.2.12.1-1 (Cont.)

Common Name	Scientific Name	Listing Status[a]	Habitat[b]	Maximum Area of Potential Habitat Affected[c]: Within SEZ (Direct Effects)[d]	Access Road (Direct Effects)[e]	Transmission Line ROW (Direct Effects)[e]	Indirect Effects (Outside SEZ)[f]	Overall Impact Magnitude[g] and Species-Specific Mitigation[h]
Invertebrates								
Maricopa tiger beetle	*Cicindela oregona maricopa*	FWS-SC	Known primarily from Maricopa County, Arizona, in sandy riparian areas such as streambanks and sand bars. Nearest quad-level occurrences are approximately 7 mi north of the SEZ. About 21,100 acres of potentially suitable habitat occurs within the SEZ region.	15 acres of potentially suitable riparian habitat lost (<0.1% of available potentially suitable habitat)	0 acres	0 acres	145 acres of potentially suitable riparian habitat (0.7% of available potentially suitable habitat)	Small overall impact. Avoiding or minimizing disturbance to riparian or desert wash habitat in the area of direct effects could reduce impacts. In addition, pre-disturbance surveys and avoiding or minimizing disturbance to occupied habitats in the areas of direct effects or compensatory mitigation of direct effects on occupied habitats could reduce impacts.

TABLE 8.2.12.1-1 (Cont.)

Common Name	Scientific Name	Listing Status[a]	Habitat[b]	Maximum Area of Potential Habitat Affected[c]: Within SEZ (Direct Effects)[d]	Access Road (Direct Effects)[e]	Transmission Line ROW (Direct Effects)[e]	Indirect Effects (Outside SEZ)[f]	Overall Impact Magnitude[g] and Species-Specific Mitigation[h]
Fish								
Desert pupfish[l]	***Cyprinodon macularius***	ESA-E; AZ-WSC; AZ-S1	Colorado and Gila River drainages in desert springs and outflow marshes, river-edge marshes, backwaters, saline pools, and streams. Introduced in several locations in Graham, Santa Cruz, and Yavapai Counties. Historical quad-level occurrences intersect the SEZ, the transmission corridor, and portions of the area of indirect effects. Introduced into Tres Alamos Spring, approximately 5 mi north of the SEZ. However, currently considered extirpated from the SEZ region. About 21,500 acres of potentially suitable habitat occurs within the SEZ region.	0 acres	0 acres	0 acres	Less than 25 acres of historically occupied habitat (0.1% of available potentially suitable habitat)	Small to large overall impact; no direct effects. Historically occupied habitat for this species in Tres Alamos Spring may be affected by water withdrawals. Avoiding or limiting water withdrawals for solar energy development on the SEZ could reduce impacts on this species to negligible levels.

TABLE 8.2.12.1-1 (Cont.)

Common Name	Scientific Name	Listing Status[a]	Habitat[b]	Maximum Area of Potential Habitat Affected[c]: Within SEZ (Direct Effects)[d]	Access Road (Direct Effects)[e]	Transmission Line ROW (Direct Effects)[e]	Indirect Effects (Outside SEZ)[f]	Overall Impact Magnitude[g] and Species-Specific Mitigation[h]
Fish (Cont.)								
Gila topminnow	***Poeciliopsis occidentalis occidentalis***	ESA-E; AZ-WSC; AZ-S1	Gila River system, currently only at a few localities in the Gila River drainage and one locality in the Bill Williams drainage. Inhabits headwater springs and vegetated margins and backwater areas of intermittent and perennial streams and rivers. Historical quad-level occurrence intersects the affected area. Once occurred downstream of Tres Alamos Spring, approximately 5 mi north of the SEZ. This population is now considered extirpated. The nearest known population is known from Yerba Mansa Springs, approximately 15 mi northwest of the SEZ. About 21,500 acres of potentially suitable current, future, or historical habitat occurs within the SEZ region.	0 acres	0 acres	0 acres	Less than 50 acres of historically and currently occupied habitat (0.1% of available potentially suitable habitat)	Small to large overall impact; no direct effects. Historically occupied habitat for this species associated with Tres Alamos Spring and currently occupied habitat within the Yerba Mansa Springs may be affected by water withdrawals. Avoiding or limiting water withdrawals for solar energy development on the SEZ could reduce impacts on this species to negligible levels.

TABLE 8.2.12.1-1 (Cont.)

Common Name	Scientific Name	Listing Status[a]	Habitat[b]	Maximum Area of Potential Habitat Affected[c]: Within SEZ (Direct Effects)[d]	Access Road (Direct Effects)[e]	Transmission Line ROW (Direct Effects)[e]	Indirect Effects (Outside SEZ)[f]	Overall Impact Magnitude[g] and Species-Specific Mitigation[h]
Amphibians								
Arizona toad	*Bufo microscaphus*	FWS-SC	Woodlands and low-elevation riparian habitats in association with permanent or semipermanent water bodies, including streams, ditches, flooded fields, irrigated croplands, and permanent reservoirs. Nearest quad-level occurrences are approximately 7 mi north of the SEZ. About 23,250 acres of potentially suitable habitat occurs within the SEZ region.	28 acres of potentially suitable habitat lost (<0.1% of available potentially suitable habitat)	0 acres	0 acres	127 acres of potentially suitable habitat (0.5% of available potentially suitable habitat)	Small overall impact. Avoiding or minimizing disturbance to riparian habitat in the area of direct effects could reduce impacts. In addition, pre-disturbance surveys and avoiding or minimizing disturbance to occupied habitats in the areas of direct effects; translocation of individuals from areas of direct effects; or compensatory mitigation of direct effects on occupied habitats could reduce impacts.

TABLE 8.2.12.1-1 (Cont.)

Common Name	Scientific Name	Listing Status[a]	Habitat[b]	Maximum Area of Potential Habitat Affected[c]: Within SEZ (Direct Effects)[d]	Access Road (Direct Effects)[e]	Transmission Line ROW (Direct Effects)[e]	Indirect Effects (Outside SEZ)[f]	Overall Impact Magnitude[g] and Species-Specific Mitigation[h]
Amphibians (Cont.)								
Lowland leopard frog	***Lithobates yavapaiensis***	BLM-S; AZ-WSC; FWS-SC	Aquatic systems in desert grasslands, pinyon-juniper woodlands, and agricultural areas, rivers, streams, beaver ponds, and springs. Man-made systems include earthen cattle tanks, livestock guzzlers, canals, and irrigation sloughs. Quad-level occurrences intersect the transmission corridor and portions of the area of indirect effects. About 395,450 acres of potentially suitable habitat occurs within the SEZ region.	560 acres of potentially suitable habitat lost (0.1% of available potentially suitable habitat)	4 acres of potentially suitable habitat lost (<0.1% of available potentially suitable habitat)	16 acres of potentially suitable habitat lost (<0.1% of available potentially suitable habitat)	9,400 acres of potentially suitable habitat (2.4% of available potentially suitable habitat)	Small overall impact. Avoiding or minimizing disturbance to riparian habitats in the area of direct effects could reduce impacts. In addition, pre-disturbance surveys and avoiding or minimizing disturbance to occupied habitats in the areas of direct effects; translocation of individuals from areas of direct effects; or compensatory mitigation of direct effects on occupied habitats could reduce impacts.

TABLE 8.2.12.1-1 (Cont.)

Common Name	Scientific Name	Listing Status[a]	Habitat[b]	Maximum Area of Potential Habitat Affected[c]: Within SEZ (Direct Effects)[d]	Access Road (Direct Effects)[e]	Transmission Line ROW (Direct Effects)[e]	Indirect Effects (Outside SEZ)[f]	Overall Impact Magnitude[g] and Species-Specific Mitigation[h]
Reptiles								
Arizona night lizard	*Xantusia arizonae*	AZ-S1	Endemic to Arizona from Mohave, Pinal, and Yavapai Counties in arid and semiarid granite outcroppings and rocky areas, among fallen leaves, trunks of agave, or other vegetative debris. Associated with pinyon-juniper and chaparral-oak plant communities. Nearest quad-level occurrences are approximately 17 mi east of the SEZ. About 1,935,500 acres of potentially suitable habitat occurs within the SEZ region.	1,122 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)	122 acres of potentially suitable habitat lost (<0.1% of available potentially suitable habitat)	48,500 acres of potentially suitable habitat (2.5% of available potentially suitable habitat)	Small overall impact. Pre-disturbance surveys and avoiding or minimizing disturbance to occupied habitats in the areas of direct effects; translocation of individuals from areas of direct effects; or compensatory mitigation of direct effects on occupied habitats could reduce impacts.
Arizona skink	*Eumeces gilberti arizonensis*	AZ-WSC; FWS-SC; AZ-S1	Known only from west–central Arizona among rocks, logs, and leaf litter areas near permanent or semipermanent streams; riparian drainages up through oak-pine woodlands. Nearest quad-level occurrences are approximately 15 mi east of the SEZ. About 907,500 acres of potentially suitable habitat occurs within the SEZ region.	0 acres	0 acres	0 acres	114 acres of potentially suitable habitat (<0.1% of available potentially suitable habitat)	Small overall impact; no direct effects. No species-specific mitigation is warranted.

TABLE 8.2.12.1-1 (Cont.)

Common Name	Scientific Name	Listing Status[a]	Habitat[b]	Maximum Area of Potential Habitat Affected[c]: Within SEZ (Direct Effects)[d]	Access Road (Direct Effects)[e]	Transmission Line ROW (Direct Effects)[e]	Indirect Effects (Outside SEZ)[f]	Overall Impact Magnitude[g] and Species-Specific Mitigation[h]
Reptiles (Cont.)								
Desert rosy boa	*Charina trivirgata gracia*	BLM-S; FWS-SC	Arid scrublands, rocky deserts, and canyons with permanent or intermittent streams. Nearest quad-level occurrences are from the Santa Maria River, approximately 15 mi northwest of the SEZ. About 3,135,000 acres of potentially suitable habitat occurs within the SEZ region.	7,200 acres of potentially suitable habitat lost (0.2% of available potentially suitable habitat)	26 acres of potentially suitable habitat lost (<0.1% of available potentially suitable habitat)	143 acres of potentially suitable habitat lost (<0.1% of available potentially suitable habitat)	88,600 acres of potentially suitable habitat (2.8% of available potentially suitable habitat)	Small overall impact. Pre-disturbance surveys and avoiding or minimizing disturbance to occupied habitats in the area of direct effects; translocation of individuals from areas of direct effects; or compensatory mitigation of direct effects on occupied habitats could reduce impacts.
Desert tortoise (Sonoran population)	***Gopherus agassizii***	ESA-UR; BLM-S; AZ-WSC	Mojave and Sonoran Deserts in desert creosotebush communities on firm soils for digging burrows, along riverbanks, washes, canyon bottoms, creosote flats, and desert oases. Quad-level occurrences intersect the SEZ, the road and transmission corridors, and portions of the area of indirect effects. About 2,775,500acres of potentially suitable habitat occurs within the SEZ region.	6,225 acres of potentially suitable habitat lost (0.2% of available potentially suitable habitat)	29 acres of potentially suitable habitat lost (<0.1% of available potentially suitable habitat)	32 acres of potentially suitable habitat lost (<0.1% of available potentially suitable habitat)	75,200 acres of potentially suitable habitat (2.7% of available potentially suitable habitat)	Small overall impact. Pre-disturbance surveys and avoiding or minimizing disturbance to occupied habitats in the area of direct effects; translocation of individuals from areas of direct effects; or compensatory mitigation of direct effects on occupied habitats could reduce impacts. Mitigation measures should be developed in coordination with the USFWS and AZGFD.

TABLE 8.2.12.1-1 (Cont.)

Common Name	Scientific Name	Listing Status[a]	Habitat[b]	Maximum Area of Potential Habitat Affected[c]: Within SEZ (Direct Effects)[d]	Access Road (Direct Effects)[e]	Transmission Line ROW (Direct Effects)[e]	Indirect Effects (Outside SEZ)[f]	Overall Impact Magnitude[g] and Species-Specific Mitigation[h]
Reptiles (Cont.)								
Gila monster	***Heloderma suspectum cinctum***	FWS-SC	Mojave and Sonoran Deserts in rocky, deeply incised topography and riparian habitat, desert scrub, thorn scrub, desert riparian, oak woodland, and semidesert grassland. On lower mountain slopes, rocky bajadas, canyon bottoms, and arroyos at elevations below 3,950 ft. Quad-level occurrences intersect the SEZ, the transmission corridor, and portions of the area of indirect effects. About 4,409,000 acres of potentially suitable habitat occurs within the SEZ region.	7,230 acres of potentially suitable habitat lost (0.2% of available potentially suitable habitat)	36 acres of potentially suitable habitat lost (<0.1% of available potentially suitable habitat)	155 acres of potentially suitable habitat lost (<0.1% of available potentially suitable habitat)	102,450 acres of potentially suitable habitat (2.3% of available potentially suitable habitat)	Small overall impact. Pre-disturbance surveys and avoiding or minimizing disturbance to occupied habitats in the area of direct effects; translocation of individuals from areas of direct effects; or compensatory mitigation of direct effects on occupied habitats could reduce impacts.
Mojave shovel-nosed snake	***Chionactis occipitalis occipitalis***	AZ-S1	Known only from Arizona in sparsely vegetated desert areas on rocky slopes, dunes, washes, and sandy flats. Quad-level occurrences intersect the road corridor and portions of the area of indirect effects. About 1,603,500 acres of potentially suitable habitat occurs within the SEZ region.	1,250 acres of potentially suitable habitat lost (0.1% of available potentially suitable habitat)	11 acres of potentially suitable habitat lost (<0.1% of available potentially suitable habitat)	23 acres of potentially suitable habitat lost (<0.1% of available potentially suitable habitat)	29,400 acres of potentially suitable habitat (1.8% of available potentially suitable habitat)	Small overall impact. Pre-disturbance surveys and avoiding or minimizing disturbance to occupied habitats in the area of direct effects; translocation of individuals from areas of direct effects; or compensatory mitigation of direct effects on occupied habitats could reduce impacts.

TABLE 8.2.12.1-1 (Cont.)

Common Name	Scientific Name	Listing Status[a]	Habitat[b]	Maximum Area of Potential Habitat Affected[c]: Within SEZ (Direct Effects)[d]	Access Road (Direct Effects)[e]	Transmission Line ROW (Direct Effects)[e]	Indirect Effects (Outside SEZ)[f]	Overall Impact Magnitude[g] and Species-Specific Mitigation[h]
Birds								
American peregrine falcon	*Falco peregrinus anatum*	BLM-S; AZ-WSC; FWS-SC	Year-round resident in the SEZ region. Open habitats, including deserts, shrublands, and woodlands that are associated with high, near vertical cliffs and bluffs above 200 ft. Forages in farmlands, marshes, lakes, rivers, and urban areas. Nearest quad-level occurrences are from the vicinity of Alamo Lake, approximately 18 mi northwest of the SEZ. About 4,963,500 acres of potentially suitable habitat occurs within the SEZ region.	7,230 acres of potentially suitable foraging habitat lost (0.1% of available potentially suitable habitat)	36 acres of potentially suitable foraging habitat lost (<0.1% of available potentially suitable habitat)	155 acres of potentially suitable foraging habitat lost (<0.1% of available potentially suitable habitat)	102,500 acres of potentially suitable foraging habitat (2.1% of available potentially suitable habitat)	Small overall 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 effects.
Bald eagle (Sonoran population)	*Haliaeetus leucocephalus*	ESA-T; BLM-S; AZ-WSC; AZ-S2	Winter resident in the SEZ region, most commonly along large bodies of water where fish and waterfowl prey are available. Occasionally forages in arid shrubland habitats. Nearest quad-level occurrences are from the vicinity of Alamo Lake, approximately 18 mi northwest of the SEZ. About 3,921,500 acres of potentially suitable habitat occurs within the SEZ region.	6,200 acres of potentially suitable foraging habitat lost (0.2% of available potentially suitable habitat)	31 acres of potentially suitable foraging habitat lost (<0.1% of available potentially suitable habitat)	23 acres of potentially suitable foraging habitat lost (<0.1% of available potentially suitable habitat)	79,600 acres of potentially suitable foraging habitat (2.0% of available potentially suitable habitat)	Small overall impact on foraging habitat only. Avoidance of direct impacts on all foraging habitat is not feasible because suitable foraging habitat is widespread in the area of direct effects. The potential for impact and need for mitigation should be determined in consultation with the USFWS and AZGFD.

TABLE 8.2.12.1-1 (Cont.)

Common Name	Scientific Name	Listing Status[a]	Habitat[b]	Maximum Area of Potential Habitat Affected[c]: Within SEZ (Direct Effects)[d]	Access Road (Direct Effects)[e]	Transmission Line ROW (Direct Effects)[e]	Indirect Effects (Outside SEZ)[f]	Overall Impact Magnitude[g] and Species-Specific Mitigation[h]
Birds (Cont.)								
Ferruginous hawk	*Buteo regalis*	BLM-S; AZ-WSC; FWS-SC; AZ-S2	Winter resident in the SEZ region. Grasslands, sagebrush and saltbrush habitats, as well as the periphery of pinyon-juniper woodlands. Nearest quad-level occurrence is from the vicinity of Boulder Creek, approximately 33 mi north of the SEZ. About 116,500 acres of potentially suitable habitat occurs within the SEZ region.	0 acres	0 acres	0 acres	14 acres of potentially suitable habitat (<0.1% of available potentially suitable habitat)	Small overall impact on foraging habitat only; no direct effects. No species-specific mitigation is warranted.
Long-eared owl	*Asio otus*	AZ-S2	Winter resident in the SEZ affected area. Deciduous and evergreen forests, orchards, wooded parks, farm woodlots, riparian areas, and desert oases. Nests in trees in old nests of other birds or squirrels; sometimes nests in tree cavities. Nearest quad-level occurrence is 45 mi south of the SEZ. About 4,654,000 acres of potentially suitable habitat occurs within the SEZ region.	7,230 acres of potentially suitable foraging habitat lost (0.2% of available potentially suitable habitat)	34 acres of potentially suitable foraging habitat lost (<0.1% of available potentially suitable habitat)	144 acres of potentially suitable foraging habitat lost (<0.1% of available potentially suitable habitat)	97,900 acres of potentially suitable habitat (2.1% of available potentially suitable habitat)	Small overall impact on foraging habitat only. Avoidance of direct impacts on all foraging habitat is not feasible because suitable foraging habitat is widespread in the area of direct effects.

TABLE 8.2.12.1-1 (Cont.)

Common Name	Scientific Name	Listing Status[a]	Habitat[b]	Maximum Area of Potential Habitat Affected[c]: Within SEZ (Direct Effects)[d]	Access Road (Direct Effects)[e]	Transmission Line ROW (Direct Effects)[e]	Indirect Effects (Outside SEZ)[f]	Overall Impact Magnitude[g] and Species-Specific Mitigation[h]
Birds (Cont.)								
Snowy egret	*Egretta thula*	BLM-S; AZ-WSC; AZ-S1	Year-round resident in the lower Colorado River Valley in open water areas such as marshes, estuaries, lagoons, lakes, ponds, rivers and flooded fields. Transient in affected area. Nearest quad-level occurrence is from the vicinity of the Hassayampa River, approximately 23 mi east of the SEZ. About 722,000 acres of potentially suitable habitat occurs within the SEZ region.	950 acres of potentially suitable foraging habitat lost (0.1% of available potentially suitable habitat)	6 acres of potentially suitable foraging habitat lost (<0.1% of available potentially suitable habitat)	30 acres of potentially suitable foraging habitat lost (<0.1% of available potentially suitable habitat)	18,000 acres of potentially suitable habitat (2.5% of available potentially suitable habitat)	Small to large overall impact. No direct effects on nesting habitat. No species-specific mitigation of direct effects is feasible because the species is expected to only occur as a transient in the area of direct effects. Potentially suitable aquatic or riparian habitats for this species may be indirectly affected outside the SEZ from groundwater withdrawals. Avoiding or limiting water withdrawals for solar energy development on the SEZ could reduce impacts on this species to negligible levels.

TABLE 8.2.12.1-1 (Cont.)

Common Name	Scientific Name	Listing Status[a]	Habitat[b]	Maximum Area of Potential Habitat Affected[c]: Within SEZ (Direct Effects)[d]	Access Road (Direct Effects)[e]	Transmission Line ROW (Direct Effects)[e]	Indirect Effects (Outside SEZ)[f]	Overall Impact Magnitude[g] and Species-Specific Mitigation[h]
Birds (Cont.)								
Southwestern willow flycatcher	*Empidonax traillii extimus*	ESA-E; AZ-WSC; AZ-S1	Summer breeding resident in the SEZ region. Riparian shrublands and woodlands. Nests in thickets, scrubby and brushy areas, open second growth, swamps, and open woodlands. Nearest quad-level occurrences are from Alamo Lake approximately 12 mi northwest of the SEZ. About 31,300 acres of potentially suitable habitat occurs within the SEZ region.	29 acres of potentially suitable foraging habitat lost (0.1% of available potentially suitable habitat)	0 acres	0 acres	50 acres of potentially suitable habitat (0.1% of available potentially suitable habitat)	Small to large overall impact. Potentially suitable riparian habitats for this species may be directly affected on the SEZ or indirectly affected outside the SEZ from groundwater withdrawals. Avoiding or minimizing disturbance to riparian habitats and avoiding or limiting water withdrawals for solar energy development on the SEZ could reduce impacts on this species to negligible levels. In addition, avoiding or minimizing disturbance to occupied habitat in the area of direct effects or compensatory mitigation of direct effects on occupied habitats could reduce impacts. The potential for impact and need for mitigation should be determined in consultation with the USFWS and AZGFD.

TABLE 8.2.12.1-1 (Cont.)

Common Name	Scientific Name	Listing Status[a]	Habitat[b]	Maximum Area of Potential Habitat Affected[c]: Within SEZ (Direct Effects)[d]	Access Road (Direct Effects)[e]	Transmission Line ROW (Direct Effects)[e]	Indirect Effects (Outside SEZ)[f]	Overall Impact Magnitude[g] and Species-Specific Mitigation[h]
Birds (Cont.)								
Swainson's hawk	*Buteo swainsoni*	BLM-S; FWS-SC	Summer breeding resident in the SEZ region. Savanna, open pine-oak woodlands, grasslands, and cultivated lands. Nests in solitary trees, bushes, or small groves. Known to occur in Yavapai County, Arizona. About 1,880,500 acres of potentially suitable habitat occurs within the SEZ region.	156 acres of potentially suitable foraging or nesting habitat lost (<0.1% of available potentially suitable habitat)	7 acres of potentially suitable foraging or nesting habitat lost (<0.1% of available potentially suitable habitat)	7 acres of potentially suitable foraging or nesting habitat lost (<0.1% of available potentially suitable habitat)	32,300 acres of potentially suitable foraging or nesting habitat (1.7% of available potentially suitable habitat)	Small overall impact. Avoiding or minimizing disturbance to potentially suitable nesting habitats (riparian woodland) could reduce impacts. In addition, pre-disturbance surveys and avoiding or minimizing disturbance to occupied nesting habitat in the area of direct effects or compensatory mitigation of direct effects on occupied habitats could reduce impacts.

TABLE 8.2.12.1-1 (Cont.)

Common Name	Scientific Name	Listing Status[a]	Habitat[b]	Maximum Area of Potential Habitat Affected[c]: Within SEZ (Direct Effects)[d]	Access Road (Direct Effects)[e]	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; FWS-SC	Year-round resident in the SEZ region. 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.). Nearest quad-level occurrence is from the vicinity of Boulder Creek, approximately 33 mi north of the SEZ. About 3,971,500 acres of potentially suitable habitat occurs within the SEZ region.	7,230 acres of potentially suitable habitat lost (0.2% of available potentially suitable habitat)	36 acres of potentially suitable habitat lost (<0.1% of available potentially suitable habitat)	153 acres of potentially suitable habitat lost (<0.1% of available potentially suitable habitat)	102,650 acres of potentially suitable habitat (2.6% of available potentially suitable habitat)	Small overall impact on foraging and nesting habitat. Pre-disturbance surveys and avoiding or minimizing disturbance to occupied burrows in the area of direct effects or compensatory mitigation of direct effects on occupied habitats could reduce impacts.
Mammals								
California leaf-nosed bat	*Macrotus californicus*	BLM-S; AZ-WSC; FWS-SC	Year-round resident in SEZ region in desert riparian, desert wash, desert scrub, and palm oasis habitats at elevations below 2,000 ft. Roosts in mines, caves, and buildings. Quad-level occurrences intersect the SEZ, the road corridor, and portions of the area of indirect effects. About 3,131,500 acres of potentially suitable habitat occurs within the SEZ region.	7,230 acres of potentially suitable foraging habitat lost (0.2% of available potentially suitable habitat)	26 acres of potentially suitable foraging habitat lost (<0.1% of available potentially suitable habitat)	144 acres of potentially suitable foraging habitat lost (<0.1% of available potentially suitable habitat)	88,750 acres of potentially suitable habitat (2.8% of available potentially suitable habitat)	Small overall impact. No direct impact on roost habitat. Avoidance of direct impacts on all foraging habitat is not feasible because suitable foraging habitat is widespread in the area of direct effects.

TABLE 8.2.12.1-1 (Cont.)

				Maximum Area of Potential Habitat Affected[c]				
Common Name	Scientific Name	Listing Status[a]	Habitat[b]	Within SEZ (Direct Effects)[d]	Access Road (Direct Effects)[e]	Transmission Line ROW (Direct Effects)[e]	Indirect Effects (Outside SEZ)[f]	Overall Impact Magnitude[g] and Species-Specific Mitigation[h]
Mammals (Cont.)								
Cave myotis	*Myotis velifer*	FWS-SC	Lower Colorado River Basin in desert scrub, shrublands, washes, and riparian habitats. Roosts in colonies in caves. Quad-level occurrences intersect the SEZ, the road corridor, and portions of the area of indirect effects. About 4,186,000 acres of potentially suitable habitat occurs within the SEZ region.	6,200 acres of potentially suitable foraging habitat lost (0.1% of available potentially suitable habitat)	31 acres of potentially suitable foraging habitat lost (<0.1% of available potentially suitable habitat)	23 acres of potentially suitable foraging habitat lost (<0.1% of available potentially suitable habitat)	79,600 acres of potentially suitable habitat (1.9% of available potentially suitable habitat)	Small overall impact. No direct impact on roost habitat. Avoidance of direct impacts on all foraging habitat is not feasible because suitable foraging habitat is widespread in the area of direct effects.
Townsend's big-eared bat	*Corynorhinus townsendii*	BLM-S; FWS-SC	Year-round resident in SEZ region near forests and shrubland habitats below 9,000-ft elevation throughout the SEZ region. Roosts and hibernates in caves, mines, and buildings. Nearest quad-level occurrence is from the vicinity of Burro Creek, approximately 28 mi northwest of the SEZ. About 4,440,500 acres of potentially suitable habitat occurs within the SEZ region.	6,200 acres of potentially suitable foraging habitat lost (0.1% of available potentially suitable habitat)	31 acres of potentially suitable foraging habitat lost (<0.1% of available potentially suitable habitat)	23 acres of potentially suitable foraging habitat lost (<0.1% of available potentially suitable habitat)	79,800 acres of potentially suitable habitat (1.8% of available potentially suitable habitat)	Small overall impact. No direct impact on roost habitat. Avoidance of direct impacts on all foraging habitat is not feasible because suitable foraging habitat is widespread in the area of direct effects.

TABLE 8.2.12.1-1 (Cont.)

Common Name	Scientific Name	Listing Status[a]	Habitat[b]	Maximum Area of Potential Habitat Affected[c]: Within SEZ (Direct Effects)[d]	Access Road (Direct Effects)[e]	Transmission Line ROW (Direct Effects)[e]	Indirect Effects (Outside SEZ)[f]	Overall Impact Magnitude[g] and Species-Specific Mitigation[h]
Mammals (Cont.)								
Western red bat	*Lasiurus blossevillii*	BLM-S; AZ-WSC	Year-round resident in SEZ region. Forages in riparian and other wooded areas. Roosts primarily in cottonwood trees along riparian areas and in fruit orchards. Nearest quad-level occurrence is from the vicinity of the Hassayampa River, approximately 23 mi east of the SEZ. About 19,700 acres of potentially suitable habitat occurs within the SEZ region.	29 acres of potentially suitable foraging or roosting habitat lost (0.1% of available potentially suitable habitat)	0 acres	0 acres	141 acres of potentially suitable foraging or roosting habitat (0.7% of available potentially suitable habitat)	Small overall impact. Avoiding or minimizing disturbance to riparian woodlands on the SEZ could reduce impacts on foraging or roosting habitat. In addition, pre-disturbance surveys and avoiding or minimizing disturbance to occupied roosts in the area of direct effects or compensatory mitigation of direct effects on occupied habitats could reduce impacts.

TABLE 8.2.12.1-1 (Cont.)

Common Name	Scientific Name	Listing Status[a]	Habitat[b]	Maximum Area of Potential Habitat Affected[c]: Within SEZ (Direct Effects)[d]	Access Road (Direct Effects)[e]	Transmission Line ROW (Direct Effects)[e]	Indirect Effects (Outside SEZ)[f]	Overall Impact Magnitude[g] and Species-Specific Mitigation[h]
Mammals (Cont.)								
Western yellow bat	*Lasiurus xanthinus*	BLM-S; AZ-WSC; AZ-S2	Year-round resident in the SEZ region in desert riparian, desert wash, and palm oasis habitats at elevations below 2,000 ft. Roosts in trees. Nearest quad-level occurrence is from the vicinity of the Hassayampa River, approximately 23 mi east of the SEZ. About 3,676,000 acres of potentially suitable habitat occurs within the SEZ region.	7,230 acres of potentially suitable foraging or roosting habitat lost (0.2% of available potentially suitable habitat)	36 acres of potentially suitable foraging or roosting habitat lost (<0.1% of available potentially suitable habitat)	154 acres of potentially suitable foraging or roosting habitat lost (<0.1% of available potentially suitable habitat)	102,300 acres of potentially suitable foraging or roosting habitat (2.8% of available potentially suitable habitat)	Small overall impact. Avoiding or minimizing disturbance to riparian woodlands on the SEZ could reduce impacts on foraging or roosting habitat. In addition, pre-disturbance surveys and avoiding or minimizing disturbance to occupied roosting areas in the area of direct effects or compensatory mitigation of direct effects on occupied habitats could reduce impacts.
Yuma myotis	*Myotis yumanensis*	FWS-SC	Year-round resident in the SEZ region in montane forest habitats at elevations between 2,000 and 8,000 ft. Roosts in buildings, mines, caves, and crevices. Nearest quad-level occurrences are from the vicinity of Alamo Lake, approximately 18 mi northwest of the SEZ. About 4,588,000 acres of potentially suitable habitat occurs within the SEZ region.	6,250 acres of potentially suitable foraging habitat lost (0.1% of available potentially suitable habitat)	33 acres of potentially suitable foraging habitat lost (<0.1% of available potentially suitable habitat)	33 acres of potentially suitable foraging habitat lost (<0.1% of available potentially suitable habitat)	84,200 acres of potentially suitable foraging habitat (1.8% of available potentially suitable habitat)	Small overall impact. No direct impact on roost habitat. Avoidance of direct impacts on all foraging habitat is not feasible because suitable foraging habitat is widespread in the area of direct effects.

Footnotes on next page.

TABLE 8.2.12.1-1 (Cont.)

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[a] AZ-S1 = ranked as S1 in the State of Arizona; AZ-S2 = ranked as S2 in the state of Arizona; AZ-SR = salvage restricted plant species under the Arizona Native Plant Law; AZ-WSC = listed as a wildlife species of concern in the State of Arizona; BLM-S = listed as a sensitive species by the BLM; ESA-T = listed as threatened under the ESA; ESA-UR = under review for listing under the ESA; FWS-SC = USFWS species of concern.

[b] For plant species, potentially suitable habitat was determined by using SWReGAP land cover types. For terrestrial vertebrate species, 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.

[c] 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.

[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 access road development, direct effects were estimated within a 5-mi (8-km), 60-ft (18-m) wide road corridor from the SEZ to the nearest existing state or federal highway. For transmission ROW development, direct effects were estimated within a 5-mi (8-km), 250-ft (76-m) wide ROW from the SEZ to the nearest existing transmission line. Direct impacts within these areas were determined from the proportion of potentially suitable habitat within the 1-mi (1.6-km) wide access road and transmission corridors.

[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 portions of the access road and transmission corridors where ground-disturbing activities would not occur. Indirect effects include effects from groundwater withdrawal, 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. Indirect effects on groundwater-dependent species were considered outside these defined areas.

[g] 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.

[h] 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.

[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 within 5 mi (8 km) of the SEZ boundary.

On the basis of ANHP records, quad-level occurrences for the following eight special status species intersect the affected area of the Bullard Wash SEZ: desert pupfish, Gila topminnow, lowland leopard frog, Sonoran desert tortoise, Gila monster, Mojave shovel-nosed snake, California leaf-nosed bat, and cave myotis. These species are indicated in bold text in Table 8.2.12.1-1.

8.2.12.1.1 Species Listed under the Endangered Species Act That Could Occur in the Affected Area

In its scoping comments on the proposed Bullard Wash SEZ (Stout 2009), the USFWS expressed concern for impacts of project development within the SEZ on suitable habitat for the Gila topminnow—a species listed as endangered under the ESA. In addition to this species, there are four other species listed under the ESA that have potentially suitable habitat within the affected area: Arizona cliff rose (endangered), desert pupfish (endangered), Sonoran population of the bald eagle (threatened), and southwestern willow flycatcher (endangered). Of these species, the desert pupfish and Gila topminnow have historical quad-level occurrences within the affected area in the Tres Alamos Spring system, approximately 5 mi (8 km) north of the SEZ. These five species are discussed below, and information on their habitat is presented in Table 8.2.12.1-1; additional basic information on life history, habitat needs, and threats to populations of these species is provided in Appendix J.

Arizona Cliff Rose

The Arizona cliff rose is a perennial shrub endemic to central Arizona. This species is currently listed as endangered under the ESA. This species occurs on rolling, rocky, limestone hills, and slopes within Sonoran Desert scrub communities. This species inhabits a unique plant community on limestone soils, which is commonly composed of creosotebush (*Larrea tridentata*), Wright lippia (*Aloysia wrightii*), desert trumpet (*Baileya multiradiata*), snakeweed (*Gutierrezia sarothrae*), Indian ricegrass (*Oryzopsis hymenoides*), and ocotillo (*Fouquieria splendens*). The Arizona cliff rose occurs at elevations between 2,100 and 4,000 ft (640 and 1,220 m). The nearest known quad-level occurrence of this species is from the vicinity of Burro Creek, approximately 24 mi (38 km) north of the SEZ. According to the SWReGAP land cover model, potentially suitable desert scrub habitat may occur on the SEZ and within portions of the affected area. Critical habitat for this species has not been designated.

Desert Pupfish

The desert pupfish is a small fish that is listed as endangered under the ESA. Natural populations of this species have been extirpated from Arizona; however, populations have been introduced in several locations in Graham, Santa Cruz, and Yavapai Counties. Within Arizona, this species inhabits shallow waters of springs, small streams, and marshes at elevations below 4,920 ft (1,500 m). Historical quad-level occurrences of this species are known within the affected area of the Bullard Wash SEZ in Tres Alamos Spring, approximately 5 mi (8 km) north of the SEZ (Figure 8.2.12.1-1). This population is now considered extirpated, and the species is not currently known to occur within the SEZ region. However, currently unoccupied, aquatic habitat associated with the Tres Alamos Spring may represent potentially suitable habitat for this species. Tres Alamos Spring is supported by groundwater that may also be used to support solar energy development within the SEZ (Table 8.2.12.1-1). Designated critical habitat for this species does not occur within the SEZ region.

Gila Topminnow

The Gila topminnow is a small fish that is listed as endangered under the ESA. Current populations are known in Arizona from a few localities in the Gila River drainage and in one locality in the Bill Williams River drainage. This species inhabits headwater springs and vegetated margins and backwater areas of intermittent and perennial streams and rivers. Historical quad-level occurrences of this species are known within the affected area of the Bullard Wash SEZ in Tres Alamos Spring, approximately 5 mi (8 km) north of the SEZ (Figure 8.2.12.1-1). This population is now considered extirpated. The nearest currently known population is from Yerba Mansa Spring near the Santa Maria River, approximately 15 mi (24 km) north of the SEZ. According to the USFWS (Stout 2009), this population in Yerba Mansa Spring may be affected by project developments within the SEZ, especially if groundwater withdrawals to serve development on the SEZ affect surface discharge in the spring system. In addition, although currently unoccupied, aquatic habitat associated with Tres Alamos Spring may represent potentially suitable habitat for this species. This spring is supported by groundwater that may also be used to support solar energy development within the SEZ (Table 8.2.12.1-1). Critical habitat for this species has not been designated.

Sonoran Bald Eagle

The Sonoran population of the bald eagle is currently listed as threatened under the ESA, although recent findings by the USFWS have indicated that listing for this species is not warranted (USFWS 2010b). According to ANHP records, the species is known to occur in the vicinity of Alamo Lake, approximately 18 mi (29 km) northwest of the SEZ (Figure 8.2.12.1-1). This species is primarily known to occur in riparian habitats associated with larger permanent water bodies such as lakes, rivers, and reservoirs. However, it may occasionally forage in arid shrubland habitats. According to the SWReGAP habitat suitability model, approximately 85,900 acres (348 km^2) of potentially suitable winter foraging habitat for the Sonoran population of the bald eagle may occur in the affected area of the Bullard Wash SEZ (Table 8.2.12.1-1). Because there are no permanent surface water features and little riparian habitat (150 acres [0.6 km^2]) in the affected area, most of this potentially suitable foraging habitat is represented by shrubland. Critical habitat has not been designated for this species.

Southwestern Willow Flycatcher

The southwestern willow flycatcher is a small neotropical migrant bird that inhabits riparian shrublands, woodlands, and thickets in the southwestern United States. The nearest recorded occurrence of this species is from Alamo Lake, approximately 12 mi (19 km) northwest of the SEZ (Figure 8.2.12.1-1). Potentially suitable riparian habitats for breeding and foraging may be dependent upon surface discharges from the regional groundwater system that may be used to support solar energy development on the SEZ. According to the SWReGAP habitat suitability model, approximately 29 acres (0.1 km^2) of potentially suitable riparian habitat may occur in the area of direct effects. Approximately 28 acres (0.1 km^2) of potentially suitable habitat may also occur within the area of indirect effects (Table 8.2.12.1-1). About 4,660 acres (19 km^2) of designated critical habitat for this species exists within the SEZ region outside of the affected area approximately 35 mi (56 km) northwest of the SEZ along the Big Sandy River.

8.2.12.1.2 Species That Are Candidates for Listing under the ESA

In its scoping comments on the proposed Bullard Wash SEZ (Stout 2009), the USFWS did not express concern for impacts of project development within the SEZ on any species that are candidates for listing under the ESA. There are no ANHP records or potentially suitable habitats for any ESA candidate species within the affected area.

8.2.12.1.3 Species That Are under Review for Listing under the ESA

In its scoping comments on the proposed Bullard Wash SEZ (Stout 2009), the USFWS identified one species under ESA review that may be directly or indirectly affected by solar energy development on the SEZ—the Sonoran population of the desert tortoise. This distinct population segment of desert tortoise occurs south and east of the Colorado River (Mojave populations north and west of the Colorado River are currently listed as threatened under the ESA, but are outside of the affected area of the Bullard Wash SEZ). The Sonoran population of the desert tortoise was petitioned for listing under the ESA on October 9, 2008 (WildEarth Guardians and Western Watersheds Project 2008). Quad-level occurrences for this species intersect the Bullard Wash SEZ and other portions of the affected area (Figure 8.2.12.1-1). According to the SWReGAP land cover model, approximately 3,848 acres (16 km^2) of potentially suitable habitat for this species occurs on the SEZ; approximately 84,500 acres (342 km^2) of potentially suitable habitat occurs in the area of indirect effects (Table 8.2.12.1-1). The USGS desert tortoise model (Nussear et al. 2009) does not encompass the same geographic area as the Bullard Wash SEZ; however, BLM-developed Category I and Category III habitats for the Sonoran desert tortoise exist immediately south of the SEZ. Category II habitats occur north of the SEZ within the area of indirect effects. There are no BLM-developed habitat categories on the SEZ, but Category III habitat does occur in the access road corridor. These BLM habitat categories are used for BLM planning and land management (as reviewed in the WildEarth Guardians and Western Watersheds Project [2008]). Category I habitats are the most essential for the maintenance of large long-term populations; Category II habitats are intermediate in the maintenance of large long-term populations; Category III habitats are not essential to the maintenance of viable long-term populations and are identified to limit further declines in the population size to the extent practical. Additional basic information on life history, habitat needs, and threats to populations of these species is provided in Appendix J.

8.2.12.1.4 BLM-Designated Sensitive Species

A total of 17 BLM-designated sensitive species may occur in the affected area of the Bullard Wash SEZ (Table 8.2.12.1-1). These BLM-designated sensitive include the following: (1) plants—Aravaipa wood fern, Arizona giant sedge, Hohokam agave, Parish's phacelia, and Pima Indian mallow; (2) amphibian—lowland leopard frog; (3) reptile—desert rosy boa and desert tortoise; (4) birds—American peregrine falcon, ferruginous hawk, snowy egret, Swainson's hawk, and western burrowing owl; and (5) mammals—California leaf-nosed bat, Townsend's big-eared bat, western red bat, and western yellow bat. Of these BLM-designated sensitive species with potentially suitable habitat in the affected area, only quad-level occurrences of the lowland leopard frog, desert tortoise, and California leaf-nosed bat intersect the affected area of the Bullard Wash SEZ. Habitats in which BLM-designated sensitive 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 8.2.12.1-1. One of these species—the Sonoran desert tortoise—has been previously discussed because it is being reviewed for listing under the ESA (Section 8.2.12.1.3). All other BLM-designated sensitive species as related to the SEZ are described in the remainder of this section. Additional life history information for these species is provided in Appendix J.

Aravaipa Wood Fern

The Aravaipa wood fern is a perennial fern that is known from southern Arizona and southeastern California. It occurs in shady canyon areas and along riparian habitats such as washes, rivers, seeps, and meadows at elevations between 2,200 and 4,500 ft (670 and 1,372 m). Nearest quad-level occurrences of this species are approximately 8 mi (13 km) northwest of the SEZ. Although it is not known to occur in the affected area, potentially suitable desert wash and riparian habitat may occur in the SEZ (Table 8.2.12.1-1).

Arizona Giant Sedge

The Arizona giant sedge is a perennial sedge that is known from Arizona and southwestern New Mexico. It occurs in shady south-facing exposures of gravelly substrates near springs and streams. Nearest quad-level occurrences of this species are approximately 22 mi (35 km) east of the SEZ. Although it is not known to occur in the affected area, potentially suitable desert wash and riparian habitat may occur in the SEZ and other portions of the affected area (Table 8.2.12.1-1).

Hohokam Agave

The Hohokam agave is a perennial shrub endemic to Arizona and adjacent Sonora, Mexico. It occurs on desert benches or alluvial terraces near bajadas, washes, or other major drainages in desert scrub communities. Nearest quad-level occurrences of this species are approximately 23 mi (37 km) east of the SEZ. Although it is not known to occur in the affected area, potentially suitable desert wash and riparian habitat may occur in the SEZ and other portions of the affected area (Table 8.2.12.1-1).

Parish's Phacelia

The Parish's phacelia is an annual forb that is known from Arizona, California, and Nevada. It is a wetland-dependent species, occurring in moist to superficially dry soils in valley bottoms, lake deposits, and playa edges. Nearest quad-level occurrences of this species are approximately 24 mi (38 km) north of the SEZ. Although it is not known to occur in the affected area, potentially suitable desert wash and riparian habitat may occur in the SEZ and other portions of the affected area (Table 8.2.12.1-1).

Pima Indian Mallow

The Pima Indian mallow is a perennial shrub endemic to Arizona and adjacent Sonora, Mexico. It occurs on hillsides, cliff bases, canyon bottoms, and washes. Nearest quad-level occurrences of this species are approximately 24 mi (38 km) north of the SEZ. Although it is not known to occur in the affected area, potentially suitable desert wash and riparian habitat may occur in the SEZ and other portions of the affected area (Table 8.2.12.1-1).

Lowland Leopard Frog

The lowland leopard frog is a medium-sized frog primarily known from central and southern Arizona, although the species is also known to occur in western New Mexico and northern Mexico. It inhabits aquatic to mesic systems such as grasslands, pinyon-juniper forests, agricultural areas, lakes, streams, and reservoirs. Nearest quad-level occurrences of this species intersect the affected area of the Bullard Wash SEZ. Occurrences of this species are known from Date Creek, as near as 5 mi (8 km) northeast of the SEZ. According to the SWReGAP habitat suitability model, potentially suitable habitat for this species occurs on the SEZ and throughout portions of the affected area (Table 8.2.12.1-1).

Desert Rosy Boa

The desert rosy boa is a snake known from Arizona and southeastern California. This snake inhabits arid scrublands, rocky deserts, and canyons near washes or streams. Nearest quad-level occurrences of this species are from the Santa Maria River, approximately 15 mi (24 km) northwest of the SEZ. According to the SWReGAP habitat suitability model, potentially suitable habitat for this species occurs on the SEZ and throughout portions of the affected area (Table 8.2.12.1-1).

American Peregrine Falcon

The American peregrine falcon is known throughout the western United States from 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 recorded quad-level occurrences of this species are from the vicinity of Alamo Lake, approximately 18 mi (29 km) northwest of the SEZ (Table 8.2.12.1-1). According to the SWReGAP habitat suitability model, potentially suitable year-round foraging and nesting habitat for the American peregrine falcon may occur within the affected area of the Bullard Wash SEZ. However, on the basis of an evaluation of SWReGAP land cover types, there is no suitable nesting habitat (cliffs or outcrops) within the affected area.

Ferruginous Hawk

The ferruginous hawk is known to occur throughout the western United States. According to the SWReGAP habitat suitability model, only potentially suitable winter foraging habitat for this species may occur within the affected area of the Bullard Wash SEZ. This species inhabits open grasslands, sagebrush flats, desert scrub, and the edges of pinyon-juniper woodlands. Nearest recorded quad-level occurrences of this species are from the vicinity of Boulder Creek, approximately 33 mi (53 km) north of the SEZ. According to the SWReGAP habitat suitability model, suitable habitat for this species does not occur within the area of direct effects; however, potentially suitable foraging habitat occurs in portions of the area of indirect effects outside of the SEZ (Table 8.2.12.1-1).

Snowy Egret

The snowy egret is considered to be a year-round resident in the lower Colorado River Valley in southwestern Arizona and southeastern California. This species is primarily associated with open water areas such as marshes, lakes, ponds, and reservoirs. Nearest recorded quad-level occurrences of this species are from the Hassayampa River, approximately 23 mi (37 km) east of the SEZ. According to the SWReGAP habitat suitability model, potentially suitable year-round habitat may occur on the SEZ, access road and transmission corridors, as well as portions of the area of indirect effects (Table 8.2.12.1-1). There are no permanent surface water features in the affected area that may provide suitable habitat; therefore, this species may only occur in the area of direct effects as a transient. However, aquatic and riparian habitats outside the area of direct effects that may be potentially suitable for breeding and foraging could be dependent upon surface discharges from the regional groundwater system that may be used to support solar energy development on the SEZ.

Swainson's Hawk

The Swainson's hawk occurs throughout the southwestern United States. According to the SWReGAP habitat suitability model, potentially suitable summer foraging or nesting habitat may occur in the Bullard Wash SEZ region. This species inhabits desert, savanna, open pine-oak woodland, grassland, and cultivated habitats. Nests are typically constructed in solitary trees, bushes, or small groves. This species is known to occur in Yavapai County, Arizona, and potentially suitable foraging habitat occurs in the area of direct effects and in other portions of the affected area (Table 8.2.12.1-1). On the basis of an evaluation of SWReGAP land cover types, approximately 15 acres (<0.1 km^2) of riparian woodland habitat that may be potentially suitable nesting habitat could occur on the SEZ. In addition to potentially suitable riparian woodland habitats, approximately 155 acres (0.6 km^2) of pinyon-juniper woodland habitat that may be potentially suitable nesting habitat occurs in the area of indirect effects.

Western Burrowing Owl

The western burrowing owl is known to occur in the SEZ region, where it forages in grasslands, shrublands, and open disturbed areas. According to the SWReGAP habitat suitability model for the western burrowing owl, potentially suitable year-round foraging and nesting habitat may occur in the affected area of the Bullard Wash SEZ. The species nests in burrows usually constructed by mammals. Nearest recorded quad-level occurrences of this species are from the vicinity of Boulder Creek, approximately 33 mi (53 km) north of the SEZ. Potentially suitable foraging and breeding habitat is expected to occur in the area of direct effects and in other portions of the affected area (Table 8.2.12.1-1). The availability of nest sites (burrows) within the affected area has not been determined, but shrubland habitat that may be suitable for either foraging or nesting occurs throughout the affected area.

California Leaf-Nosed Bat

The California leaf-nosed bat is a large-eared bat with a leaflike flap of protective skin on the tip of its nose. It primarily occurs along the Colorado River from southern Nevada, through Arizona and California, to Baja California and Sinaloa Mexico. The species forages in a variety of desert habitats, including desert riparian, desert wash, desert scrub, and palm oasis. It roosts in caves, crevices, and mines. Quad-level occurrences of this species intersect the affected area of the Bullard Wash SEZ. According to the SWReGAP habitat suitability model, potentially suitable year-round foraging habitat for this species may occur on the SEZ, portions of the access road and transmission corridors, and throughout the affected area (Table 8.2.12.1-1). On the basis of an evaluation of SWReGAP land cover types, however, there is no suitable roosting habitat (rocky cliffs and outcrops) within the affected area.

Townsend's Big-Eared Bat

The Townsend's big-eared bat is a year-round resident in the Bullard Wash SEZ region where it forages in a wide variety of desert and nondesert habitats. The species roosts in caves, mines, tunnels, buildings, and other man-made structures. Nearest recorded occurrences of this species are approximately 28 mi (45 km) northwest of the SEZ. According to the SWReGAP habitat suitability model, potentially suitable year-round foraging habitat for this species may occur on the SEZ, portions of the access road and transmission corridors, and throughout the area of indirect effects (Table 8.2.12.1-1). On the basis of an evaluation of SWReGAP land cover types, however, there is no suitable roosting habitat (rocky cliffs and outcrops) within the affected area.

Western Red Bat

The western red bat is an uncommon year-round resident in the Bullard Wash SEZ region where it forages in desert riparian and other woodland areas. This species may occasionally forage in desert shrubland habitats. The species primarily roosts in cottonwood trees in riparian areas. Nearest recorded occurrences of this species are from the Hassayampa River, approximately 23 mi (37 km) east of the SEZ. According to the SWReGAP habitat suitability model, potentially suitable year-round foraging habitat for this species may occur on the SEZ and throughout portions of the affected area (Table 8.2.12.1-1). On the basis of an evaluation of SWReGAP land cover types, approximately 15 acres (<0.1 km^2) of riparian woodland habitat that may be potentially suitable roosting habitat could occur on the SEZ.

Western Yellow Bat

The western yellow bat is an uncommon year-round resident in the Bullard Wash SEZ region where it forages in desert riparian and desert oasis habitats. The species roosts in trees. Nearest recorded occurrences of this species are from the Hassayampa River, approximately 23 mi (37 km) east of the SEZ. According to the SWReGAP habitat suitability model, potentially suitable year-round foraging habitat for this species may occur on the SEZ, portions of the access road and transmission corridors, and throughout the affected area (Table 8.2.12.1-1). On the basis of an evaluation of SWReGAP land cover types, approximately 15 acres (<0.1 km^2) of riparian woodland habitat that may be potentially suitable roosting habitat could occur on the SEZ.

8.2.12.1.5 State-Listed Species

There are 21 species listed by the State of Arizona that may occur in the Bullard Wash SEZ affected area (Table 8.2.12.1-1). These state-listed species include the following: (1) plants—Arizona cliff rose, Bigelow onion, golden barrel cactus, Hohokam agave, McKelvey's agave, Parish alkali grass, Pima Indian mallow, and straw-top cholla; (2) fish—desert pupfish and Gila topminnow; (3) amphibian—lowland leopard frog; (4) reptiles—Arizona skink and Sonoran desert tortoise; (5) birds—American peregrine falcon, Sonoran bald eagle, ferruginous hawk, snowy egret, and southwestern willow flycatcher; and (5) mammals—California leaf-nosed bat, western red bat, and western yellow bat. All of these species are protected in Arizona under the Arizona Native Plant Law or by the AZGFD as Wildlife of Special Concern (WSC). Of these species, the following six species have not been previously described as ESA-listed (Section 8.2.12.1.1), under review for ESA listing (Section 8.2.12.1.3), or BLM-designated sensitive (Section 8.2.12.1.4): Bigelow onion, golden barrel cactus, McKelvey's agave, Parish alkali grass, straw-top cholla, and Arizona skink. These species as related to the SEZ are described in this section and Table 8.2.12.1-1. Additional life history information for these species is provided in Appendix J.

Bigelow Onion

The Bigelow onion is a perennial herb known from central Arizona, southern Nevada, and southwestern New Mexico. This species occurs on dry rocky slopes in grasslands, chaparral, and Sonoran–Mojave desert scrub communities. Nearest quad-level occurrences are from the Black Mountains approximately 10 mi (16 km) north of the Bullard Wash SEZ (Table 8.2.12.1-1). According to the SWReGAP land cover model, potentially suitable desert scrub habitat occurs within the SEZ, portions of the access road and transmission corridors, and throughout the area of indirect effects.

Golden Barrel Cactus

The golden barrel cactus is endemic to central Arizona. This species occurs on rocky hillsides, canyon walls, and in wash margins. Nearest quad-level occurrences are approximately 15 mi (24 km) north of the Bullard Wash SEZ (Table 8.2.12.1-1). According to the SWReGAP land cover model, potentially suitable desert riparian habitat occurs within the SEZ and portions of the area of indirect effects.

McKelvey's Agave

The McKelvey's agave is a perennial shrub endemic to central Arizona. This species occurs in dry desert scrubland at elevations between 3,000 and 6,000 ft (915 and 1,830 m). Nearest quad-level occurrences are approximately 15 mi (24 km) north of the Bullard Wash SEZ (Table 8.2.12.1-1). According to the SWReGAP land cover model, potentially suitable desert scrub habitat occurs within the SEZ, the access road and transmission corridors, and portions of the area of indirect effects.

Parish Alkali Grass

The Parish alkali grass is an annual grass that is known from Arizona, California, Nevada, and New Mexico. This species occurs in open saline areas on moist soils near springs.

Nearest quad-level occurrences are approximately 25 mi (40 km) north of the Bullard Wash SEZ (Table 8.2.12.1-1). According to the SWReGAP land cover model, potentially suitable desert riparian habitat occurs within the SEZ and portions of the area of indirect effects.

Straw-Top Cholla

The straw-top cholla is a perennial shrub-like cactus that is known from the southwestern United States. This species occurs on sandy or gravelly soils on desert flats, mesas, and washes. Nearest quad-level occurrences are approximately 10 mi (16 km) west of the Bullard Wash SEZ (Table 8.2.12.1-1). According to the SWReGAP land cover model, potentially suitable desert riparian habitat occurs on the SEZ and in portions of the area of indirect effects.

Arizona Skink

The Arizona skink is a subspecies of Gilbert's skink (*Eumeces gilberti*) that is known only from west–central Arizona. This species occurs in riparian and woodland areas among logs, rocks, and leaf litter near streams. Nearest quad-level occurrences are approximately 15 mi (24 km) east of the Bullard Wash SEZ (Table 8.2.12.1-1). According to the SWReGAP habitat suitability model, potentially suitable habitat for this species does not occur anywhere within the SEZ or within the access road or transmission corridors; however, some potentially suitable habitat may occur in the area of indirect effects.

8.2.12.1.6 Rare Species

There are 34 rare species (i.e., state rank of S1 or S2 in Arizona or a species of concern by the USFWS) that may be affected by solar energy development on the Bullard Wash SEZ (Table 8.2.12.1-1). Of these species, 10 rare species have not been discussed previously. These include the following: (1) plants—arid tansy-aster and Davidson sage; (2) invertebrate—Maricopa tiger beetle; (3) amphibian—Arizona toad; (4) reptiles—Arizona night lizard, Gila monster, and Mojave shovel-nosed snake; (5) bird—long-eared owl; and (6) mammals—cave myotis and Yuma myotis. These species as related to the SEZ are described in Table 8.2.12.1-1.

8.2.12.2 Impacts

The potential for impacts on special status species from utility-scale solar energy development within the proposed Bullard Wash SEZ is presented 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 8.2.12.1 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 8.2.12.3).

Solar energy development within the Bullard Wash SEZ could affect a variety of habitats (see Sections 8.2.9 and 8.2.10). These impacts on habitats could in turn affect special status species that are dependent on those habitats. Based on ANHP records, quad-level occurrences for the following eight species intersect the Bullard Wash affected area: desert pupfish, Gila topminnow, lowland leopard frog, Sonoran desert tortoise, Gila monster, Mojave shovel-nosed snake, California leaf-nosed bat, and cave myotis. Suitable habitat for the Gila topminnow, snowy egret, and southwestern willow flycatcher is known to occur approximately 15 mi (24 km) northwest of the SEZ boundary in spring-fed aquatic and riparian habitats near the Yerba Mansa Spring and Santa Maria River that could be affected by groundwater withdrawals from the Bullard Wash SEZ. Withdrawals from this regional groundwater system may also affect aquatic and riparian habitat associated with the Tres Alamos Spring, approximately 5 mi (8 km) north of the SEZ. Although currently unoccupied, this spring system represents historically occupied habitat for the desert pupfish and the Gila topminnow. This spring system may also support riparian habitat for the snowy egret and southwestern willow flycatcher. Withdrawals from this regional groundwater system may be needed to support construction and operations of solar energy facilities on the proposed Bullard Wash SEZ, which could in turn affect those special status species with habitats that are dependent on groundwater. 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 8.2.12.1, 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 on some special status species.

Potential direct and indirect impacts on special status species within the SEZ, access road, and transmission corridors, and in the area of indirect effect outside the SEZ are presented in Table 8.2.12.1-1. 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 8.2.1.2, it is assumed that a new 5-mi (8-km) long access road and a 5-mi (8-km) long transmission ROW would be created to connect existing infrastructure to the SEZ (Figure 8.2.12.1-1).

Direct impacts would result from habitat destruction or modification. It is assumed that direct impacts would occur only within the SEZ, access road corridor, and transmission corridor where ground-disturbing activities are expected to occur. Indirect impacts could result from depletions of groundwater resources, 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 developments 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, Section A.2.2) would reduce direct impacts on some special status species, especially those that depend on habitat types that can be easily avoided (e.g., desert riparian habitats). Indirect impacts on special status species could be reduced to negligible levels by implementing programmatic design features, especially those engineering controls that would reduce groundwater consumption, runoff, sedimentation, spills, and fugitive dust.

8.2.12.2.1 Impacts on Species Listed under the ESA

In its scoping comments on the proposed Bullard Wash SEZ (Stout 2009), the USFWS expressed concern for impacts of project development within the SEZ on suitable habitat for the Gila topminnow—a species listed as endangered under the ESA. In addition to this species, four other species listed under the ESA have potentially suitable habitat within the affected area: Arizona cliff rose, desert pupfish, Sonoran population of the bald eagle, and southwestern willow flycatcher. Impacts on these species are discussed below and summarized in Table 8.2.12.1-1.

Arizona Cliff Rose

The Arizona cliff rose is endemic to central Arizona and is currently listed as endangered under the ESA. This species inhabits rocky slopes and hillsides in Sonoran Desert scrub communities. This species is not known to occur within the affected area of the Bullard Wash SEZ. However, on the basis of SWReGAP land cover types, approximately 7,000 acres (28 km^2) of potentially suitable desert scrub habitat on the SEZ, 24 acres (0.1 km^2) of potentially suitable desert scrub habitat in the access road corridor, and 142 acres (0.6 km^2) of potentially suitable desert scrub habitat in the transmission corridor could be directly affected by construction and operations of solar energy development. This direct effects area represents about 0.5% of available suitable habitat in the region. About 58,750 acres (238 km^2) of suitable desert scrub habitat occurs in the area of potential indirect effects; this area represents about 4.5% of the available suitable habitat in the region (Table 8.2.12.1-1).

The overall impact on the Arizona cliff rose from construction, operation, and decommissioning of utility-scale solar energy facilities within the Bullard Wash 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 habitats for this species is not a feasible means of mitigating impacts because these habitats (desert scrub) are widespread throughout the area of direct effects. Pre-disturbance surveys and avoiding or minimizing disturbance to occupied habitats in the areas of direct effects would be the preferred method of mitigating impacts on this species. If avoidance or minimization is not feasible, translocation of individuals from areas of direct effect; or compensatory mitigation of direct effects on occupied habitats could reduce impacts. Development of actions to reduce impacts (e.g., reasonable and prudent alternatives, reasonable and prudent measures, and terms and conditions) on the Arizona cliff rose, including development of a survey protocol, avoidance measures, minimization measures, and, potentially, compensatory mitigation, would require consultation with the USFWS per Section 7 of the ESA. These consultations may also be used to develop incidental take statements per Section 10 of the ESA (if necessary). Consultation with AZGFD should also occur to determine any state mitigation requirements.

Desert Pupfish

The desert pupfish is listed as endangered under the ESA, and natural populations of this species are considered extirpated from Arizona. However, populations have been introduced in several locations throughout the state, and the species once occurred in Tres Alamos Spring, approximately 5 mi (8 km) north of the SEZ. Suitable habitat for this species does not occur in the area of direct effects; however, indirect impacts on potentially suitable habitat in the Tres Alamos Spring may be affected by groundwater withdrawals to serve development on the SEZ. It is estimated that less than 25 acres (0.1 km^2) of suitable aquatic habitat for this species exists at Tres Alamos Spring. This habitat represents about 0.1% of available potentially suitable habitat in the region. Other potentially suitable habitats throughout the region include the Bill Williams River, Santa Maria River, and Alamo Lake.

Impacts of groundwater depletion from solar energy development in the Bullard Wash SEZ cannot be quantified without identification of the cumulative amount of groundwater withdrawals needed to support development on the SEZ. Consequently, the overall impact on the desert pupfish could range from negligible to large and would depend in part on the solar energy technology deployed, the scale of development within the SEZ, the type of cooling system used, and the degree of influence water withdrawals in the SEZ would have on drawdown and surface water discharges in habitats supporting these species (Table 8.2.12.1-1). Avoiding or limiting groundwater withdrawals for solar energy development on the SEZ could reduce or eliminate impacts on this species. Because the species is considered extirpated from the SEZ region, the need for mitigation should first be discussed with the USFWS and AZGFD. If determined to be necessary, consultation would identify actions to reduce impacts (e.g., reasonable and prudent alternatives, reasonable and prudent measures, and terms and conditions) on the desert pupfish, including avoidance measures, minimization measures, and, potentially, compensatory mitigation. These consultations may also be used to develop incidental take statements per Section 10 of the ESA (if necessary).

Gila Topminnow

The Gila topminnow is listed as endangered under the ESA, and natural populations of this species are not known to occur within the SEZ region. However, populations have been introduced in several locations throughout the state, and the species is known to occur in an introduction site at Yerba Mansa Spring, approximately 15 mi (24 km) northwest of the SEZ. The species also once occurred in Tres Alamos Spring, approximately 5 mi (8 km) north of the SEZ. Suitable habitat for this species does not occur in the area of direct effects; however, indirect impacts on potentially suitable habitat in the Tres Alamos and Yerba Mansa Springs may be affected by groundwater withdrawals to serve development on the SEZ. It is estimated that less than 50 acres (0.2 km^2) of suitable aquatic habitat for this species exists in these two spring systems. This habitat represents about 0.1% of available suitable habitat in the region. Other potentially suitable habitats throughout the region include the Bill Williams River, Santa Maria River, and Alamo Lake.

Impacts of groundwater depletion from solar energy development in the Bullard Wash SEZ cannot be quantified without identification of the cumulative amount of groundwater withdrawals needed to support development on the SEZ. Consequently, the overall impact on the Gila topminnow could range from negligible to large and would depend in part on the solar energy technology deployed, the scale of development within the SEZ, the type of cooling system used, and the degree of influence water withdrawals in the SEZ would have on drawdown and surface water discharges in habitats supporting these species (Table 8.2.12.1-1). Avoiding or limiting groundwater withdrawals for solar energy development on the SEZ could reduce or eliminate impacts on this species. Development of actions to reduce impacts (e.g., reasonable and prudent alternatives, reasonable and prudent measures, and terms and conditions) on the desert pupfish, including avoidance measures, minimization measures, and, potentially, compensatory mitigation, would require consultation with the USFWS per Section 7 of the ESA. These consultations may also be used to develop incidental take statements per Section 10 of the ESA (if necessary). Consultation with AZGFD should also occur to determine any state mitigation requirements.

Sonoran Bald Eagle

The Sonoran population of the bald eagle is currently listed as threatened under the ESA[5] and is known to occur in the vicinity of Alamo Lake, approximately 18 mi (29 km) northwest of the SEZ (Figure 8.2.12.1-1). According to the SWReGAP habitat suitability model, only winter foraging habitat is expected to occur in the affected area of the Bullard Wash SEZ. Approximately 6,200 acres (25 km^2) of potentially suitable foraging habitat within the SEZ, 31 acres (0.1 km^2) of potentially suitable foraging habitat within the access road corridor, and 23 acres (0.1 km^2) of potentially suitable foraging habitat within the transmission corridor could be directly affected by construction and operations of solar energy development. This direct effects area represents about 0.2% of available suitable habitat in the region. About 79,600 acres

[5] A recent finding by the USFWS has indicated that listing of this species under the ESA is no longer warranted (USFWS 2010b).

(322 km^2) of suitable foraging habitat occurs in the area of potential indirect effects; this area represents about 2.0% of the available suitable habitat in the region (Table 8.2.12.1-1). On the basis of SWReGAP land cover data, there are no permanent surface water features and little riparian habitat (155 acres [0.6 km^2]) in the affected area. Therefore, most of this potentially suitable foraging habitat is desert shrubland.

The overall impact on the bald eagle from construction, operation, and decommissioning of utility-scale solar energy facilities within the Bullard Wash 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 potentially suitable foraging habitats for this species is not a feasible means of mitigating impacts because these habitats (desert scrub) are widespread throughout the area of direct effect and readily available in other portions of the affected area.

Development of actions to reduce impacts (e.g., reasonable and prudent alternatives, reasonable and prudent measures, and terms and conditions) on the Sonoran population of the bald eagle, including development of a survey protocol, avoidance measures, minimization measures, and, potentially, compensatory mitigation, would require consultation with the USFWS per Section 7 of the ESA. These consultations may also be used to develop incidental take statements per Section 10 of the ESA (if necessary). Consultation with AZGFD should also occur to determine any state mitigation requirements.

Southwestern Willow Flycatcher

The southwestern willow flycatcher is listed as endangered under the ESA and is known to occur near Alamo Lake, approximately 12 mi (<0.1 km) northwest of the SEZ. According to the SWReGAP habitat suitability model, approximately 29 acres (0.1 km^2) of potentially suitable habitat on the SEZ could be directly affected by construction and operations of solar energy development on the SEZ (Table 8.2.12.1-1). This direct effects area represents 0.1% of available suitable habitat of the southwestern willow flycatcher in the region. About 50 acres (0.2 km^2) of suitable habitat occurs in the area of potential indirect effects; this area represents about 0.1% of the available suitable habitat in the region (Table 8.2.12.1-1).

Riparian habitats on and in the vicinity of the Bullard Wash SEZ that may provide suitable nesting and foraging habitat for the southwestern willow flycatcher may be influenced by spring discharges associated with the regional groundwater system and may be affected by groundwater withdrawals to serve development on the Bullard Wash SEZ. As discussed for the desert pupfish and Gila topminnow, impacts on this species could range from small to large depending upon the solar energy technology deployed, the scale of development within the SEZ, and the cumulative rate of groundwater withdrawals (Table 11.2.12.1-1).

The implementation of programmatic design features, avoiding or minimizing disturbance of riparian habitats in the area of direct effects, and avoidance or limitations of groundwater withdrawals from the regional groundwater system could reduce impacts on the southwestern willow flycatcher to small or negligible levels. Impacts can be better quantified for specific projects once water needs are identified.

Development of actions to reduce impacts (e.g., reasonable and prudent alternatives, reasonable and prudent measures, and terms and conditions) on the southwestern willow flycatcher, including development of a survey protocol, avoidance measures, minimization measures, and, potentially, compensatory mitigation, would require consultation with the USFWS per Section 7 of the ESA. These consultations may also be used to develop incidental take statements per Section 10 of the ESA (if necessary). Consultation with AZGFD should also occur to determine any state mitigation requirements.

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

In its scoping comments on the proposed Bullard Wash SEZ (Stout 2009), the USFWS did not express concern for impacts of project development within the SEZ on any species that are candidates for listing under the ESA. There are no ANHP records or potentially suitable habitats for any ESA candidate species within the affected area.

8.2.12.2.3 Impacts on Species That Are under Review for Listing under the ESA

In its scoping comments on the proposed Bullard Wash SEZ (Stout 2009), the USFWS identified one species under ESA review that may be directly or indirectly affected by solar energy development on the SEZ—the Sonoran population of the desert tortoise. This distinct population segment of desert tortoise occurs south and east of the Colorado River (Mojave populations north and west of the Colorado River are currently listed as threatened under the ESA but are outside of the affected area of the Bullard Wash SEZ). Quad-level occurrences for this species intersect the Bullard Wash SEZ and other portions of the affected area (Figure 8.2.12.1-1). According to the SWReGAP habitat suitability model, approximately 6,225 acres (25 km^2) of potentially suitable habitat on the SEZ, 29 acres (0.1 km^2) of potentially suitable habitat within the access road corridor, and 32 acres (0.1 km^2) of potentially suitable habitat within the transmission corridor could be directly affected by construction and operations of solar energy development on the SEZ (Table 8.2.12.1-1). This direct effects area represents about 0.2% of available suitable habitat of the desert tortoise in the region. About 75,200 acres (304 km^2) of suitable habitat occurs in the area of potential indirect effects; this area represents about 2.7% of the available suitable habitat in the region (Table 8.2.12.1-1).

The overall impact on the Sonoran population of the desert tortoise from construction, operation, and decommissioning of utility-scale solar energy facilities within the Bullard Wash 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 alone is unlikely to reduce these impacts to negligible levels. Avoidance of potentially suitable habitats for this species is not a feasible means of mitigating impacts because these habitats (desert scrub) are widespread throughout the area of direct effect.

Development of actions to reduce impacts (e.g., reasonable and prudent alternatives, reasonable and prudent measures, and terms and conditions) for the desert tortoise, including a survey protocol, avoidance measures, minimization measures, and, potentially, translocation actions, and compensatory mitigation, should be conducted in coordination with the USFWS and AZDFG.

There are inherent dangers to tortoises associated with their capture, handling, and translocation from the SEZ. These actions, if done improperly, can result in injury or death. To minimize these risks, the desert tortoise translocation plan should be developed in consultation with the USFWS, and follow the *Guidelines for Handling Desert Tortoises during Construction Projects* (Desert Tortoise Council 1994) and other current translocation guidance provided by the USFWS or other state agencies. If considered appropriate, consultation will identify potentially suitable recipient locations, density thresholds for tortoise populations in recipient locations, procedures for pre-disturbance clearance surveys and tortoise handling, as well as disease testing and post-translocation monitoring and reporting requirements. Despite some risk of mortality or decreased fitness, translocation is widely accepted as a useful strategy for the conservation of the desert tortoise (Field et al. 2007).

To offset impacts of solar development on the SEZ, compensatory mitigation may be needed to balance the acreage of habitat lost with the acquisition of lands that would be improved and protected for desert tortoise populations (USFWS 1994). Compensation can be accomplished by improving the carrying capacity for the desert tortoise on the acquired lands. Other mitigation actions may include funding for the enhancement of desert tortoise habitat on existing federal lands. Coordination with the USFWS and AZGFD would be necessary to determine the appropriate mitigation ratio to acquire, enhance, and preserve desert tortoise compensation lands.

8.2.12.2.4 Impacts on BLM-Designated Sensitive Species

There are 16 BLM-designated sensitive species that are not previously discussed as listed under the ESA or under review for ESA listing. Impacts on these BLM-designated sensitive species that may be affected by solar energy development on the Bullard Wash SEZ are discussed below.

Aravaipa Wood Fern

The Aravaipa wood fern is not known to occur in the affected area of the Bullard Wash SEZ; however, approximately 15 acres (<0.1 km^2) of potentially suitable riparian habitat on the SEZ may be directly affected by construction and operations of solar energy development on the SEZ (Table 8.2.12.1-1). This direct effects area represents about less than 0.1% of available suitable habitat in the region. About 145 acres (0.6 km^2) of potentially suitable riparian habitat occurs in the area of potential indirect effects; this area represents about 0.7% of the available suitable habitat in the region (Table 8.2.12.1-1).

The overall impact on the Aravaipa wood fern from construction, operation, and decommissioning of utility-scale solar energy facilities within the Bullard Wash SEZ is considered small because less than 1% of potentially suitable habitat for this species occurs in the area of direct effects. The implementation of programmatic design features is expected to be sufficient to reduce indirect impacts to negligible levels.

Avoiding or minimizing disturbance to riparian habitats in the area of direct effects could reduce direct impacts on this species to negligible levels. Alternatively, impacts could be reduced by conducting pre-disturbance surveys and avoiding or minimizing disturbance of occupied habitats in the area of direct effects. If avoidance or minimization is not a feasible option, plants 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.

Arizona Giant Sedge

The Arizona giant sedge is not known to occur in the affected area of the Bullard Wash SEZ; however, approximately 15 acres (<0.1 km^2) of potentially suitable riparian habitat on the SEZ may be directly affected by construction and operations of solar energy development on the SEZ (Table 8.2.12.1-1). This direct effects area represents about less than 0.1 % of available suitable habitat in the region. About 145 acres (0.6 km^2) of potentially suitable riparian habitat occurs in the area of potential indirect effects; this area represents about 0.7% of the available suitable habitat in the region (Table 8.2.12.1-1).

The overall impact on the Arizona giant sedge from construction, operation, and decommissioning of utility-scale solar energy facilities within the Bullard Wash SEZ is considered small because less than 1% of potentially suitable habitat for this species occurs in the area of direct effects. The implementation of programmatic design features is expected to be sufficient to reduce indirect impacts to negligible levels. Avoiding or minimizing disturbance to riparian habitats in the area of direct effects and the implementation of other mitigation measures described previously for the Aravaipa wood fern could reduce direct impacts on this species to negligible levels. 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.

Hohokam Agave

The Hohokam agave is not known to occur in the affected area of the Bullard Wash SEZ; however, approximately 15 acres (<0.1 km^2) of potentially suitable riparian habitat on the SEZ may be directly affected by construction and operations of solar energy development on the SEZ (Table 8.2.12.1-1). This direct effects area represents about less than 0.1% of available suitable habitat in the region. About 145 acres (0.6 km^2) of potentially suitable riparian habitat occurs in the area of potential indirect effects; this area represents about 0.7% of the available suitable habitat in the region (Table 8.2.12.1-1).

The overall impact on the Hohokam agave from construction, operation, and decommissioning of utility-scale solar energy facilities within the Bullard Wash SEZ is considered small because less than 1% of potentially suitable habitat for this species occurs in the area of direct effects. The implementation of programmatic design features is expected to be sufficient to reduce indirect impacts to negligible levels. Avoiding or minimizing disturbance to riparian habitats in the area of direct effects and the implementation of other mitigation measures described previously for the Aravaipa wood fern could reduce direct impacts on this species to negligible levels. 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.

Parish's Phacelia

The Parish's phacelia is not known to occur in the affected area of the Bullard Wash SEZ; however, approximately 15 acres (<0.1 km^2) of potentially suitable riparian habitat on the SEZ may be directly affected by construction and operations of solar energy development on the SEZ (Table 8.2.12.1-1). This direct effects area represents less than 0.1% of available suitable habitat in the region. About 145 acres (0.6 km^2) of potentially suitable riparian habitat occurs in the area of potential indirect effects; this area represents about 0.7% of the available suitable habitat in the region (Table 8.2.12.1-1).

The overall impact on the Parish's phacelia from construction, operation, and decommissioning of utility-scale solar energy facilities within the Bullard Wash SEZ is considered small because less than 1% of potentially suitable habitat for this species occurs in the area of direct effects. The implementation of programmatic design features is expected to be sufficient to reduce indirect impacts to negligible levels. Avoiding or minimizing disturbance to riparian habitats in the area of direct effects and the implementation of other mitigation measures described previously for the Aravaipa wood fern could reduce direct impacts on this species to negligible levels. 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.

Pima Indian Mallow

The Pima Indian mallow is not known to occur in the affected area of the Bullard Wash SEZ; however, approximately 15 acres (<0.1 km^2) of potentially suitable riparian habitat on the

SEZ may be directly affected by construction and operations of solar energy development on the SEZ (Table 8.2.12.1-1). This direct effects area represents about less than 0.1% of available suitable habitat in the region. About 145 acres (0.6 km^2) of potentially suitable riparian habitat occurs in the area of potential indirect effects; this area represents about 0.7% of the available suitable habitat in the region (Table 8.2.12.1-1).

The overall impact on the Pima Indian mallow from construction, operation, and decommissioning of utility-scale solar energy facilities within the Bullard Wash SEZ is considered small because less than 1% of potentially suitable habitat for this species occurs in the area of direct effects. The implementation of programmatic design features is expected to be sufficient to reduce indirect impacts to negligible levels. Avoiding or minimizing disturbance to riparian habitats in the area of direct effects and the implementation of other mitigation measures described previously for the Aravaipa wood fern could reduce direct impacts on this species to negligible levels. 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.

Lowland Leopard Frog

Quad-level occurrences for the lowland leopard frog intersect the affected area of the Bullard Wash SEZ. Approximately 560 acres (2 km^2) of potentially suitable habitat on the SEZ, 4 acres (<0.1 km^2) of potentially suitable habitat in the access road corridor, and 16 acres (<0.1 km^2) of potentially suitable habitat in the transmission corridor could be directly affected by construction and operations (Table 8.2.12.1-1). This direct impact area represents about 0.1% of potentially suitable habitat in the SEZ region. About 9,400 acres (38 km^2) of potentially suitable habitat occurs in the area of indirect effects; this area represents about 2.4% of the potentially suitable habitat in the SEZ region (Table 8.2.12.1-1).

The overall impact on the lowland leopard frog from construction, operation, and decommissioning of utility-scale solar energy facilities within the Bullard Wash 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 SEZ region. The implementation of programmatic design features is expected to be sufficient to reduce indirect impacts to negligible levels.

Avoiding or minimizing disturbance to all aquatic and riparian habitats within the area of direct effects could reduce impacts on this species to negligible levels. In addition, impacts could be reduced by conducting pre-disturbance surveys and 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.

Desert Rosy Boa

The desert rosy boa is known to occur within the SEZ region, and potentially suitable habitat is expected to occur in the affected area. Approximately 7,200 acres (29 km^2) of potentially suitable habitat on the SEZ, 26 acres (0.1 km^2) of potentially suitable habitat in the access road corridor, and 143 acres (0.6 km^2) of potentially suitable habitat in the transmission corridor could be directly affected by construction and operations (Table 8.2.12.1-1). This direct impact area represents about 0.2% of potentially suitable habitat in the SEZ region. About 88,600 acres (359 km^2) of potentially suitable habitat occurs in the area of indirect effects; this area represents about 2.8% of the potentially suitable habitat in the SEZ region (Table 8.2.12.1-1).

The overall impact on the desert rosy boa from construction, operation, and decommissioning of utility-scale solar energy facilities within the Bullard Wash 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 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 habitats to mitigate impacts on the desert rosy boa is not feasible because potentially suitable desert scrub and wash habitats are widespread throughout the area of direct effects. However, direct impacts could be reduced by conducting pre-disturbance surveys and 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.

American Peregrine Falcon

The American peregrine falcon is a year-round resident in the Bullard Wash SEZ region, and potentially suitable foraging habitat is expected to occur in the affected area. Approximately 7,230 acres (29 km^2) of potentially suitable habitat on the SEZ, 36 acres (0.1 km^2) of potentially suitable habitat in the access road corridor, and 155 acres (0.6 km^2) of potentially suitable habitat in the transmission corridor could be directly affected by construction and operations (Table 8.2.12.1-1). This direct impact area represents 0.1% of potentially suitable habitat in the SEZ region. About 102,500 acres (415 km^2) of potentially suitable habitat occurs in the area of indirect effects; this area represents about 2.1% of the potentially suitable habitat in the SEZ region (Table 8.2.12.1-1). Most of this area could serve as foraging habitat (open shrublands). On the basis of SWReGAP land cover data, there is no suitable nesting habitat (cliffs or outcrops) within the affected area.

The overall impact on the American peregrine falcon from construction, operation, and decommissioning of utility-scale solar energy facilities within the Bullard Wash 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 to mitigate impacts on the American peregrine falcon is not feasible because potentially suitable foraging habitats are widespread throughout the area of direct effects and readily available in other portions of the affected area.

Ferruginous Hawk

The ferruginous hawk is a winter resident in the Bullard Wash SEZ region, and potentially suitable foraging habitat is expected to occur 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 access road or transmission corridors. However, about 14 acres (<0.1 km^2) of potentially suitable foraging habitat occurs in the area of indirect effects; this area represents about less than 0.1% of the potentially suitable habitat in the SEZ region (Table 8.2.12.1-1).

The overall impact on the ferruginous hawk from construction, operation, and decommissioning of utility-scale solar energy facilities within the Bullard Wash 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.

Snowy Egret

The snowy egret is a year-round resident in the Bullard Wash SEZ region, and potentially suitable habitat is expected to occur in the affected area. According to the SWReGAP habitat suitability model, approximately 950 acres (4 km^2) of potentially suitable habitat on the SEZ, 6 acres (<0.1 km^2) of potentially suitable habitat in the access road corridor, and 30 acres (0.1 km^2) of potentially suitable habitat in the transmission corridor could be directly affected by construction and operations (Table 8.2.12.1-1). This direct impact area represents 0.1% of potentially suitable habitat in the SEZ region. Approximately 18,000 acres (73 km^2) of potentially suitable habitat occurs in the area of indirect effects; this area represents about 2.5% of the potentially suitable habitat in the SEZ region (Table 8.2.12.1-1). Because there are no permanent surface water features in the affected area that may provide suitable foraging or nesting habitat, this species may occur in the affected area only as a transient.

The snowy egret is expected to occur only as a transient in the area of direct effects. Aquatic and riparian habitats outside of the area of direct effects that may provide suitable nesting and foraging habitat for this species may be influenced by spring discharges associated with the regional groundwater system and may be affected by groundwater withdrawals to serve development on the Bullard Wash SEZ. As discussed for the southwestern willow flycatcher

(Section 8.2.12.2.1), impacts on this species could range from small to large depending upon the solar energy technology deployed, the scale of development within the SEZ, and the cumulative rate of groundwater withdrawals (Table 8.2.12.1-1).

The implementation of programmatic design features and avoidance or limitations of groundwater withdrawals from the regional groundwater system could reduce impacts on the snowy egret to small or negligible levels. Impacts can be better quantified for specific projects once water needs are identified. In addition, avoiding or minimizing disturbance to riparian areas within the access road corridor would further reduce impacts.

Swainson's Hawk

According to the SWReGAP habitat suitability model, only potentially suitable summer foraging or nesting habitat for the Swainson's hawk may occur in the Bullard Wash SEZ region. Approximately 156 acres (0.6 km^2) of potentially suitable habitat on the SEZ, 7 acres (<0.1 km^2) of potentially suitable habitat in the access road corridor, and 7 acres (<0.1 km^2) of potentially suitable habitat in the transmission corridor could be directly affected by construction and operations (Table 8.2.12.1-1). This direct impact area represents less than 0.1% of potentially suitable habitat in the SEZ region. About 32,300 acres (131 km^2) of potentially suitable habitat occurs in the area of indirect effects; this area represents about 1.7% of the potentially suitable habitat in the SEZ region (Table 8.2.12.1-1). Most of this area could serve as foraging habitat (open shrublands). On the basis of SWReGAP land cover data, approximately 15 acres (<0.1 km^2) of riparian woodland habitat that could provide suitable nesting habitat may occur on the SEZ; however, the availability of suitable nesting habitat within the area of direct effects has not been determined. In addition to riparian woodlands, approximately 155 acres (0.6 km^2) of pinyon-juniper woodland habitat that may be potentially suitable nesting habitat occurs in the area of indirect effects.

The overall impact on the Swainson's hawk from construction, operation, and decommissioning of utility-scale solar energy facilities within the Bullard Wash 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 to negligible levels.

Avoidance of all potentially suitable habitats is not a feasible way to mitigate impacts on the Swainson's hawk because potentially suitable desert scrub habitats are widespread throughout the area of direct effect and readily available in other portions of the SEZ region. Impacts on the Swainson's hawk could be reduced to negligible levels through the implementation of programmatic design features and by conducting pre-disturbance surveys and avoiding or minimizing disturbance to occupied nests in the area of direct effects. If avoidance or minimization is not a feasible option, 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 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 pre-disturbance surveys for the species and its habitat in the area of direct effects.

Western Burrowing Owl

The western burrowing owl is a year-round resident in the Bullard Wash SEZ region, and potentially suitable foraging and nesting habitat is expected to occur in the affected area. Approximately 7,230 acres (29 km^2) of potentially suitable habitat on the SEZ, 36 acres (0.1 km^2) of potentially suitable habitat in the access road corridor, and 153 acres (0.6 km^2) of potentially suitable habitat in the transmission corridor could be directly affected by construction and operations (Table 8.2.12.1-1). This direct impact area represents 0.2% of potentially suitable habitat in the SEZ region. About 102,650 acres (415 km^2) of potentially suitable habitat occurs in the area of indirect effects; this area represents about 2.6% of the potentially suitable habitat in the SEZ region (Table 8.2.12.1-1). Most of this area could serve as foraging and nesting habitat (shrublands). The abundance of burrows suitable for nesting in the affected area 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 Bullard Wash 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 SEZ region. The implementation of programmatic design features is expected to be sufficient to reduce indirect impacts to negligible levels.

Avoidance of all potentially suitable habitats is not a feasible way to mitigate impacts on the western burrowing owl because potentially suitable desert scrub habitats are widespread throughout the area of direct effect and readily available in other portions of the SEZ region. Impacts on the western burrowing owl could be reduced to negligible levels through the implementation of programmatic design features and by conducting pre-disturbance surveys and avoiding or minimizing disturbance to occupied burrows in the area of direct effects. If avoidance or minimization is not a feasible option, 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 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 pre-disturbance surveys for the species and its habitat in the area of direct effects.

California Leaf-Nosed Bat

The California leaf-nosed bat is a year-round resident within the Bullard Wash SEZ region. On the basis of SWReGAP land cover data, suitable roosting habitats (caves and mines) do not occur in the affected area. However, approximately 7,230 acres (29 km^2) of potentially suitable habitat on the SEZ, 26 acres (0.1 km^2) of potentially suitable habitat in the access road corridor, and 144 acres (0.6 km^2) of potentially suitable habitat in the transmission corridor could be directly affected by construction and operations (Table 8.2.12.1-1). This direct impact area represents 0.2% of potentially suitable habitat in the SEZ region. About 88,750 acres (359 km^2) of potentially suitable foraging habitat occurs in the area of indirect effect; this area represents about 2.8% of the available suitable foraging habitat in the region (Table 8.2.12.1-1). 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 are no potentially suitable roosting habitats (rocky cliffs and outcrops) in the affected area.

The overall impact on the California leaf-nosed bat from construction, operation, and decommissioning of utility-scale solar energy facilities within the Bullard Wash 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 this species to negligible levels. Avoidance of all potentially suitable foraging habitats is not a feasible way to mitigate impacts because potentially suitable habitat is widespread throughout the area of direct effects and readily available in other portions of the SEZ region.

Townsend's Big-Eared Bat

The Townsend's big-eared bat is a year-round resident within the Bullard Wash SEZ region. On the basis of SWReGAP land cover data, suitable roosting habitats (caves and mines) do not occur in the affected area. However, approximately 6,200 acres (25 km^2) of potentially suitable habitat on the SEZ, 31 acres (0.1 km^2) of potentially suitable habitat in the access road corridor, and 23 acres (0.1 km^2) of potentially suitable habitat in the transmission corridor could be directly affected by construction and operations (Table 8.2.12.1-1). This direct impact area represents 0.1% of potentially suitable habitat in the SEZ region. About 79,800 acres (323 km^2) of potentially suitable foraging habitat occurs in the area of indirect effect; this area represents about 1.8 % of the available suitable foraging habitat in the region (Table 8.2.12.1-1). 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 are no potentially suitable roosting habitats (rocky cliffs and outcrops) in the affected area.

The overall impact on the Townsend's big-eared bat from construction, operation, and decommissioning of utility-scale solar energy facilities within the Bullard Wash 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 this species to negligible levels. Avoidance of all potentially suitable foraging habitats is not a feasible way to mitigate impacts because potentially suitable habitat is widespread throughout the area of direct effects and readily available in other portions of the SEZ region.

Western Red Bat

The western red bat is an uncommon year-round resident within the Bullard Wash SEZ region. On the basis of SWReGAP land cover data, suitable roosting habitats may occur in riparian woodlands on the SEZ (15 acres [<0.1 km^2]) or in other portions of the affected area. Approximately 29 acres (0.1 km^2) of potentially suitable habitat on the SEZ could be directly affected by construction and operations (Table 8.2.12.1-1). This direct impact area represents 0.1% of potentially suitable habitat in the SEZ region. Potentially suitable habitat does not occur in the access road or transmission corridors. About 141 acres (0.6 km^2) of potentially suitable foraging habitat occurs in the area of indirect effect; this area represents about 0.7% of the available suitable foraging habitat in the region (Table 8.2.12.1-1). The potentially suitable habitat in the affected area is primarily foraging habitat represented by desert shrubland. On the basis of an evaluation of SWReGAP land cover types, approximately 15 acres (<0.1 km^2) of riparian woodland habitat that may be potentially suitable roosting habitat could occur on the SEZ.

The overall impact on the western red bat from construction, operation, and decommissioning of utility-scale solar energy facilities within the Bullard Wash 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 region. The implementation of programmatic design features may be sufficient to reduce indirect impacts on this species to negligible levels.

Avoiding or minimizing disturbance to riparian woodland habitats in the area of direct effects may reduce direct impacts on roosting habitat to negligible levels. Alternatively, conducting pre-disturbance surveys and avoiding or minimizing disturbance to roost trees would reduce potential impacts. Avoidance of all potentially suitable foraging habitats is not a feasible way to mitigate impacts because potentially suitable habitat is widespread throughout the area of direct effects and readily available in other portions of the SEZ region.

Western Yellow Bat

The western yellow bat is an uncommon year-round resident within the Bullard Wash SEZ region. On the basis of SWReGAP land cover data, suitable roosting habitats may occur in riparian woodlands on the SEZ (15 acres [<0.1 km^2]) or in other portions of the affected area. Approximately 7,230 acres (29 km^2) of potentially suitable habitat on the SEZ, 36 acres (0.1 km^2) of potentially suitable habitat in the access road corridor, and 154 acres (0.6 km^2) of potentially suitable habitat in the transmission corridor could be directly affected by construction and operations (Table 8.2.12.1-1). This direct impact area represents 0.2% of potentially suitable habitat in the SEZ region. About 102,300 acres (414 km^2) of potentially suitable foraging habitat occurs in the area of indirect effect; this area represents about 2.8% of the available suitable foraging habitat in the region (Table 8.2.12.1-1). The potentially suitable habitat in the affected area is primarily foraging habitat represented by desert shrubland. On the basis of an evaluation of SWReGAP land cover types, approximately 15 acres (<0.1 km^2) of riparian woodland habitat that may be potentially suitable roosting habitat could occur on the SEZ.

The overall impact on the western yellow bat from construction, operation, and decommissioning of utility-scale solar energy facilities within the Bullard Wash 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 region. The implementation of programmatic design features may be sufficient to reduce indirect impacts on this species to negligible levels.

Avoiding or minimizing disturbance to riparian woodland habitats in the area of direct effects may reduce direct impacts on roosting habitat to negligible levels. Alternatively, conducting pre-disturbance surveys and avoiding or minimizing disturbance to roost trees would reduce potential impacts. Avoidance of all potentially suitable foraging habitats is not a feasible way to mitigate impacts because potentially suitable habitat is widespread throughout the area of direct effects and readily available in other portions of the SEZ region.

8.2.12.2.5 Impacts on State-Listed Species

A total of 21 species listed by the State of Arizona may occur in the Bullard Wash SEZ affected area (Table 8.2.12.1-1). Of these species, impacts on the following 6 state-listed species have not been previously described: Bigelow onion, golden barrel cactus, McKelvey's agave, Parish alkali grass, straw-top cholla, and Arizona skink. Impacts on each of these 6 species are discussed below and summarized in Table 8.2.12.1-1.

Bigelow Onion

The Bigelow onion is not known to occur in the affected area of the Bullard Wash SEZ; however, according to the SWReGAP land cover model, potentially suitable desert scrub and shrubland habitat may occur on the SEZ, within the access road or transmission corridors, and throughout portions of the area of indirect effects. Approximately 6,150 acres (25 km^2) of potentially suitable habitat on the SEZ, 21 acres (0.1 km^2) of potentially suitable habitat in the access road corridor, and 24 acres (0.1 km^2) of potentially suitable habitat in the transmission corridor could be directly affected by construction and operations (Table 8.2.12.1-1). This direct impact area represents 0.4% of potentially suitable habitat in the SEZ region. About 40,400 acres (163 km^2) of potentially suitable habitat occurs in the area of indirect effect; this area represents about 2.4% of the available suitable habitat in the region (Table 8.2.12.1-1).

The overall impact on the Bigelow onion from construction, operation, and decommissioning of utility-scale solar energy facilities within the Bullard Wash 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 this species to negligible levels.

Avoidance of all potentially suitable habitats to mitigate impacts on the Bigelow onion is not feasible because potentially suitable habitat (desert scrub) is widespread in the area of direct effects and readily available throughout the SEZ region. For this species and other special status plants, impacts could be reduced by conducting pre-disturbance surveys and avoiding or minimizing disturbance to occupied habitats in the area of direct effects. If avoidance or minimization is not a feasible option, plants could be translocated from areas 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 uses one or more of these options could be designed to completely offset the impacts of development.

Golden Barrel Cactus

The golden barrel cactus is not known to occur in the affected area of the Bullard Wash SEZ; however, approximately 15 acres (<0.1 km^2) of potentially suitable desert wash or riparian habitat on the SEZ may be directly affected by construction and operations of solar energy development on the SEZ (Table 8.2.12.1-1). This direct effects area represents about <0.1% of available suitable habitat in the region. About 145 acres (0.6 km^2) of potentially suitable desert wash or riparian habitat occurs in the area of potential indirect effects; this area represents about 0.7% of the available suitable habitat in the region (Table 8.2.12.1-1).

The overall impact on the golden barrel cactus from construction, operation, and decommissioning of utility-scale solar energy facilities within the Bullard Wash SEZ is considered small because less than 1% of potentially suitable habitat for this species occurs in the area of direct effects. The implementation of programmatic design features is expected to be sufficient to reduce indirect impacts to negligible levels.

Avoiding or minimizing disturbance of desert riparian habitats in the area of direct effects could reduce direct impacts on this species to negligible levels. Alternatively, impacts could be reduced with the implementation of programmatic design features, and the other mitigation options described previously for the Bigelow onion could reduce direct impacts on this species to negligible levels. 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.

McKelvey's Agave

The McKelvey's agave is not known to occur in the affected area of the Bullard Wash SEZ; however, according to the SWReGAP land cover model, potentially suitable desert scrub and shrubland habitat may occur on the SEZ, within the access road or transmission corridors, and throughout portions of the area of indirect effects. Approximately 7,150 acres (29 km^2) of potentially suitable habitat on the SEZ, 33 acres (0.1 km^2) of potentially suitable habitat in the access road corridor, and 142 acres (0.6 km^2) of potentially suitable habitat in the transmission corridor could be directly affected by construction and operations (Table 8.2.12.1-1). This direct impact area represents 0.2% of potentially suitable habitat in the SEZ region. About

97,450 acres (394 km^2) of potentially suitable habitat occurs in the area of indirect effect; this area represents about 2.8% of the available suitable habitat in the region (Table 8.2.12.1-1).

The overall impact on the McKelvey's agave from construction, operation, and decommissioning of utility-scale solar energy facilities within the Bullard Wash 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 this species to negligible levels.

Avoidance of potentially suitable habitat (desert scrub) in the area of direct effects is not feasible because potentially suitable habitat is widespread throughout the area of direct effect. However, impacts could be reduced with the implementation of programmatic design features, and the mitigation options described previously for the Bigelow onion could reduce direct impacts on this species to negligible levels. 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.

Parish Alkali Grass

The Parish alkali grass is not known to occur in the affected area of the Bullard Wash SEZ; however, approximately 15 acres (<0.1 km^2) of potentially suitable desert wash or riparian habitat on the SEZ may be directly affected by construction and operations of solar energy development on the SEZ (Table 8.2.12.1-1). This direct effects area represents about less than 0.1% of available suitable habitat in the region. About 145 acres (0.6 km^2) of potentially suitable desert wash or riparian habitat occurs in the area of potential indirect effects; this area represents about 0.7% of the available suitable habitat in the region (Table 8.2.12.1-1).

The overall impact on the Parish alkali grass from construction, operation, and decommissioning of utility-scale solar energy facilities within the Bullard Wash SEZ is considered small because less than 1% of potentially suitable habitat for this species occurs in the area of direct effects. The implementation of programmatic design features is expected to be sufficient to reduce indirect impacts to negligible levels.

Avoiding or minimizing disturbance to desert riparian habitats in the area of direct effects could reduce direct impacts on this species to negligible levels. Alternatively, impacts could be reduced with the implementation of programmatic design features and the mitigation options described previously for the Bigelow onion could reduce direct impacts on this species to negligible levels. 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.

Straw-Top Cholla

The straw-top cholla is not known to occur in the affected area of the Bullard Wash SEZ; however, approximately 15 acres (<0.1 km^2) of potentially suitable desert wash or riparian habitat on the SEZ may be directly affected by construction and operations of solar energy development on the SEZ (Table 8.2.12.1-1). This direct effects area represents about less than 0.1 % of available suitable habitat in the region. About 145 acres (0.6 km^2) of potentially suitable desert wash or riparian habitat occurs in the area of potential indirect effects; this area represents about 0.7% of the available suitable habitat in the region (Table 8.2.12.1-1).

The overall impact on the straw-top cholla from construction, operation, and decommissioning of utility-scale solar energy facilities within the Bullard Wash SEZ is considered small because less than 1% of potentially suitable habitat for this species occurs in the area of direct effects. The implementation of programmatic design features is expected to be sufficient to reduce indirect impacts to negligible levels.

Avoiding or minimizing disturbance to desert riparian habitats in the area of direct effects could reduce direct impacts on this species to negligible levels. Alternatively, impacts could be reduced with the implementation of programmatic design features, and the mitigation options described previously for the Bigelow onion could reduce direct impacts on this species to negligible levels. 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.

Arizona Skink

The Arizona skink is not known to occur in the affected area of the Bullard Wash SEZ, and suitable habitat for this species is not expected to occur in the area of direct effects. However, approximately 114 acres (0.5 km^2) of potentially suitable habitat occurs in the area of indirect effects; this area represents less than 0.1% of the potentially suitable habitat in the SEZ region (Table 8.2.12.1-1).

The overall impact on the Arizona skink from construction, operation, and decommissioning of utility-scale solar energy facilities within the Bullard Wash SEZ is considered small because suitable habitat for this species does not occur anywhere 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 on this species to negligible levels. No species-specific mitigation for this species is necessary because potentially suitable habitat does not occur within the area of direct effects.

8.2.12.2.6 Impacts on Rare Species

There are 34 rare species (i.e., state rank of S1 or S2 in Arizona or a species of concern by the USFWS) that may be affected by solar energy development on the Bullard Wash SEZ

(Table 8.2.12.1-1). Impacts on 10 rare species have not been discussed previously. These include the following: (1) plants—arid tansy-aster and Davidson sage; (2) invertebrate—Maricopa tiger beetle; (3) amphibian—Arizona toad; (4) reptiles—Arizona night lizard, Gila monster, and Mojave shovel-nosed snake; (5) bird—long-eared owl; and (6) mammals—cave myotis and Yuma myotis. Impacts on these species are presented in Table 8.2.12.1-1.

8.2.12.3 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 of utility-scale solar energy development on special status species. While some SEZ-specific design features are best established when 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 8.2.12.1-1; 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 effects 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.

- Consultation with the USFWS and AZGFD should be conducted to address the potential for impacts on the following species currently listed as threatened or endangered under the ESA: Arizona cliff rose, desert pupfish, Gila topminnow, Sonoran bald eagle, and southwestern willow flycatcher. Consultation would identify an appropriate survey protocol, avoidance and minimization measures, and, if appropriate, reasonable and prudent alternatives, reasonable and prudent measures, and terms and conditions for incidental take statements (if necessary).

- Coordination with the USFWS and AZGFD should be conducted to address the potential for impacts on the Sonoran population of the desert tortoise, a species under review for listing under the ESA. Coordination would identify an appropriate survey protocol and mitigation requirements, which may include avoidance, minimization, translocation, or compensation.

- Avoiding or minimizing disturbance to desert wash or riparian habitat within the area of direct effects could reduce or eliminate impacts on the following special status species: Aravaipa wood fern, arid tansy-aster, Arizona giant sedge, golden barrel cactus, Hohokam agave, Parish alkali grass, Parish's phacelia, Pima Indian mallow, straw-top cholla, Maricopa tiger beetle, Arizona toad, lowland leopard frog, southwestern willow flycatcher, western red bat, and western yellow bat.

- Avoidance or minimization of groundwater withdrawals to serve solar energy development on the SEZ could reduce or eliminate impacts on the following special status species with habitats dependent upon groundwater discharge in the SEZ region: desert pupfish, Gila topminnow, snowy egret, and southwestern willow flycatcher. In particular, aquatic and riparian habitat associated with the Tres Alamos and Yerba Mansa springs should be avoided.

- Harassment or disturbance of special status 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 AZGFD.

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

8.2.13 Air Quality and Climate

8.2.13.1 Affected Environment

8.2.13.1.1 Climate

The proposed Bullard Wash SEZ is located in near central Arizona, in the southwest corner of Yavapai County. The topography of the county has a drastic transition from the lower Sonoran Desert to the south to higher elevations to the north and the east. The SEZ has an average elevation of 2,440 ft (740 m) and is located on the valley floor near the edge of neighboring mountain ranges, which are developed in the northeast–southwest direction. The SEZ is located in the northern portion of the Sonoran Desert, which covers the southwest of Arizona, southern California, and northwestern Mexican states. The area experiences a desert-like arid climate, characterized by hot summers, mild winters, light precipitation, a high rate of evaporation, low relative humidity, abundant sunshine, and large temperature ranges (NCDC 2010a). Meteorological data collected at Wintersburg, about 50 mi (80 km) south–southeast of the Bullard Wash SEZ boundary, and at Aguila, about 10 mi (16 km) south, are summarized below.

A wind rose from Wintersburg, for the 5-year period 1994 to 1998, taken at a level of 33 ft (10 m), is presented in Figure 8.2.13.1-1 (Mao 2010).[6] During this period, the annual average wind speed at the airport was about 8.7 mph (3.9 m/s); the prevailing wind direction was from the southwest (about 16.6% of the time) and secondarily from the south–southwest (about 9.6% of the time) and the west–southwest (about 9.3% of the time). Winds blew more frequently from the southwest from March to October, and from the north–northeast from November to February. Wind speeds categorized as calm (<1.1 mph [0.5 m/s]) occurred infrequently (about 0.3% of the time). Average wind speeds by season were the highest in summer at 9.9 mph (4.4 m/s); lower in spring and fall at 9.7 mph (4.3 m/s) and 7.9 mph (3.5 m/s), respectively; and lowest in winter at 7.4 mph (3.3 m/s).

In Arizona, topography plays a large role in determining the temperature of any specific location. For the 1924 to 2010 period, the annual average temperature at Aguila was 65.6°F (18.7°C) (WRCC 2010). January was the coldest month, with an average minimum temperature of 33.2°F (0.7°C), and July was the warmest month, with an average maximum of 102.4°F (39.1°C). In summer, daytime maximum temperatures more than 100°F (37.8°C) are common, and minimums are in the 60s. The minimum temperatures recorded were below freezing (≤32°F [0°C]) during the colder months (about 15 days in December and January), but subzero temperatures were never recorded. During the same period, the highest temperature,

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6 No meteorological stations representative of the proposed Bullard Wash SEZ exist near the SEZ. Wintersburg is chosen to be representative of the SEZ, although it is located rather far from the Bullard Wash SEZ, considering that the northeast–southwest orientation of the valley and mountain ranges near the SEZ match the prevailing wind direction at Wintersburg.

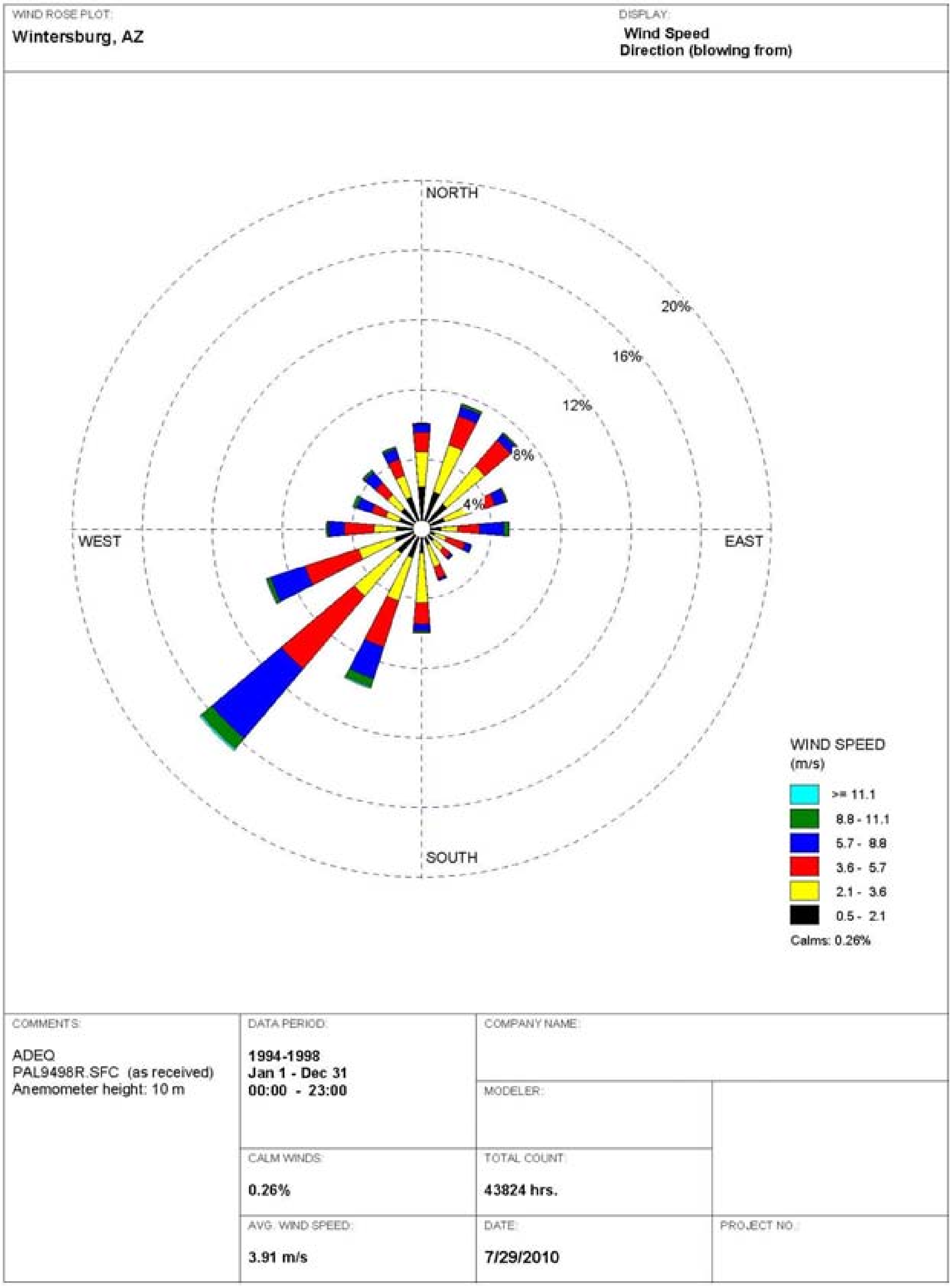

FIGURE 8.2.13.1-1 Wind Rose at 33 ft (10 m) at Wintersburg, Arizona, 1994 to 1998 (Source: Mao 2010)

117°F (47.2°C), was reached in July 1958, and the lowest, 11°F (−11.7°C), in January 1950. In a typical year, about 144 days had a maximum temperature of 90°F (32.2°C) or higher, while about 49 days had minimum temperatures at or below freezing.

Throughout Arizona, precipitation patterns largely depend on elevation and the season of the year. In Arizona, rain comes mostly in two distinct seasons (winter and summer monsoon season) (NCDC 2010a). For the 1924 to 2010 period, annual precipitation at Aguila averaged about 8.48 in. (21.5 cm) (WRCC 2010). On average, there are 28 days annually with measurable precipitation (0.01 in. [0.025 cm] or higher). Seasonally, precipitation is the highest in winter followed by summer, and the lowest in spring. Snowfall at Aguila is uncommon and limited to winter months. The annual average snowfall at Aguila was about 0.4 in. (1.0 cm), and the highest monthly snowfall recorded was 6.0 in. (15.2 cm) in December 1967.

The proposed Bullard Wash SEZ is far from major water bodies (more than 180 mi [290 km] to the Gulf of California). Severe weather events, such as floods, hails, high winds, thunderstorm winds, have been reported in Yavapai County, which encompasses the Bullard Wash SEZ (NCDC 2010b). However, most events were reported at higher elevations, not near the SEZ.

In Arizona, flood conditions occur infrequently, but heavy thunderstorms during summer thunderstorm season cause floods at times that do considerable local damage. Since 1993, 90 floods (two-thirds of which were flash floods) were reported in Yavapai County, most of which occurred in towns at higher elevations, far from the SEZ. These floods caused one death and some property damage.

In Yavapai County, 129 hail events were reported, mostly from July to September since 1962, which caused one death, two injuries, and considerable property damage. Hail size of 4.5 in. (11.4 cm) in diameter was reported in 1995. Since 1994, 19 high wind events with the highest wind speed of 89 mph (40 m/s) were reported, which occurred any month of the year. Since 1961, 78 thunderstorm winds were reported, and those up to a maximum wind speed of 115 mph (51 m/s) occurred mostly during summer months and caused two injuries and some property damage (NCDC 2010b).

One dust storm event was reported in Yavapai County in 2009 (NCDC 2010b). However, the ground surface of the SEZ is covered predominantly with sandy loams (with some gravelly sandy loams), which have moderate dust storm potential. On occasion, high winds accompanied by thunderstorms and dry soil conditions could result in blowing dust in Yavapai County. Dust storms can deteriorate air quality and visibility and have adverse health effects.

Hurricanes and tropical storms formed off the coast of Central America and Mexico weaken over the cold waters off the California coast. Accordingly, hurricanes rarely hit Arizona through California. Historically, two tropical storm/depressions from the Gulf of California passed within 100 mi (160 km) of the proposed Bullard Wash SEZ (CSC 2010). In the period from 1950 to April 2010, a total of 22 tornadoes (0.4 per year each) were reported in Yavapai County (NCDC 2010b). Most tornadoes occurring in Yavapai County were relatively weak (i.e., 4 were F [uncategorized[7]], 14 were F0, 3 were F1, and one was F3 on the Fujita tornado scale), and all of these tornadoes occurred far from the SEZ. None of these tornadoes caused deaths or injuries, but some of them caused property and crop damages.

8.2.13.1.2 Existing Air Emissions

Yavapai County has limited industrial emission sources over the county, and their emissions are relatively small with a few exceptions. No emission sources are located around the proposed Bullard Wash SEZ. Several major roads exist in Yavapai County, such as I-17 and I-40, U.S. 93, and several state routes. Thus, onroad mobile source emissions are substantial compared with other sources in Yavapai County. Data on annual emissions of criteria pollutants and VOCs in Yavapai County are presented in Table 8.2.13.1-1 (WRAP 2009). Emission data are classified into six source categories: point, area (including fugitive dust), onroad mobile, nonroad mobile, biogenic, and fire (wildfires, prescribed fires, agricultural fires, structural fires). In 2002, point sources were major contributors to total SO_2 emissions (about 62%) and secondary contributors to NO_x emissions (about 18%). Onroad sources were major contributors to NO_x and CO emissions (about 53 and 65%, respectively). Biogenic sources (i.e., vegetation—including trees, plants, and crops—and soils) that release naturally occurring emissions contributed secondarily to CO emissions (about 18%), and accounted for most of the VOC emissions (about 93%). Area sources accounted for about 90% of PM_{10} and 84% of $PM_{2.5}$. In Yavapai County, nonroad sources were secondary contributors to SO_2 and NO_x emissions, while fire sources were minor contributors to criteria pollutants and VOCs.

TABLE 8.2.13.1-1 Annual Emissions of Criteria Pollutants and VOCs in Yavapai County, Arizona, Encompassing the Proposed Bullard Wash SEZ, 2002[a]

Pollutant	Emissions (tons/yr)
SO_2	1,579
NO_x	19,249
CO	140,829
VOCs	184,328
PM_{10}	16,808
$PM_{2.5}$	4,322

[a] Includes point, area (including fugitive dust), 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; VOC = volatile organic compounds.

Source: WRAP (2009).

In 2010, Arizona is projected to produce about 116.6 MMt of *gross*[8] carbon dioxide equivalent (CO_2e)[9] emissions, which is about 1.6% of total U.S. GHG emissions in 2007 (Bailie et al. 2005). Gross GHG emissions in Arizona increased by about 77% from 1990 to 2010 because of Arizona's rapid population growth and attendant economic growth, compared to

[7] Not categorized by the Fujita tornado scale because damage level was not reported.

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

[9] 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.

16% growth in U.S. GHG emissions during the 1990 to 2005 period. In 2005, electricity use (about 40.0%) and transportation (about 38.9%) were the primary contributors to gross GHG emission sources in Arizona. Fuel use in the residential, commercial, and industrial (RCI) sectors combined accounted for about 15.4% of total state emissions. Arizona's *net* emissions were about 109.9 MMt CO_2e, considering carbon sinks from forestry activities and agricultural soils throughout the state. The EPA (2009a) also estimated 2005 emissions in Arizona. Its estimate of CO_2 emissions from fossil fuel combustion was 97.2 MMt, which was comparable to the state's estimate. Electric power generation and transportation accounted for about 51.8% and 38.8% of the CO_2 emissions total, respectively, while the RCI sectors accounted for the remainder (about 9.4%).

8.2.13.1.3 Air Quality

The State of Arizona has adopted the NAAQS for six criteria pollutants: SO_2, NO_2, CO, O_3, PM_{10} and $PM_{2.5}$, and Pb (ADEQ 2009; EPA 2010a). Table 8.2.13.1-2 gives the NAAQS for criteria pollutants.

Yavapai County is located administratively within the Northern Arizona Intrastate AQCR (40 CFR 81.270), along with Apache, Coconino, and Navajo Counties. Currently, the area surrounding the proposed SEZ is designated by the U.S. EPA as being in unclassifiable/ attainment of NAAQS for all criteria pollutants (40 CFR 81.303).

Because of relatively low population density in Yavapai County, it has no significant industrial emission sources of its own, and mobile emissions along major highways account for considerable NO_x and CO emissions. Accordingly, ambient air quality in Yavapai County is relatively good, except for O_3 and possibly PM. There are three ambient air-monitoring stations in Yavapai County: Hillside, located about 22 mi (35 km) north–northeast of the SEZ; Prescott, about 47 mi (76 km) northeast; and Prescott Valley, about 55 mi (88 km) northeast. O_3 concentrations were monitored at Hillside until 2005 and at Prescott in 2008. PM_{10} and $PM_{2.5}$ concentrations have been collected at Prescott Valley but are judged as not representative of the SEZ considering the difference in land use. NO_2 monitoring data at Alamo Lake State Park in La Paz County, which is located about 22 mi (35 km) west–northwest of the SEZ, and ozone monitoring data at Hillside are presented. To characterize ambient air quality for other criteria pollutants around the SEZ, the three closest monitoring stations (all in Maricopa County) were chosen. CO and PM_{10} concentrations from Buckeye, which is located about 58 mi (93 km) south–southeast of the SEZ, are presented. For SO_2 and $PM_{2.5}$, the highest concentrations at two monitoring stations in the Phoenix area, which are located about 71 mi (114 km) and more southeast of the SEZ, are presented. No Pb measurements have been made in the state of Arizona because of low Pb concentration levels after the phaseout of leaded gasoline. The highest background concentrations of criteria pollutants at these stations for the period 2004 to 2008 are presented in Table 8.2.13.1-2 (EPA 2010b). The highest concentration levels were lower than their respective standards (up to 10%), except for O_3, PM_{10}, and $PM_{2.5}$, which approached or exceeded their respective NAAQS. These criteria pollutants are of regional concern in the area, due to high temperatures, abundant sunshine, and windblown dust from occasional high winds and dry soil conditions.

TABLE 8.2.13.1-2 NAAQS and Background Concentration Levels Representative of the Proposed Bullard Wash SEZ in Yavapai County, Arizona, 2004 to 2008

			Background Concentration Level	
Pollutant[a]	Averaging Time	NAAQS	Concentration[b,c]	Measurement Location, Year
SO_2	1-hour	75 ppb[d]	–[e]	–
	3-hour	0.5 ppm	0.013 ppm (2.6%)	Phoenix, Maricopa County, 2007
	24-hour	0.14 ppm	0.008 ppm (5.7%)	Phoenix, Maricopa County, 2004
	Annual	0.030 ppm	0.003 ppm (10%)	Phoenix, Maricopa County, 2004
NO_2	1-hour	100 ppb[f]	–	–
	Annual	0.053 ppm	0.003 ppm (5.7%)	Alamo Lake State Park, La Paz County, 2006
CO	1-hour	35 ppm	1.6 ppm (4.6%)	Buckeye, Maricopa County, 2007
	8-hour	9 ppm	0.9 ppm (10%)	Buckeye, Maricopa County, 2005
O_3	1-hour	0.12 ppm[g]	0.085 ppm (71%)	Hillside, Yavapai County, 2004
	8-hour	0.075 ppm	0.077 ppm (103%)	Hillside, Yavapai County, 2004
PM_{10}	24-hour	150 $\mu g/m^3$	204 $\mu g/m^3$ (136%)	Buckeye, Maricopa County, 2008
	Annual	50 $\mu g/m^3$ [h]	53 $\mu g/m^3$ (106%)	Buckeye, Maricopa County, 2007
$PM_{2.5}$	24-hour	35 $\mu g/m^3$	42.3 $\mu g/m^3$ (121%)	Phoenix, Maricopa County, 2005
	Annual	15.0 $\mu g/m^3$	13.5 $\mu g/m^3$ (90%)	Phoenix, Maricopa County, 2006
Pb	Calendar quarter	1.5 $\mu g/m^3$	–	–
	Rolling 3-month	0.15 $\mu g/m^3$ [i]	–	–

[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; SO_2 = sulfur dioxide.

[b] Monitored concentrations are the 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 the 98th percentile for 24-hour $PM_{2.5}$; and arithmetic mean for annual SO_2, NO_2, PM_{10}, and $PM_{2.5}$.

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

[d] Effective August 23, 2010.

[e] A dash indicates not applicable or not available.

[f] Effective April 12, 2010.

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

[h] Effective December 18, 2006, the EPA revoked the annual PM_{10} standard of 50 $\mu g/m^3$ but annual PM_{10} concentrations are presented for comparison purposes.

[i] Effective January 12, 2009.

Sources: ADEQ (2009); EPA (2010a,b).

The PSD regulations (see 40 CFR 52.21), which are designed to limit the growth of air pollution in clean areas, apply to a major new source 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 sensitive Class I area. There are several Class I areas around the Bullard Wash SEZ, none of which are situated within the 62-mi (100-km) distance in Arizona and California. The nearest Class I area is Pine Mountain WA (40 CFR 81.403), about 72 mi (116 km) east of the Bullard Wash SEZ. This Class I area is not located downwind of prevailing winds at the Bullard Wash SEZ (Figure 8.2.13.1-1). The next nearest Class I areas include Sycamore Canyon WA, Mazatzal WA, and Superstition WA, which are located about 76 mi (122 km) northeast, 79 mi (127 km) east, and 104 mi (167 km) east–southeast of the SEZ, respectively.

8.2.13.2 Impacts

Potential impacts on ambient air quality associated with a solar project would be of most concern during the construction phase. Impacts on ambient air quality from fugitive dust emissions resulting from soil disturbances are anticipated, but they would be of short duration. During the operations 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 proposed Bullard Wash 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 the application of any additional mitigation. Section 8.2.13.3, below, identifies SEZ-specific design features of particular relevance to the Bullard Wash SEZ.

8.2.13.2.1 Construction

The Bullard Wash 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 windblown dust problems. Fugitive dusts, which are released near ground level, typically have more localized impacts than 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 by using the EPA-recommended AERMOD model (EPA 2009b). Details for emissions estimation, the description of AERMOD, input data processing procedures, and modeling assumption are described in Appendix M, Section M.13. Estimated air concentrations were compared with the applicable NAAQS levels at the site boundaries and nearby communities and with PSD increment levels at nearby Class I areas.[10] However, no receptors were modeled for PSD analysis at the nearest Class I area, Pine Mountain WA, because it is about 72 mi (116 km) from the SEZ, which is farther than the maximum modeling distance of 31 mi (50 km) for the AERMOD. Rather, several regularly spaced receptors in the direction of the Pine Mountain WA were selected as surrogates for the PSD analysis. For the Bullard Wash SEZ, the modeling was conducted based on the following assumptions and input:

- Uniformly distributed emissions of 3,000 acres (12.1 km^2) in the southern portion of the SEZ, close to the nearest residences and the town of Aguila;

- Surface hourly meteorological data from Phoenix Sky Harbor International Airport, upper air sounding data from Tucson, and on-site data from Wintersburg for the 1994 to 1998 period (Mao 2010); and

- A regularly spaced receptor grid over a modeling domain of 62 × 62 mi (100 km × 100 km) centered on the proposed SEZ, and additional discrete receptors at the SEZ boundaries.

Results

Table 8.2.13.2-1 summarizes the modeling results for concentration increments and total concentrations (modeled plus background concentrations) for both PM_{10} and $PM_{2.5}$ that would result from construction-related fugitive emissions. Maximum 24-hour PM_{10} concentration increments modeled to occur at the SEZ boundary would be an estimated 845 $\mu g/m^3$, which far exceeds the relevant standard level of 150 $\mu g/m^3$. Total 24-hour PM_{10} concentrations of 1,049 $\mu g/m^3$ would also exceed the standard level at the SEZ boundary. However, high PM_{10} concentrations would be limited to the immediate areas surrounding the SEZ boundary and would decrease quickly with distance. Predicted maximum 24-hour PM_{10} concentration increments would be about 45 $\mu g/m^3$ at the nearest residences, which are about 5.6 mi (9 km) south–southwest of the SEZ, about 30 to 40 $\mu g/m^3$ at Aguila, and about 15 $\mu g/m^3$ at Wickenburg. Annual average modeled concentration increments and total concentrations (increment plus background) for PM_{10} at the SEZ boundary would be about 155 $\mu g/m^3$ and

[10] To provide a quantitative assessment, the modeled air impacts of construction were compared to the NAAQS 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.

TABLE 8.2.13.2-1 Maximum Air Quality Impacts from Emissions Associated with Construction Activities for the Proposed Bullard Wash SEZ

			Concentration ($\mu g/m^3$)				Percentage of NAAQS	
Pollutant[a]	Averaging Time	Rank[b]	Maximum Increment[b]	Background[c]	Total	NAAQS	Increment	Total
PM_{10}	24 hours	H6H	845	204	1,049	150	563	699
	Annual	–[d]	155	53.0	208	50	310	416
$PM_{2.5}$	24 hours	H8H	56.9	42.3	99.2	35	162	283
	Annual	–	15.5	13.5	29.0	15.0	103	193

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 5-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 5-year period are presented. Maximum concentrations are predicted to occur at the site boundaries.

c See Table 8.2.13.1-2.

d A dash indicates not applicable.

208 $\mu g/m^3$, respectively, which are higher than the NAAQS level of 50 $\mu g/m^3$, which was revoked by EPA in December 2006. Annual PM_{10} increments would be much lower, about 3 $\mu g/m^3$ at the nearest receptors, and about 1 to 2 $\mu g/m^3$ at Aguila, and about 0.2 $\mu g/m^3$ at Wickenburg.

Total 24-hour $PM_{2.5}$ concentrations would be 99.2 $\mu g/m^3$ at the SEZ boundary, which is higher than the NAAQS level of 35 $\mu g/m^3$; modeled increments contribute slightly more than background concentration to this total. The total annual average $PM_{2.5}$ concentration would be 29.0 $\mu g/m^3$, which is above the NAAQS level of 15.0 $\mu g/m^3$. At the nearest residences, predicted maximum 24-hour and annual $PM_{2.5}$ concentration increments would be about of about 2.5 and 0.3 $\mu g/m^3$, respectively.

Predicted 24-hour and annual PM_{10} concentration increments at the surrogate receptors for the nearest Class I Area—Pine Mountain WA—would be about 8.4 and 0.14 $\mu g/m^3$, or 105 and 3.5% of the PSD increments for the Class I area, respectively. These surrogate receptors are more than 41 mi (66 km) from the Pine Mountain WA, and thus predicted concentrations in Pine Mountain WA would be much lower than the above values (about 45% of the PSD increments for 24-hour PM_{10}), considering the same decay ratio with distance.

In conclusion, predicted 24-hour and annual PM_{10} and $PM_{2.5}$ concentration levels could exceed the NAAQS levels at the SEZ boundaries and in the immediate surrounding areas during the construction of solar facilities. To reduce potential impacts on ambient air quality and in compliance with programmatic design features, aggressive dust control measures would be used. Potential air quality impacts on nearby communities would be much lower. Modeling indicates that emissions from construction activities are not anticipated to exceed Class I PSD PM_{10} increments at the nearest federal Class I area (Pine Mountain WA). Construction activities are not subject to the PSD program, and the comparison provides only a screen for gauging the size of the impact. Accordingly, it is anticipated that impacts of construction activities on ambient air quality would be moderate and temporary.

Construction emissions from the engine exhaust from heavy equipment and vehicles have the potential to affect AQRVs (e.g., visibility and acid deposition) at the nearby federal Class I area. However, SO_X emissions from engine exhaust would be very low, because programmatic design features would require ultra-low-sulfur fuel with a sulfur content of 15 ppm. 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.

Transmission lines within a designated ROW would be constructed to connect to the nearest regional grid. A regional 500-kV transmission line is located about 5 mi (8 km) from the proposed Bullard Wash SEZ; thus construction of a transmission line over this distance would likely be needed. Construction activities would result in fugitive dust emissions from soil disturbance and engine exhaust emissions from heavy equipment and vehicles. Construction time for the transmission line could be about 6 months. However, the site of construction along the transmission line ROW would move continuously, thus no particular area would be exposed to air emissions for a prolonged period. Therefore, potential air quality impacts on nearby residences along the transmission line ROW, if any, would be minor and temporary in nature.

8.2.13.2.2 Operations

Emission sources associated with the operation of a solar facility would include auxiliary boilers; vehicle (commuter, visitor, support, and delivery) traffic; maintenance (e.g., mirror cleaning and repair and replacement of damaged mirrors); and drift from cooling towers for the parabolic trough or power tower technology if wet cooling were implemented (drift comprises low-level PM emissions). Some of these sources may need to comply with emissions standards including, but not limited to, the New Source Performance Standards (NSPS) for boilers (40 CFR Part 60), the NSPS for stationary diesels (40 CFR 60 Subpart IIII), federal requirements for nonroad diesels (40 CFR Part 89), and the NESHAP for stationary reciprocating engines (40 CFR 63 Subpart ZZZZ). In addition, given the typically small emissions, it is unlikely that PSD requirements would apply to typical solar energy facilities.

Table 8.2.13.2-2 presents potential air emissions displaced by solar project development at the proposed Bullard Wash SEZ. Total power generation capacity ranging from 643 to 1,158 MW is estimated for the Bullard Wash SEZ for various solar technologies (see Section 8.2.2). 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

TABLE 8.2.13.2-2 Annual Emissions from Combustion-Related Power Generation Avoided by Full Solar Development of the Proposed Bullard Wash 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
7,239	643–1,158	1,127–2,029	868–1,563	1,337–2,406	0.012–0.022	958–1,725
Percentage of total emissions from electric power systems in Arizona[d]			1.6–2.9%	1.6–2.9%	1.6–2.9%	1.6–2.9%
Percentage of total emissions from all source categories in Arizona[e]			0.78–1.4%	0.37–0.66%	–[f]	0.89–1.6%
Percentage of total emissions from electric power systems in the six-state study area[d]			0.35–0.62%	0.36–0.65%	0.42–0.75%	0.37–0.66%
Percentage of total emissions from all source categories in the six-state study area[e]			0.18–0.33%	0.05–0.09%	–	0.11–0.21%

[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 (for parabolic trough technology) to 9 acres (0.036 km^2) per MW (power tower, dish engine, and photovoltaic technologies) would be required.

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

[c] Composite combustion-related emission factors for SO_2, NO_x, Hg, and CO_2 of 1.54, 2.37, 2.2×10^{-5}, and 1,700 lb/MWh, respectively, were used for the state of Arizona.

[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.

Sources: EPA (2009a,c); WRAP (2009).

is assumed (EPA 2009c). If the Bullard Wash SEZ were fully developed, it is expected that emissions avoided would be somewhat considerable. Development of solar power in the SEZ would result in avoided air emissions ranging from 1.6 to 2.9% of total emissions of SO_2, NO_x, Hg, and CO_2 from electric power systems in the state of Arizona (EPA 2009c). Avoided emissions would be up to 0.75% of total emissions from electric power systems in the six-state study area. When compared with all source categories, power production from the same solar facilities would displace up to 1.4% of SO_2, 0.66% of NO_x, and 1.6% of CO_2 emissions in the state of Arizona (EPA 2009a; WRAP 2009). These emissions would be up to 0.33% of total emissions from all source categories in the six-state study area. Power generation from fossil fuel–fired power plants accounts for about 68% of the total electric power generated in Arizona for which contribution of coal combustion is about 40%, followed by natural gas combustion of about 28%. Thus, solar facilities to be built in the Bullard Wash SEZ could reduce fuel-combustion-related emissions in Arizona to some extent, but relatively less so than those built in other states with higher fossil use rates.

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 inspections and maintenance. However, these activities would occur infrequently, and the amount of 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 high-voltage lines during rain or very humid conditions. Since the Bullard Wash SEZ is located in an arid desert environment, these emissions would be small, and potential impacts on ambient air quality associated with transmission lines would be negligible, considering the infrequent occurrences and small amount of emissions from corona discharges.

8.2.13.2.3 Decommissioning/Reclamation

As discussed in Section 5.11.1.4, decommissioning/reclamation activities are similar to construction activities but are 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. The same mitigation measures adopted during the construction phase would also be implemented during the decommissioning phase (Section 5.11.3).

8.2.13.3 SEZ-Specific Design Features and Design Feature Effectiveness

No SEZ-specific design features are required. Limiting dust generation during construction and operations at the proposed Bullard Wash SEZ (such as increased watering frequency or road paving or treatment) is a required design feature under BLM's proposed Solar Energy Program. These extensive fugitive dust control measures would keep off-site PM levels as low as possible during construction.

8.2.14 Visual Resources

8.2.14.1 Affected Environment

The proposed Bullard Wash SEZ is located in Yavapai County in southwestern Arizona. The western border of the SEZ is 53 mi (85 km) east of the California border. The SEZ occupies 7,239 acres (29 km^2) and extends about 4.5 mi (7.2 km) east to west and north to south. The SEZ is located within the Sonoran Basin and Range Level III ecoregion. which contains scattered low mountains. The area has large tracts of federally owned land. The Sonoran Basin and Range is slightly hotter than the Mojave Basin and Range to the north and contains large areas of palo verde-cactus shrub and giant saguaro cactus, as well as creosote bush (EPA 2002). The SEZ ranges in elevation from 2,315 ft (706 m) in the western portion to 2,580 ft (786 m) in the northeastern portion.

The SEZ is in a valley bounded by mountain ranges to the north and southwest, with open views to the east and northwest. The Black Mountains are 3.8 mi (6.1 km) north of the SEZ; the lone peak of Black Mountain is 2.5 mi (4 km) northeast of the SEZ. The Harcuvar Mountains are 4 mi (6 km) southwest of the SEZ. The Date Creek Mountains are about 8 mi (13 km) east-northeast of the SEZ. These mountains include peaks generally between 3,000 and 4,000 ft (914 and 1,219 m) in elevation, but with some peaks higher than 5,000 ft (1,524 m). The valley containing the SEZ extends about 12 mi (19 km) northwest-southeast and is about 7 mi (11 km) wide.

The SEZ is on the flat plain of the valley floor, with the strong horizon line and surrounding mountain ranges being the dominant visual features. The SEZ slopes gently down from northeast to southwest, with numerous washes crossing the SEZ in the same direction, especially in the northern portion. The surrounding mountains are generally brown in color, but distant mountains appear blue to purple. In contrast, tan-colored sand dominates the desert floor, which is highlighted with the olive-green of creosotebush and the deeper greens of Joshua trees, prickly pear, and barrel cacti. The locations of the SEZ and surrounding mountain ranges are shown in Figure 8.2.14.1-1.

The Bullard Wash SEZ is more heavily vegetated than most of the other proposed SEZs analyzed in the PEIS, with green vegetation nearly covering the sandy valley floor. Vegetation within the SEZ is predominantly scrubland, with creosotebush and other low shrubs dominating. During a September 2009 site visit, the vegetation presented a limited range of greens (mostly olive green of creosotebushes) with some grays and tans (from lower shrubs), with medium to coarse textures, and generally low visual interest. Joshua trees and ocotillo add interesting form and vertical line contrasts where they occur, and the rounded forms of trees add form and color contrast in some areas. The vegetation is tall enough and dense enough in some areas to provide screening of views from non-elevated viewpoints.

No permanent surface water is present within the SEZ; however, numerous washes cross the SEZ, especially in the northern portion.

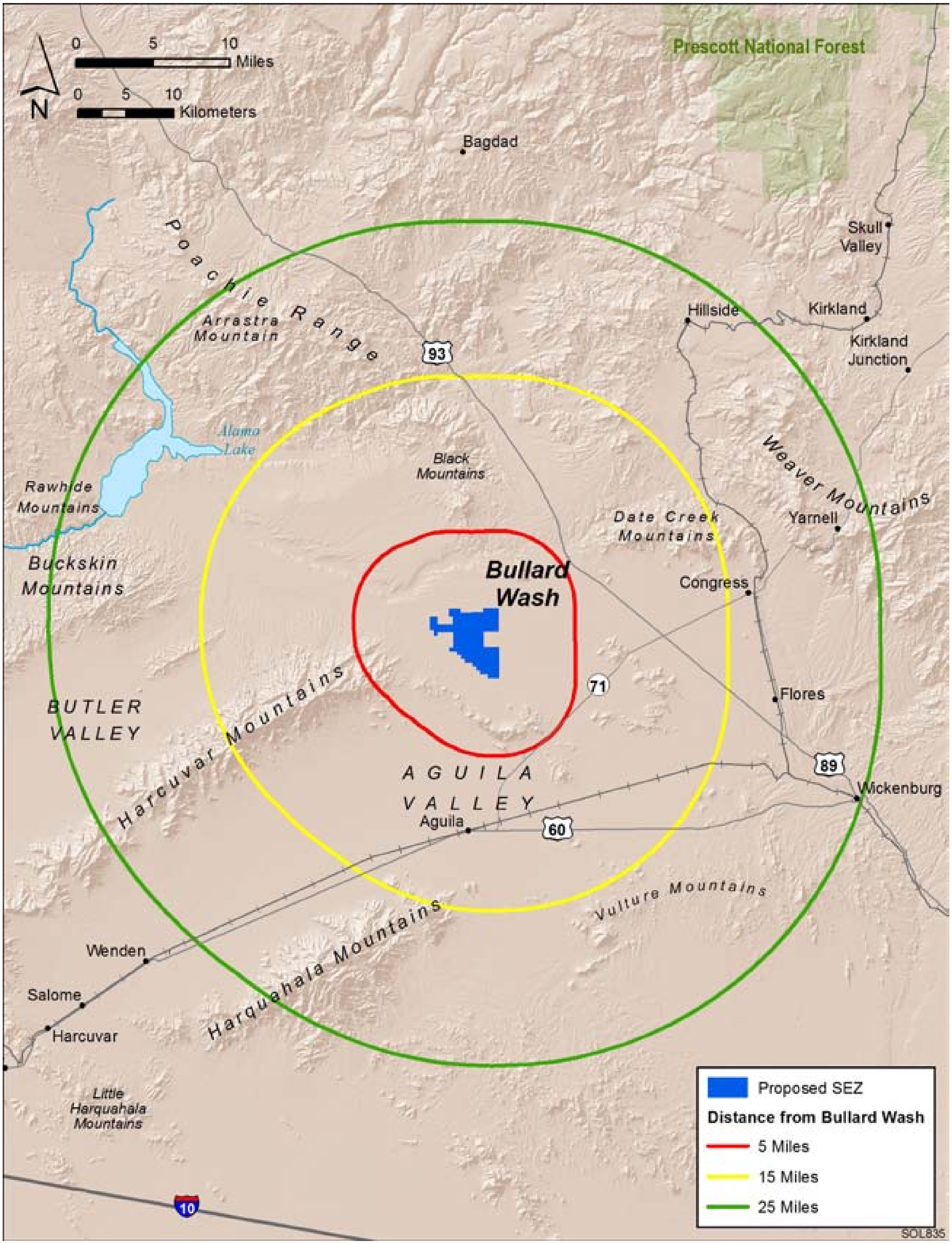

FIGURE 8.2.14.1-1 Proposed Bullard Wash SEZ and Surrounding Lands

Cultural disturbances visible within the SEZ include fences and a few dirt roads. The area is isolated, with no substantial development nearby. However, military jet activity occurs frequently over the SEZ. Off-site cultural disturbances include a transmission line 3 to 4 mi (5 to 6 km) northeast of the SEZ, a road immediately north of the SEZ, and a private residence with a windmill and corrals. These cultural modifications detract very slightly from the scenic quality of the SEZ. The SEZ sufficiently large that from many locations within the SEZ, these features are either not visible or are so distant as to have minimal effect on views. From most locations within the SEZ, the landscape is natural in appearance, with little or no disturbance visible.

Although overall the general lack of topographic relief, water, and physical variety results in low scenic value, the scenic value in some locations in the SEZ is not uniformly low. Because of the flatness of the land and the breadth of the surrounding valley, the SEZ presents a panoramic landscape with sweeping views of the nearby mountains that add significantly to the scenic values within the SEZ viewshed. In general, the upper slopes of the mountains appear to be devoid of vegetation, and the varied and irregular forms and brown to tan colors of the mountains provide pleasing visual contrasts to the strong horizontal line, green vegetation, and light sand of the valley floor, particularly when viewed from nearby locations within the SEZ. The mountain slopes and peaks surrounding the SEZ are visually pristine and enhance the scenic quality of the area. Panoramic views of the SEZ are shown in Figures 8.2.14.1-2, 8.2.14.1-3, and 8.2.14.1-4.

The BLM conducted a VRI for the SEZ and surrounding lands in 2005 (BLM 2010e); however, the VRI was not completed in time for the new data to be included in this draft PEIS. The new VRI data will be incorporated into the analyses presented in the final PEIS. The VRI evaluates BLM-administered lands on the basis of scenic quality; sensitivity level (in terms of public concern for preservation of scenic values in the evaluated lands); and distance from travel routes or key observation points (KOPs). Based on these three factors, BLM-administered lands are placed into one of four Visual Resource Inventory 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 Bradshaw-Harquahala Record of Decision and Approved Resource Management Plan (BLM 2010b)indicates that the SEZ is managed as visual resource management (VRM) Class IV. VRM Class IV permits major modification of the existing character of the landscape. More information about the BLM VRM program is available in Section 5.12 and in BLM Manual Handbook 8400, *Visual Resource Management* (BLM 1984).

8.2.14.2 Impacts

The potential for impacts from utility-scale solar energy development on visual resources within the proposed Bullard Wash SEZ and surrounding lands, as well as the impacts of related

FIGURE 8.2.14.1-2 Approximately 120° Panoramic View toward the Proposed Bullard Wash SEZ from Alamo Road near Northeast Corner of the SEZ, Facing Southwest, with Harcuvar Mountains in Background

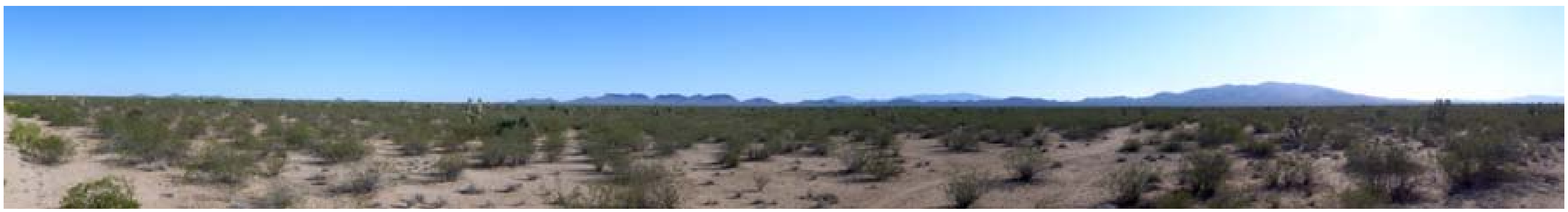

FIGURE 8.2.14.1-3 Approximately 180° Panoramic View toward the Proposed Bullard Wash SEZ from Alamo Road near North Central Portion of the SEZ, Facing South, with Harcuvar Mountains in Background

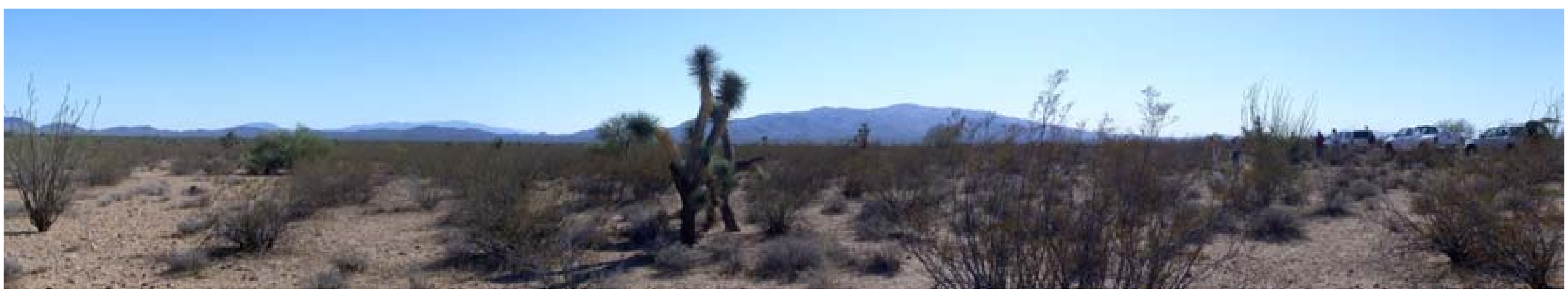

FIGURE 8.2.14.1-4 Approximately 120° Panoramic View toward the Proposed Bullard Wash SEZ from Alamo Road near Northwest Corner of the SEZ, Facing Southeast, with Harcuvar Mountains in Background

developments (e.g., access roads and transmission lines) outside of the SEZ, is presented in this section.

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 visual impacts can be made by describing the range of expected visual changes and discussing contrasts typically associated with such changes. In addition, a general analysis can identify sensitive resources that may be at risk if a future project is sited in a particular area. Detailed information about the methodology used for the visual impact assessment conducted for this 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, which is not possible given the scope of this 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 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.

8.2.14.2.1 Impacts on the Proposed Bullard Wash 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 E. 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 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 nearby views. Additional, and potentially large, impacts would occur as a result of the construction, operation, and decommissioning of associated 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 on 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 projects in the SEZ would be in addition to impacts from solar energy and other projects that may occur on other public or private lands within the SEZ viewshed. For discussion of cumulative impacts, see Section 8.2.22.4.13 of this PEIS.

The changes described above would be expected to be consistent with BLM VRM objectives for VRM Class IV, as seen from nearby KOPs. VRM Class IV is the current designation for the area that would be occupied by the proposed Bullard Wash SEZ. More information about impact determination using the BLM VRM program methodology is available in Section 5.12 and in BLM Manual Handbook 8431-1, *Visual Resource Contrast Rating* (BLM 1986b).

Implementation of the programmatic design features intended to reduce visual impacts (described in Appendix A, Section A.2.2) 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 could 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, but would be important to reduce visual contrasts to the greatest extent possible.

8.2.14.2.2 Impacts on Lands Surrounding the Proposed Bullard Wash SEZ

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 from facility construction, operation, and decommissioning. 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 around the proposed SEZ could have views of solar facilities in at least some portion of the SEZ (see Appendix M for information on the 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 8.2.14.2-1 shows the combined results of the viewshed analyses for all four solar technologies. The colored segments 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 parabolic trough arrays in the SEZ could be visible. Solar dishes and power blocks for CSP technologies would be visible from the areas shaded in light brown and the additional areas shaded in light purple. Transmission towers and short solar power towers would be visible from the areas shaded light brown, light purple, and the additional areas shaded in dark purple. Power tower facilities in the SEZ could be visible from areas shaded light brown, light purple, dark purple, and at least the upper portions of power tower receivers could be visible from the additional areas shaded in medium brown.

For the following visual impact discussion, viewsheds for the tall solar power tower (650 ft [198.1 m]) and PV and parabolic trough array (24.6 ft [7.5 m]) are shown in figures and discussed in the text. These heights represent the maximum and minimum landscape visibility for solar energy technologies analyzed in the PEIS. Viewsheds for solar dish and CSP technology power blocks (38 ft [11.6 m]), and transmission towers and short solar power towers (150 ft [45.7 m]) are presented in Appendix N. The visibility of those 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 8.2.14.2-2 shows the results of a geographical information system (GIS) analysis that overlays selected federal, state, and BLM-designated sensitive visual resource areas onto the combined viewsheds for the tall solar power tower (650 ft [198.1 m]) and PV and parabolic trough array (24.6 ft [7.5 m]) 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 km]), and a 25-mi (40-km) distance zone are shown as well to indicate the effect of distance from the SEZ on impact levels.

The scenic resources included in the analyses 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;

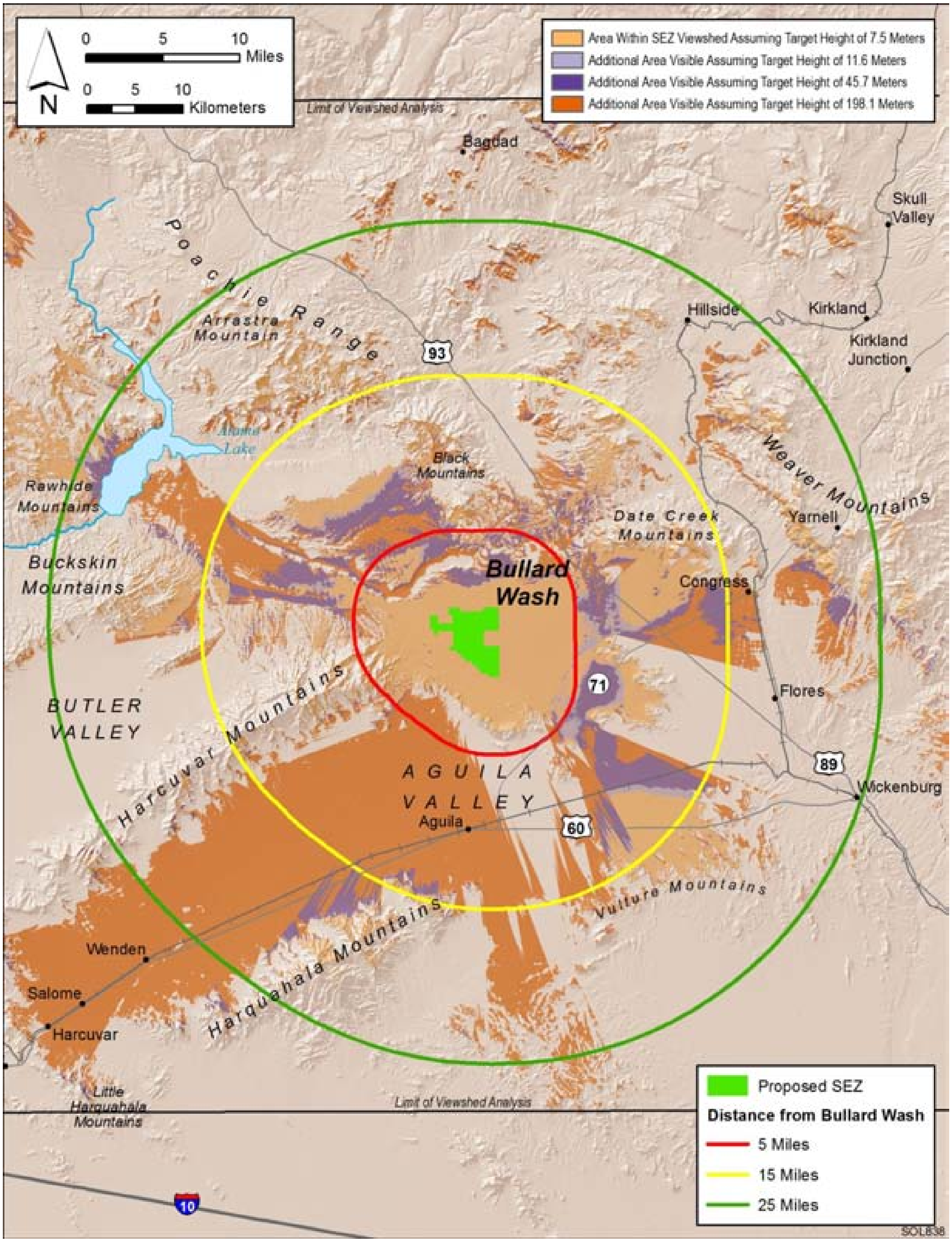

FIGURE 8.2.14.2-1 Viewshed Analyses for the Proposed Bullard Wash SEZ and Surrounding Lands, Assuming Solar Technology Heights of 24.6 ft (7.5 m), 38 ft (11.6 m), 150 ft (45.7 m), and 650 ft (198.1 m) (shaded areas indicate lands from which solar development within the SEZ could be visible)

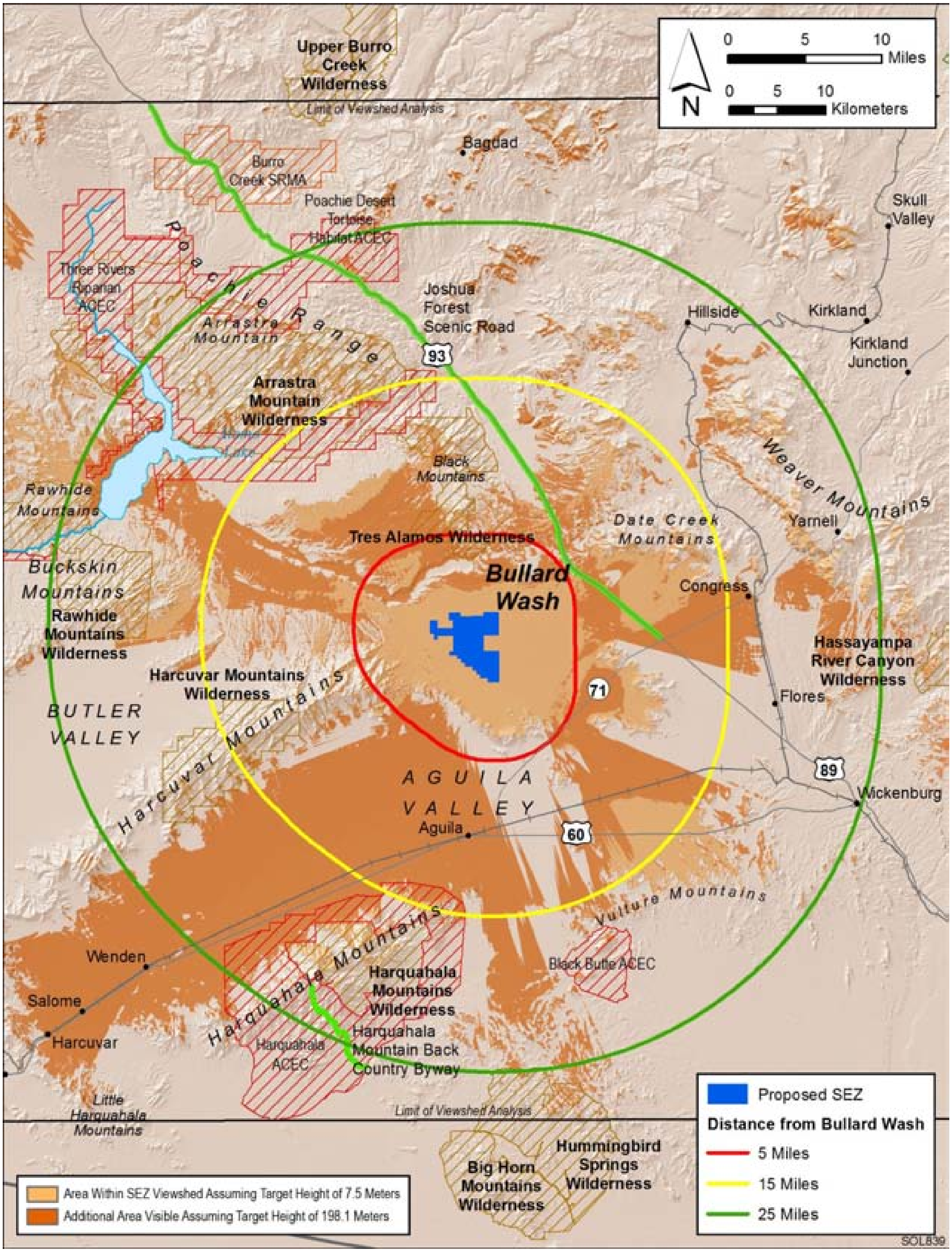

FIGURE 8.2.14.2-2 Overlay of Selected Sensitive Visual Resource Areas onto Combined 650-ft (198.1-m) and 24.6-ft (7.5-m) Viewsheds for the Proposed Bullard Wash SEZ

- Wilderness Study Areas;
- National Wild and Scenic Rivers;
- Congressionally authorized Wild and Scenic Study Rivers;
- National Scenic Trails and National Historic Trails;
- 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 Bullard Wash SEZ are discussed below. The results of this analysis are also summarized in Table 8.2.14.2-1. Further discussion of impacts on these areas is available in Sections 8.2.3 (Specially Designated Areas and Lands with Wilderness Character) and 8.2.17 (Cultural Resources) of the 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 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 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 in this 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.

Wilderness Areas

- *Arrastra Mountain*—Arrastra Mountain is a 129,413-acre (523.716-km^2) congressionally designated wilderness area (WA) located 8.6 mi (13.8 km) north of the SEZ. The WA contains scenic landscapes and unique natural features, including Artillery Peak (a volcanic cone) and the pristine Peoples Canyon.

TABLE 8.2.14.2-1 Selected Potentially Affected Sensitive Visual Resources within the 25-mi (40-km) Viewshed of the Proposed Bullard Wash SEZ, Assuming a Target Height of 650 ft (198.1 m)

		Feature Area or Linear Distance		
			Visible between	
Feature Type	Feature Name and (Total Acreage/Highway Length)[a]	Visible within 5 mi	5 and 15 mi	15 and 25 mi
WAs	Arrastra Mountain (129,413 acres)	0 acres	3,653 acres (3%)[b]	13,074 acres (10%)
	Harcuvar Mountains (25,178 acres)	0 acres	796 acres (3%)	1,240 acres (5%)
	Harquahala Mountains (22,947 acres)	0 acres	0 acres	4,933 acres (22%)
	Hummingbird Springs (31,429 acres)	0 acres	0 acres	3 acres (0.01%)
	Rawhide Mountains (37,968 acres)	0 acres	0 acres	4,433 acres (12%)
	Tres Alamos (8,278 acres)	1,694 acres (21%)	3,450 acres (42%)	0 acres
Scenic Byway	Joshua Forest Scenic Road	0 mi	13.9 mi	0.12 mi
ACECs designated for outstanding scenic values	Three Rivers Riparian (87,716 acres)	0 acres	503 acres (0.6%)	3,478 acres (4%)
	Poachie Desert Tortoise (33,512 acres)	0 acres	0 acres	1,764 acres (5%)
	Harquahala Mountains (77,201 acres)	0 acres	3,180 acres (4%)	13,012 acres (17%)
	Black Butte (9,549 acres)	0 acres	0 acres	422 acres (4%)

[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.

Within the WA, solar facilities in the SEZ would be visible from about 16,727 acres (67.692 km^2) in the 650-ft (198.1-m) viewshed, or 13% of the total WA acreage, and 10,383 acres (42.019 km^2) in the 24.6-ft (7.5-m) viewshed, or 8% of the total WA acreage. As shown in Figure 8.2.14.2-2, the visible area of the WA extends beyond 25 mi (40 km) from the northwestern boundary of the SEZ. The upper slopes and peak of the mountains are barren, with little opportunity for screening.

Figure 8.2.14.2-3 is a Google Earth visualization of the SEZ as seen from an unnamed peak (elevation of about 3,410 ft [1,040 m] above mean sea level) in the central portion of the WA, about 18 mi (29 km) northwest of the northwest corner of the SEZ. The visualization includes simplified wireframe models of a hypothetical solar power tower facility. The models were placed within the SEZ as a visual aide for assessing the approximate size and viewing angle of utility-scale solar facilities. The receiver towers depicted in the visualization are properly scaled models of a 459-ft (140-m) power tower with an 867-acre (3.5-km^2) field of 12-ft (3.7-m) heliostats, each representing about 100 MW of electric generating capacity. Two models were placed in the SEZ for this and other visualizations shown in this section of the PEIS. In the visualization, the SEZ area is depicted in orange, the heliostat fields in blue.

The viewpoint in the visualization is about 1,000 ft (300 m) higher in elevation than the SEZ. Because of the long distance to the SEZ, the SEZ would occupy a very small portion of the horizontal field of view. The collector/reflector arrays of solar facilities within the SEZ would be seen nearly edge-on, which would reduce their apparent size and make their strong regular geometry less apparent. The edge-on view would also cause them to

GOOGLE EARTH™ VISUALIZATIONS

The visual impact analysis discussion in this section utilizes 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 this 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.

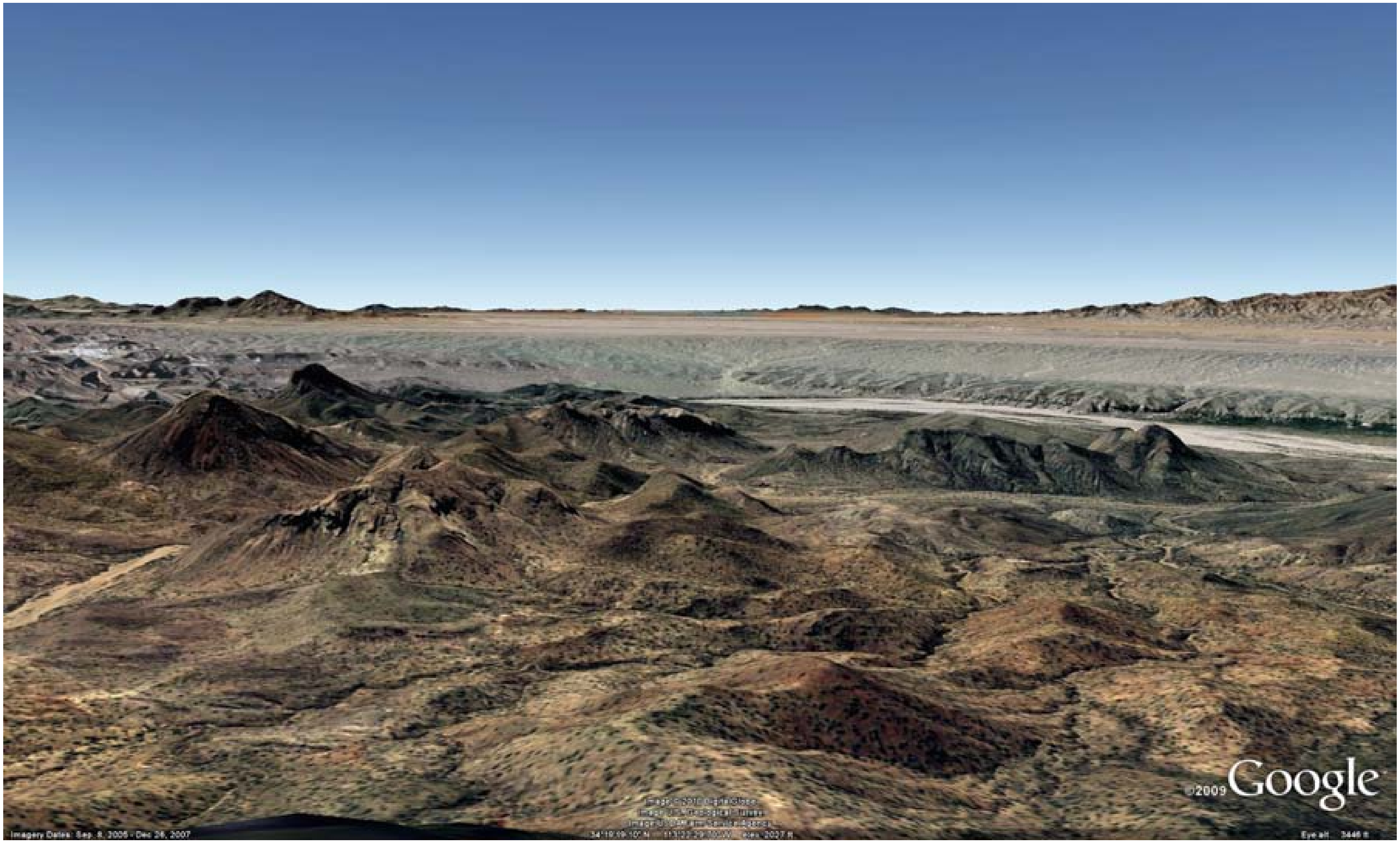

FIGURE 8.2.14.2-3 Google Earth Visualization of the Proposed Bullard Wash SEZ (shown in orange tint) and Surrounding Lands, with Power Tower Wireframe Models, as Seen from an Unnamed Peak in the Central Portion of the Arrastra Mountain WA

appear to repeat the strong line of the horizon, which would tend to reduce visual contrast.

If power tower facilities were located within the SEZ, the light from the operating receivers would likely appear as distant points of light on the southeastern horizon during the day and, if more than 200 ft (61 m) tall, would have flashing red or white navigation warning lights at night that could be visible from this location.

Potential visual contrast levels from solar energy development within the SEZ would vary depending on the type, size, and number of solar energy projects within the SEZ, project location and layout, lighting, atmospheric conditions, and other visibility factors. Under the 80% development scenario analyzed in the PEIS, weak visual contrasts from solar energy development within the SEZ would be expected at this viewpoint.

Figure 8.2.14.2-4 is a Google Earth visualization of the SEZ (highlighted in orange) as seen from an unnamed peak in the eastern portion of the WA, about 12 mi (19 km) from the northernmost boundary of the SEZ. The viewpoint is elevated about 1,600 ft (490 m) above the nearest point in the SEZ.

The visualization suggests that from this viewpoint, the tops of collector/reflector arrays within the SEZ might be visible, but the angle of view would be low because of the distance to the SEZ. The SEZ and solar facilities within it would be seen as a thin band just below the mountains on the southern horizon, and the facilities would tend to repeat the line of the horizon, reducing visual contrast. However, the SEZ would occupy a greater portion of the horizontal field of view than it would as seen from the more distant viewpoint described above.

If power towers were present within the SEZ, when operating they would likely appear as star-like points of light against a backdrop of the Bullard Wash floor, or the bases of the far eastern end of the Harcuvar Mountains south of the SEZ. At night, if more than 200 ft (61 m) tall, power towers could have red or white flashing hazard navigation lights that could be visible from this location.

Potential visual contrast levels associated with solar development within the SEZ would vary depending on the project-related and visibility factors noted above. Under the 80% development scenario analyzed in the PEIS, weak to moderate visual contrasts from solar energy development within the SEZ would be expected at this viewpoint. In general, weak to moderate visual contrasts would be expected to be observed from viewpoints within the WA.

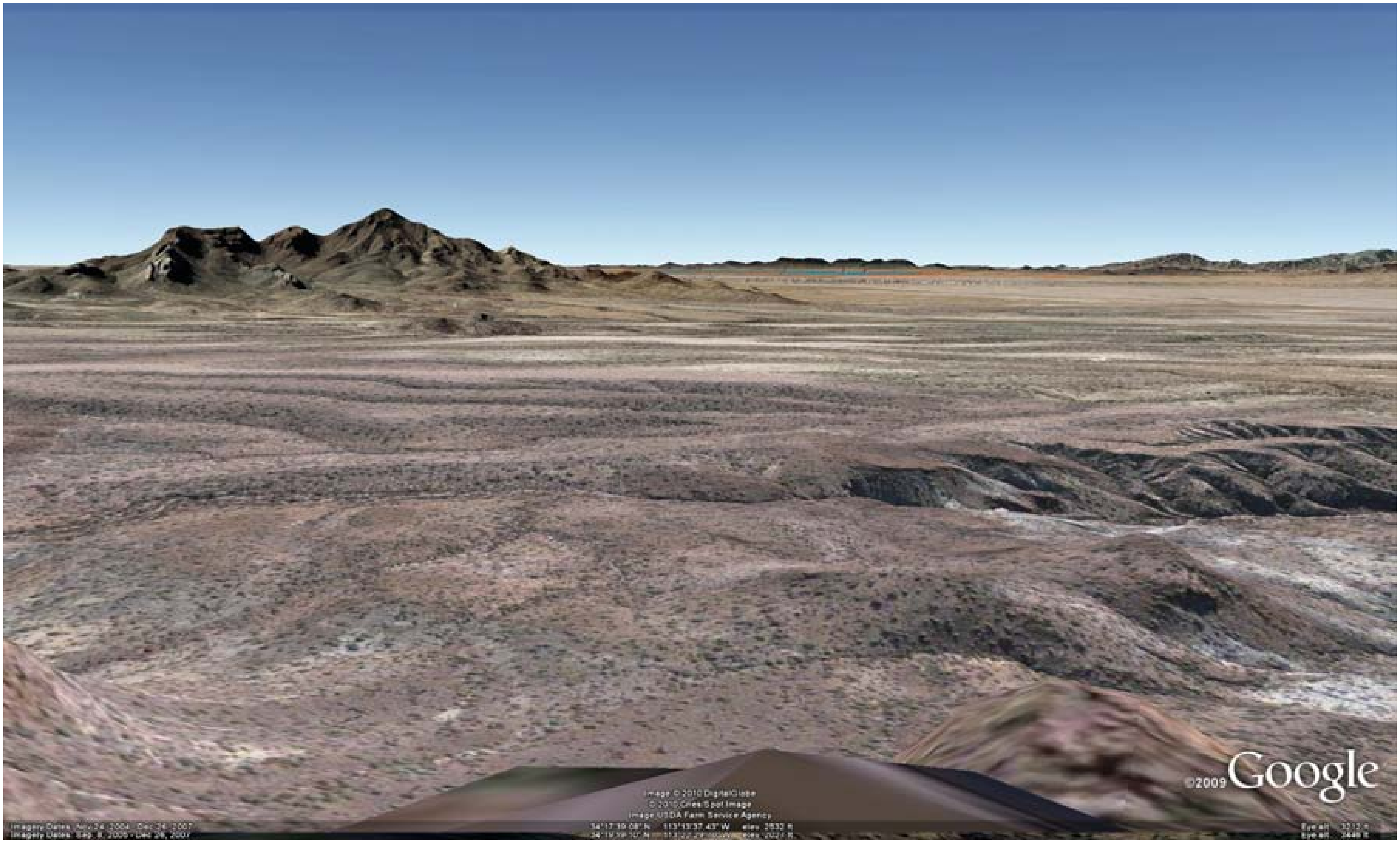

FIGURE 8.2.14.2-4 Google Earth Visualization of the Proposed Bullard Wash SEZ (shown in orange tint) and Surrounding Lands, with Power Tower Wireframe Models, as Seen from an Unnamed Peak in the Eastern Portion of the Arrastra Mountain WA

- *Harcuvar Mountains*—The Harcuvar Mountains WA is a 25,178-acre (102-km^2) congressionally designated WA 10 mi (16 km) southwest of the SEZ. Because of its isolation, the Harcuvar Mountains WA offers outstanding opportunities for wilderness recreation and solitude. The canyons and ridgelines provide a high-quality setting for hiking, backpacking, hunting, and climbing. Sightseeing use has increased in recent years and is attributed to the increased number of winter visitors in the Wenden/Salome area (BLM 2009b).

  As shown in Figure 8.2.14.2-2, within 25 mi (40 km) of the SEZ, solar energy facilities could be visible from the northeastern portions of the WA (about 2,036 acres [8.2 km^2] in the 650-ft [198.1-m] viewshed, or 8% of the total WA acreage, and 1,040 acres [4.2 km^2] in the 25-ft [7.5-m] viewshed, or 4% of the total WA acreage). The area of the WA with potential visibility of solar facilities within the SEZ extends to beyond 25 mi (40 km) from the southwestern boundary of the SEZ.

  Figure 8.2.14.2-5 is a Google Earth visualization of the SEZ (highlighted in orange) as seen from an unnamed peak on the eastern boundary of the WA, on the southern side of the Harcuvar Mountains about 11 mi (18 km) from the northernmost boundary of the SEZ. The viewpoint is elevated about 1,400 ft (430 m) above the nearest point in the SEZ. Because the Harcuvar Mountains are generally higher in elevation east of the WA than they are within the WA, views of the SEZ from the WA are screened by mountains outside the WA; the viewpoint selected for this visualization is near the point of maximum visibility of the SEZ within the WA.

  The visualization suggests that from this viewpoint, mountains farther east from this viewpoint near the easternmost boundary of the WA would screen a substantial portion of the SEZ from view. Within the visible portion of the SEZ, the tops of collector/reflector arrays within the SEZ might be visible, but the angle of view would be low because of the 11-mi (18-km) distance to the SEZ. The SEZ and solar facilities within it would be seen as a narrow band just over the tops of the mountains between the viewpoint and the SEZ toward the east. The facilities would tend to repeat the line of the valley floor in which the SEZ is located, reducing visual contrast. The edge-on view would also tend to reduce their apparent size and conceal their strong regular geometry, which would also reduce visual contrast.

  Any operating power towers within the SEZ would be visible as potentially bright star-like points of light atop visible tower structures against a backdrop of the Bullard Wash floor during the day and, if more than 200 ft (61 m) tall, would have navigation warning lights at night that could be visible from this location. Other lighting associated with solar facilities in the SEZ could be visible as well.

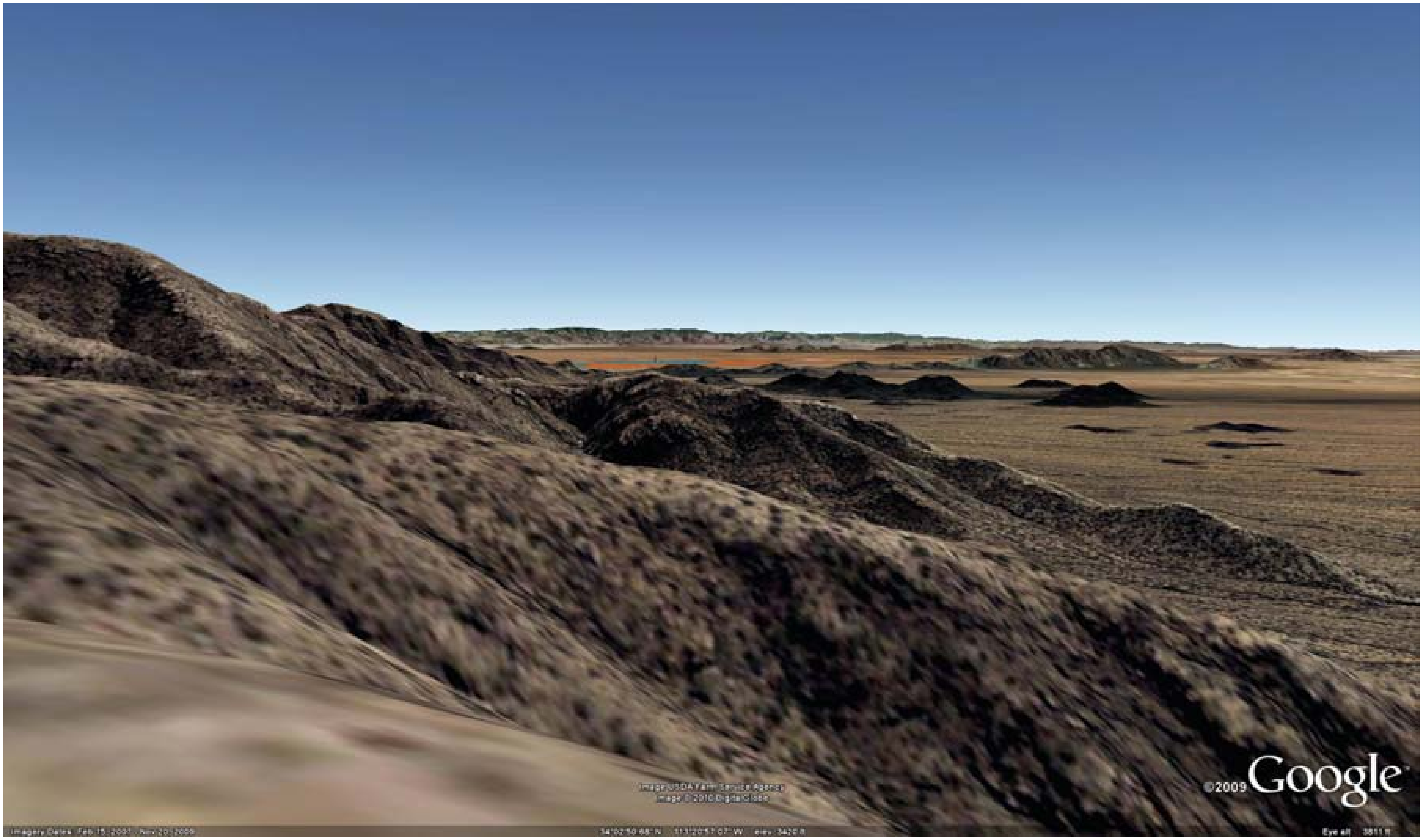

FIGURE 8.2.14.2-5 Google Earth Visualization of the Proposed Bullard Wash SEZ (shown in orange tint) and Surrounding Lands, with Power Tower Wireframe Models, as Seen from Viewpoint in Eastern Portion of Harcuvar Mountains WA

Potential visual contrast levels associated with solar development within the SEZ would vary depending on the project-related and visibility factors noted above, but under the 80% development scenario analyzed in the PEIS, weak visual contrasts from solar energy development within the SEZ would be expected at this viewpoint. Because this viewpoint is near the point of greatest SEZ visibility within the WA, similar or lower visual contrasts would be expected for other viewpoints within the WA.

- *Harquahala Mountains*—The Harquahala Mountains WA is a 22,947-acre (93-km^2) congressionally designated WA located 15.6 mi (25 km) away at the point of closest approach southwest of the SEZ. This wilderness contains part of one of western Arizona's largest desert mountain ranges. The 5,691-ft (1,735-m) high Harquahala Peak, the highest point in southwest Arizona, provides sweeping panoramic views of surrounding desert and distant mountain ranges.

  Within 25 mi (40 km), solar energy facilities within the SEZ could be visible from portions of the northern slopes of the mountains within the WA. Visible areas of the WA within the 25-mi (40-km) radius of analysis total about 4,933 acres (20 km^2) in the 650-ft (198.1-m) viewshed, or 22% of the total WA acreage, and 3,951 acres (16 km^2) in the 24.6-ft (7.5-m) viewshed, or 17% of the total WA acreage. As shown in Figure 8.2.14.2-2, the visible area of the WA extends to about 22 mi (35 km) from the southern boundary of the SEZ.

  Figure 8.2.14.2-6 is a Google Earth visualization of the SEZ (highlighted in orange) as seen from an unnamed peak on the boundary of the Harquahala Mountain WA and the ACEC, at the most northeastern point in the WA, 16 mi (26 km) from the southernmost boundary of the SEZ. This is the closest point to the SEZ within the WA; however, visibility of the SEZ in this part of the WA is limited to the immediate vicinity of this peak because of the screening of the SEZ by the mountain in other locations. The viewpoint is elevated about 2,100 ft (640 m) above the nearest point in the SEZ.

  The visualization suggests that from this viewpoint, the SEZ would be viewed across a wide plain containing a large array of rectangular agricultural fields, just beyond the far eastern arm of the Harcuvar Mountains, which would screen some portions of the SEZ from view. Because of the long distance to the SEZ, the SEZ would occupy a small portion of the field of view. Within the visible portion of the SEZ, the tops of collector/reflector arrays might be visible, but the angle of view would be low because of the distance to the SEZ. The SEZ and solar facilities within it would be seen as a narrow band just over the tops of the mountains between the viewpoint and the SEZ, and the facilities would tend to repeat the line of the valley floor in which the SEZ is located, thus reducing visual contrast.

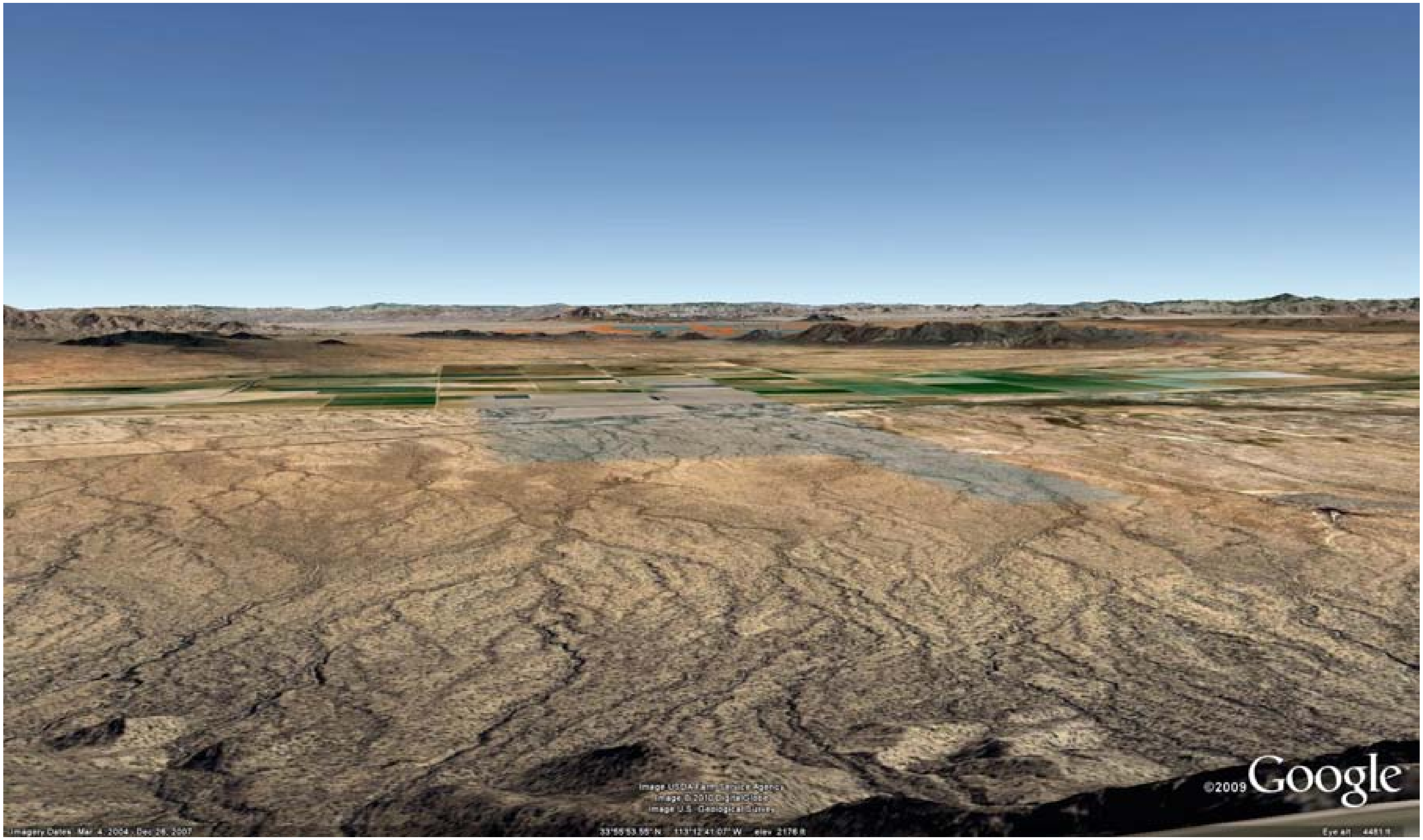

FIGURE 8.2.14.2-6 Google Earth Visualization of the Proposed Bullard Wash SEZ (shown in orange tint) and Surrounding Lands, with Power Tower Wireframe Models, as Seen from Viewpoint within the Harquahala Mountains WA

If power towers were present within the SEZ, they would be visible as distant star-like points of light against a backdrop of the Bullard Wash floor. At night, if more than 200 ft (61 m) tall, the power towers would have navigation warning lights that could be visible from this location.

Potential visual contrast levels associated with solar development within the SEZ would vary depending on the project-related and visibility factors noted above, but under the 80% development scenario analyzed in the PEIS, weak visual contrasts from solar energy development within the SEZ would be expected at this viewpoint. Other viewpoints within the WA would have less obstructed views of the SEZ; however, they are farther from the SEZ, and expected visual contrasts seen from these viewpoints would be weak.

- *Hummingbird Springs*—The Hummingbird Springs WA is a 31,429-acre (127-km^2) congressionally designated WA 25 mi (40 km) from the point of closest approach south of the SEZ. The eastern Big Horn Mountains cross this WA for more than 8 mi (13 km). The area is dominated by Sugarloaf Mountain, a landmark encircled by many lower peaks, hills, washes, and bajadas. This WA offers numerous recreation opportunities.

  As shown in Figure 8.2.14.2-2, visible areas of the WA within the 25-mi (40-km) radius of analysis total about 3 acres (0.01 km^2) in the 650-ft (198.1-m) viewshed, or 0.01% of the total WA acreage. None of the WA is visible within the 24.6-ft (7.5-m) viewshed. A small portion of the visible area of the WA extends beyond 25 mi (40 km) from the southern boundary of the SEZ.

  Because of the very long distance to the SEZ, the resultant very low viewing angle, and screening by intervening terrain, only the upper portions of tall power tower receivers would be visible from a very small portion (3 acres [0.01 km^2]) of the WA, at a distance of nearly 25 mi (40 km). At night, if more than 200 ft (61 m) tall, power towers would have navigation warning lights that could potentially be visible from the WA. Expected visual impacts from solar energy development within the SEZ would be expected to be minimal.

- *Rawhide Mountains*—Rawhide Mountains WA is a 37,968-acre (154-km^2) congressionally designated WA located 19 mi (31 km) at the point of closest approach west of the SEZ. The Rawhide Mountains are low hills punctuated by numerous rugged outcrops. These hills rise from 700 ft (213 m) to an elevation of 2,430 ft (741 m) in elevation.

  Within 25 mi (40 km), solar energy facilities within the SEZ could be visible from portions of the eastern slopes of the mountains within the WA. Areas of the WA within the 25-mi (40-km) radius of analysis total about 4,433 acres (18 km^2) in the 650-ft (198.1-m) viewshed, or 12% of the total WA acreage, and 3,351 acres (14 km^2) in the 24.6-ft (7.5-m) viewshed, or 9% of the total WA acreage. As shown in Figure 8.2.14.2-2, the visible area of the WA extends to beyond 25 mi (40 km) from the southwestern boundary of the SEZ.

Figure 8.2.14.2-7 is a Google Earth visualization of the SEZ (highlighted in orange) as seen from an unnamed peak in the eastern portion of the WA, about 20 mi (32 km) from the northwestern corner of the SEZ. The viewpoint is elevated about 710 ft (220 m) above the nearest point in the SEZ.

The visualization suggests that from this viewpoint, the SEZ would be viewed across a wide plain. Because of the long distance to the SEZ, the SEZ would occupy a very small portion of the field of view, and the vertical angle of view would be very low. The SEZ and solar facilities within it would be seen nearly edge-on and would tend to repeat the line of the horizon, thus reducing visual contrast. The edge-on view would also tend to reduce their apparent size and conceal their strong regular geometry, as well as reduce visual contrast.

If power towers were present within the SEZ, they would be visible as distant points of light against a backdrop of distant mountains. At night, if more than 200 ft (61 m) tall, power towers would have navigation warning lights that could potentially be visible from the WA.

Potential visual contrast levels associated with solar development within the SEZ would vary depending on the project-related and visibility factors noted above, but under the 80% development scenario analyzed in the PEIS, weak visual contrasts from solar energy development within the SEZ would be expected at this viewpoint. Other viewpoints within the WA are generally either lower in elevation or they are farther from the SEZ than this viewpoint and would be expected to be subject to similar or lower levels of visual contrast associated with solar development within the SEZ.

- *Tres Alamos*—Tres Alamos WA is an 8,278-acre (34-km^2) congressionally designated WA located 3.5 mi (5.6 km) at the point of closest approach north of the SEZ. All of the area offers landscapes suitable for hiking, backpacking, sight-seeing, photography, and camping. Sawyer Peak, at 4,293 ft, (1,309 m) elevation, is the highest point in the WA and in the Black Mountains. Wilderness visitation is estimated at less than 200 visits annually and is not expected to increase significantly in the foreseeable future because the area is remote and access is difficult (BLM 2000).

  As shown in Figure 8.2.14.2-2, within 25 mi (40 km), solar energy facilities within the SEZ could be visible from the southern portions of the WA. Visible areas of the WA within the 25-mi (40-km) radius of analysis total about 5,144 acres (21 km^2) in the 650-ft (198.1-m) viewshed, or 62% of the total WA acreage, and 1,347 acres (5.5 km^2) in the 24.6-ft (7.5-m) viewshed, or 16% of the total WA acreage. The area of the WA with potential visibility of

FIGURE 8.2.14.2-7 Google Earth Visualization of the Proposed Bullard Wash SEZ (shown in orange tint) and Surrounding Lands, with Power Tower Wireframe Models, as Seen from Viewpoint within the Rawhide Mountains WA

solar facilities within the SEZ extends to about 7.2 mi (11.6 km) from the northern boundary of the SEZ.

Figure 8.2.14.2-8 is a Google Earth visualization of the SEZ (highlighted in orange) as seen from an unnamed hill in the southeastern portion of the WA, 4.2 mi (6.7 km) from the nearest point in the SEZ, on its northern boundary. The viewpoint is elevated about 230 ft (70 m) above the nearest point in the SEZ.

The visualization suggests that from this viewpoint, the SEZ would be viewed across the shallow canyon containing Date Creek. Because of the short distance to the SEZ, the SEZ would occupy much of the horizontal field of view, but the vertical angle of view would be very low because of the small elevation difference between the viewpoint and the SEZ. The SEZ and solar facilities within it would be seen nearly edge-on and would tend to repeat the line of the horizon, reducing visual contrast. The edge-on view would also tend to reduce their apparent size and conceal their strong regular geometry, as well as reduce visual contrast. However, taller ancillary facilities, such as buildings, transmission structures, and 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 could 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 utilized in the facilities.

If power towers were present within the SEZ, the receivers would be visible as very bright non-point light sources against a backdrop of the Harcuvar Mountains south of the SEZ, or silhouetted against the sky in gaps between the mountains. They would be expected to be visually prominent, and would likely attract visual attention. The tower structures would likely be plainly visible, adding short vertical line contrasts into the strongly horizontal landscape. At night, if more than 200 ft (61 m) tall, power towers would have navigation warning lights that could potentially be very conspicuous from this location, given the dark night skies typical of this remote area. Other lighting associated with solar facilities in the SEZ could be visible as well.

Potential visual contrast levels associated with solar development within the SEZ would vary depending on the project-related and visibility factors noted above, but under the 80% development scenario analyzed in the PEIS, strong visual contrasts from solar energy development within the SEZ would be expected at this viewpoint.

Figure 8.2.14.2-9 is a Google Earth visualization of the SEZ (highlighted in orange) as seen from a low ridge in the southwestern portion of the WA, 3.9 mi (6.3 km) from the nearest point in the SEZ, on its northern boundary.

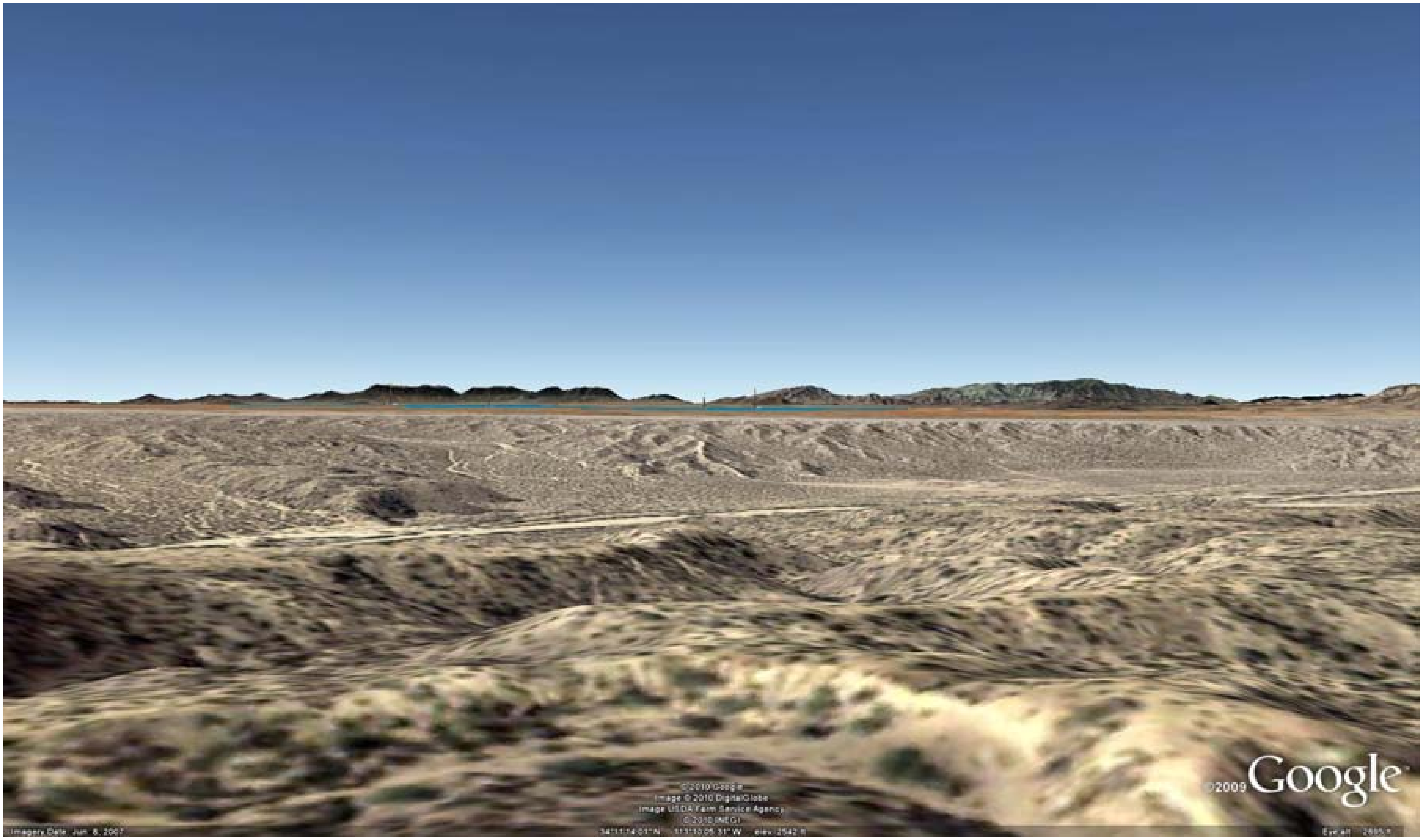

FIGURE 8.2.14.2-8 Google Earth Visualization of the Proposed Bullard Wash SEZ (shown in orange tint) and Surrounding Lands, with Power Tower Wireframe Models, as Seen from a Viewpoint within the Southeastern Portion of Tres Alamos WA

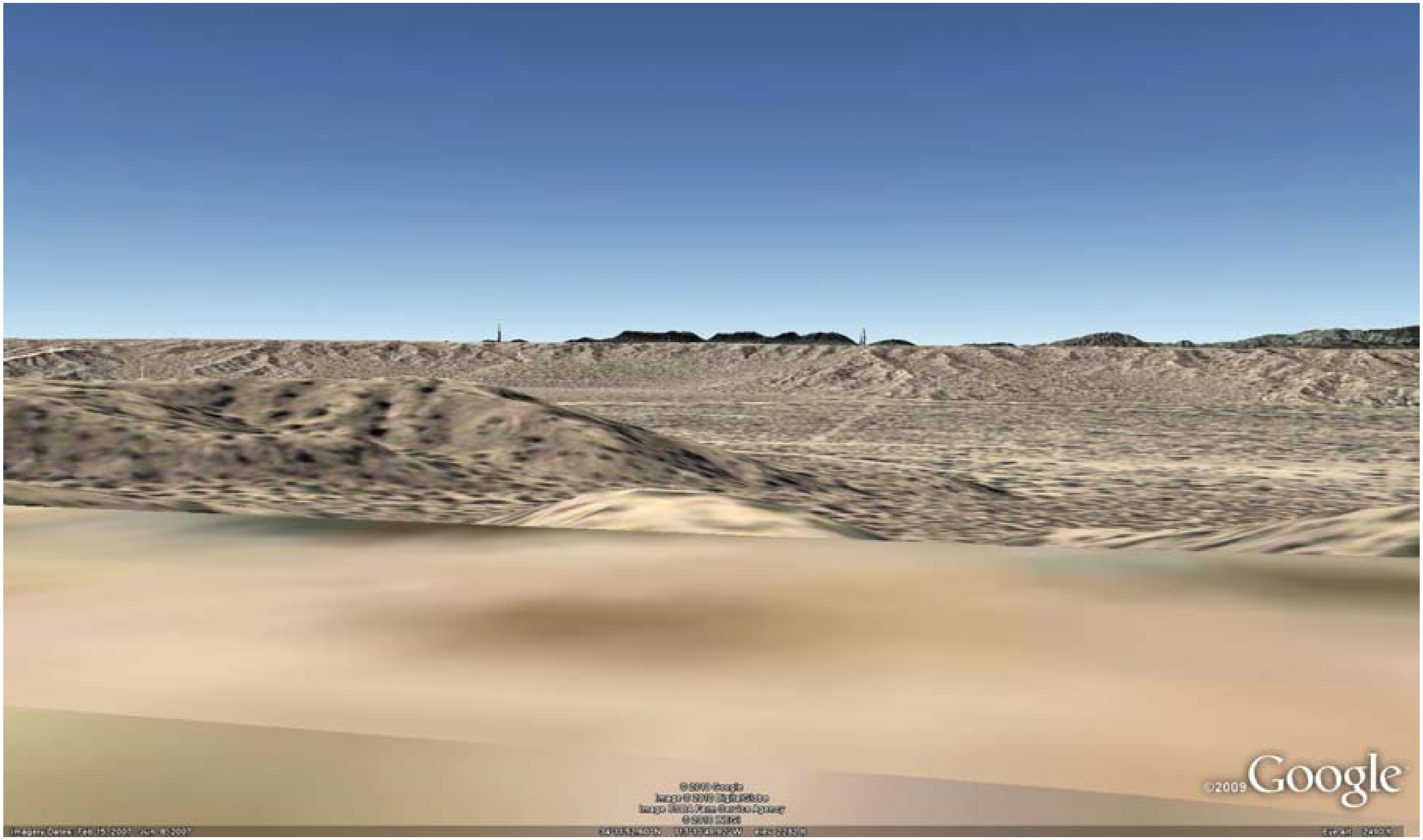

FIGURE 8.2.14.2-9 Google Earth Visualization of the Proposed Bullard Wash SEZ (shown in orange tint) and Surrounding Lands, with Power Tower Wireframe Models, as Seen from a Low Ridge within the Southwestern Portion of Tres Alamos WA

The viewpoint is elevated about 35 ft (11 m) above the nearest point in the SEZ.

The visualization suggests that from this viewpoint, the SEZ would be viewed across the shallow canyon containing Date Creek. Because the southern rim of the canyon is slightly elevated with respect to both the viewpoint and the SEZ, it would screen the SEZ entirely from view, but the upper portions of power towers and possibly other tall structures and plumes associated with solar facilities might be visible above the canyon rim. Because of the short distance to the SEZ, these structures, if visible, could be spread across much of the horizontal field of view. If power towers were present within the closest portions of the SEZ, when operating the receivers would be visible as brilliant white nonpoint light sources against a backdrop of the Harcuvar Mountains south of the SEZ, or silhouetted against the sky in gaps between the mountains. They would be expected to be visually prominent and would likely attract visual attention. At night, if more than 200 ft (61 m) tall, power towers would have navigation warning lights that could potentially be very conspicuous from this location, given the dark night skies typical of this remote area. Other lighting associated with solar facilities in the SEZ could be visible as well.

Potential visual contrast levels associated with solar development within the SEZ would vary depending on the project-related and visibility factors noted above, but could vary quite widely. If sufficiently tall power towers or other tall project components were absent from the northern portions of the SEZ, there could be little or no visible impacts. If power tower receivers were visible, visual contrasts would still vary widely, ranging from low contrast levels during cloudy conditions or at other times when the facility was not operating, to potentially high contrast levels if multiple towers were visible in sunlit conditions. However, even this scenario would involve significantly lower contrast levels than those expected if the full collector/reflector arrays and ancillary facilities were visible.

Figure 8.2.14.2-10 is a Google Earth visualization of the SEZ (highlighted in orange) as seen from the highest of the Tres Alamos mountains in the northern portion of the WA, 6.5 mi (10.5 km) from the nearest point in the SEZ, on its northern boundary. The viewpoint is elevated about 330 ft (100 m) above the nearest point in the SEZ.

This viewpoint is much higher in elevation than the two viewpoints previously described, but substantially farther from the SEZ. The SEZ would be viewed across the shallow canyon containing Date Creek. The visualization suggests that from this viewpoint, the vertical angle of view is high enough that the entire SEZ would be visible, as would the tops of collector/reflector arrays of solar facilities located within the SEZ. Compared to lower-angle views, this elevated viewing angle would increase the apparent size of the SEZ and solar

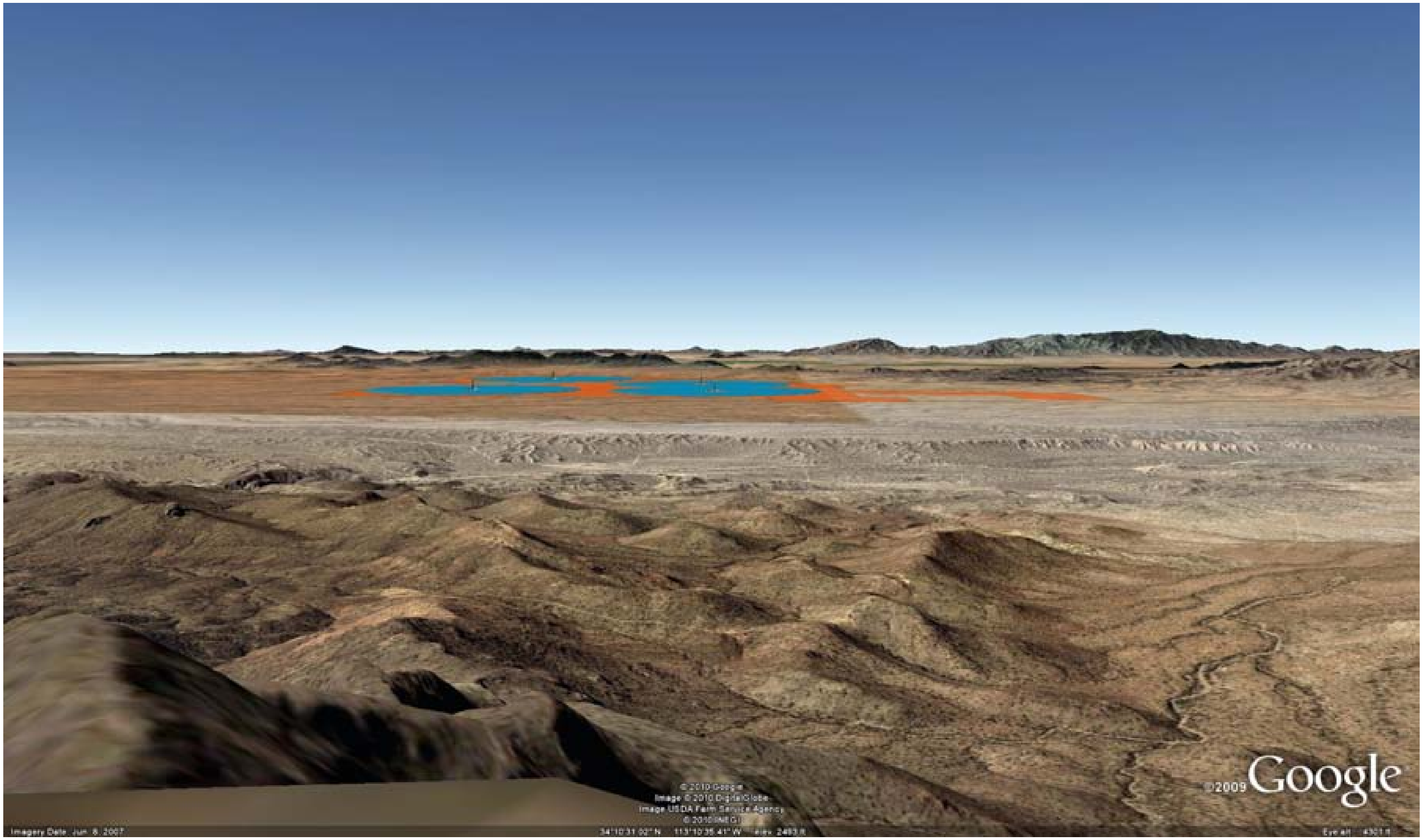

FIGURE 8.2.14.2-10 Google Earth Visualization of the Proposed Bullard Wash SEZ (shown in orange tint) and Surrounding Lands, with Power Tower Wireframe Models, as Seen from a Mountain Peak within the Northern Portion of Tres Alamos WA

facilities within the SEZ, and the strong regular geometry of the solar arrays would be more apparent.

If power towers were present within the SEZ, the receivers would be visible as bright to very bright non-point light sources against a backdrop of the floor of the valley containing the SEZ. They would be expected to be visually prominent and would likely attract visual attention when operating. Other lighting associated with solar facilities could be visible as well.

Potential visual contrast levels associated with solar development within the SEZ would vary depending on the project-related and visibility factors noted above, but under the 80% development scenario analyzed in the PEIS, strong visual contrasts from solar development within the SEZ would be expected at this viewpoint.

In summary, the Tres Alamos WA is close enough to the SEZ that strong visual contrasts resulting from solar development within the SEZ would be expected for most viewpoints within the WA with a clear view of the SEZ. Lower contrast levels would be expected at lower elevations, in part because of lower viewing angles, but also (for some low-elevation viewpoints in the WA) because of screening by landforms between the WA and the SEZ.

Scenic Byways

- *Joshua Forest Scenic Road (U.S. 93)*—Joshua Forest Scenic Road (U.S. 93, and also referred to as the Joshua Tree Parkway) is a state- and congressionally designated scenic byway that is 53 mi (86 km) long and provides views of boulder fields, granite formations, and several creeks and rivers. At the point of closest approach, the byway is within 5.5 mi (8.9 km) of the northeast corner of the SEZ. Solar energy development within the Bullard Wash SEZ would be visible from a portion of the Joshua Forest Scenic Road mostly east and northeast of the northern portion of the SEZ, at distances ranging from 5.5 mi (8.9 km) to 12 mi (19 km).

  As shown in Figure 8.2.14.2-2, about 14 mi (22.5 km) of the road is within the 650-ft (198.1-m) viewshed of the SEZ. Elevations of the byway that are within the viewshed of the SEZ are as much as 400 ft (122 m) higher than the eastern portion of the SEZ.

  For north-bound travelers on the Scenic Road, sufficiently tall power towers at some locations within the SEZ could become visible about 10 mi (16 km) northwest of the community of Wickenburg, AZ. At an approximate distance of 12 mi (19 km) from the SEZ, the receivers of sufficiently tall operating power towers could appear as bright points of light against a sky backdrop or against a backdrop of the Harcuvar Mountains west of the SEZ and, if sufficiently tall to require hazard navigation lighting, likely would be visible at night. The upper parts of the tower structures could be visible as well, but the lower portions of the towers and the other facility components would be screened by landform and vegetation. The receivers and visible portions of the towers would be visible to the left (west) of northbound vehicles. Northbound vehicles would have already passed the far southern portion of the SEZ when any visible towers would first come into view, and at no point would the SEZ be seen directly in front of vehicles on the Scenic Road.

In about 2 minutes (at highway speeds), as the road rises in elevation to the northwest in the vicinity of the SEZ, lower-height solar facilities and associated project components would come into view and gradually increase in size as the road approached the SEZ. At about 9.7 mi (15.6 km) from the SEZ (approximately 15 mi [23 km] from Wickenburg), parabolic trough and PV arrays located in some portions of the SEZ might come into view briefly, but after about 2 minutes they would disappear again because of topographic screening. Partial screening of lower-height solar facilities within the SEZ would then occur for the next several minutes, followed by brief periods of total screening of solar facilities within the SEZ as the road passed through an area of undulating terrain. The first brief period of full screening would occur near the point of closest approach of the roadway to the SEZ (5.5 mi [8.9 km] away, about 18.6 mi [29.9 km] northwest of Wickenburg). Views of the SEZ would eventually be screened by the slopes of the Black Mountains at about 9.3 mi (15.0 km) from the SEZ, and about 28 mi (45 km) northwest of Wickenburg.

Figure 8.2.14.2-11 is a Google Earth visualization of the SEZ (highlighted in orange) as seen from the Joshua Forest Scenic Road near the point of closest approach to the SEZ, 5.8 mi (9.3 km) from the northeast corner of the SEZ. The viewpoint is elevated about 1,840 ft (561 m) above the nearest point in the SEZ.

The visualization suggests that from this viewpoint, the SEZ would occupy much of the horizontal field of view, but the vertical angle of view would be very low because of the small elevation difference between the viewpoint and the SEZ and because of partial screening of the SEZ by the sloping ground between the road and the SEZ. The SEZ and solar facilities within it would be seen nearly edge-on, which would tend to repeat the line of the horizon and reduce visual contrast. The edge-on view would also tend to reduce their apparent size and conceal their strong regular geometry. STGs, other power block components, transmission components, cooling towers and plumes (for parabolic trough and power tower facilities), and buildings (for all facility types) could be visible above the collector/reflector arrays, however, at this relatively short distance, their forms, lines, colors, and reflective surfaces could create noticeable visual contrasts.

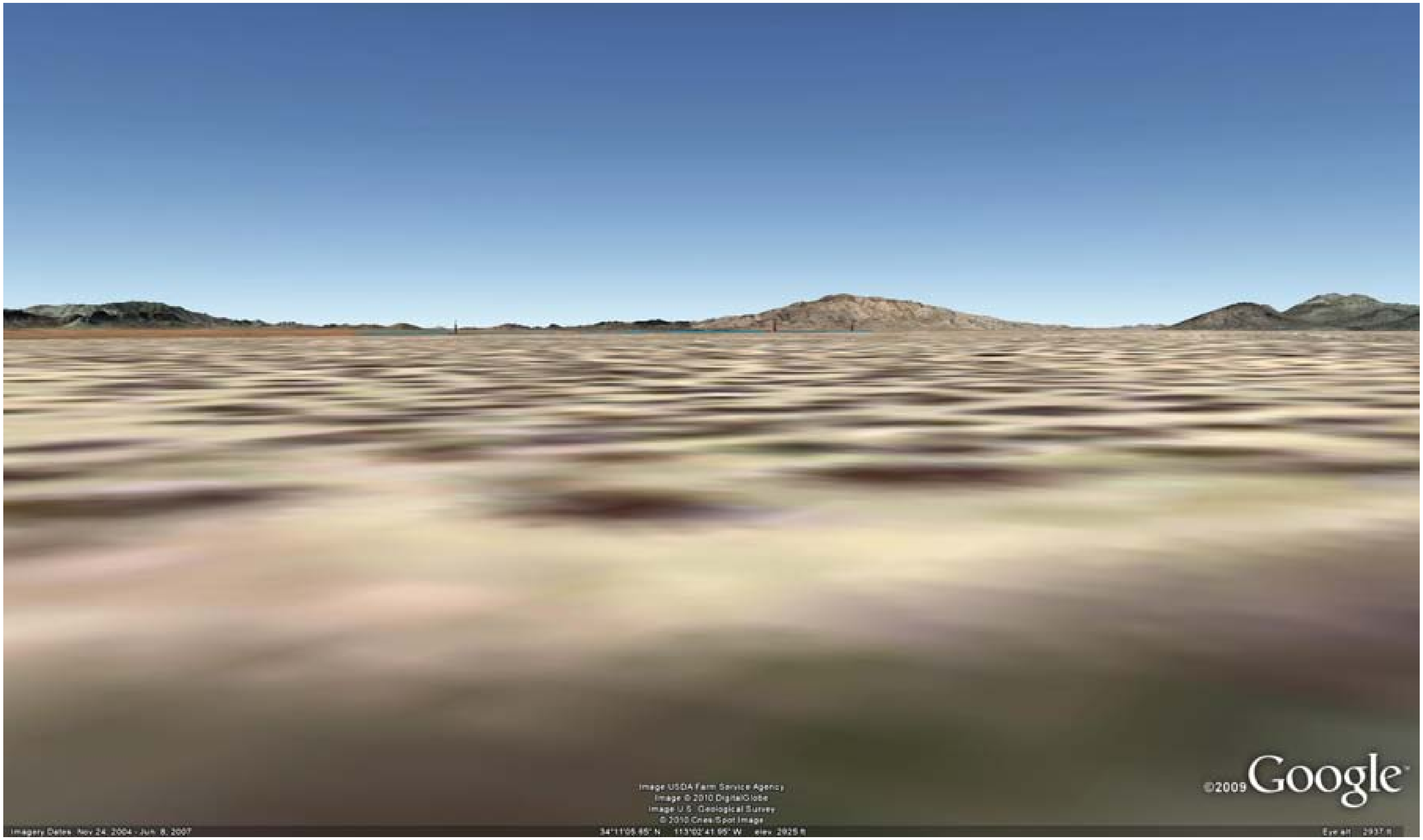

FIGURE 8.2.14.2-11 Google Earth Visualization of the Proposed Bullard Wash SEZ (shown in orange tint) and Surrounding Lands, with Power Tower Wireframe Models, as Seen from a Viewpoint on the Joshua Forest Scenic Roadway

If power towers were present within the SEZ, the receivers would be visible as very bright light sources against a backdrop of the Harcuvar Mountains south of the SEZ, or silhouetted against the sky above the mountains. Operating power towers could visually prominent and would likely attract visual attention. The tower structures would likely be visible, adding short vertical line contrasts into the strongly horizontal landscape. At night, if more than 200 ft (61 m) tall, power towers would have navigation warning lights that could be conspicuous from this viewpoint.

Potential visual contrast levels associated with solar development within the SEZ would vary depending on the project-related and visibility factors noted above, but under the 80% development scenario analyzed in the PEIS, moderately strong visual contrasts from solar energy development within the SEZ would be expected at this viewpoint. However, at this viewpoint, northbound vehicle occupants would need to look almost perpendicular to the direction of travel to see the SEZ, and because travelers would be passing the SEZ rather than approaching directly toward it, view duration would be relatively brief.

Southbound travelers on the Joshua Tree Scenic Road would have a different visual experience from northbound travelers. Southbound viewers would first see the receivers of sufficiently tall power towers and other tall solar facility components (if present in visible parts of the SEZ) at the far right of their vehicles as they passed the southeast portion of the Black Mountains. An extended period of potential visibility of solar facilities within the SEZ would begin as southbound vehicles passed the point of closest approach of the Scenic Road to the SEZ at 5.8 mi (9.3 km) from the northeast corner of the SEZ, but at this point vehicles would have passed the northwestern half of the SEZ and their vehicles would actually be pointed southeast, away from the SEZ. Very quickly, vehicle occupants would need to look behind and to the right of their vehicles to see the SEZ, which would tend to reduce the frequency and duration of viewing the SEZ. Therefore, in general, southbound travelers on the Scenic Roadway would be subject to lower levels of visual impact for solar energy development within the SEZ than northbound travelers.

ACEC Designated for Outstandingly Remarkable Scenic Values

- *Three Rivers Riparian*—The 87,716-acre (355-km^2) Three Rivers Riparian ACEC is about 12 mi (19 km) northwest of the SEZ at the closest point of approach. Within the ACEC, the Big Sandy, Santa Maria, and Bill Williams Rivers are free-flowing and have outstanding scenic qualities, including riparian vegetation, surrounding mountains and cliff features, and largely undeveloped shorelines uncluttered by human activity (BLM 1993). Approximately 3,981 acres (16 km^2), or 5% of the ACEC, is within the 650-ft

(198.1-m) viewshed of the SEZ, and 473 acres (2 km^2), or 0.5% of the total ACEC acreage is in the 24.6-ft (7.5-m) viewshed. As shown in Figure 8.2.14.2-2, the visible area of the ACEC extends to beyond 25 mi (40 km) from the northwestern boundary of the SEZ.

Some small, scattered areas at higher elevations within the ACEC are within the SEZ viewshed, although from most of these locations only taller solar facility components (such as power towers) would be visible. In four very small areas totaling about 473 acres (1.9 km^2), low-height collector/reflector arrays (such as parabolic trough mirrors and PV panels) could be visible. These areas are primarily in the far western portions of the ACEC. In most of these areas, the distances to the SEZ (22 to 25 mi [35 to 40 km]) are great enough and the angle of view low enough that visual contrasts from solar energy development would be expected to be minimal. However, contrasts would possibly increase to weak levels in the areas with the clearest views of the SEZ. Where operating power tower receivers within the SEZ were visible, they likely would appear as distant points of light silhouetted against the sky on the southwest horizon and, if tall enough to require navigation hazard lighting, could potentially be visible at night as well.

Along the northern and southern boundaries of the eastern portion of the ACEC are three very small areas of visibility, each containing several parcels, with each parcel less than 50 acres (0.20 km^2) in size. From these parcels, lower-height solar facilities within a part of the SEZ could be visible. However, the angle of view would be very low, so that collector/reflector arrays within the SEZ would be viewed edge-on or nearly so, thus greatly reducing their apparent size and repeating the strong horizontal line of the horizon. This would tend to reduce visual contrast. At distances ranging from 12 to 14 mi (19 to 23 km), the SEZ would occupy a large enough portion of the horizontal field of view that expected visual contrast levels could reach weak levels.

In summary, solar energy development within the SEZ would not be visible from most of the ACEC. The receivers of power towers within the SEZ could be visible from small, scattered locations at higher elevations within the ACEC, with visual contrast levels associated with solar development within the SEZ expected to range from minimal to weak. From a few very small and scattered parcels of land within the ACEC lower height solar facilities within the SEZ might be visible, with visual contrast expected to be weak.

- *Poachie Desert Tortoise*—The 33,512-acre (136-km^2) Poachie Desert Tortoise ACEC is 21 mi (34 km) northwest of the SEZ at the closest point. The Poachie Mountains are small, desert mountains with rugged boulder-strewn slopes rising above the surrounding bajadas. Very few roads enter the area. The environment of unique vegetation, jumbled granitic boulder piles that dominate the area, and limited vehicle access offers visitors both scenic views and backcountry recreation opportunities (BLM 1993). About 1,714 acres (7 km^2), or 5% of the ACEC, is within the 650-ft (198.1-m) viewshed of the SEZ, and 668 acres (2.7 km^2), or 2% of the total ACEC acreage, is in the 24.6-ft (7.5-m) viewshed. The visible area of the ACEC extends to beyond 25 mi (40 km) from the northern boundary of the SEZ.

Some small, scattered areas at higher elevations within the Poachie Desert Tortoise ACEC are within the SEZ viewshed, although from most of these locations only taller solar facility components, such as power towers, would be visible. SEZ visibility is confined to two general areas: higher elevations within and near Poachie Ridge in the southwestern portion of the ACEC, and scattered hilltops in the far western portion of the ACEC. In these areas, the distances to the SEZ (21 to 25 mi [34 to 40 km]) are great enough, and the angle of view is low enough, that visual contrasts from solar energy development would be expected to range from minimal to weak in the areas with the clearest views of the SEZ. Where operating power tower receivers within the SEZ were visible, they would likely appear as distant points of light silhouetted against the sky on the southern horizon during the day and, if more than 200 ft (61 m) tall, would have navigation warning lights at night that could be visible from the ACEC.

- *Harquahala Mountains*—The 77,201-acre (312-km^2) Harquahala Mountains ACEC is located 14.5 mi (23 km) southwest of the SEZ at the closest point. The Bradshaw-Harquahala Approved RMP and FEIS and the associated ROD (BLM 2010b) state that long-term conservation of scenic, natural resource, and cultural values is a management goal for the ACEC. Approximately 16,192 acres (66 km^2), or 21% of the ACEC, is within the 650-ft (198.1-m) viewshed of the SEZ, and 2,302 acres (9.3 km^2), or 3% of the total ACEC acreage, is in the 24.6-ft (7.5-m) viewshed. The visible area of the ACEC extends approximately 25 mi (40 km) from the southern boundary of the SEZ.

  As shown in Figure 8.2.14.2-2, within the ACEC, areas in the 25-mi (40-km) viewshed of the SEZ are limited primarily to the northeast-facing ridges on the northwest sides of the Harcuvar Mountains, southwest of the SEZ. Solar development within the SEZ could also be visible from an area just southwest of Eagle Eye Mountain, including a very small area with limited visibility on the southeastern side of the Harcuvar Mountains.

  Figure 8.2.14.2-6 (see above under Harquahala Mountain WA discussion) is a Google Earth visualization of the SEZ (highlighted in orange) as seen from an unnamed peak on the boundary of the Harquahala Mountain WA and the ACEC, about 16 mi (26 km) from the southernmost boundary of the SEZ. The viewpoint is elevated about 2,100 ft (640 m) above the nearest point in the SEZ. This viewpoint is very near the highest elevation within the ACEC that is also within the SEZ viewshed, and even though it is not the closest point in the ACEC within the SEZ viewshed, because it has the least obstructed view of the SEZ and the highest vertical angle of view to the SEZ, it is at or very close to the point of greatest potential visual impact from solar development within the SEZ.

The visualization suggests that from this viewpoint, the SEZ would be viewed across a wide plain containing a large array of rectangular agricultural fields, just beyond the far eastern arm of the Harcuvar Mountains, which would screen some portions of the SEZ from view. Because of the long distance to the SEZ, the SEZ would occupy a small portion of the field of view. Within the visible portion of the SEZ, the tops of collector arrays within the SEZ might be visible, but the angle of view would be low because of the distance to the SEZ. The SEZ and solar facilities within it would be seen as a narrow band just over the tops of the mountains between the viewpoint and the SEZ, and the facilities would tend to repeat the line of the valley floor in which the SEZ is located, thus reducing visual contrast.

If power towers were present within the SEZ, they would be visible as distant star-like points of light against a backdrop of the Bullard Wash floor. At night, if more than 200 ft (61 m) tall, the power towers would have navigation warning lights that could be visible from this location.

Potential visual contrast levels associated with solar development within the SEZ would vary depending on the project-related and visibility factors noted above, but under the 80% development scenario analyzed in the PEIS, weak visual contrasts from solar energy development within the SEZ would be expected at this viewpoint.

Other viewpoints within the ACEC that are closer to the SEZ than the viewpoint discussed above and shown in Figure 8.2.14.2-6 are necessarily at lower elevations, and because of topographic screening, views of the SEZ would be more obstructed. These locations also have lower vertical angles of view and would therefore be expected to have visual contrast levels generally ranging from minimal to weak. Other viewpoints within the ACEC that are farther from the SEZ than the viewpoint discussed above and shown in Figure 8.2.14.2-6 also are necessarily at lower elevations and therefore would have more obstructed views of the SEZ because of topographic screening. Because they are also farther from the SEZ, the apparent height and size of solar facilities within the SEZ would be smaller, and reflected light and color intensity of facility components would be further reduced, so that expected contrast levels would be minimal.

In summary, solar energy development within the SEZ would cause the highest levels of visual contrast for viewpoints at high elevations within the northeastern portion of the ACEC; but primarily because of the distances involved, the low viewing angles, and partial topographic screening, under the 80% development scenario analyzed in the PEIS, visual contrast levels from solar energy facilities within the SEZ would be expected to be weak. For viewpoints at lower elevations within the ACEC, regardless of the distance from the SEZ, expected visual contrast would be minimal to weak.

- *Black Butte*—The 9,549-acre (39-km^2) Black Butte ACEC is located 17 mi (27 km) southeast of the SEZ at the closest point of approach. The Bradshaw-Harquahala Approved RMP and FEIS and the associated ROD (BLM 2010b) state that the cliffs at the crest of Black Butte are a pristine, scenic landmark. The RMP states the importance of minimizing visual intrusions associated with any management activity so as to preserve the outstanding scenic quality and natural landscape appearance.

  About 422 acres (2 km^2), or 4% of the ACEC, is within the 650-ft (198.1-m) viewshed of the SEZ, and 44 acres (0.2 km^2), or 0.5% of the total ACEC acreage, is in the 24.6-ft (7.5-m) viewshed. The visible area of the ACEC extends to about 20 mi (32 km) from the southern boundary of the SEZ.

  Areas within the 25-mi (40-km) viewshed of the SEZ are limited to the vicinity of the peak of Black Butte and the highest points on the ridge south-southwest of Black Butte. Collector/reflector arrays for lower-height solar facilities could be visible from about 44 acres at the peak of Black Butte, but the Harcuvar Mountains immediately south of the SEZ would screen most of the SEZ from view from this area. Therefore, only a very small portion of the SEZ would be visible within a notch between two peaks in the Harcuvar Mountains north of the ACEC. If operating power tower receivers within the SEZ were visible from this area, they would appear as points of light just above the gap in the Harcuvar Mountains. At night, if more than 200 ft (61 m) tall, the power towers would have navigation warning lights that could be visible from the ACEC. Expected visual contrast levels would be minimal to weak.

  From viewpoints elsewhere within the ACEC, visible solar energy facilities would be limited to taller solar facility components, which if located in very specific locations within the SEZ, might be just visible within notches in the Harcuvar Mountains. Expected visual contrast levels for viewpoints on Black Butte would be minimal to weak, and visual contrasts seen from the ridgetops southwest of Black Butte would be expected to be minimal, because of the increased distance to the SEZ.

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. Note that 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, sensitive visual resources could be affected by other 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 no suitable transmission line within the proposed SEZ, so construction and operation of a transmission line outside the proposed SEZ would be required, and construction of transmission lines within the SEZ to connect facilities to the main line would be required as well. 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. 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 Nonfederal Lands and Resources

Towns of Aguila and Congress. The viewshed analyses indicate visibility of the SEZ from the towns of Aguila (about 10 mi [16 km] south of the SEZ) and Congress (about 16 mi [26 km] east of the SEZ).

The viewshed analysis indicates that within the community of Aguila, where local buildings or vegetation did not screen views toward the SEZ, the upper portions of power tower facilities could potentially be visible in gaps within the line of low mountains at the far eastern end of the Harcuvar Mountains. Lower-height solar facilities in the SEZ would be completely screened by the mountains. At distances exceeding 11 mi (18 km), the receivers of power towers within the SEZ could appear as bright points of light appearing just over the mountains; however, it is unlikely that more than one power tower receiver would be visible from any given location. In addition, vegetation within the community and north of the community might screen views of the power towers from some locations. Visibility of power towers would be somewhat greater in the agricultural fields west of the urban center of Aguila. At night, if more than 200 ft (61 m) tall, power towers would have navigation warning lights that could potentially be visible from Aguila as well. Potential visual contrast levels associated with solar development within the SEZ would vary depending on the project-related and visibility factors noted above, but under the 80% development scenario analyzed in the PEIS, weak visual contrasts from solar energy development within the SEZ would be expected for viewpoints within the Aguila area.

The viewshed analysis indicates that within the community of Congress, where local buildings or vegetation did not screen views toward the SEZ, the upper portions of sufficiently tall power tower facilities could potentially be visible. Congress is at the extreme limit of visibility within the 650-ft (198.1-m) viewshed of the SEZ, however, so if power towers were tall enough to be seen at all, the receiver lights would appear just at the horizon and would likely be difficult to see under most circumstances. If they were visible, the receiver lights would appear as distant point light sources just at the western horizon. Expected visual contrast levels would be minimal.

Regardless of visibility from Aguila and Congress, residents, workers, and visitors to the area would likely 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 U.S. 60, State Route 71, U.S. 93, and Alamo Road, an unpaved road providing access to the northern boundary of the SEZ. The range of impacts experienced would be highly dependent on viewer location, project types, locations, sizes, and layouts, as well as the presence of screening, but under the 80% development scenario analyzed in this PEIS, from some locations, strong visual contrasts from solar facilities within the SEZ could potentially be observed.

U.S. 60. U.S. 60, a two-lane highway, passes within 10 mi (16 km) south of the Bullard Wash SEZ. The AADT value for U.S. 60 in the vicinity of the SEZ was about 1,600 vehicles in 2008, the latest year for which figures are available (ADOT 2010a), although traffic could increase slightly as a result of solar energy development within the SEZ. About 31 mi (50 km) of U.S. 60 is within the SEZ 650-ft (198.1-m) viewshed, but only about 5.5 mi (8.9 km) is within the 24.6-ft (7.5-m) viewshed, along a stretch of the roadway southeast of the SEZ, about midway between Aguila and Wickenburg, and between 13 to 17 mi (21 to 27 km) from the SEZ. Elevation of the roadway in this stretch varies from about 300 ft (90 m) higher than the lowest point in the SEZ to about the same elevation as the highest point within the SEZ. For almost the entire remainder of the roadway within the viewshed, visibility of solar facilities within the SEZ would be limited to the upper portions of sufficiently tall power towers, at distances ranging from about 10 mi (16 km) to beyond 25 mi (40 km) from the SEZ.

Low-height solar facilities within the SEZ would be in view from U.S. 60 for about 5 minutes as travelers approached from either direction. During this time, if solar facilities within the SEZ were visible, they would be seen behind and to the left of eastbound vehicles, and roughly 45 degrees north of the direction of travel for westbound vehicles. Because of the minimal elevation difference between the roadway and the SEZ, and the 12- to 16-mi (21- to 27-km) distance from the roadway to the SEZ in this stretch of the road, the SEZ would occupy a very small portion of the horizontal angle of view, and the angle of view would be very low, tending to decrease the visual contrast from solar facilities within the SEZ. Sufficiently tall operating power towers located within the SEZ could project beyond the mountain backdrop to be viewed against the sky. At night, if more than 200 ft (61 m) tall, power towers would have navigation warning lights that could be visible from U.S. 60. Under the PEIS development scenario, solar energy facilities within the SEZ would be expected to cause weak visual contrasts for travelers on U.S. 60. For those portions of U.S. 60 where only the upper portions of power towers within the SEZ could be visible, solar energy facilities within the SEZ would be expected to cause minimal to weak visual contrasts for travelers on U.S. 60.

State Route 71. About 15mi (24 km) of State Route 71 passes through the 650-ft (198.1-m) viewshed of the SEZ, but only 0.3 mi (0.5 km) is within the 24.6-ft (7.5-m) viewshed. The AADT value for State Route 71 in the vicinity of the SEZ was between 600 and 800 vehicles in 2008, the latest year for which figures are available (ADOT 2010a). State Route 71 passes through the viewshed of the SEZ in three separate areas, as follows (east to west):

- *Road segment starting in the community of Congress and extending west for 7.8 mi (12.6 km).* Visibility of solar facilities within the SEZ from the roadway in this segment would be limited to the upper parts of taller power towers in some portions of the roadway, but could include lower power towers and transmission towers/lines in some other portions. Elevations in this stretch of the roadway exceed the highest elevation in the SEZ by about 150 to 470 ft (46 to 143 m), and the distance to the SEZ ranges from 9.7 to 17 mi (15.6 to 27.4 km). Sufficiently tall operating power towers located within the SEZ could project beyond the mountain backdrop to be viewed against the sky, but the SEZ would occupy a very small portion of the horizontal field of view. At night, if more than 200 ft (61 m) tall, power towers would have navigation warning lights that could potentially be visible from State Route 71. Under the PEIS development scenario, solar energy facilities within the SEZ would be expected to cause minimal to weak visual contrasts for travelers on this segment of State Route 71.

- *Road segment starting just southwest of Merritt Pass and extending southwest for 6.6 mi (11 km).* Within the first 0.3 mi (0.5 km) of this segment, low-height solar facilities within the SEZ could be visible almost perpendicular to the direction of travel for about 20 seconds at highway speeds. For most of the remainder of the segment, only power towers and transmission towers/lines could be visible. Taller facilities located within the SEZ could be visible for several minutes. Elevation of the roadway in this stretch varies from about 100 ft (30 m) higher than the lowest point in the SEZ to about 70 ft (21 m) higher than the highest point within the SEZ, and the distance to the SEZ ranges from 4.9 to 7.8 mi (7.9 to 12.6 km). From this segment, topographic screening would conceal some of the SEZ from view. Operating power towers within the SEZ could be seen against the mountain backdrop west of the SEZ, or might project beyond the mountain backdrop to be viewed against the sky, but the SEZ would occupy only a small portion of the horizontal field of view. The lights could be very bright at the short distances involved and, if more than 200 ft (61 m) tall, would have navigation warning lights that could potentially be conspicuous from this segment of the roadway. The tower structures (and potentially transmission towers and other taller structures) could be visible. Under the PEIS development scenario, solar energy facilities within the SEZ would be expected to cause weak visual contrasts for travelers on this segment of State Route 71.

- *Very short road segment near the southwestern end of State Route 71 at and near Aguila.* Within this 2.5-mi (4-km) segment of State Route 71, the upper portions of sufficiently tall power towers located in the far western portion of the SEZ could be visible at a distance of about 13 mi (21 km). Views of the SEZ would be brief and the direction of view toward the SEZ would be nearly perpendicular to the line of travel for most of the segment. The receivers of sufficiently tall power towers within the far western portion of the SEZ might be visible as points of light within gaps in the Harcuvar Mountains south of the SEZ. At night, if more than 200 ft (61 m) tall, power towers would have navigation warning lights that could potentially be visible from this segment of the roadway. Under the PEIS development scenario, solar energy facilities within the SEZ would be expected to cause minimal to weak visual contrasts for travelers on this segment of State Route 71.

8.2.14.2.3 Summary of Visual Resource Impacts for the Proposed Bullard Wash SEZ

The proposed Bullard Wash SEZ is in an area of low scenic quality, though generally free of cultural disturbances. Because under the 80% development scenario analyzed in this PEIS there could be numerous solar facilities within the SEZ, a variety of technologies employed, and a range of supporting facilities that would contribute to visual impacts, a visually complex, man-made appearing industrial landscape could result. This essentially industrial-appearing landscape would contrast greatly with the surrounding generally natural-appearing lands. Large visual impacts on the SEZ and surrounding lands within the SEZ viewshed would be associated with solar energy development within the SEZ due to major modification of the character of the existing landscape. There would be additional impacts from construction and operation of transmission lines and access roads within and outside the SEZ.

Under the 80% development scenario analyzed in the PEIS, utility-scale solar energy development within the proposed Bullard Wash SEZ is likely to result in weak to strong visual contrasts for some viewpoints within the Tres Alamos WA, which is 3.5 mi (5.6 km) from the SEZ at the point of closest approach. Weak to moderate visual contrasts would be expected for some viewpoints within the Arrastra Mountain WA, which is within 8.6 mi (13.8 km) of the SEZ at the point of closest approach. 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.

Joshua Forest Scenic Road passes within 5.5 mi (8.9 km) of the SEZ and is in the viewshed of the SEZ for about 14 mi (22.5 km). Because of the proximity of Joshua Forest Scenic Road to the SEZ, moderate to strong visual contrasts could be observed by road users. Residents of nearby areas, 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 other area roads.

8.2.14.3 SEZ-Specific Design Features and Design Feature Effectiveness

No SEZ-specific design features have been identified to protect visual resources for the proposed Bullard Wash SEZ. As noted in Section 8.2.14.2, the Tres Alamos WA is 3.5 mi (5.6 km) away at the point of closest approach north of the SEZ and is within the SEZ viewshed. Some portions of the WA within the SEZ viewshed would have clear views of the SEZ at a distance within the BLM VRM program’s foreground-middleground distance, and could therefore be subject to strong visual contrasts from solar facilities within the SEZ. However, wilderness visitation is estimated at less than 200 visits annually and is not expected to increase significantly in the foreseeable future, so SEZ-specific design features would not be warranted for the very small number of potential viewers.

As noted in Section 5.12, the presence and operation of large-scale solar energy facilities and equipment would introduce major visual changes into non-industrialized landscapes and could create strong visual contrasts in line, form, color, and texture that could not easily be mitigated substantially. Implementation of the programmatic design features presented in Appendix A, Section A.2.2, would be expected to reduce the magnitude of visual impacts experienced; however, the degree of effectiveness of these design features could 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 typical lack of screening vegetation and landforms within the SEZ viewshed, siting the facilities away from sensitive visual resource areas and other sensitive viewing areas is the primary means of mitigating visual impacts. The effectiveness of other visual impact mitigation measures would generally be limited.

8.2.15 Acoustic Environment

8.2.15.1 Affected Environment

The proposed Bullard Wash SEZ is located in near central Arizona, in the southwest corner of Yavapai County. Neither the State of Arizona nor Yavapai County has established quantitative noise-limit regulations applicable to solar energy development.

State Route 71 runs southwest–northeast as close as 5 mi (8 km) to the southeast. U.S. 93 runs northwest–southeast as close as about 5.5 mi (8.8 km) to the northeast, while U.S 60 runs east–west as close as about 10 mi (16 km) to the south of the proposed Bullard Wash SEZ. There is an access road to the north side of the SEZ, and several low-quality dirt roads enter the areas. The nearest railroads run about 9 mi (14.5 km) south of the SEZ and about 15 mi (24 km) to the east. Nearby airports include Flying Dare's Ranch, Eagle Roost, and Forepaugh, which are located about 6 mi (10 km) south–southwest, 11 mi (18 km) south, and 12 mi (19 km) southeast of the SEZ, respectively. Wickenburg Municipal Airport is located about 21 mi (34 km) east–southeast of the SEZ. No industrial activities except traditionally heavy grazing are located around the SEZ, and water development (windmill) occurs on private land to the west. Large-scale irrigated agricultural lands are developed around Aguila, about 7 mi (11 km) to the south. No sensitive receptors (e.g., residences, hospitals, schools, or nursing homes) exist around the proposed Bullard Wash SEZ. The nearest receptors are located about 5.6 mi (9.0 km) south–southwest of the SEZ. The nearest population center with schools is Aguila in Maricopa County, about 10 mi (16 km) south of the SEZ. Accordingly, noise sources around the SEZ include road traffic, railroad traffic, infrequent private/commercial and frequent military aircraft flyover, and cattle grazing. The proposed Bullard Wash SEZ is isolated and mostly undeveloped, the overall character of which is considered as rural. To date, no environmental noise survey has been conducted around the proposed Bullard Wash SEZ. On the basis of the population density, the day-night average noise level (L_{dn} or DNL) is estimated to be 35 dBA for Yavapai County, in the low end of the range of 33 to 47 dBA L_{dn} typical of a rural area (Eldred 1982; Miller 2002).[11]

8.2.15.2 Impacts

Potential noise impacts associated with solar projects in the Bullard Wash 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 residences (about 5.6 mi [9.0 km] to the south–southwest of the SEZ boundary) would not be anticipated, due to considerable separation distances. During the operations phase, potential minor impacts on the nearest 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

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[11] 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 the daytime level, and it can be interpreted as 33 to 47 dBA (mean 40 dBA) during daytime hours and 23 to 37 dBA (mean 30 dBA) during nighttime hours.

technology-specific impacts are presented in Section 5.13.2. Impacts specific to the proposed Bullard Wash SEZ are presented in this section. Any such impacts would be minimized through the implementation of required programmatic design features described in Appendix A, Section A.2.2 and the application of any additional SEZ-specific design features (see Section 8.2.15.3, below). This section primarily addresses noise impacts on human beings only, although impacts on wildlife at nearby sensitive areas are discussed. Additional discussion on potential noise impacts on wildlife is presented in Section 5.10.2.

8.2.15.2.1 Construction

The proposed Bullard Wash 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 and installing equipment, piping, and electrical).

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 impact equipment such as pile drivers or rock drills are not being used. Typically, the power block area is located in the center of the solar facility, at a distance of more than 0.5 mi (0.8 km) from the facility boundary. Noise levels from construction of the solar array would be lower than 95 dBA. When geometric spreading and ground effects are considered, 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 level. In addition, mid- and high-frequency noise from construction activities is significantly attenuated by atmospheric absorption under the low-humidity conditions 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 1.2 mi (1.9 km). 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 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 residences closest to the southern SEZ boundary, estimated noise levels at the nearest residences would be about 23 dBA, which is well below the typical daytime mean rural background level of 40 dBA. In addition, an estimated 40 dBA L_{dn}[12] at these residences (i.e., no contribution from construction activities) is well below the EPA guidance of 55 dBA L_{dn} for residential areas. Accordingly, noise from construction activities would be drowned in the background noise level at the nearest residences.

In addition, noise levels were estimated at the specially designated areas within 5-mi (8-km) of the proposed Bullard Wash SEZ, which is the farthest distance that noise (except extremely loud noise) would be discernable. There is only one specially designated area within

[12] For this analysis, background levels of 40 and 30 dBA for daytime and nighttime hours, respectively, were assumed, which result in a day-night average noise level (L_{dn}) of 40 dBA.

this area: Tres Alamos WA, which is about 3.4 mi (5.5 km) north of the SEZ. For construction activities occurring near the northern SEZ boundary, the noise level is estimated to be about 28 dBA at the boundary of the Tres Alamos WA, which is well below the typical daytime mean rural background level of 40 dBA. Thus, construction noise from the SEZ is not likely to adversely affect the Tres Alamos WA (Manci et al. 1988), as discussed in Section 5.10.2.

Depending on soil conditions, pile driving might be required for installation of solar dish engines. However, the pile drivers used, such as vibratory or sonic drivers, would be relatively small and quiet, in contrast to the impulsive impact pile drivers frequently used at large-scale construction sites. Potential impacts on the nearest residences would be anticipated to be negligible, considering the distance (about 5.6 mi [9.0 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 within the proposed Bullard Wash SEZ would cause negligible but localized short-term noise impacts on neighboring communities, even when construction would occur near the southern proposed SEZ boundary, close to the nearest 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 pile driving for dish engines.

Transmission lines would be constructed within a designated ROW to connect to the nearest regional power grid. A regional 500-kV transmission line is located about 5 mi (8 km) from the proposed Bullard Wash SEZ; thus, construction of a transmission line over this distance would be needed to connect to the regional grid. For construction of transmission lines, noise sources and their noise levels might be similar to construction noise sources at an industrial facility of a comparable size. Transmission line construction for the Bullard Wash SEZ could be performed in about 6 months. However, the area under construction along the transmission line ROW would move continuously, and no particular area would be exposed to noise for a prolonged period. Therefore, potential noise impacts on nearby residences along the transmission line ROW, if any, would be minor and temporary in nature.

8.2.15.2.2 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 mirrors or replacing 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 firewater 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. By comparison, dish engine technology, which employs collector and converter devices in a single unit, generally has the strongest noise sources.

For the parabolic trough and power tower technologies, most noise sources during operations would be in 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, and about 0.5 mi (0.8 km) from the power block area. For a facility located near the southern SEZ boundary, the predicted noise level would be about 27 dBA at the nearest residences, about 5.6 mi (9.0 km) from the SEZ boundary, which is much lower than the typical daytime mean rural background level of 40 dBA. Such noise from a solar facility would be indiscernible at the nearest residences most of the time. If TES were not used (i.e., if the operation were limited to daytime, 12 hours only[13]), the EPA guideline level of 55 dBA (as L_{dn} for residential areas) would occur at about 1,370 ft (420 m) from the power block area and thus would not be exceeded outside of the proposed SEZ boundary. At the nearest residences, about 40 dBA L_{dn} (i.e., no contribution from facility operation) 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 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 Bullard Wash 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] within 1 or 2 mi (1.6 or 3 km) of the noise source in the presence of a strong temperature inversion (Beranek 1988). In particular, such conditions add to the effect of noise being more discernable during nighttime hours, when the background noise levels are lowest. To estimate the day-night average noise 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). On the basis of these assumptions, the estimated noise level at the nearest residences (about 5.6 mi [9.0 km] from the SEZ boundary) would be 37 dBA, which is above the typical nighttime mean rural background level of 30 dBA. The day-night average noise level is

[13] Maximum possible operating hours at the summer solstice, but limited to 7 to 8 hours at the winter solstice.

[14] A shadow zone is defined as the region in which direct sound does not penetrate because of upward diffraction.

estimated to be about 42 dBA L_{dn}, which is well below the 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 42 dBA at the nearest residences, even if TES were used at a solar facility. Consequently, operating parabolic trough or power tower facilities using TES and located near the southern SEZ boundary could result in minor noise impacts on the nearest residences, depending on background noise levels and meteorological conditions.

The estimated noise level associated with operation of a solar facility using TES near the northern SEZ boundary would be about 31 dBA at the boundary of Tres Alamos WA, which is below the typical daytime mean rural background level of 40 dBA. Thus, operation noise from the SEZ is not likely to adversely affect the Tres Alamos WA (Manci et al. 1988).

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 does not require a power block. A single, large solar dish engine has relatively low noise levels, but a solar facility might employ tens of thousands of dish engines, 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 Bullard Wash SEZ, on the basis of the assumption of dish engine facilities of up to 643-MW total capacity (covering 80% of the total area, or 5,791 acres [23.4 km^2]), up to 25,740 25-kW dish engines could be employed. For a large dish engine facility, several hundred step-up transformers would be embedded in the dish engine solar field, along with a substation; however, the noise from these sources 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 330 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 49 dBA at 1.0 mi (1.6 km) and 45 dBA at 2 mi (3.2 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 residences, it was assumed that dish engines were placed all over the Bullard Wash SEZ at intervals of 98 ft (30 m). Under these assumptions, the estimated noise level at the nearest residences, about 5.9 mi (9.0 km) from the SEZ boundary, would be about 36 dBA, which is below the typical daytime mean rural background level of 40 dBA. On the basis of 12-hour daytime operation, the estimated 41 dBA L_{dn} at these residences is well below the EPA guideline of 55 dBA L_{dn} for residential areas. On the basis of other noise attenuation mechanisms, noise levels at the nearest residences would be lower than the values estimated above. However, noise from dish engines could adversely, albeit in a minor way, affect the nearest residences, depending on background noise levels and meteorological conditions.

For dish engines placed all over the SEZ, the estimated noise level would be about 41 dBA at the boundary of Tres Aamos WA, which is comparable to a typical daytime mean rural background level of 40 dBA. Thus, dish engine noise from the SEZ is not likely to adversely affect the Tres Alamos WA (Manci et al. 1988).

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 Bullard Wash SEZ to experience physical damage. Therefore, during operation of any solar facility, potential vibration impacts on surrounding communities and vibration-sensitive structures would be negligible.

Transformer-generated humming noise and switchyard impulsive noises would be generated during the operation of solar facilities. These noise sources would be located 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 not be heard at the nearest residences, assuming a 6.1-mi (9.8-km) distance (at least 0.5 mi [0.8 km] to the facility boundary and 5.6 mi [9.0 km] to the nearest residences). Accordingly, potential impacts of these noise sources on the nearest residences would be negligible.

For impacts from transmission line corona discharge noise during rainfall events (Section 5.13.1.5), 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 noise levels in rural environments. The noise levels at 65 ft (20 m) and 300 ft (91 m) from the center of 500-kV transmission line towers would be about 49 and 42 dBA, typical of high-end and mean, respectively, daytime background noise levels in rural environments. Corona noise includes high-frequency components, which may be judged to be more annoying than other environmental noises. However, corona noise would not likely cause impacts, unless a residence was located close to the source (e.g., within 500 ft (152 m) of a 230-kV transmission line and 0.5 mi (0.8 km) of a 500-kV transmission line). The proposed Bullard Wash SEZ is located in an arid desert environment, and incidents of corona discharge would be infrequent. Therefore, potential impacts on nearby residents along the transmission line ROW would be negligible.

8.2.15.2.3 Decommissioning/Reclamation

Decommissioning/reclamation requires many of the same procedures and equipment used in traditional construction. Decommissioning/reclamation would include dismantling of solar facilities and 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 for construction but more limited. Potential noise impacts on surrounding communities would be correspondingly lower than those for construction activities. Decommissioning activities would be of short duration, and their potential impacts would be negligible and temporary in nature due to considerable separation distances. 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 lower than those during construction and thus negligible.

8.2.15.3 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 development and operation of solar energy facilities. Because of the considerable separation distances to the nearest residences, most activities within the proposed Bullard Wash SEZ during construction and operation are not anticipated to increase noise levels at the nearest residences. Accordingly, no SEZ-specific design features are required.

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8.2.16 Paleontological Resources

8.2.16.1 Affected Environment

The surface geology of the proposed Bullard Wash SEZ is composed predominantly of more than 100-ft (30-m) thick alluvial deposits ranging in age from the Pliocene to Holocene. The alluvial deposits cover 4,209 acres (17 km^2) within the SEZ, or 58% of the SEZ. Portions of the SEZ are composed of residual materials developed in sedimentary rocks. These discontinuous residual deposits account for 3,030 acres (12.3 km^2), or 42%, of the SEZ. In the absence of a PFYC map for Arizona, a preliminary classification of PFYC Class 3b is assumed for the young Quaternary alluvial deposits and the residual materials. Class 3b indicates that the potential for the occurrence of significant fossil materials is unknown and needs to be investigated further (see Section 4.14 for a discussion of the PFYC system). There is a potential for Miocene fauna from the basin fill deposits. Rhinoceros and camel have been documented at Anderson Mine in southwestern Yavapai County (Morgan and White 2005). These finds indicate the potential for other similar finds in the region.

8.2.16.2 Impacts

The potential for impacts on significant paleontological resources in the proposed SEZ is unknown. A more detailed investigation of the alluvial deposits as well as the residual materials, especially along the edge of the basin where Tertiary units are shallow or exposed, is needed prior to project approval. A paleontological survey will likely be needed following consultation with the BLM. The appropriate course of action would be determined as established in BLM IM2008-009 (BLM 2007c) and IM2009-011 (BLM 2008a). Section 5.14 discusses the types of impacts that could occur to any significant paleontological resources found within the Bullard Wash SEZ. Impacts would be minimized through the implementation of required programmatic design features described in Appendix A, Section A.2.2.

Indirect impacts on paleontological resources outside of the SEZ, such as through looting or vandalism, are unknown but possible if any such resources are at or near the surface. Areas adjacent to the SEZ should be investigated for surface outcrops of potential fossil-bearing formations during the paleontological survey of the SEZ. Programmatic design features for controlling water runoff and sedimentation would prevent erosion-related impacts on buried deposits outside of the SEZ.

The nearest state or U.S. route is 5 mi (8 km) from the SEZ (State Route 71); thus a new road is anticipated to be needed to access the proposed Bullard Wash SEZ, resulting in approximately 36 acres (0.15 km^2) of disturbance to PFYC Class 3b deposits, mostly alluvial sediments to the southeast of the SEZ. Approximately 5 mi (8 km) of transmission line is anticipated to be needed to connect to the nearest existing line northeast of the SEZ, resulting in approximately 152 acres (0.62 km^2) of disturbance also in areas classified as PFYC Class 3b, including mostly alluvial but some residual deposits similar to the SEZ. The potential for impacts on significant paleontological resources in the anticipated corridors is unknown. Similar to the

SEZ footprint, a more detailed investigation of the corridors is needed and a paleontological survey will likely be required. Impacts on paleontological resources related to the creation of new corridors not assessed in this PEIS would be evaluated at the project-specific level if new road or transmission construction or line upgrades are to occur.

Programmatic design features 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 modification to the project footprint. Since the SEZ is located in an area classified as PFYC Class 3b, a stipulation would be included in permitting documents to alert solar energy developers of the possibility of a delay if paleontological resources are uncovered during surface-disturbing activities.

8.2.16.3 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.

The need for and the nature of any SEZ-specific design features would depend on the results of future paleontological investigations.

8.2.17 Cultural Resources

8.2.17.1 Affected Environment

8.2.17.1.1 Prehistory

The proposed Bullard Wash SEZ is located in the northern Sonoran Desert within the basin and range province in western Arizona. The earliest known use of the area was likely during the Paleoindian Period, sometime between 12,000 and 10,000 B.P. Surface finds of Paleoindian projectile points, the hallmark of the Clovis culture, have been found in the Juniper Mountains, about 55 mi (89 km) north of the proposed Bullard Wash SEZ; however, the majority of Paleoindian sites are concentrated in the southeastern portion of the state. In addition to projectile points, the Clovis culture is characterized by a hunting and gathering subsistence economy, following migrating herds of Pleistocene mega fauna. Paleoindian sites in Arizona are typically characterized by either fluted or unfluted points, extinct mega fauna, chipped stone tools, and bone and horn implements. Tools were fashioned from either chert or obsidian; the closest known source of obsidian to the proposed Bullard Wash SEZ is 23 mi (37 km) to the southeast in the Vulture Mountains. The majority of Paleoindian sites occur in the transition zone between mountain and desert environments, and those that have been found in the desert are located close enough to the transition zone so as to assume that they were likely located there during Paleoindian times. Paleoindian sites that are found are usually either kill sites where large numbers of animals were slaughtered, or sites that are thought to be base camps (Martin and Plog 1973; Reid and Whittlesey 1997; NROSL 2009; Anduze et al. 2003).

The Archaic Period began at the end of the Pleistocene, about 10,000 B.P. to 8,000 B.P., and continued until the advent of ceramics, about 2,000 B.P. Also referred to as the Cochise Culture, the Archaic lifeways were similar to those of their Paleoindian predecessors, hunting and gathering wild animals and plants. However, plants took on a greater role because there was no longer mega fauna to hunt, and smaller animals such as deer, antelope, and rabbits were hunted. Consequently, plant processing tools, such as manos and metates, are more prevalent in the archaeological record. Archaic peoples likely followed a seasonal round of movement, harvesting and hunting what was available at that place and time; therefore these ephemeral sites are difficult to distinguish. The Juniper Mountains, and the area around the mountains, contain several Archaic Period sites, in addition to the few isolated Paleoindian finds already mentioned. Because Archaic Period people were so mobile, they maintained light and portable equipment; baskets, milling stones, and spear points are the hallmarks of the Archaic culture. It is assumed that Archaic Period groups would have lived and traveled with groups of related families when local resources were abundant, but during hard times groups likely dispersed, separated from other families or bands by environmental features such as deserts or mountain ranges. It is possible that groups may have isolated themselves in resource-rich regions for sustained periods of time, resulting in vast tracts of land that would have been unpopulated for long spans of time. Other artifacts associated with southern Arizonan Archaic Period lifeways are sleeping circles or camp clearings, trails, shrines, rock alignments, and zoomorphic intaglios (Reid and Whittlesey 1997; Anduze et al. 2003).

The Late Archaic Period saw the beginnings of agriculture in Arizona. The Sonoran Desert is believed to have been the heartland from which corn agriculture spread to the rest of Arizona. In the middle of the twentieth century, it was proposed that corn agriculture spread to Arizona from Mexico via the Sierra Madre corridor to the Mogollon highlands, into the Colorado Plateau, and then into the Sonoran Desert prior to being adopted by the rest of the region. More recent research has suggested the opposite, that the Sonoran Desert's warm growing conditions and the planting of corn at low elevations using well-watered floodplains was more conducive to corn agriculture and the technology spread widely from the Sonoran Desert into the rest of Arizona. While these Late Archaic farmers were growing corn, it was not their only means of subsistence, and therefore they continued to maintain a seasonal round of hunting and gathering, while maintaining a residence for a period of time near their fields to plant and harvest their crops. Their base camps were located in the lowlands, likely occupied in the summer; these clusters of houses usually formed a generally circular arrangement with pits located in the floors of houses or in the areas between houses for the storage of tools and food. Often the floors of houses were completely taken up by the storage pits, which, combined with the lack of hearths in the houses, leads some archaeologists to believe that the primary function of the houses was for storage and not habitation. Some Late Archaic sites have been found to have large, dome-shaped structures, believed to be ceremonial in nature. The artifacts that have been found in these structures were likely used in a religious context, such as a baton made of phyllite, pigments, figurines, bone tubes, and worked shell pieces. It is believed that these structures were the predecessors to the subsurface kivas constructed by later Southwestern groups. Late Archaic groups also were known to have produced ceramics, although they were not fashioned into containers but figurines and beads (Reid and Whittlesey 1997; Matson 1991).

The proposed Bullard Wash SEZ is situated in an area that is near the boundaries of several different Formative Period culture groups—the Hohokam, the Patayan, and the Prescott cultural tradition. The Hohokam were concentrated largely around the Gila River and its tributaries; the Patayan were focused on the Colorado River and its tributaries; and the territory of the Prescott cultural tradition extended from the modern-day Prescott area west to the Big Sandy River Valley and the Juniper Mountains.

There are two branches of the Hohokam culture, the River Hohokam and the Desert Hohokam, the Hohokam tradition beginning around A.D. 300 and extending until A.D. 1450. The River Hohokam lived in large villages, sometimes occupied for hundreds of years, and they utilized the rivers to irrigate their crops through the construction of canals. Their ability to establish long-term occupations because of the reliable river as a water source, allowed for extensive public architectural projects to be undertaken and craft specialization to occur. At some River Hohokam sites, platform mounds and ball courts have been excavated. It has been suggested that the construction of large-scale irrigation projects, platform mounds, and ball courts is reflective of a complex social and political relationship among the Hohokam. The Desert Hohokam relied on flood water and rainwater for farming. They lived in the valleys and bajadas that were not near the river zones and planted their fields on alluvial fans and at the mouth of washes. Because the Desert Hohokam relied on more ephemeral sources of water, they did not develop the long-term occupation of sites and social complexity that the River Hohokam were able to. Both the River and Desert Hohokam groups supplemented their diets through the collection of wild plants and hunting, helping to provide some subsistence reliability during difficult agricultural times. During the course of the Hohokam culture, settlements became more and more densely populated, with shifts in material culture and changes in ceremonial and agricultural practices occurring. The archaeological assemblage associated with the Hohokam cultural tradition consists of ceramics (vessels and figurines); bedrock mortars; carved, ground, and flaked stone artifacts; shell jewelry; and stone bowls with effigies. Evidence of Hohokam occupation in the archaeological record becomes very sparse during the late fourteenth and fifteenth centuries, suggesting that either the culture changed its lifeways significantly enough to affect interpretation of cultural materials related to the Hohokam or the Hohokam left the area, possibly due to excessive flooding, oversalinization of agricultural fields, or conflicts with competing groups (Reid and Whittlesey 1997; BLM 2010a; McGuire and Schiffer 1982).

The Patayan culture occupied different regions of the Colorado River Valley; some groups were concentrated in the upland environments, others in the lowlands. Similar to the Desert Hohokam, the Patayan culture used floodwater to irrigate their crops, with the first evidence of the Patayan culture seen around A.D. 700. Most Patayan sites were not permanent, generally indicating temporary habitation or activity camps, although there are a few large Patayan sites on the southwest portion of the Gila River representing longer-term village settlements. It is believed that the Patayan and Hohokam maintained a friendly relationship, with interaction between the groups increasing through time. The Patayan moved seasonally, occupying the river valleys in the summer, maintaining their horticultural endeavors, and moving to the uplands to exploit piñon nuts and other upland resources. Trade was important for the Patayan people, and they created a vast network of trails, used not only for trade but for travel and connecting ceremonial territories. Along the trails, cairns and shrines can be found, as well as campsites, intaglios, cleared circles, and petroglyphs. It is believed that the Patayan culture was the antecedent culture to some of the contemporary Native American groups that were in the area: the Maricopa, Mohave, Quechan, and Yavapai, but some suggest Hohokam derivation instead. Pima groups are thought to have been descended from the Hohokam culture (Reid and Whittlesey 1997; BLM 2010a; Neusius and Gross 2007; McGuire and Schiffer 1982).

The Prescott cultural tradition was centered on the modern-day town of Prescott, Arizona, and dated from about A.D. 800 to 1300. This group may have been an offshoot of the Patayans with Hohokam influences, as evidenced in the ceramic and architectural styles. The Prescott tradition manufactured black-on-gray pottery, also called Prescott ware, and constructed shallow, slab-lined pit houses. They practiced a limited form of agriculture and relied primarily on hunting and gathering. The most intensive occupation of the Prescott culture sites seems to have occurred around A.D. 1000 to 1100, before about A.D. 1300 when some of the people may have left the region or remained and became the ancestors of the modern-day Yavapai and Hopi tribes (Stone 1986; Jeter 1977).

8.2.17.1.2 Ethnohistory

The proposed Bullard Wash SEZ, like the proposed Brenda SEZ, lies in the western part of traditional Yavapai territory. This area was inhabited by the Tolkapaya or Western Yavapai. Tolkapaya territory ranged from the mountains east of the Colorado, eastward to the western slopes of Kirkland Valley (Khera and Mariella 1983). The proposed SEZ is just northeast of the eastern end of the Harcuvar Mountains, the traditional home base of the Hakehelapa (people of the running water) or Wiltaikakpaya (people of the two mountains) Bands (Gifford 1936).

Yavapai

The Yavapai were inhabitants of west–central Arizona who spoke a common language and thought of themselves as one people. A general discussion of Yavapai ethnohistory is found in Section 8.1.17.1.2. Like other Yavapai bands, the Hakehelapa or Wiltaikapaya depended on a mixture of agriculture and a seasonal round of hunting and gathering for their subsistence. Settlement size and duration were dictated by the abundance and availability of nearby resources. In the Sonoran Desert, the presence of water, whether rivers, streams, springs, or natural tanks, was essential, and sites in the Harcuvar Mountains generally cluster along the lower slopes of the mountains and in canyons where springs and natural tanks are present, as well as wild food resources not available on the valley floors (BLM 2008b). The Hakehelapa ranged from the Harcuvar and Harquahala Mountains to Peeples and Kirkland Valleys, where they harvested walnuts, acorns, piñon nuts, and prickly pear fruit (Gifford 1936). They may also have ranged westward and planted crops along the Colorado River near other Yuman-speaking Tribes with whom they were on good terms (Khera and Mariella 1983).

8.2.17.1.3 History

After Christopher Columbus landed in the Caribbean in 1492, Spanish exploration of the Americas quickly ensued, with Spain claiming vast tracts of land in the New World in the name of King Ferdinand and Queen Isabella. There is some debate as to which of the Spanish explorers made the first entry into Arizona. Some historians believe it was Alvar Nunez Cabeza de Vaca, a Spaniard who shipwrecked off the coast of Texas in 1528 and developed friendly relations with the Native Americans who then helped to guide him to Mexico City. It has been suggested that Cabeza de Vaca may have passed through the southeastern corner of Arizona on his travels, but because he did not have any way of recording where he was, his exact route is unknown. Cabeza de Vaca is important to the history of Arizona not just because he may have been the first European presence in the state, but because he claimed to have been told and seen some of the "Seven Cities of Cibola," fictitious cities that were full of gold and wealth, ripe for Spanish plundering. When Cabeza de Vaca eventually got to Mexico City in 1536, he spread the rumors of these fabled cities, which led to the desire of other Spaniards to search for riches in the hopes of finding another civilization rich in gold similar to the Aztec in Mexico. The first documented expedition into what is today Arizona, was made under an expedition headed by Fray Marcos de Niza in 1539. Fray Marcos wanted to assure the Native Americans whom he encountered on his expedition that they would be treated well, as news of the poor treatment of Native Americans by European explorers had preceded the actual presence of the explorers. Accompanying Fray Marcos was an African slave, Estebanico, who had survived the journey along with Cabeza de Vaca, and Francisco Vazquez de Cornado, the governor of a northern Mexican province. After stopping in Mexico at Vacapa, Fray Marcos sent Estebanico ahead with orders to scout the area and wait for the rest of the explorers. Estebanico did not follow Fray Marcos's instructions and entered into Arizona, where he may have reached the Piman villages near Tucson, before heading farther north to the Zuni pueblo, Cibola. Estebanico was killed by the Zuni, and Fray Marcos followed his trail north claiming all of the land along the way in the name of New Spain. He claimed to have made it all the way to Cibola, and after returning to Mexico City claimed to have seen vast riches, confirming Cabeza de Vaca's story. In 1540, Francisco Vazquez de Coronado led an expedition into eastern Arizona in search of the rumored cities full of gold, following the Sonora and San Pedro Rivers, then into New Mexico, and may have made his way as far as Kansas before turning back to Mexico City empty handed. Also funded by the Coronado expedition was Hernando de Alarcon, who sailed up the Gulf of California and explored the Colorado delta area, perhaps, going as far north as the Gila and Colorado confluence. When Coronado came back without any gold or any prospects for further exploration, the Spanish stayed out of most of the hostile Arizona desert southwest for the next 40 years (Farish 1915; Sheridan 1995; Kessell 2002; BLM 2010a).

Antonio de Espejo explored portions of northern and central Arizona in 1583 in an effort to find precious metals. Espejo traded with the Hopi and discovered silver and copper deposits east of Prescott, Arizona, about 47 mi (76 km) to the northeast of the proposed Bullard Wash SEZ. In 1604, Juan de Onate, a Mexican-born Spaniard who had settled in northern New Mexico, explored portions of Arizona north of the SEZ along the Bill Williams River, to its confluence with the Colorado River, and followed the Colorado River south to the Gulf of California, likely coming within about 38 mi (61 km) to the northwest of the SEZ (Sheridan 1995; Kessell 2002).

The Spanish did not maintain an established presence in Arizona, other than a few short-lived missions in the south–central portion of the state, until the discovery of large silver deposits near Nogales in 1736, 227 mi (365 km) to the southeast of the proposed Bullard Wash SEZ. Most of the prospectors who came to mine the silver and stayed in Arizona were forced to make their living as subsistence farmers and ranchers, as mining did not prove lucrative for another 100 years. The first permanent Spanish settlement in Arizona was at Tubac, located just north of Nogales, in an effort to prevent uprisings of the O'odam Tribe. The Spanish attempted to build permanent settlements along the Lower Colorado River, but hostile Yuman Tribes prevented any sustained development. With Native Americans hostile to Spanish intrusion in the northern and eastern portion of the state, Spanish settlement was basically restricted to the Tucson area and south (Sheridan 1995; Kessell 2002).

Missionary explorer Eusebio Francisco Kino made nine different expeditions into the territories of California and Arizona, establishing relationships with the Yuman and Piman groups in the area, likely traversing the lower Colorado River to the west of the proposed Bullard Wash SEZ. In 1775, Juan Batista de Anza was authorized by the viceroy of New Spain to lead a group of settlers from Tubac to the San Francisco Bay area. De Anza set out along the Santa Cruz River, which he followed to the Gila and Colorado confluence, and then into California. This expedition established a trail that eventually became a congressionally designated National Historic Trail, passing about 73 mi (118 km) to the south of the SEZ (Sheridan 1995, Kessell 2002).

In 1810, Mexicans declared their independence from Spanish colonial rule, and eventually won the war in 1821. Mexican authority and control in Arizona was disjointed, and often states would act independently from the rest of the country. Increasingly tense relations between Native Americans and the non-Native occupiers were intensified with the expansion of ranchers and homesteaders into Native American areas, leading to several conflicts. The Mexican–American War began in 1846 with the United States eyeing the Rio Grande River and California territory, and two years later the Treaty of Guadalupe Hidalgo was signed, giving the United States control of Texas, New Mexico (which included Arizona north of the Gila River), and California. With the Gadsden Purchase in 1854, the United States gained control of Arizona south of the Gila River and the Mesilla Valley of New Mexico, and settlement of the area increased to previously unseen levels (Sheridan 1995; Kessell 2002).

Prior to the Mexican–American War, Americans had ventured into Arizona on fur-trapping expeditions. The first known American fur trappers in Arizona were Sylvester Pattie and his son James in 1825, trapping along the San Francisco, Gila and San Pedro Rivers in the southeastern portion of the state. Frequently, hostilities broke out between Native Americans and fur trappers, but the trappers did not remain in the state long enough to make much of an economic or ecological impact. One of the largest United States expeditions to cross Arizona at the time was made by the Mormon Battalion in 1846. Led by Lieutenant Colonel Phillip St. George Cooke, the group intended to establish a wagon trail across the southern Great Plains and the Southwest. The Mormon Battalion was the first representative of the United States government to encounter the Mexican population of Arizona, a nonconfrontational meeting. The trail that the Mormon Battalion took later became a part of the Gila Route, or Southern Overland Route, a network of Native American and European trails that entered the state in the east, converged on the Pima villages on the Gila River, and traversed the Gila River floodplain to the Colorado and Gila River juncture (Sheridan 1995).

Most occupation of Arizona after the acquisition of the territory by the United States government was concentrated in the southern part of the state in mining ventures. It was not until the establishment of Fort Yuma on the California side of the Colorado River and other nearby military garrisons (Camp Colorado near Parker, and Camp Date Creek just 15 mi (24 km) northeast of the proposed Bullard Wash SEZ) that Americans began to settle in the region near the SEZ. The forts provided the necessary security against Native Americans who resented the American occupation of their land, and who were competing for the same resources as the miners and ranchers settling in the desert. After the start of the Civil War, most of the military personnel in Arizona were withdrawn, leaving the settlers to their own defenses until the end of the war when the military returned (Sheridan 1995; Stone 1982).

In 1857, 20 mi (32 km) up the Gila River from the Colorado junction, Arizona's first boomtown, Gila City, was established after a small gold strike. The largest and most prosperous gold mine in Arizona occurred at Vulture Mine, just 24 mi (39 km) to the southeast of the SEZ. The town of Wickenburg was established in 1864 to support the influx of miners to the area, becoming a prosperous town in the nineteenth century. The creation of canals, roads, and other infrastructure developments helped to increase the population of Arizona and their ability to grow crops, export and import goods, and maintain the mines. The Phoenix Stage Route was established as part of this infrastructure, leading to Wickenburg becoming a transportation hub and the headquarters of the Arizona–California Stage Company. During the 1870s, copper, silver, and other less valuable minerals were mined fervently throughout the state, and with the construction of the railroad in 1881 and 1882, mining increased. The Atchison, Topeka, and Santa Fe Railroad was a key rail line that connected major cities in the American West, and a branch of this railroad passes just 9 mi (15 km) to the south of the SEZ. Much of the early mining in Arizona was undertaken in Yuma County, and by 1910, Arizona was the largest producer of copper in the United States, and continues to be so. In the vicinity of the proposed Bullard Wash SEZ, mining occurred in the Harcuvar Mountains to the immediate south of the SEZ, the Black Mountains to the north, the Date Creek Mountains to the northeast, and the Vulture Mountains to the southeast (Stone 1982; Sheridan 1995).

Settlement, ranching, and mining in Arizona are dependent upon water regulation and dispersal, and consequently water control projects were started early in the development of Arizona. Often prehistoric canals were used and/or expanded in order to facilitate water usage. Just as in prehistoric times, people would generally only settle in places where water was available. The CAP is currently the major supplier of water to Arizona. Transferring water from the Colorado River, the aqueduct is 336 mi (541 km) long, and starts in Lake Havasu and stretches to the south of Tucson. Initial construction on the CAP began in 1973 and was completed in 1993, delivering 1.5 million ac-ft (1.9 billion m^3) of water per year. Portions of the CAP pass just 35 mi (56 km) to the south of the proposed Bullard Wash SEZ (Stone 1982).

The U.S. Military has a long relationship with the southwest desert. The vast, uninhabited lands make it prime real estate to conduct training exercises. Large amounts of the desert to the east of the proposed Bullard Wash SEZ were used for training troops for the North African invasion in World War II, with bases and air fields placed throughout the desert. Most of those bases are not very close to the proposed SEZ, except for the Luke Air Force Base. The base was established for training pilots during World War II, and continues today to operate as a training facility for the U.S. Air Force. Under the control of the Luke Air Force Base are the Barry M. Goldwater Range and the Gila Bend Auxiliary Air Field. These ranges also serve as training facilities for the U.S. Air Force in air-to-air and air-to-ground training. The closest portion of the Luke Air Force Base complex to the proposed Bullard Wash SEZ is about 39 mi (64 km) to the southeast, although the Bullard Wash SEZ is within the DoD's Airspace Consultation Area (Bischoff 2000; Stone 1982).

8.2.17.1.4 Traditional Cultural Properties—Landscape

The Yavapai consider their traditional use area to be sacred land—the land where the Yavapai first emerged and the land that they are divinely required to protect. This sacred landscape is composed of an interrelated complex of important plants, animals, and places of power, tied together by a network of trails linking the Colorado and Gila Valleys (Stone 1986). From the Yavapai point of view, places, features, and artifacts of power are dangerous and can only be handled, discussed, or visited safely by powerful religious practitioners. Their locations and properties are not discussed openly. Because the Yavapai reservations are located in the eastern part of their former traditional range, and because many knowledgeable elders familiar with the western part of their traditional territory have passed away, over the years, knowledge of ancestral places of power in the western part of Yavapai territory has been lost. Lacking specific knowledge, the Yavapai of today believe that any artifacts of the past from these areas have the potential for being powerful and should be treated with respect (Bean et al. 1978).

Places of power include caves, mountains, and small rock shrines. Certain minerals were also thought to be imbued with power, particularly turquoise (Gifford 1936). Many of the most important Yavapai sacred places are located well to the east of the proposed SEZ near Sedona and the Verde River. Montezuma Well, a spring-fed lake in a limestone sink now located in Montezuma Castle National Monument 86 mi (138 km) to the northeast, is considered by the Yavapai to be the place where their ancestors first emerged into this world. A cave in Boynton Canyon, 90 mi (146 km) to the northeast, located in the Sedona Red Rock Mountains of the Coconino National Forest, is the most sacred Yavapai site, the place where First Woman, the only survivor of the destruction of the third world according to Yavapai cosmology, lived. Mountains in general may be the home of the *qaqáqə,* or "little people" who may be called on for help in times of distress (Khera and Mariella 1983).

The Hakehelapa or Wiltaikapaya Band of the Western Yavapai was centered in the Harcuvar and Harquahala Mountains, 2.1 mi (3.4 km) and 14 mi (23 km) southwest of the proposed SEZ, respectively (Gifford 1936). Both ranges were well watered and provided a variety of resources not available on the desert floor, and provided bighorn sheep habitat (BLM 2008b). The Harquahala Mountains provide a "Sky Island" dominating the skyline for 100 mi (161 km) around. Peaks that dominate the skyline are likely to have cultural importance. Archaeological remains, likely resulting from Yavapai occupation, are among the reasons it has been designated an ACEC, including a SCRMA. The cultural importance of the Harquahala and Harcuvar ranges must be determined in consultation with appropriate Native American Tribes. The Black Butte ACEC, located about 18 mi (29 km) to the east, was a local source of obsidian used for stone tools (BLM 2008b, 2010b). Evidence of Native American use of the Harcuvar Mountains include camp sites, tool manufacturing areas, milling areas, rockshelters and rock art, pictographs as well as petroglyphs, and crystals and minerals important to Native Americans. Stone suitable for tool making from Harvucar was traded over a considerable distance (BLM 2006, 2008b). Two SCRMAs have been established there (BLM 2007a). As part of the traditional use area of the Western Yavapai, any archaeological sites associated with Native American populations, rock art panels, shrines, or geoglyphs found in the area are likely to be constituent parts of a cultural landscape important to the Yavapai. The proposed Bullard Wash SEZ is located at the base of the Harcuvar Mountains in Aguila Valley. It is likely that the Western Yavapai made use of the resources available there, including cactus fruit, mesquite, creosotebush, and small game such as jackrabbits.

8.2.17.1.5 Cultural Surveys and Known Archaeological and Historical Resources

No cultural resource surveys have been conducted in the proposed Bullard Wash SEZ; therefore no cultural resources have been identified within the boundaries of the SEZ. However, within 5 mi (8 km) of the SEZ, seven surveys have been conducted, resulting in the recording of five sites, one of which is prehistoric; the other four are of an unknown temporal sequence. The prehistoric site is a lithic reduction site and bedrock grinding stone, and has been determined eligible for inclusion in the NRHP (AZSITE 2009, 2010).

The BLM has designated several ACECs and SCRMAs in the vicinity of the proposed Bullard Wash SEZ, as these areas have been determined to be rich in cultural resources and worthy of having the cultural resources managed and protected by the BLM. The closest designated area to the proposed Bullard Wash SEZ is the Harcuvar Mountain East SCRMA just 6 mi (10 km) to the west of the SEZ, and the Harcuvar Mountain West SCRMA, 25 mi (40 km) to the west of the SEZ. These SCRMAs are designated to protect prehistoric habitation sites, stone tool manufacture areas, milling areas, rock shelters and rock art, and historic transportation route sites associated with mining, transportation, commerce, and military activities that occurred during the nineteenth century. In the Harquahala Mountains 14 mi (23 km) to the southwest of the SEZ, is the Harquahala ACEC, and within the boundaries of the Harquahala ACEC is the Harquahala SCRMA. This ACEC and SCRMA are designated to protect the historic Harquahala Peak Observatory and Historic District, which is listed in the NRHP; Ellison's Camp and historic trails; and several prehistoric habitation camps, milling areas, and rock art sites. The Black Butte ACEC is located 18 mi (29 km) south of the SEZ and is managed by the BLM to protect an obsidian source that was used by Native Americans prehistorically and ecological resources. Twenty-five miles (40 km) west of the proposed Bullard Wash SEZ is the Swansea ACEC and SCRMA, designated to protect the historic mining sites associated with the Swansea Mining District. The Weaver/Octave SCRMA, 22 mi (35 km) northeast of the SEZ, is designated to protect the historic Rich Hill gold mine and associated historical sites. Beyond the 25-mi (40-km) distance, there are two additional areas of note. The Wickenburg/Vulture SCRMA, 26 mi (42 km) east of the SEZ, is designated to protect the historic sites and roads associated with mining and settlement of the area, as well as a prehistoric obsidian source. The Tule Creek ACEC is 49 mi (79 km) to the east of the SEZ; the BLM manages this land to protect prehistoric Fort Tule, a hilltop ruin, as well as historic miners' camps (BLM 2010b; BLM 2007a).

National Register of Historic Places

There are no historic properties listed in the NRHP in the SEZ, or within 5 mi (8 km). However, a prehistoric lithic reduction site less than 5 mi (8 km) northeast of the SEZ is considered potentially eligible for inclusion in the NRHP.

There are 131 properties listed in the NRHP in Yavapai County, 67 of which are either a part of the Prescott Multiple Resource Area (MRA) or in the vicinity of Prescott, about 47 mi (75 km) northeast of the SEZ. The closest property listed in the NRHP to the proposed Bullard Wash SEZ is Camp Date Creek, just 14 mi (23 km) to the northeast. Peeples Valley School is situated about 25 mi (40 km) northeast of the SEZ. Twenty-three miles (37 km) southeast is the Kay-El-Bar Ranch, which is just north of Wickenburg, in Maricopa County. The Wickenburg MRA, about 25 mi (40 km) southeast of the SEZ, maintains 23 properties listed in the NRHP. The Harquahala Peak Observatory and Historic District is about 22 mi (35 km) southwest of the SEZ, in La Paz County, and the Rhoda Nohlechek House, in Wenden, La Paz County, is about 29 mi (46 km) to the southwest. Other properties listed in the NRHP, but that are 30 to 35 mi (48 to 56 km) from the SEZ, include the Walnut Creek Bridge and Kirkland Store to the northeast and the Morristown Store and Sun-up Ranch southeast of the proposed Bullard Wash SEZ.

8.2.17.2 Impacts

Direct impacts on significant cultural resources could occur in the proposed Bullard Wash SEZ; however, further investigation is needed as no cultural resource surveys have been conducted within the boundaries of the SEZ. A cultural resources survey of the entire APE of a proposed project, including consultation with affected Tribes, would first need to be conducted to identify archaeological sites, historic structures and features, and traditional cultural properties, and an evaluation would need to follow to determine whether any are eligible for listing in the NRHP. The proposed Bullard Wash SEZ has potential for containing historic sites, as homesteading, ranching, Civilian Conservation Corps projects, and mining occurred in the vicinity of the SEZ. The potential for prehistoric sites also exists, as prehistoric groups likely traversed the area in search of game. Possible impacts from solar energy development on cultural resources that are encountered within the SEZ or along related ROWs, as well as general mitigation measures, are described in more detail in Section 5.15. Impacts would be minimized through the implementation of required programmatic design features as described in Appendix A, Section A.2.2. Programmatic design features assume that the necessary surveys, evaluations, and consultations will occur.

Programmatic design features to reduce water runoff and sedimentation would prevent the likelihood of indirect impacts on cultural resources resulting from erosion outside the SEZ boundary (including along ROWs).

The nearest transmission line is approximately 5 mi (8 km) to the northeast. It is anticipated that a transmission connection would be considered at the shortest distance. A 5-mi (8-km) transmission line, if constructed, would result in the disturbance of 152 acres (0.62 km^2). Four cultural resources have been identified that fall along the anticipated line, but they could easily be avoided during design of the line. The nearest road, State Route 71, is 5 mi (8 km) to the southeast. An access road, connecting the proposed SEZ to State Route 71, would result in the disturbance of approximately 36 acres (0.15 km^2); no known cultural resources have been identified within this corridor. Impacts on cultural resources are possible in areas related to the access and transmission corridors, as new areas of potential cultural significance could be directly affected by the construction or opened to increased access from use. Indirect impacts, such as vandalism or theft, could occur if significant resources were located in close proximity to the corridors. Programmatic design features assume that the necessary surveys, evaluations, and consultations will occur for the access road and transmission line, as with the project footprint within the SEZ. Impacts on cultural resources related to the creation of new corridors not assessed in this PEIS would be evaluated at the project-specific level if new road or transmission construction or line upgrades are to occur.

8.2.17.3 SEZ-Specific Design Features and Design Feature Effectiveness

Programmatic design features to mitigate adverse effects on significant cultural resources, such as avoidance of significant sites and features and cultural awareness training for the workforce, are described in Appendix A, Section A.2.2.

SEZ-specific design features would be determined during consultation with the Arizona SHPO and affected Tribes and would depend on the findings of the cultural surveys.

8.2.18 Native American Concerns

As discussed in Section 8.2.17, Native Americans tend to view their environment holistically and share many environmental and socioeconomic concerns with other ethnic groups. For a discussion of issues of possible Native American concern shared with the population as a whole, several sections in this PEIS should be consulted. General topics of concern are addressed in Section 4.16. Specifically for the proposed Bullard Wash SEZ, Section 8.2.8 discusses mineral resources; Section 8.2.9.1.3 discusses water rights and water use; Section 8.2.10 discusses plant species; 8.2.11 discusses wildlife species, including wildlife migration patterns; Section 8.2.13 discusses air quality; Section 8.2.14 discusses visual resources; Section 8.2.17 discusses archaeological sites, structures, landscapes, and traditional cultural properties; and Sections 8.2.19 and 8.2.20 discuss socioeconomics and environmental justice, respectively. Issues of human health and safety are discussed in Section 5.21. This section focuses on concerns that are specific to Native Americans and to which Native Americans bring a distinct perspective.

All federally recognized tribes with traditional ties to the proposed Bullard Wash SEZ have been contacted so that they could identify their concerns regarding solar energy development. The tribes contacted with traditional ties to the Bullard Wash SEZ are listed in Table 8.2.18-1. Appendix K lists all federally recognized tribes contacted for this PEIS.

8.2.18.1 Affected Environment

The territorial boundaries of the tribes that inhabited the Sonoran Desert appear to have been fluid over time. Depending on existing relationships or amity or enmity, resources were shared where abundant. The proposed Bullard Wash SEZ lies within the traditional range of the Western Yavapai, but it may have been used from time to time by neighboring tribes that were on good terms with the Yavapai. The Indian Claims Commission included the area in the judicially established Yavapai traditional territory (Royster 2008).

TABLE 8.2.18-1 Federally Recognized Tribes with Traditional Ties to the Proposed Bullard Wash SEZs

Tribe	Location	State
Cocopah Indian Tribe	Somerton	Arizona
Colorado River Indian Tribes	Parker	Arizona
Fort McDowell Yavapai Nation	Fountain Hills	Arizona
Fort Mojave Indian Tribe	Needles	California
San Carlos Apache Tribe	San Carlos	Arizona
Yavapai-Apache Nation	Camp Verde	Arizona
Yavapai-Prescott Indian Tribe	Prescott	Arizona

8.2.18.1.1 Yavapai Territorial Boundaries

Western Yavapai or Tolkapaya territory ranged from the mountains east of the Colorado eastward to the western slopes of Kirkland Valley. The Tolkapaya also established gardens on the floodplain of the Colorado River adjacent to their friends, the Quechan. On the north, they ranged into the mountains north of the Bill Williams and Santa Maria Rivers. On the south they sometimes ranged as far a Yuma, but for the most part, the mountains north of the Gila River formed their southwestern boundary. On the southeast it extended to the Gila River (Khera and Mariella 1983). Contrary to their relationships on their eastern and western borders, they were not on good terms with neighboring tribes to the north and south. Yavapai descendants are found primarily on the Fort McDowell, Camp Verde, Middle Verde, Clarkdale, and Prescott Yavapai reservations, as well as the Cocopah and San Carlos Apache reservations.

8.2.18.1.2 Plant Resources

This section focuses on those Native American concerns that have an ecological as well as cultural component. For many Native Americans, the taking of game or the gathering of plants or other natural resources may have been seen as both a sacred and secular act (Bean et al. 1978; Stoffle et al. 1990).

The traditional Yavapai subsistence base was a mixture of gardening and hunting and gathering. The proportion of gardening to gathering varied with the land they occupied. The proposed Bullard Wash SEZ does not appear to be well suited for indigenous agriculture, lacking a reliable water source. It is adjacent to the relatively well-watered Harcuvar and Harquahala Mountains that have been identified as in the traditional heartland of a Western Yavapai band (Gifford 1936). While no archaeological surveys have been conducted within the boundaries of the proposed SEZ, archaeological sites, some of which are associated with the Yavapai, have been recorded in the mountains (BLM 2006, 2008b). Because of the proximity of the proposed SEZ to mountains they inhabited, it is likely that the Yavapai gathered the plant resources available in that area and hunted what game there was. The Yavapai practiced a seasonal round in harvesting naturally occurring plant resources. Rural Yavapai commenting on previous energy development projects in the area have voiced concern over the loss of culturally important plants used for food, medicine, and ritual purposes and for making tools, implements, and structures (Bean et al. 1978).

The plant communities observed or likely to be present at the proposed Bullard Wash SEZ are discussed in Section 8.2.10. As shown in the gap analysis, the land cover at the proposed Bullard Wash SEZ is predominantly Sonora-Mojave Creosote Bursage Desert Scrub, interspersed with areas of Sonoran Mid-elevation Desert Scrub; and small patches of Sonoran Paloverde-Mixed Cacti Desert Scrub, Apacherian-Chihuahuan Mesquite Upland Scrub, and North American Warm Desert Riparian Mesquite Bosque (USGS 2005a). While these communities appear sparse most of the year, seasonal rains often result in an explosion of ephemeral herbaceous species.

Native American populations have traditionally made use of hundreds of native plants. Table 8.2.18.1-1 lists plants often mentioned as important by the Yavapai that were either observed at the proposed Bullard Wash SEZ or are probable members of the cover type plant communities identified for the SEZ. These plants are the dominant species; however, other plants important to Native Americans could occur in the SEZ, depending on localized conditions and the season. Overall, creosotebush dominates the SEZ, while cacti, mesquite, and sparse wild grasses are present. Creosotebush is important in traditional Native American medicine. Mesquite was among the most important food plants. Its long bean-like pods were harvested in the summer, could be stored, and were widely traded. Its blossoms are edible. Saltbush and buckwheat seeds were harvested, processed, and eaten. They, along with cactus fruit, were harvested in the summer (Khera and Mariella 1983).

8.2.18.1.3 Other Resources

Water is an essential prerequisite for life in the arid areas of the Southwest. As long-time desert dwellers, Native Americans have a great appreciation for the importance of water in a

TABLE 8.2.18.1-1 Plant Species Important to Native Americans Observed or Likely To Be Present in the Proposed Bullard Wash SEZ

Common Name	Scientific Name	Status
Food		
Barrel Cactus	*Ferocactus* spp.	Observed
Buckwheat	*Eriogonum* spp.	Possible
Cholla Cactus	*Opuntia* spp.	Observed
Creosote Bush	*Larrea tridentata*	Observed
Honey Mesquite	*Prosopis Glandolosa*	Possible
Ironwood	*Olneya tesota*	Possible
Jojoba	*Simmondsia chinensis*	Possible
Joshua Tree	*Yucca brevifolia*	Observed
Ocotillo	*Fouquiera splendens*	Observed
Prickly Pear Cactus	*Opuntia* spp.	Possible
Saguaro Cactus	*Carnegiea gigantean*	Possible
Saltbush	*Atriplex* spp.	Possible
Screwbean Mesquite	*Prosopis pubescens*	Possible
Yellow Palo verde	*Parkinsonia microphylla*	Possible
Medicine		
Creosotebush	*Larrea tridentata*	Possible
Mormon Tea	*Ephedra* spp.	Possible
Unspecified		
Bursage (Burro Bush)	*Ambrosia dumosa*	Possible

Sources: Field visit; Gifford (1936); Bean et al. (1978); Khera and Mariella (1983); USGS (2005a).

desert environment. They have expressed concern over the use and availability of water for solar energy installations (Jackson 2009). Tribes are also sensitive about the use of scarce local water supplies for the benefit of distant communities and recommend that determination of adequate water supplies be a primary consideration in deciding whether a site is suitable for the development of a utility-scale solar energy facility (Moose 2009).

Close to their home range, the Yavapai are likely to have hunted in the Aguila Valley and the proposed Bullard Wash SEZ. The mountains adjacent to the SEZ provide habitat for deer and bighorn sheep, which may occasionally have been present in the valley as well. Traditionally, deer have been an important source of food and of bone, sinew, and hide used to make a variety of implements. Although pronghorn antelope were present on the nearby Harquahala Plain, they were not hunted by the Yavapai. While big game was highly prized, smaller animals, such as black-tailed jackrabbits and desert cottontail (both present in the SEZ), traditionally provided a larger proportion of the protein in their diet (Gifford 1936). Wildlife likely to be found in the proposed Bullard Wash SEZ is described in Section 8.2.11. Native American game species with ranges that include the SEZ are listed in Table 8.2.18.1-2.

TABLE 8.2.18.1-2 Animal Species Used by Native Americans with Ranges That Include the Proposed Bullard Wash SEZ

Common Name	Scientific Name	Seasonal Presence
Mammals		
Badger	*Taxidea taxus*	All year
Bighorn sheep	*Ovis Canadensis*	All year
Black-tailed jack rabbit	*Lepus californicus*	All year
Bobcat	*Lynx rufus*	All year
Wood rats	*Neotoma* spp.	All year
Coyote	*Canis latrans*	All year
Desert cottontail	*Silvilagus audubonii*	All year
Kit fox	*Vulpes macotis*	All year
Mule deer	*Odocoileus hemionus*	All year
Rock squirrel	*Spermophilus variegates*	All year
Birds		
Gambel's quail	*Callipepla gambelii*	All year
Doves		
Common ground dove	*Columbina passerina*	All year
White-winged dove	*Zenaida asiatica*	Summer
Mourning dove	*Zenaida macrocura*	All year
Reptiles		
Desert tortoise	*Gopherus agassizii*	All year

Sources: Field visit; USGS (2005b); Gifford (1936); Bean et al. (1978); Khera and Mariella (1983).

Mineral resources important to Native Americans in the Colorado Desert include turquoise, clay for pottery, stone for making tools, and quartz crystals considered to have healing properties. Obsidian and quartz have been reported from the surrounding mountains (BLM 2006, 2008b).

In addition, Native Americans have expressed concern over ecological segmentation, that is, development that fragments animal habitat and does not provide corridors for movement. They would prefer solar energy development take place on land that has already been disturbed, such as abandoned farmland, rather than on undisturbed ground (Jackson 2009).

8.2.18.2 Impacts

To date, no comments have been received from the Tribes specifically referencing the proposed Bullard Wash SEZ. However, in a response letter, the Quechan Indian Tribe of Fort Yuma indicates that some of the SEZs proposed in this PEIS lie within their Tribal Traditional Use Area. They stress the importance of evaluating impacts on landscapes as a whole. From their perspective the intrusion of industrial development nearby would have negative effects on trails (Jackson 2009).

Commenting on past transmission line projects in the area, rural Yavapai were primarily concerned with wild resources. In order of importance the Yavapai expressed concerns for the following resources: game animals (deer, birds, rabbits, mountain sheep), viewshed, cremation or burial sites, wild food plants (squawbush, prickly pear, saguaro), minerals, rock art, sacred areas, medicinal plants, and fiber plants (Bean et al. 1978).

The impacts that would be expected from solar energy development within the proposed Bullard Wash SEZ on resources important to Native Americans fall into two major categories: impacts on the landscape and impacts on discrete localized resources.

Potential landscape-scale impacts are those caused by the presence of an industrial facility within a culturally important landscape that includes sacred mountains and other geophysical features often tied together by a network of trails. Impacts may be visual (the intrusion of an industrial feature in sacred space); audible (noise from the construction, operation or decommissioning of a facility detracting from the traditional cultural values of the site); or demographic (the presence of a larger number of outsiders in the area that would increase the chance that the cultural importance of the area would be degraded by more foot and motorized traffic). As consultation with the Tribes continues and project-specific analyses are undertaken, it is possible that Native Americans will express concerns over potential visual effects of solar energy development within the proposed SEZ on the landscape.

Localized effects could occur both within the proposed SEZ and in adjacent areas. Within the SEZ, these effects would include the destruction or degradation of important plant resources; destruction of the habitat of, and impeding the movement of, culturally important animal species; destruction of archaeological sites and burials; and degradation or destruction of trails. Plant resources are known to exist in the SEZ. Any ground-disturbing activity associated with the development within the SEZ has the potential for destruction of localized resources. However, significant tracts of Sonora-Mojave Creosote Bursage Desert Scrub and Sonoran Paloverde-Mixed Cacti Desert Scrub would remain outside the SEZ, and anticipated overall effects on these plant populations would be small. Animal species important to Native Americans are listed in Table 8.2.18.1-2. While the construction of utility-scale solar energy facilities would reduce the amount of habitat available to many of these species, similar habitat is abundant and the effect on animal populations is likewise likely to be small.

Since solar energy facilities cover large tracts of ground, even taking into account the implementation of programmatic design features, it is unlikely that avoidance of all resources would be possible. Programmatic design features (see Appendix A, Section A.2.2) assume that the necessary cultural surveys, site evaluations, and tribal consultations will occur. Implementation of programmatic design features, as discussed in Appendix A, Section A.2.2, should eliminate issues concerning impacts on Tribes' reserved water rights and the potential for groundwater contamination.

8.2.18.3 SEZ-Specific Design Features and Design Feature Effectiveness

Programmatic design features to address impacts of potential concern to Native Americans, such as avoidance of sacred sites, water sources, and tribally important plant and animal species, are described in Appendix A, Section A.2.2.

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 8.2.18.1-1.

Mitigation of impacts on archaeological sites and traditional cultural properties is discussed in Section 8.2.17.3, in addition to the design features for historic properties discussed in Section A.2.2 in Appendix A.

8.2.19 Socioeconomics

8.2.19.1 Affected Environment

This section describes current socioeconomic conditions and local community services within the ROI surrounding the proposed Bullard Wash SEZ. The ROI is a three-county area comprising La Paz County, Maricopa County, and Yavapai County in Arizona. 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.

8.2.19.1.1 ROI Employment

In 2008, employment in the ROI stood at 1,976,008 (Table 8.2.19.1-1). Over the period 1999 to 2008, the annual average employment growth rate was higher in Yavapai County (3.1%) than in Maricopa County (2.1%) and La Paz County (0.6%). At 2.3%, the growth rate in the ROI as a whole was the same as that for Arizona as a whole (2.3%).

In the ROI in 2006, the services sector provided the highest percentage of employment at 47.2%, followed by wholesale and retail trade at 18.3% (Table 8.2.19.1-2). Smaller employment shares were held by construction (10.4%) and finance, insurance, and real estate (9.7%). Within the three counties in the ROI, the distribution of employment across sectors was similar to that of the ROI as a whole, but employment in agriculture (11.4%) and wholesale and retail trade was higher in La Paz County than in the ROI as a whole, with lower employment shares in construction and finance, insurance, and real estate.

TABLE 8.2.19.1-1 ROI Employment in the Proposed Bullard Wash SEZ

Location	1999	2008	Average Annual Growth Rate, 1999–2008 (%)
La Paz County	6,621	7,023	0.6
Maricopa County	1,531,553	1,876,247	2.1
Yavapai County	68,097	92,638	3.1
ROI	1,606,271	1,976,008	2.3
Arizona	2,355,357	2,960,199	2.3

Sources: U.S. Department of Labor (2009a,b).

TABLE 8.2.19.1-2 ROI Employment in the Proposed Bullard Wash SEZ by Sector, 2006

	La Paz County		Maricopa County		Yavapai County		ROI	
Industry	Employment	% of Total	Employment	% of Total	Employment	% of Total	Employment	% of Total
Agriculture[a]	493	11.4	11,098	0.7	928	1.4	12,519	0.7
Mining	60	1.4	1,835	0.1	1,750	2.7	3,645	0.2
Construction	136	3.1	171,087	10.3	8,406	13.0	179,629	10.4
Manufacturing	381	8.8	120.867	7.3	3,979	6.1	125,227	7.2
Transportation and public utilities	83	1.9	83,990	5.0	1,338	2.1	85,411	4.9
Wholesale and retail trade	1,114	25.7	302,087	18.1	13,449	20.7	316,650	18.3
Finance, insurance, and real estate	120	2.8	164,953	9.9	3,406	5.3	168,479	9.7
Services	1,990	46.0	815,970	49.0	31,926	49.3	818,479	47.2
Other	10	0.2	91	0.0	8	0.0	109	0.0
Total	4,329		1,665,052		64,816		1,734,197	

[a] Agricultural employment includes 2007 data for hired farmworkers.

Sources: U.S. Bureau of the Census (2009a); USDA (2009a).

8.2.19.1.2 ROI Unemployment

Unemployment rates have been significantly different in the three counties in the ROI. Over the period 1999 to 2008, the average rate in La Paz County (6.7%) was much higher than the rates in Yavapai County (4.5%) and Maricopa County (4.2%) (Table 8.2.19.1-3). The average rate in the ROI over this period was 4.2%, lower than the average rate for Arizona as a whole (4.8%). Unemployment rates for 2009 contrast with rates for 2008; in Yavapai County, the unemployment rate increased to 9.5%; in La Paz County, to 9.1%; and in Maricopa County, to 8.3%. The average rates for the ROI (8.3%) and for Arizona (9.1%) as a whole in 2009 were also higher than the corresponding average rates for 2008.

8.2.19.1.3 ROI Urban Population

The population of the ROI in 2008 was more than 92% urban (Table 8.2.19.1-4). The largest urban area, Phoenix, had an estimated 2008 population of 1,577,812; other large cities include Mesa (459,160), Chandler (252,885), Glendale (250,746), Scottsdale (236,496), Tempe (171,444), and Peoria (158,093). These cities are part of the Phoenix metropolitan region, and most are more than 100 mi (161 km) from the site of the proposed SEZ.

Population growth rates among the cities in Maricopa County varied over the period 2000 to 2008. Buckeye grew at an annual rate of 28.1% during this period; higher-than-average growth was also experienced in Queen Creek (23.8), Goodyear (16.0), El Mirage (15.9%), Surprise (14.7%), and Avondale (10.7%). Nine other cities in the county had growth rates that were higher than the state average (3.5%).

In La Paz County, there are two small towns, Quartzite (3,468) and Parker (3,116), where population growth from 2000 to 2008 was relatively low, varying from 1.2% in Quartzite, to –0.1% in Parker. In Yavapai County, there are six small cities with a population of more than

TABLE 8.2.19.1-3 ROI Unemployment Rates (%) for the Proposed Bullard Wash SEZ

Location	1999–2008	2008	2009
La Paz County	6.7	7.4	9.1
Maricopa County	4.2	5.1	8.3
Yavapai County	4.5	5.9	9.5
ROI	4.2	5.2	8.3
Arizona	4.8	5.5	9.1

Sources: U.S. Department of Labor (2009a–c).

TABLE 8.2.19.1-4 ROI Urban Population and Income for the Proposed Bullard Wash SEZ

	Population			Median Household Income ($ 2008)		
City	2000	2008	Average Annual Growth Rate, 2000–2008 (%)	1999	2006–2008	Average Annual Growth Rate, 1999 to 2006–2008 (%)[a]
Phoenix	1,321,045	1,577,812	2.2	53,055	49,933	–0.7
Mesa	396,375	459,160	1.9	55,128	51,180	–0.8
Chandler	176,581	252,885	4.6	75,211	70,924	–0.7
Glendale	218,812	250,746	1.7	57,957	52,083	–1.2
Scottsdale	202,705	236,496	1.9	74,012	72,033	–0.3
Gilbert	109,697	211,892	8.6	87,592	80,705	–0.9
Tempe	158,625	171,444	1.0	54,540	50,147	–0.9
Peoria	108,364	158,093	4.8	67,207	65,730	–0.2
Surprise	30,848	92,679	14.7	56,852	64,465	1.4
Avondale	35,883	81,111	10.7	63,285	61,665	–0.3
Goodyear	18,911	62,170	16.0	74,022	76,823	0.4
Buckeye	6,537	47,340	28.1	45,814	65,514	4.1
Prescott	33,938	42,506	2.9	45,637	43,386	–0.6
Prescott Valley	23,535	38,215	6.2	44,215	42,310	–0.5
Fountain Hills	20,235	25,170	2.8	79,335	81,377	0.3
El Mirage	7,609	24,701	15.9	43,535	52,109	2.0
Queen Creek	4,316	23,850	23.8	82,017	78,828	–0.4
Paradise Valley	13,664	14,949	1.1	193,421	NA[b]	NA
Sedona	10,192	11,561	1.6	56,705	NA	NA
Cottonwood	9,179	11,385	2.7	35,335	NA	NA
Chino Valley	7,835	11,136	4.5	41,573	NA	NA
Camp Verde	9,451	10,892	1.8	41,031	NA	NA
Tolleson	4,974	7,179	4.7	49,921	NA	NA
Wickenburg	5,082	6,618	3.4	40,835	NA	NA
Guadalupe	5,228	5,936	1.6	38,740	NA	NA
Cave Creek	3,728	5,416	4.8	77,171	NA	NA
Litchfield Park	3,810	5,116	3.8	92,540	NA	NA
Youngtown	3,010	4,885	6.2	29,824	NA	NA
Clarkdale	3,422	4,251	2.7	44,948	NA	NA
Carefree	2,927	3,852	3.5	114,205	NA	NA
Dewey-Humboldt	3,421	3,827	1.4	47,431	NA	NA
Quartzite	3,354	3,468	1.2	54,068	NA	NA
Parker	3,140	3,116	–0.1	29,681	NA	NA
Gila Bend	1,980	1,830	–1.0	34,744	NA	NA
Jerome	329	379	1.8	35,866	NA	NA

[a] Data are averages for the period 2006 to 2008.

[b] NA = not available.

Sources: U.S. Bureau of the Census (2009b–d).

10,000, Prescott (42,506) and Prescott Valley (38,215) being the largest. Population growth from 2000 to 2008 was relatively high in Prescott Valley (6.2%) and Chino Valley (4.5%), with annual growth rates of 2.9% in Prescott and 2.7% in Clarkdale and in Cottonwood. The majority of these cities are more than 30 mi (48 km) from the site of the proposed SEZ.

8.2.19.1.4 ROI Urban Income

Median household incomes varied considerably across cities in the ROI (Table 8.2.19.1-4). Of the cities for which data are available for 2006 to 2008, there were 10 cities with median household incomes that were higher than the state average ($56,348); of these, Fountain Hills ($81,377) and Gilbert ($80,705) had the highest incomes. A number of cities, including Paradise Valley ($193,421), Carefree ($114,205), Litchfield Park ($92,540), and Cave Creek ($77,171) had median incomes in 1999 that were higher than the state average ($57,999). Five cities, including Phoenix ($49,933), Tempe ($50,147), and Mesa ($51,180) had median incomes in 2006 to 2008 that were lower than the state average.

Among the cities in Maricopa County for which data are available, median income growth rates between 1999 and 2006 to 2008 were highest in Buckeye (4.1%), El Mirage (2.0%), and Surprise (1.4%), with annual growth rates of less than 1% elsewhere. Ten cities in the county had negative growth rates between 1999 and 2006 to 2008. The average median household income growth rate for the state as a whole over this period was –0.2%.

All cities in La Paz County and Yavapai County had median incomes in 1999 that were lower than the average for the state ($57,399) (Table 8.2.19.1-4). Of these cities, Sedona ($56,705) and Quartzite ($54,068) had the highest median incomes, followed by Dewey-Humboldt ($47,431) and Prescott ($45,637). Median incomes in Parker ($29,681) were around half the state average in 1999.

Data on median household incomes for the period 2006 to 2008 are available for only two cities in Yavapai County. Both Prescott (–0.6%) and Prescott Valley (–0.5%) had median income growth rates that were negative for the period 1999 and 2006 to 2008.

8.2.19.1.5 ROI Population

Table 8.2.19.1-5 presents recent and projected populations in the ROI and state as a whole. Population in the ROI stood at 4,193,198 in 2008, having grown at an average annual rate of 3.2% since 2000. Growth rates for the ROI were higher than those for Arizona (3.0%) over the same period.

Each county in the ROI experienced growth in population from 2000 to 2008; population in Maricopa County and Yavapai County grew at an annual rate of 3.2%; the rate in La Paz County (0.2%) was lower. The ROI population is expected to increase to 5,711,375 by 2021 and 5,916,249 by 2023.

TABLE 8.2.19.1-5 ROI Population for the Proposed Bullard Wash SEZ

Location	2000	2008	Average Annual Growth Rate, 2000–2008 (%)	2021	2023
La Paz County	19,715	20,005	0.2	25,757	26,302
Maricopa County	3,072,149	3,958,263	3.2	5,374,643	5,568,104
Yavapai County	167,517	214,930	3.2	310,975	321,843
ROI	3,259,381	4,193,198	3.2	5,711,375	5,916,249
Arizona	5,130,632	6,499,377	3.0	8,945,447	9,271,163

Sources: U.S. Bureau of the Census (2009e,f); Arizona Department of Commerce (2010).

8.2.19.1.6 ROI Income

Total personal income in the ROI stood at $158.1 billion in 2007 and grew at an annual average rate of 4.1% over the period 1998 to 2007 (Table 8.2.19.1-6). Per-capita income also rose over the same period at a rate of 1.1%, increasing from $34,442 to $38,515. Per-capita incomes in 2007 were higher in Maricopa County ($38,998) than Yavapai County ($30,970) and La Paz County ($25,124). Growth rates in total personal income were slightly higher in Yavapai County (4.4%) and Maricopa County (4.0%), with higher growth rates in per-capita incomes in La Paz County. Personal income growth rates in the ROI were higher than the rate for Arizona (3.8%), but per-capita income growth rates in the ROI were the same as those in Arizona as a whole (1.1%).

Median household income over the period 2006 to 2008 varied from $56,555 in Maricopa County to $43,610 in Yavapai County and $30,797 in La Paz County (U.S. Bureau of the Census 2009d).

8.2.19.1.7 ROI Housing

In 2007, more than 1,656,235 housing units were located in the three ROI counties; about 93% of these were located in Maricopa County (Table 8.2.19.1-7). Owner-occupied units compose approximately 68% of the occupied units in the two counties; rental housing made up 32% of the total. Vacancy rates in 2007 were 38.5% in La Paz County, 14.1% in Yavapai County, and 12.9% in Maricopa County; 3.7% of housing units in the ROI were used for seasonal or recreational purposes. With an overall vacancy rate of 13.4% in the ROI, there were 221,998 vacant housing units in the ROI in 2007, of which 70,383 are estimated to be rental units that would be available to construction workers. There were 60,916 units in seasonal, recreational, or occasional use at the time of the 2000 Census.

TABLE 8.2.19.1-6 ROI Personal Income for the Proposed Bullard Wash SEZ

Location	1998	2007	Average Annual Growth Rate, 1998–2007 (%)
La Paz County			
Total income[a]	0.4	0.5	3.3
Per-capita income	19,345	25,124	2.6
Maricopa County			
Total income[a]	101.7	151.0	4.0
Per-capita income	34,944	38,998	1.1
Yavapai County			
Total income[a]	4.3	6.6	4.4
Per-capita income	26,995	30,970	1.4
ROI			
Total income[a]	106.3	158.1	4.1
Per-capita income	34,442	38,515	1.1
Arizona			
Total income[a]	149.2	215.8	3.8
Per-capita income	30,551	33,926	1.1

[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).

Housing stock in the ROI as a whole grew at an annual rate of 3.0% over the period 2000 to 2007, with 309,141 new units added to the existing housing stock (Table 8.2.19.1-6).

The median value of owner-occupied housing in 2006 to 2008 varied from $95,300 in La Paz County, to $247,200 in Yavapai County, to $263,600 in Maricopa County (U.S. Bureau of the Census 2009g).

8.2.19.1.8 ROI Local Government Organizations

The various local and county government organizations in the ROI are listed in Table 8.2.19.1-8. In addition, there are nine Tribal governments located in the county, with members of other Tribal groups located in the area whose Tribal governments are located in adjacent counties or states.

TABLE 8.2.19.1-7 ROI Housing Characteristics for the Proposed Bullard Wash SEZ

Parameter	2000	2007[a]
La Paz County		
Owner-occupied	6,521	7,312
Rental	1,841	2,322
Vacant units	6,771	6,029
Seasonal and recreational use	5,234	NA
Total units	15,133	15,663
Maricopa County		
Owner-occupied	764,547	910,811
Rental	368,339	427,237
Vacant units	117,345	198,423
Seasonal and recreational use	49,637	NA
Total units	1,250,231	1,536,471
Yavapai County		
Owner-occupied	51,519	61,400
Rental	18,652	25,155
Vacant units	11,559	14,723
Seasonal and recreational use	6,045	NA
Total units	81,730	104,101
ROI		
Owner-occupied	822,587	979,523
Rental	388,832	454,714
Vacant units	135,675	221,998
Seasonal and recreational use	60,916	NA
Total units	1,347,094	1,656,235

[a] 2007 data for number of owner-occupied, rental, and vacant units for California 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).

8.2.19.1.9 ROI Community and Social Services

This section describes educational, health care, law enforcement, and firefighting resources in the ROI.

TABLE 8.2.19.1-8 ROI Local Government Organizations and Social Institutions in the Proposed Bullard Wash SEZ

Governments	
City	
Avondale	Litchfield Park
Buckeye	Mesa
Camp Verde	Paradise Valley
Carefree	Parker
Cave Creek	Peoria
Chandler	Phoenix
Chino Valley	Prescott
Clarkdale	Prescott Valley
Cottonwood	Quartzite
Dewey-Humboldt	Queen Creek
El Mirage	Scottsdale
Fountain Hills	Sedona
Gila Bend	Surprise
Gilbert	Tempe
Glendale	Tolleson
Goodyear	Wickenburg
Guadalupe	Youngtown
Jerome	
County	
La Paz	Yavapai
Maricopa	
Tribal	
Ak Chin Indian Community of the Maricopa (Ak Chin) Indian Reservation, Arizona	
Colorado River Indian Tribes of the Colorado River Indian Reservation, Arizona and California	
Fort McDowell Yavapai Nation, Arizona	
Fort Mojave Indian Tribe of Arizona, California & Nevada	
Gila River Indian Community of the Gila River Indian Reservation, Arizona	
Hualapai Indian Tribe of the Hualapai Indian Reservation, Arizona	
Salt River Pima-Maricopa Indian Community of the Salt River Reservation, Arizona	
Yavapai-Apache Nation of the Camp Verde Indian Reservation, Arizona	
Yavapai-Prescott Tribe of the Yavapai Reservation, Arizona	

Sources: U.S. Bureau of the Census (2009b); U.S. Department of the Interior (2010).

Schools

In 2007, the three-county ROI had a total of 858 public and private elementary, middle, and high schools (NCES 2009). Table 8.2.19.1-9 provides summary statistics for enrollment and 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 Maricopa County schools (18.8) is slightly higher than that in Yavapai County schools (17.9) and in La Paz County

TABLE 8.2.19.1-9 ROI School District Data for the Proposed Bullard Wash SEZ, 2007

Location	Number of Students	Number of Teachers	Student-Teacher Ratio	Level of Service[a]
La Paz County	2,591	160	16.2	8.0
Maricopa County	624,346	33,244	18.8	8.6
Yavapai County	23,244	1,296	17.9	6.1
ROI	650,181	34,700	18.7	8.5

[a] Number of teachers per 1,000 population.

Source: NCES (2009).

(16.2). The level of service is slightly higher in Maricopa County (8.6) than in La Paz County (8.0) and Yavapai County (6.1), where there are fewer teachers per 1,000 population.

Health Care

The total number of physicians (11,993) is much higher in Maricopa County than elsewhere in the ROI, but the number of physicians per 1,000 population in Maricopa County (3.1) is only slightly higher than in Yavapai County (2.8), which is higher than in La Paz County (1.0) (Table 8.2.19.1-10).

TABLE 8.2.19.1-10 Physicians in the Proposed Bullard Wash SEZ ROI, 2007

Location	Number of Primary Care Physicians	Level of Service[a]
La Paz County	20	1.0
Maricopa County	11,993	3.1
Yavapai County	593	2.8
ROI	12,606	3.1

[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 8.2.19.1-11). Yavapai County has 132 officers and would provide law enforcement services to the SEZ; there are 763 officers in Maricopa County and 36 officers in La Paz County Levels of service of police protection are 1.8 per 1,000 population in La Paz County, 0.6 in Yavapai County, and 0.2 in Maricopa County. Currently, there are 3,451 professional firefighters in the ROI (Table 8.2.19.1-11).

8.2.19.1.10 ROI Social Structure 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 increase and levels of community satisfaction deteriorate (BLM 1980, 1983, 1996). Data on violent crime and property crime rates and on alcoholism and illicit drug use, mental health, and divorce, which might be used as indicators of social change, are presented in Tables 8.2.19.1-12 and 8.2.19-1.13, respectively.

TABLE 8.2.19.1-11 Public Safety Employment in the Proposed Bullard Wash SEZ ROI

Location	Number of Police Officers[a]	Level of Service[b]	Number of Firefighters[c]	Level of Service
La Paz County	36	1.8	14	0.7
Maricopa County	763	0.2	3,154	0.8
Yavapai County	132	0.6	283	1.3
ROI	931	0.2	3,451	0.8

[a] 2007 data.

[b] Number per 1,000 population.

[c] 2008 data; number does not include volunteers.

Sources: Fire Departments Network (2009); U.S. Department of Justice (2008).

TABLE 8.2.19.1-12 County and ROI Crime Rates for the Proposed Bullard Wash SEZ[a]

	Violent Crime[b]		Property Crime[c]		All Crime	
	Offenses	Rate	Offenses	Rate	Offenses	Rate
La Paz County	226	11.3	2,111	105.5	2,337	116.8
Maricopa County	18,719	4.7	171,143	43.2	189,682	48.0
Yavapai County	759	3.5	5,030	23.4	5,789	26.9
ROI	19,704	4.7	178,284	42.5	197,988	47.2

[a] Rates are the number of crimes per 1,000 population; data are for 2008.

[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.

Sources: U.S. Department of Justice (2009a,b).

TABLE 8.2.19.1-13 Alcoholism, Drug Use, Mental Health and Divorce in the Proposed Bullard Wash SEZ ROI[a]

Geographic Area	Alcoholism	Illicit Drug Use	Mental Health[b]	Divorce[c]
Arizona Rural South Region (includes La Paz County)	7.3	2.6	8.8	–[d]
Arizona Maricopa	8.6	2.8	10.7	–
Arizona Rural North Region (includes Yavapai County)	9.3	2.8	8.8	
Arizona				3.9

[a] Data for alcoholism and 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. Arizona data are for 2007; California data are for 1990.

[d] A dash indicates not applicable.

Sources: SAMHSA (2009); CDC (2009).

There is some variation in the level of crime across the ROI, with higher rates of violent crime in La Paz County (11.3 per 1,000 population) than in Maricopa County (4.7) and Yavapai County (3.5) (Table 8.2.19.1-12).

Property-related crime rates are also higher in La Paz County (105.5) than in Maricopa County (43.2) and Yavapai County (23.4); that is, overall crime rates in La Paz County (116.8) were higher than in Maricopa County (48.0) and Yavapai County (26.9).

Data on other measures of social change—alcoholism, illicit drug use, and mental health—are not available at the county level and thus are presented for the SAMHSA region in which the ROI is located. There is some variation across the three regions in which the three ROI counties are located; rates for alcoholism are slightly higher in the region in which Yavapai County is located; rates of illicit drug use are slightly lower in the region in which La Paz County is located; and rates of mental illness are slightly higher in the Arizona Maricopa region (Table 8.2.19.1-13).

8.2.19.1.11 Recreation

Various areas in the vicinity of the proposed SEZ are used for recreational purposes; natural, ecological, and cultural resources in the ROI attract visitors for a range of activities, including hunting, fishing, boating, canoeing, wildlife watching, camping, hiking, horseback riding, mountain climbing, and sightseeing. These areas are discussed in Section 8.2.5.

Because the number of visitors using state and federal lands for recreational activities is not available from the various administering agencies, basing the value of recreational resources in these areas 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 Appendix M).

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 development, 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; some activity occurs 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, 202,663 people were employed in the ROI in the various sectors identified as recreation, constituting 10.3% of total ROI employment (Table 8.2.19.1-14). Recreation spending also produced more than $4,967 million in income in the ROI in 2007. The primary sources of recreation-related employment were eating and drinking places.

8.2.19.2 Impacts

The following analysis begins with a description of the common impacts of solar development, including common impacts on recreation and on social change. These impacts

TABLE 8.2.19.1-14 Recreation Sector Activity in the Proposed Bullard Wash SEZ ROI, 2007

ROI	Employment	Income ($ million)
Amusement and recreation services	20,573	234.3
Automotive rental	4,855	233.8
Eating and drinking places	146,639	3,048.4
Hotels and lodging places	20,573	742.0
Museums and historic sites,	1,047	59.8
Recreational vehicle parks and campsites	1,667	50.7
Scenic tours	6,934	367.0
Sporting goods retailers	11,691	231.0
Total ROI	202,663	4,967.1

Source: MIG, Inc. (2010).

would occur regardless of the solar technology developed in the SEZ. The impacts of facilities employing various solar energy technologies are analyzed in detail in subsequent sections.

8.2.19.2.1 Common Impacts

Construction and operation of a solar energy facility at the proposed SEZ would produce direct and indirect economic impacts. Direct impacts would occur as a result of expenditures on 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; see Appendix M). 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 development 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 affected, 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 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; 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 less than 0.1% 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 in smaller rural communities in the ROI to accommodate all in-migrating workers and families, and an insufficient range of housing choices to suit all solar occupations, make it likely that many workers would commute to the SEZ from larger communities elsewhere in the ROI, reducing the potential impact of solar development 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 ROI is likely to lead to some demographic and social change in small rural communities in the ROI. Communities hosting solar developments 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

Cattle ranching and farming supported 1,408 jobs, and $21.1 million in income in the ROI in 2007 (MIG, Inc. 2010). The construction and operation of solar facilities in the proposed Bullard Wash SEZ could result in a decline in the amount of land available for livestock grazing, resulting in total (direct plus indirect) impacts of the loss of 13 jobs and less than $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 $439 annually on land dedicated to solar facilities in the SEZ.

Transmission Line Impacts

The impacts of transmission line construction could include the addition of 27 jobs in the ROI (including direct and indirect impacts) in the peak year of construction (Table 8.2.19.2-1). Construction activities in the peak year would constitute less than 1% of total ROI employment. A transmission line would also produce $1.4 million in ROI income. Direct sales taxes and direct income taxes would be 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 10 persons in-migrating into the ROI during the peak construction year. 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 five rental units expected to be occupied in the ROI. This occupancy rate would represent less than 1% of the vacant rental units expected to be available in the ROI in the peak year.

No new community service employment would be required in order to meet existing levels of service in the three-county ROI.

Total operations employment impacts in the ROI (including direct and indirect impacts) of a transmission line would be one job during the first year of operation (Table 8.2.19.2-2) 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, 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

The impacts of construction of an access road connecting the proposed Bullard Wash SEZ could include the addition of 122 jobs in the ROI (including direct and indirect impacts) in the peak year of construction (Table 8.2.19.2-2). Construction activities in the peak year would constitute less than 1% of total ROI employment. Access road construction would also

TABLE 8.2.19.2-1 ROI Socioeconomic Impacts of a 230-kV Transmission Line at the Proposed Bullard Wash SEZ[a]

Parameter	Maximum Annual Construction Impacts	Operations
Employment (no.)		
Direct	10	<1
Total	27	1
Income[b]		
Total	1.4	<0.1
Direct state taxes[b]		
Sales	<0.1	<0.1
Income	<0.1	<0.1
In-migrants (no.)	10	0
Vacant housing[c] (no.)	5	0
Local community service employment		
Teachers (no.)	0	0
Physicians (no.)	0	0
Public safety (no.)	0	0

[a] Construction impacts assume 5 mi (8 km) of transmission line 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.

produce $4.7 million in ROI income. Direct sales taxes and direct income taxes would each be $0.1 million.

Total operations (maintenance) employment impacts in the ROI (including direct and indirect impacts) of an access road would be less than one job during the first year of operation (Table 11.2.19.2-3) 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, and direct income taxes, 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

TABLE 8.2.19.2-2 ROI Socioeconomic Impacts of an Access Road Connecting the Proposed Bullard Wash SEZ[a]

Parameter	Maximum Annual Construction Impacts	Operations
Employment (no.)		
Direct	61	<1
Total	122	<1
Income[b]		
Total	4.7	<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 5 mi (8 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.

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.

8.2.19.2.2 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), 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 trough and power tower and 2022 for the minimum facility size for dish engine and PV. 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 in the ROI (including direct and indirect impacts) from the use of solar trough technologies would be up to 5,477 jobs (Table 8.2.19.2-3). Construction activities would constitute 0.2% of total ROI employment. A solar facility would also produce $338.5 million in income. Direct sales taxes would be $13.7 million, and direct income taxes, $6.3 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 743 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) mean that the impact of solar facility construction on the number of vacant rental housing units would not be expected to be large, with 371 rental units expected to be occupied in the ROI. This occupancy rate would represent 0.2% 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, 11 new teachers, 4 physicians, and 1 public safety employee (career firefighters and uniformed police officers) would be required in the ROI. These increases would represent less than 0.1% of total ROI employment expected in these occupations.

Operations. Total operations employment impacts in the ROI (including direct and indirect impacts) of a build-out using solar trough technologies would be 414 jobs (Table 8.2.19.2-3). Such a solar facility would also produce $16.2 million in income. Direct sales taxes would be $0.2 million, and direct income taxes, $0.4 million. Based on

TABLE 8.2.19.2-3 ROI Socioeconomic Impacts Assuming Full Build-out of the Proposed Bullard Wash SEZ with Trough Facilities[a]

Parameter	Maximum Annual Construction Impacts	Operations Impacts
Employment (no.)		
Direct	1,744	252
Total	5,477	414
Income[b]		
Total	338.5	16.2
Direct state taxes[b]		
Sales	13.7	0.2
Income	6.3	0.4
BLM payments ($ million 2008)		
Rental	NA[d]	0.5
Capacity[e]	NA	7.6
In-migrants (no.)	743	32
Vacant housing[c] (no.)	371	29
Local community service employment		
Teachers (no.)	11	0
Physicians (no.)	4	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 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 1,158 MW.

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.

d Not applicable.

e 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 2010f), 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.

fees established by the BLM in its Solar Energy Interim Rental Policy (BLM 2010f), acreage rental payments would be $0.5 million, and solar generating capacity payments, at least $7.6 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 32 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) mean that the impact of solar facility operation on the number of vacant owner-occupied housing units would not be expected to be large, with 29 owner-occupied units expected to be occupied in the ROI.

No new community service employment would be required to meet existing levels of service 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 up to 2,182 jobs (Table 8.2.19.2-4). Construction activities would constitute 0.1% of total ROI employment. Such a solar facility would also produce $134.8 million in income. Direct sales taxes would be less than $5.5 million; direct income taxes, $2.5 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) mean that the impact of solar facility construction on the number of vacant rental housing units would not be expected to be large, with 148 rental units expected to be occupied in the ROI. This occupancy rate would represent 0.1% 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, 5 new teachers, 2 physicians, and 1 public safety employee (career firefighters and uniformed police officers) would be required in the ROI. These increases would represent less than 0.1% of total ROI employment expected in these occupations.

Operations. Total operations employment impacts in the ROI (including direct and indirect impacts) of a build-out using power tower technologies would be 184 jobs

TABLE 8.2.19.2-4 ROI Socioeconomic Impacts Assuming Full Build-out of the Proposed Bullard Wash SEZ with Power Tower Facilities[a]

Parameter	Maximum Annual Construction Impacts	Operations Impacts
Employment (no.)		
Direct	695	130
Total	2,182	184
Income[b]		
Total	134.8	6.5
Direct state taxes[b]		
Sales	5.5	<0.1
Income	2.5	0.2
BLM payments ($ million 2008)		
Rental	NA[d]	0.5
Capacity[e]	NA	4.2
In-migrants (no.)	296	17
Vacant housing[c] (no.)	148	15
Local community service employment		
Teachers (no.)	5	0
Physicians (no.)	2	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 643 MW.

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.

d Not applicable.

e 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 2010f), 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.

(Table 8.2.19.2-5). Such a solar facility would also produce $6.5 million in income. Direct sales taxes would be less than $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 2010f), acreage rental payments would be $0.5 million, and solar generating capacity payments, at least $4.2 million.

Given the likelihood of local worker availability in the required occupational categories, operation of a solar facility means that some in-migration of workers and their families from outside the ROI would be required, with 17 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) mean that the impact of solar facility operation on the number of vacant owner-occupied housing units would not be expected to be large, with 15 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.

Dish Engine

Construction. Total construction employment impacts in the ROI (including direct and indirect impacts) from the use of dish engine technologies would be up to 1,029 jobs (Table 8.2.19.2-5). Construction activities would constitute less than 0.1% of total ROI employment. Such a solar facility would also produce $60.8 million in income. Direct sales taxes would be less than $2.2 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 120 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) mean that the impact of solar facility construction on the number of vacant rental housing units would not be expected to be large, with 60 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.

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, 2 new teachers and 1 physician would be required in the ROI. These increases would represent less than 0.1% of total ROI employment expected in these occupations.

Operations. Total operations employment impacts in the ROI (including direct and indirect impacts) of a build-out using dish engine technologies would be 179 jobs

TABLE 8.2.19.2-5 ROI Socioeconomic Impacts Assuming Full Build-out of the Proposed Bullard Wash SEZ with Dish Engine Facilities[a]

Parameter	Maximum Annual Construction Impacts	Operations Impacts
Employment (no.)		
Direct	282	127
Total	1,029	179
Income[b]		
Total	60.8	6.3
Direct state taxes[b]		
Sales	2.2	<0.1
Income	1.0	0.2
BLM payments ($ million 2008)		
Rental	NA[d]	0.5
Capacity[e]	NA	4.2
In-migrants (no.)	120	16
Vacant housing[c] (no.)	60	15
Local community service employment		
Teachers (no.)	2	0
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 643 MW.

[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.

[d] Not applicable.

[e] 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 2010f), 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.

(Table 8.2.19.2-5). Such a solar facility would also produce less than $6.3 million in income. Direct sales taxes would be less than $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 2010f), acreage rental payments would be $0.5 million, and solar generating capacity payments, at least $4.2 million.

Given the likelihood of local worker availability in the required occupational categories, operation of a dish engine solar facility means that some in-migration of workers and their families from outside the ROI would be required, with 16 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) mean that the impact of solar facility operation on the number of vacant owner-occupied housing units would not be expected to be large, with 15 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.

Photovoltaic

Construction. Total construction employment impacts in the ROI (including direct and indirect impacts) from the use of PV technologies would be up to 480 jobs (Table 8.2.19.2-6). Construction activities would constitute less than 0.1% of total ROI employment. Such a solar development would also produce $28.4 million in income. Direct sales taxes would be $1.0 million, and direct income taxes, $0.5 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 56 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) mean that the impact of solar facility construction on the number of vacant rental housing units would not be expected to be large, with 28 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.

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, 1 new teacher would be required in the ROI. This increase would represent less than 0.1% 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 18 jobs (Table 8.2.19.2-6).

TABLE 8.2.19.2-6 ROI Socioeconomic Impacts Assuming Full Build-out of the Proposed Bullard Wash SEZ with PV Facilities[a]

Parameter	Maximum Annual Construction Impacts	Operations Impacts
Employment (no.)		
Direct	132	13
Total	480	18
Income[b]		
Total	28.4	0.6
Direct state taxes[b]		
Sales	1.0	<0.1
Income	0.5	<0.1
BLM payments ($ million 2008)		
Rental	NA[d]	0.5
Capacity[e]	NA	3.4
In-migrants (no.)	56	2
Vacant housing[c] (no.)	28	1
Local community service employment		
Teachers (no.)	1	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 643 MW.

[b] Unless indicated otherwise, values are reported in $ million 2008.

[c] Construction activities would affect vacant rental housing; operations activities would affect owner-occupied housing.

[d] Not applicable

[e] 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 2010f), assuming full build-out of the site.

Such a solar facility would also produce $0.6 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 2010f), acreage rental payments would be $0.5 million, and solar generating capacity payments, at least $3.4 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 2 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) mean that the impact of solar facility operation on the number of vacant owner-occupied housing units would not be expected to be large, with 1 owner-occupied unit expected to be required in the ROI.

No new community service employment would be required to meet existing levels of service in the ROI.

8.2.19.3 SEZ-Specific Design Features and Design Feature Effectiveness

No SEZ-specific design features addressing socioeconomic impacts have been identified for the proposed Bullard Wash 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.

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8.2.20 Environmental Justice

8.2.20.1 Affected Environment

On February 11, 1994, the President signed Executive Order 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 76297, 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 Council on Environmental Quality's (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 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 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 with 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 who 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 data for census block groups, wherein consideration is given to the minority population that is both greater than 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 8.2.20.1-1 show the minority and low-income composition of total population located in the proposed 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 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, 14.3% of the population is classified as minority, while 12.7% is classified as low-income. The number of minority individuals does not exceed 50% of the total population in the area and the number of minority individuals does not exceed the state average by 20 percentage points or more; thus, there is no minority population in the SEZ area 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 area; thus, there are no low-income populations in the SEZ.

Figures 8.2.20.1-1 and 8.2.20.1-2 show the locations of the minority and low-income population groups, respectively, within the 50-mi (80-km) radius around the boundary of the SEZ.

At the individual block group level there are census block groups where the minority population exceeds the state average by more than 20 percentage points to the south of the SEZ,

TABLE 8.2.20.1-1 Minority and Low-Income Populations within the 50-mi (80-km) Radius Surrounding the Proposed Bullard Wash SEZ

Parameter	Arizona
Total population	106,692
White, non-Hispanic	91,403
Hispanic or Latino	11,859
Non-Hispanic or Latino minorities	3,430
One race	2,199
Black or African American	474
American Indian or Alaskan Native	1,072
Asian	502
Native Hawaiian or Other Pacific Islander	64
Some other race	87
Two or more races	1,231
Total minority	15,289
Low-income	13,201
Percentage minority	14.3
State percentage minority	24.5
Percentage low-income	12.7
State percentage low-income	13.9

Source: U.S Bureau of the Census (2009k,l).

and to the northeast of the site, in the city of Prescott. There are no block groups in which the minority population exceeds 50% of the total population.

There is one census block group located to the southwest of the SEZ with a low-income population which is more than 20 percentage points higher than the state average. There are no census block groups in which the low-income population exceeds 50% of the total population.

8.2.20.2 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 the programmatic design features described in Appendix A, Section A.2.2, which address the underlying environmental impacts contributing to the concerns. The potentially relevant environmental impacts associated with solar facilities within the proposed Bullard Wash SEZ include noise and dust during the construction; noise and electromagnetic field (EMF) effects

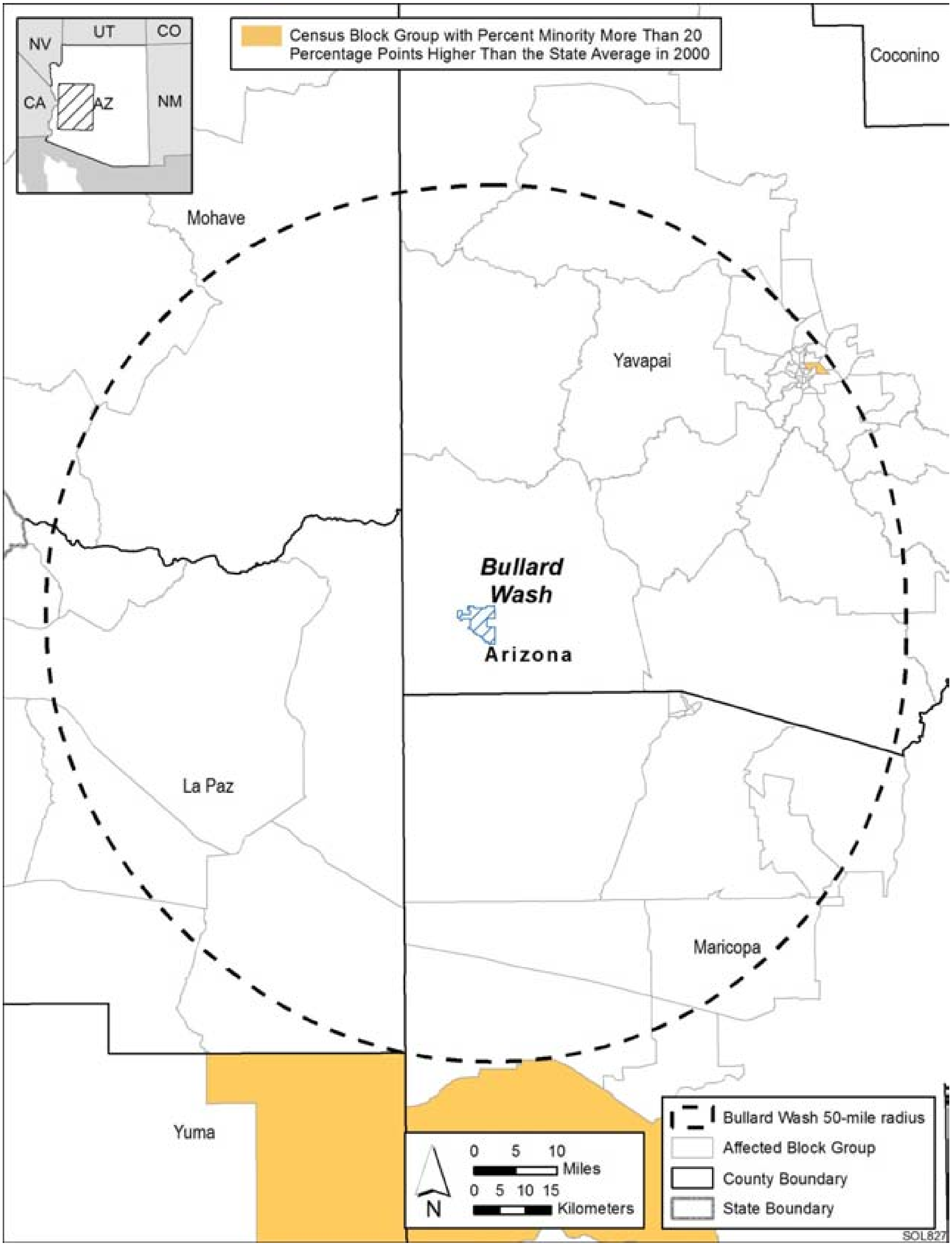


FIGURE 8.2.20.1-1 Minority Population Groups within the 50-mi (80-km) Radius Surrounding the Proposed Bullard Wash SEZ

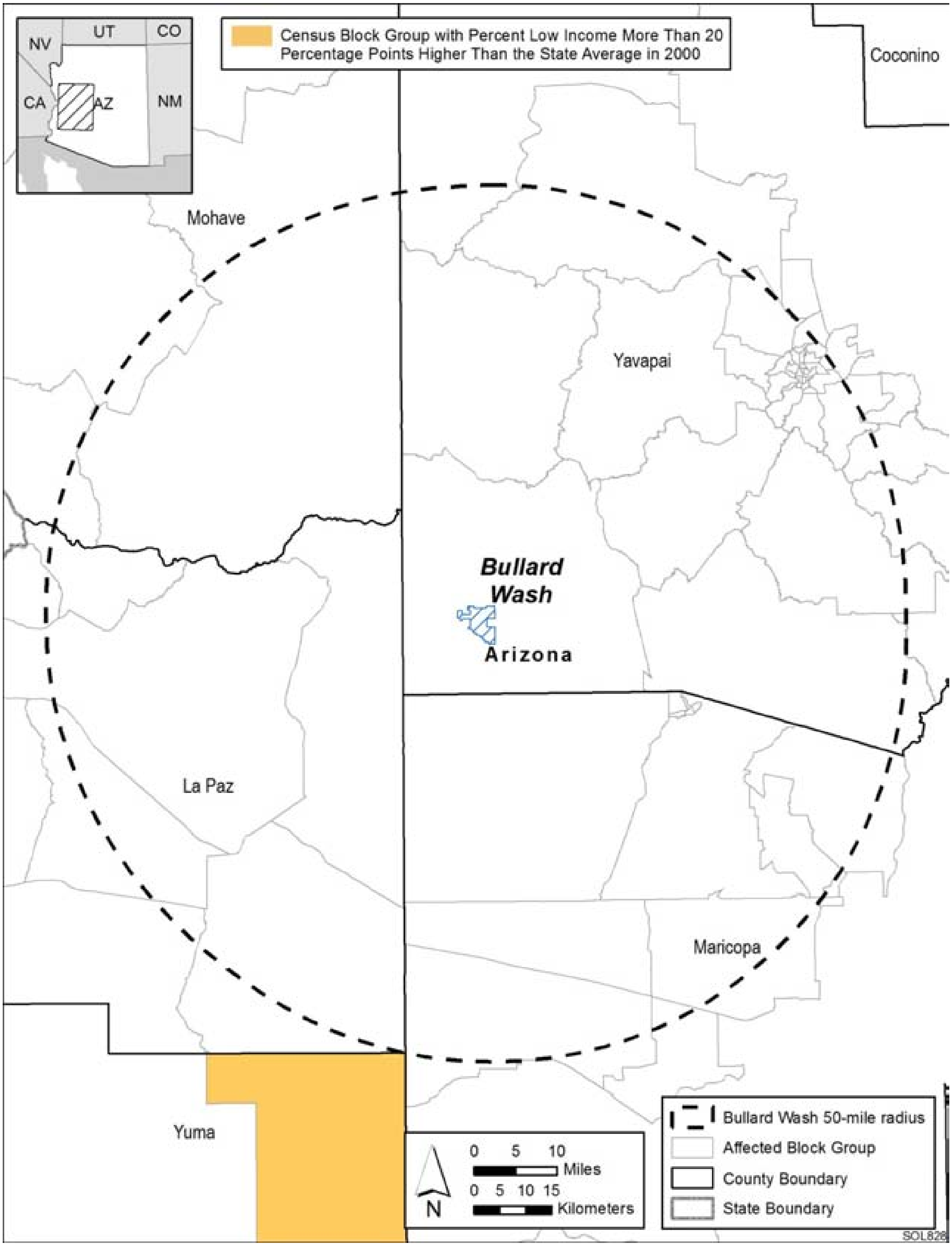


FIGURE 8.2.20.1-2 Low-Income Population Groups within the 50-mi (80-km) Radius Surrounding the Proposed Bullard Wash SEZ

associated with operations; 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. Minority populations have been identified within 50 mi (80 km) of the proposed Bullard Wash SEZ; no low-income populations are present (Section 8.2.20.1).

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 8.2.20.1) within the 50-mi (80-km) radius around the boundary of the SEZ; meaning that any adverse impacts of solar projects could not disproportionately affect minority populations. Because there are low-income populations within the 50-mi (80-km) radius, there could be impacts on low-income populations.

8.2.20.3 SEZ-Specific Design Features and Design Feature Effectiveness

No SEZ-specific design features addressing socioeconomic impacts have been identified for the proposed Bullard Wash SEZ. Implementing the programmatic design features described in Appendix A, Section A.2.2, as required under BLM's proposed Solar Energy Program, would reduce the potential for environmental justice impacts during all project phases.

8.2.21 Transportation

The proposed Bullard Wash SEZ is accessible by road and by rail. Two U.S. highways serve the immediate area, as do a regional railroad, a major railroad, a number of small airports, and one large airport. General transportation considerations and impacts are discussed in Sections 3.4 and 5.19, respectively.

8.2.21.1 Affected Environment

The northeastern tip of the proposed Bullard Wash SEZ lies about 5.5 mi (8.9 km) from U.S. 93, which runs in a general northwest to southeast direction, as shown in Figure 8.2.21.1-1, with I-40 about 86 mi (138 km) northwest of the SEZ and Wickenburg about 20 mi (32 mi) southeast. U.S. 93 connects with U.S. 60 in Wickenburg, with U.S. 60 continuing for approximately 30 mi (48 km) to the southeast, where it encounters the northwestern edge of the Phoenix metropolitan area. State Route 71 passes approximately 5 mi (8 km) southeast of the southeastern tip of the SEZ and intersects with U.S. 93 just over 10 mi (16 km) due east of the SEZ. State Route 71 connects with U.S. 60 near the small town of Aguila to the south and State Route 89 in Congress to the east. U.S. 60 also passes approximately 10 mi (16 km) south of the Bullard Wash SEZ and passes through Wickenburg, where it turns southeast towards Phoenix. Several local unimproved dirt roads cross the SEZ. The route inventory for the area of the SEZ shows seven inventoried OHV routes within the area of the SEZ (Baker and Bickauskas 2010). As listed in Table 8.2.21.1-1, U.S. 93 carries an average traffic volume of about 6,700 vehicles per day in the vicinity of the Bullard Wash SEZ (ADOT 2010b).

The ARZC Railroad serves the area (RailAmerica 2010). This regional railroad originates in the west at Cadiz, California, where it has an interchange with the Burlington Northern Santa Fe (BNSF) Railroad. The ARZC Railroad passes into Arizona through Parker and travels southeast to Vicksburg, from which it travels northeast to Matthie (adjacent to Wickenburg [70 mi (113 km)]), where it again has an interchange with the BNSF Railroad. This interchange is about an 18 mi (29 km) drive from the closest approach of U.S. 93 to the Bullard Wash SEZ. The BNSF Railroad runs from Phoenix up through Wickenburg, Matthie, Congress, and other stops on its way northward. The BNSF stop in Congress is closer to the SEZ than the Matthie stop, about 12 mi (19 km) from the closest approach of U.S. 93 to the SEZ.

Eight small airports and one major airport that are open to the public are within a driving distance of approximately 86 mi (138 km) of the proposed Bullard Wash SEZ, as listed in Table 8.2.21.1-2. The nearest public airport is the Wickenburg Municipal Airport, 22 mi (35 km) southeast of the SEZ. With the exception of Prescott Regional Airport, none of the small airports has regularly scheduled passenger service. Two regional carriers provide direct commercial passenger service from Prescott to Los Angeles, California; Ontario, California; Farmington, New Mexico; Durango, Colorado; and Denver, Colorado (City of Prescott 2010). Phoenix Sky Harbor International Airport is a major airport in Phoenix (86 mi [138 km]) to the east, with passenger service to most major cities in the United States provided by all major and some regional U.S. carriers. Table 8.2.21.1-3 summarizes the commercial passenger and freight traffic with reported values at airports in the vicinity of the Bullard Wash SEZ.

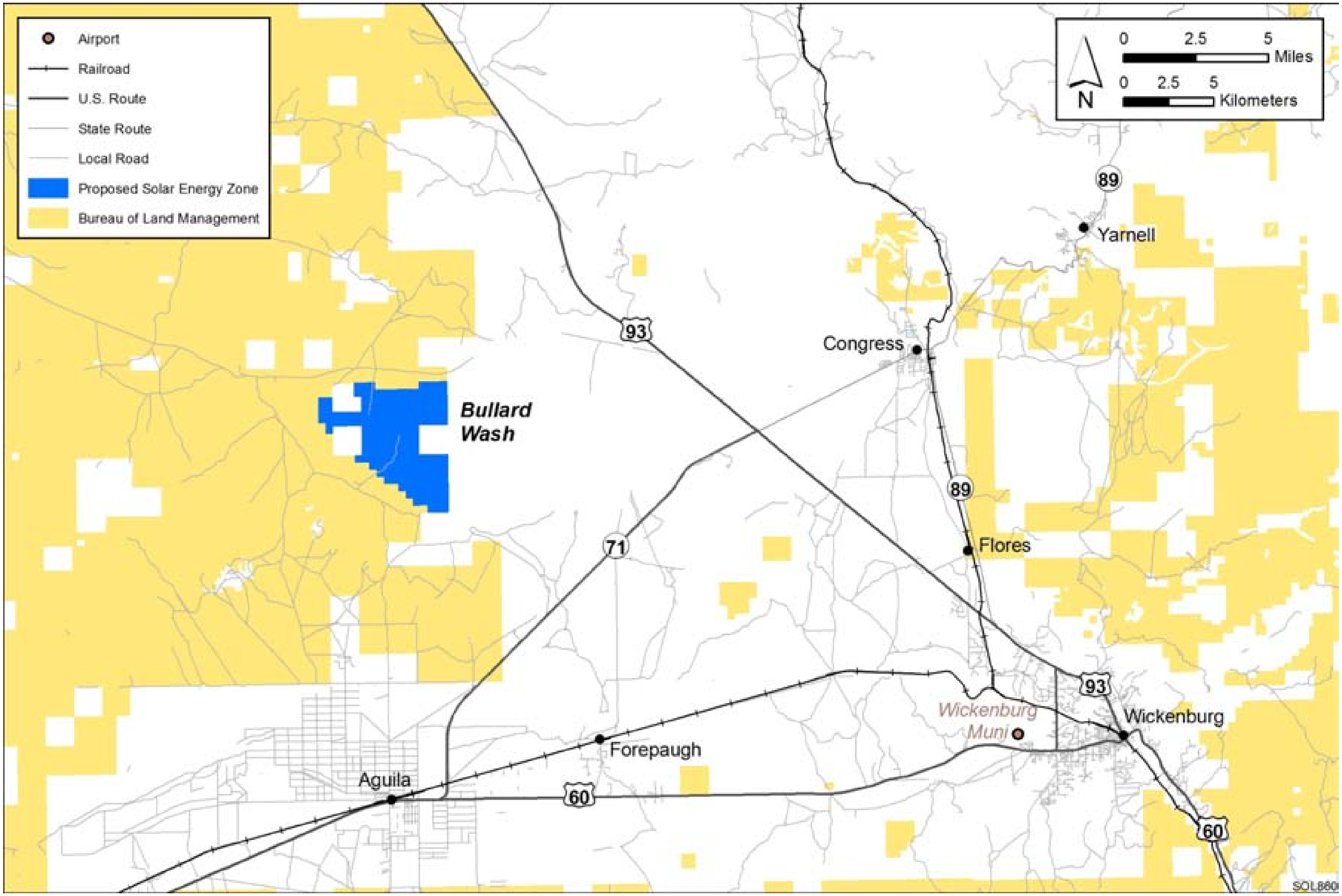


FIGURE 8.2.21.1-1 Local Transportation Network Serving the Proposed Bullard Wash SEZ

TABLE 8.2.21.1-1 AADT on Major Roads near the Proposed Bullard Wash SEZ for 2008

Road	General Direction	Location	AADT (Vehicles)
U.S. 60	Southwest–northeast (I-10 to Wickenburg), Northwest–southwest (Wickenburg to Phoenix)	I-10 Exit 31 to Vicksburg Road	1,500
		Vicksburg Rd. to State Route 72	1,500
		State Route 72 to Buckeye Road	2,500
		Buckeye Road to 2nd St. (in Wenden)	2,000
		2nd St. (in Wenden) to State Route 71	1,600
		State Route 71 to Wickenburg Airport Rd.	1,600
		Wickenburg Airport Rd. to Vulture Mine Rd.	4,600
		West of U.S. 93 junction	12,500
		East of U.S. 93 junction	20,000
		Northwest of State Route 74	15,000
		Southeast of State Route 74	12,500
		Northwest of Happy Valley Rd.	19,500
		Northwest of State Route 303	31,500
U.S. 93	Northwest–southeast	U.S. 60 to Vulture Mine Rd.	13,500
		Vulture Mine Rd. to State Route 89	9,500
		State Route 89 to State Route 71	6,700
		State Route 71 to State Route 97	6,700
		North of State Route 97	6,400
State Route 71	Southwest–northeast	U.S. 60 to U.S. 93	600
		U.S. 93 to State Route 89	800
State Route 89	North–south	U.S. 93 to State Route 71	3,300
		North of Congress	2,800

Source: ADOT (2010b).

8.2.21.2 Impacts

As discussed in Section 5.19, the primary transportation impacts are anticipated to be from commuting worker traffic. Single projects could involve up to 1,000 workers each day, with an additional 2,000 vehicle trips per day (maximum). This volume of traffic on U.S. 93 would represent an increase in traffic of about 30% in the area of the proposed Bullard Wash SEZ. Such traffic levels would represent about a 300% increase of the traffic levels experienced on State Route 71 near the SEZ if all project traffic were to be routed through State Route 71. Because higher traffic volumes would be experienced during shift changes, traffic on U.S. 93 could experience minor slowdowns during these time periods in the area of any junctions with SEZ site access roads. Local road improvements in addition to turn lanes may be necessary on any portion of U.S. 93 near any site access point(s).

Solar development within the SEZ would affect public access along OHV routes designated open and available for public use. If there are any routes designated as open within

TABLE 8.2.21.1-2 Airports Open to the Public in the Vicinity of the Proposed Bullard Wash SEZ

			Runway 1			Runway 2		
Airport	Location	Owner/Operator	Length (ft [m])	Type	Condition	Length (ft [m])	Type	Condition
Wickenburg Municipal	In Wickenburg, 22 mi (35 km) southeast off U.S. 60	Town of Wickenburg	6,100 (1,859)	Asphalt	Good	NA[a]	NA	NA
Bagdad	In Bagdad, 42 mi (68 km) north of the SEZ	Yavapai County	4,575 (1,394)	Asphalt	Good	NA	NA	NA
Pleasant Valley	In Peoria, 56 mi (90 km) southeast of the SEZ along U.S. 60 to State Route 74	Pleasant Valley Airport Association	2,400 (732)	Dirt	Excellent	4,200 (1,280)	Dirt	Fair
			4,200 (1,280)	Dirt	Fair	4,200 (1,280)	Dirt	Fair
Glendale Municipal	In Glendale, 64 mi (103 km) southeast of the SEZ near U.S. 60	City of Glendale	7,150 (2,179)	Asphalt	Good	NA	NA	NA
Prescott Municipal (Ernest A. Love Field)	In Prescott, 64 mi (103 km) northeast along State Route 89	City of Prescott	4,408 (1,344)	Asphalt	Good	4,848 (1,748)	Asphalt	Good
			7,616 (2,321)	Asphalt/ porous friction courses	Good	NA	NA	NA
Buckeye Municipal	In Buckeye, 68 mi (109 km) south–southeast on the western edge of the Phoenix metropolitan area	Town of Buckeye	5,500 (1,676)	Asphalt	Good	NA	NA	NA
Phoenix-Deer Valley Municipal	In Deer Valley, 71 mi (114 km) southeast in the Phoenix metropolitan area	City of Phoenix	4,508 (1,374)	Asphalt	Good	8,197 (2,498)	Asphalt	Good
Phoenix Goodyear	In Goodyear, 72 mi (116 km) southeast in the Phoenix metropolitan area	City of Phoenix	8,500 (2,591)	Asphalt	Good	NA	NA	NA

TABLE 8.2.21.1-2 (Cont.)

			Runway 1			Runway 2		
Airport	Location	Owner/Operator	Length (ft [m])	Type	Condition	Length (ft [m])	Type	Condition
Phoenix Sky Harbor International	In Phoenix, 86 mi (138 km) southeast	City of Phoenix	7,800 (2,377)	Concrete/ grooved	Good	10,300 (3,139)	Concrete / grooved	Good
			11,489 (3,502)	Concrete/ grooved	Good	NA	NA	NA

[a] NA = not applicable.

Source: FAA (2010).

TABLE 8.2.21.1-3 Commercial Passenger and Freight Traffic at Airports in the Vicinity of the Proposed Bullard Wash SEZ for 2008

	Passengers[a]		Freight[a] (lb [kg])	
Airport	Arrived	Departed	Arrived	Departed
Wickenburg Municipal	3	2	2,622 (1,189)	1,311 (595)
Glendale Municipal	76	109	0	0
Prescott Regional (Ernest A. Love Field)	11,653	11,872	4,568 (2,072)	185 (84)
Phoenix-Deer Valley Municipal	0	0	5,014 (2,274)	2,507 (1,137)
Phoenix Sky Harbor International	19.5 million	19.5 million	292 million (132 million)	234 million (106 million)

[a] Source: BTS (2009).

the proposed SEZ, open routes crossing areas granted ROWs for solar facilities 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).

8.2.21.3 SEZ-Specific Design Features and Design Feature Effectiveness

No SEZ-specific design features have been identified related to impacts on transportation systems around the proposed Bullard Wash 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 from traffic congestion on local roads leading to the site. Depending on the location of solar facilities within the SEZ, more specific access locations and local road improvements could be implemented.

8.2.22 Cumulative Impacts

The analysis presented in this section addresses the potential cumulative impacts in the vicinity of the proposed Bullard Wash SEZ in Yavapai County, Arizona. The CEQ guidelines for implementing NEPA define cumulative impacts as environment 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 the agency (federal or nonfederal), organization, or person that undertakes them. The time frame of this cumulative impacts 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 land surrounding the proposed Bullard Wash SEZ is undeveloped, with few permanent residents living in the area. The nearest population center is the small community of Aguila (population 1,064 in 2000), located about 10 mi (16 km) south of the SEZ. The town of Wickenburg (population 5,082 in 2000) is located about 25 mi (40 km) east of the SEZ. About 14 WAs are located within 50 mi (80 km) of the SEZ to the north, south, east and west. The Prescott National Forest is about 35 mi (56 km) northeast of the SEZ. The Bill Williams River National Wildlife Refuge is about 43 mi (69 km) west of the SEZ, and the Kofa National Wildlife Refuge is about 50 mi (80 km) southwest of the SEZ. The Luke Air Force Auxiliary Field is about 43 mi (69 km) southeast of the SEZ. The Hualapai Reservation is about 50 mi (80 km) northwest of the SEZ, and the Yavapai Reservation is about 50 mi (80 km) northeast of the SEZ. In addition, the Bullard Wash SEZ is located about 45 mi (72 km) northeast of the Brenda SEZ. For some resources the geographic extent of effects of the two SEZs overlap.

The geographic extent of the cumulative impacts analysis for potentially affected resources near the proposed Bullard Wash SEZ is identified in Section 8.2.22.1. An overview of ongoing and reasonably foreseeable future actions is presented in Section 8.2.22.2. General trends in population growth, energy demand, water availability, and climate change are discussed in Section 8.2.22.3. Cumulative impacts for each resource area are discussed in Section 8.2.22.4.

8.2.22.1 Geographic Extent of the Cumulative Impacts Analysis

The geographic extent of the cumulative impacts analyses for potentially affected resources evaluated near the proposed Bullard Wash SEZ is provided in Table 8.2.22.1-1. The extent of these geographic areas, which define the boundaries encompassing potentially affected resources, may vary based on 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.) The BLM and the USFS administer most of the land around the SEZ. The BLM administers 48% of the lands within a 50-mi (80-km) radius of the SEZ.

TABLE 8.2.22.1-1 Geographic Extent of the Cumulative Impacts Analysis by Resource Area: Proposed Bullard Wash SEZ

Resource Area	Geographic Extent
Land Use	Yavapai, Maricopa, La Paz, and Mohave Counties
Specially Designated Areas and Lands with Wilderness Characteristics	Within a 25-mi (40-km) radius of the Bullard Wash SEZ
Rangeland Resources	
Grazing	Grazing allotments within 5 mi (8 km) of the Bullard Wash SEZ
Wild Horses and Burros	A 50-mi (80-km) radius from the center of the Bullard Wash SEZ
Recreation	Yavapai, Maricopa, La Paz, and Mohave Counties
Military and Civilian Aviation	Yavapai, Maricopa, La Paz, and Mohave Counties
Soil Resources	Areas within and adjacent to the Bullard Wash SEZ
Minerals	Yavapai, Maricopa, La Paz, and Mohave Counties
Water Resources	
Surface Water	Bullard Wash, Date Creek, Santa Maria River, Bill Williams River, Lake Alamo
Groundwater	Date Creek basin portion of the Bill Williams groundwater basin
Air Quality and Climate	A 31-mi (50-km) radius from the center of the Bullard Wash SEZ
Vegetation, Wildlife and Aquatic Biota, Special Status Species	A 50-mi (80-km) radius from the center of the Bullard Wash SEZ, including portions of Yavapai, Maricopa, La Paz, and Mohave Counties
Visual Resources	Viewshed within a 25-mi (40-km) radius of the Bullard Wash SEZ
Acoustic Environment (noise)	Areas adjacent to the Bullard Wash SEZ
Paleontological Resources	Areas within and adjacent to the Bullard Wash SEZ
Cultural Resources	Areas within and adjacent to the Bullard Wash SEZ for archaeological sites; viewshed within a 25-mi (40-km) radius of the SEZ for other properties, such as traditional cultural properties
Native American Concerns	Areas within and adjacent to the Bullard Wash SEZ; viewshed within a 25-mi (40-km) radius of the Bullard Wash SEZ
Socioeconomics	A 50-mi (80-km) radius from the center of the Bullard Wash SEZ
Environmental Justice	A 50-mi (80-km) radius from the center of the Bullard Wash SEZ
Transportation	U.S. Interstate Highway 10; U.S. Highways 60and 93; State Routes 71 and 89.

8.2.22.2 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 are as follows:

- 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 legislations 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 were not included in the cumulative impact 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 foreseeable and potential solar energy projects within 50 mi (80 km) of the proposed SEZ (Section 8.2.22.2.1); and (2) other ongoing and reasonably foreseeable actions within this distance, including those related to mining and mineral processing, grazing management, transportation, recreation, water management, and conservation (Section 8.2.22.2.2). Together, these actions and trends have the potential to affect human and environmental receptors within the geographic range of potential impacts over the next 20 years.

8.2.22.2.1 Energy Production and Distribution

In November 2006, the Arizona Corporation Commission adopted final rules to expand the state's Renewable Energy Standard to 15% by 2025, with 30% of the renewable energy to be derived from distributed energy (DOE 2010).

No fast-track solar energy projects and no foreseeable wind or geothermal projects have been identified for areas within 50 mi (80 km) of the proposed Bullard Wash SEZ (Table 8.2.22.2-1). Other potential future actions related to renewable energy production and energy distribution are described in the following paragraphs.

Renewable Energy Development

Renewable energy ROW applications are considered in two categories: fast-track and regular-track applications. Fast-track applications, which apply principally to solar energy

TABLE 8.2.22.2-1 Reasonably Foreseeable Future Actions Related to Energy Development and Distribution near the Proposed Bullard Wash SEZ[a]

Description	Status	Resources Affected	Primary Impact Location
Fast-Track Solar Energy Projects on BLM-Administered Land			
None	NA[a]	NA	NA
Transmission and Distribution Systems			
None	NA	NA	NA

[a] NA = not applicable because no projects have been identified.

facilities, are those applications on public lands for which the environmental review and public participation process is underway and the applications could be approved by December 2010. A fast-track project would be considered foreseeable because the permitting and environmental review processes would be under way. There are no solar fast-track project applications within 50 mi (80 km) of the proposed Bullard Wash SEZ. Regular-track proposals are considered potential future projects but not necessarily foreseeable projects, since not all applications would be expected to be carried to completion. These proposals are discussed in the following section.

Pending Solar Applications on BLM-Administered Lands. Several regular-track ROW applications for solar projects that have been submitted to the BLM would be located within 50 mi (80 km) of the SEZ. Table 8.2.22.2-2 lists the 17 solar projects that had pending applications submitted to BLM as of March 2010 (BLM and USFS 2010b). The locations of these projects are shown in Figure 8.2.22.2-1.There are no pending wind or geothermal ROW applications within this distance.

The likelihood of any of the regular-track application projects actually being developed is uncertain but is generally assumed to be less than that for fast-track applications. The projects are all listed in Table 8.2.22.2-2 for completeness and as an indication of the level of interest in development of solar energy in the region. Some number of these applications would be expected to result in actual projects. Thus, the cumulative impacts of these potential projects are analyzed for their aggregate effects.

8.2.22.2.2 Other Actions

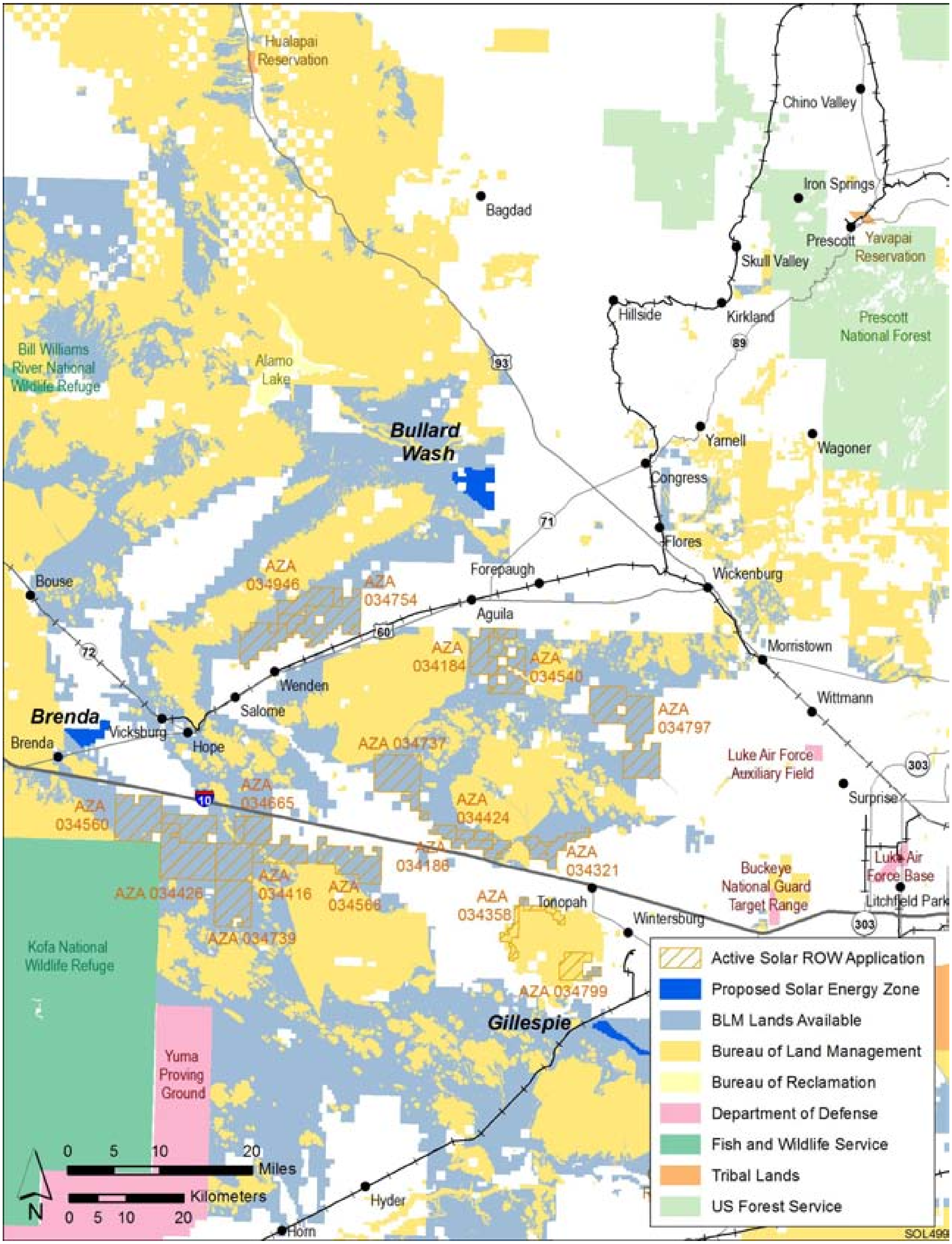
Other major ongoing actions identified within 50 mi (80 km) of the proposed Bullard Wash SEZ are listed in Table 8.2.22.2-3 and are described in the following paragraphs. No other major foreseeable actions have been identified within this distance.

TABLE 8.2.22.2-2 Pending Renewable Energy Project ROW Applications on BLM-Administered Land within 50 mi (80 km) of the Proposed Bullard Wash SEZ[a]

Serial No.	Project Name	Application Received	Size (acres[b])	MW	Technology	Status (NOI date)	Field Office
Solar Applications							
AZA 034184	Boulevard Assoc., LLC (Aguila)	June 26, 2007	7,375	500	CSP/trough	Pending	Hassayampa
AZA 034186	Boulevard Assoc., LLC (Big Horn)	June 26, 2007	6,232	500	CSP/trough	Pending	Hassayampa
AZA 034321	AUSRA AZ II, LLC (Palo Verde)	Oct. 1, 2007	5,748	840	CSP/CLFR	Pending	Hassayampa
AZA 034358	First Solar (Saddle Mtn.)	Nov. 6, 2007	5,997	300	PV	Pending	Lower Sonoran
AZA 034416	Pacific Solar Invst., Inc. (Iberdrola) (Eagle Trail)	Dec. 2, 2007	19,000	1,500	CSP/trough	Pending	Yuma
AZA 034424	Pacific Solar Invst., Inc. (Iberdrola) (Big Horn)	Dec. 4, 2007	13,440	900	CSP	Pending	Hassayampa
AZA 034426	Pacific Solar Invst., Inc. (Iberdrola) (Ranegras)	Dec. 2, 2007	25,860	2,000	CSP/trough	Pending	Yuma
AZA 034540	Horizon Wind Energy, LLC (Aguila)	March 4, 2008	11,535	250	CSP/trough	Pending	Hassayampa
AZA 034560	Nextlight Renewable Power, LLC	March 26, 2008	15,040	500	CSP/trough	Pending	Yuma
AZA 034566	Nextlight Renewable Power, LLC	March 26, 2008	13,428	500	CSP/trough	Pending	Yuma
AZA 034665	Solarreserve, LLC (Black Rack Hill)	May 27, 2008	5,600	600	CSP/tower	Pending	Yuma
AZA 034737	Arizona Solar Invst., Inc. (Haraquahala)	July 10, 2008	14,047	500	CSP/trough	Pending	Hassayampa
AZA 034739	IDIT, Inc.	July 9, 2008	15,000	1,000	CSP/trough	Pending	Yuma
AZA 034754	Horizon Wind Energy, LLC	March 4, 2008	28,760	250	CSP/trough	Pending	Lake Havasu
AZA 034797	LSR Jackrabbit, LLC (Jackrabbit)	Aug. 27, 2008	27,036	500	CSP/tower	Pending	Hassayampa
AZA 034799	LSR Palo Verde, LLC (Palo Verde)	Aug. 27, 2008	5,855	600	CSP/trough	Pending	Lower Sonoran
AZA 034946	Wildcat Harcuvar South, LLC	Jan. 28, 2009	10,947	800	CSP/tower	Pending	Lake Havasu

[a] Total of 17 projects; solar acres = 230,900; total solar MW = 12,040.

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

1 

2 **FIGURE 8.2.22.2-1 Locations of Renewable Energy Project ROW Applications within a 50-mi**
3 **(80-km) Radius of the Proposed Bullard Wash SEZ**

TABLE 8.2.22.2-3 Other Major Actions near the Proposed Bullard Wash SEZ

Description	Status	Resources Affected	Primary Impact Location
Bagdad Mine	Operating since 1928	Groundwater, terrestrial habitat, wildlife, air quality, noise/vibration, cultural, visual	30 mi (48 km) north of the SEZ
Prescott Airport Solar Plant	Operating since 2005	Terrestrial habitat, visual	45 mi (72 km) northeast of the SEZ

Bagdad Mine

Freeport-McMoRan Copper and Gold, Inc., operates a copper mine with molybdenum by-products near Bagdad, Arizona, about 30 mi (48 km) north of the SEZ. The ore is processed in a concentrated leach processing facility. The first mill began operation in 1928 to process ore from an underground mine. Open-pit mining began in 1945. Employment at the facility was 797 at the end of 2009 (Freeport-McMoRan 2010).

Prescott Airport Solar Plant

The Arizona Public Service (APS) operates a solar plant near the Prescott Arizona Airport, about 45 mi (72 km) northeast of the SEZ. The facility, constructed by Sharp Solar Electricity, is a 3.5-MW photovoltaic plant utilizing solar concentrators. The modules are on a single-axis tracking system (Sharp 2008).

Grazing Allotments

Three grazing allotments overlap Bullard Wash SEZ: the Pipeline, Forepaugh, and Carco allotments. Within 50 mi (80 km) of the SEZ, most of the land is covered with grazing allotments with the exception of the land to the northeast.

Mining

The BLM GeoCommunicator database (BLM and USFS 2010a) shows several active mining claims on file with BLM. The highest density (over 200 claims) is located about 10 mi (16 km) northwest of Bullard Wash SEZ. The Bagdad copper mine, located 30 mi (48 km) north of the SEZ, is described above.

8.2.22.3 General Trends

8.2.22.3.1 Population Growth

All three counties in the ROI experienced growth in population over the period 2000 to 2008. The population in La Paz County grew at an annual rate of 0.2%, and both Maricopa and Yavapai Counties grew by 3.2%. The population of the ROI in 2008 was 4,193,198, having grown at an average annual rate of 3.2% since 2000. The growth rate for the state of Arizona as a whole was 3.0% (Section 8.2.19.1).

8.2.22.3.2 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 La Paz, Maricopa and Yavapai Counties between 2006 and 2016, an increase in energy demand is also expected. However, the Energy Information Administration (EIA) projects a decline in per-capita energy use through 2030, mainly because of the high cost of oil and improvements in energy efficiency 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; the fastest growth is 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).

8.2.22.3.3 Water Availability

As described in Section 8.2.9.2, the ADWR has estimated that there are between 10 million and 23 million ac-ft (12 billion to 28 billion m^3) of stored water available in the entire Bill Williams basin and 8 million ac-ft (9.9 billion m^3) in the region of the basin where the Bullard Wash SEZ is located (the Date Creek basin). Groundwater recharge has been estimated to be 32,000 ac-ft/yr (39.5 million m^3/yr) within the entire Bill Williams basin, and 10,000 ac-ft/yr (12.3 million m^3/yr) in the Date Creek basin, where the SEZ is located.

Data collected from 1974 to 2006 indicate that groundwater levels have fluctuated but generally increased since the late 1980s in the Date Creek subbasin because of decreased pumping in the basin (USGS 2010b).

In 2005, water withdrawals from surface waters and groundwater in Maricopa County were 1,577,316 ac-ft/yr (1.9 billion m^3/yr), 84% of which came from groundwater and 16% from surface water. The largest water use category was irrigation (81%), at 1,271,515 ac-ft/yr (1.56 billion m^3/yr). Between 2001 and 2005, 5,650 ac-ft/yr (7 million m^3/yr) of water was used in the Bill Williams basin, of which 91% came from groundwater and 9% from surface water. The primary use for groundwater in the basin is irrigation (80%), with smaller amounts used for public supply (12%), and for industrial purposes (6%). Surface water from the Bill Williams River is used primarily for municipal supply (ADWR 2010b).

8.2.22.3.4 Climate Change

A report on global climate change in the United States prepared by the U.S. Global Change Research Program (GCRP 2009) documents current temperature and precipitation conditions and historic trends. Excerpts of the conclusions from that report indicate the following for the Southwest region of the United States, which includes Arizona:

- Decreased precipitation, with a greater percentage of that precipitation coming from rain, will result in a greater likelihood of winter and spring flooding and decreased stream flow in the summer.

- Increased frequency and altered timing of flooding have occurred. For example, winter precipitation in Arizona is already becoming more variable, with a trend toward both more frequent extremely dry and extremely wet winters.

- The average temperature in the Southwest has already increased by about 1.5 F (0.8ºC) compared to a 1960 to 1979 baseline, and by the end of the century, the average annual temperature is projected to rise 4ºF to 10ºF (2ºC to 6ºC).

- A warming climate and the related reduction in spring snowpack and soil moisture have increased the length of the wildfire season and intensity of forest fires.

- Later snow and less snow coverage in ski resort areas could force ski areas to shut down before the season would otherwise end.

- Much of the Southwest has experienced drought conditions since 1999. This represents the most severe drought in the last 110 years. Projections indicate an increasing probability of drought in the region.

- As temperatures rise, the landscape will be altered as species shift their ranges northward and upward to cooler climates.

- Temperature increases, when combined with urban heat island effects for major cities such as Phoenix, present significant stress to health and electricity and water supplies.

- Increased minimum temperatures and warmer springs extend the range and lifetime of many pests that stress trees and crops, and lead to northward migration of weed species.

8.2.22.4 Cumulative Impacts on Resources

This section addresses potential cumulative impacts in the vicinity of the proposed Bullard Wash SEZ on the basis of the following assumptions: (1) because of the small size of the proposed SEZ (<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 5,791 acres (23.4 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. It is also assumed that 152 acres (0.62 km^2) would be disturbed to construct 5 mi (8 km) of new transmission line to reach an existing 500-kV line to connect to the regional grid. Regarding site access, the nearest major road is State Route 71, which is 5 mi (8 km) southeast of the SEZ. It is assumed that 5 mi (8 km) of new access road, disturbing and additional 36 acres (0.15 km^2), would need to be constructed from the SEZ to this road to support solar development in the SEZ.

Cumulative impacts that would result from the construction, operation, and decommissioning of solar energy development projects within the proposed SEZ when added to other past, present, and reasonably foreseeable future actions described in the previous section are discussed below for each resource area. At this stage of development, because of the uncertain nature of the future projects in terms of size, number, location within the proposed SEZ, 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.

8.2.22.4.1 Lands and Realty

The area covered by the proposed Bullard Wash SEZ is rural and undeveloped and is used primarily for grazing and some recreation. An existing gravel road from U.S. 93 passes less than 0.5 mi (0.8 km) north of the SEZ. There are no existing ROWs within the proposed SEZ and no ROW applications for solar facilities as of February 2010 (Section 8.2.2.1).

Development of the SEZ for utility-scale solar energy production would establish an isolated, industrial area that would exclude many existing and potential uses of the land, perhaps in perpetuity. Since the SEZ is rural and undeveloped, utility-scale solar energy development would be a new and dominant land use in the area. Access to such areas by both the general public and much wildlife would be eliminated.

As shown in Table 8.2.22.2-1, there are no fast-track solar applications or other firmly foreseeable renewable energy or energy distribution projects within a 50-mi (80-km) radius of the proposed Bullard Wash SEZ. However, as shown in Table 8.2.22.2-2 and Figure 8.2.22.2-1, there 17 pending solar applications, but no wind or geothermal applications, on public land within this distance. The large number of pending solar energy applications indicates strong interest in solar energy development in the region south of the SEZ. The proposed Brenda SEZ is located about 45 mi (72 km) southwest.

Other major ongoing actions within 50 mi (80 km) of the proposed SEZ (Section 8.2.22.2.2), mainly the Bagdad copper mine, would have minimal impacts on land use on or near the SEZ, as they are few in number and far away.

The development of utility-scale solar projects in the proposed Bullard Wash SEZ in combination with other ongoing, foreseeable and potential actions within the geographic extent of effects, nominally 50 mi (80 km), could have small cumulative effects on land use in the vicinity of the proposed SEZ through impacts on land access and use for other purposes, groundwater availability, and on visual resources, especially if the SEZ is fully developed with solar projects. Cumulative impacts would depend mainly on the number of pending solar applications in the region that result in actual developments. However, projects within the SEZ would make only a small contribution to cumulative impacts due to its relatively small size.

8.2.22.4.2 Specially Designated Areas and Lands with Wilderness Characteristics

Thirteen specially designated areas are located within 25 mi (40 km) of the proposed Bullard Wash SEZ that potentially could be affected by solar energy development within the SEZ. All but one of these areas is more than 5 mi (8 km) from the SEZ (Section 8.2.3.1). Potential exists for cumulative visual impacts on these areas from the construction of utility-scale solar energy facilities within the SEZ and outside the SEZ within the geographic extent of effects and from the construction of transmission lines and roads outside the SEZ. The exact nature of cumulative visual impacts on the users of these areas would depend on the specific solar technologies employed and the locations of solar facilities, transmission lines, and roads actually built within and outside the SEZ. About five pending solar applications lie within 25 mi (40 km) of the proposed SEZ, all to the south (Figure 8.2.22.2-1). Some of these projects, if built, could affect some of the same sensitive areas as facilities built within the SEZ. Such effects could include visual impacts, impacts on wilderness values, reduced accessibility, and ecological effects.

8.2.22.4.3 Rangeland Resources

The proposed Bullard Wash SEZ contains small portions of three perennial grazing allotments (Section 8.2.4.1.1). If utility-scale solar facilities are constructed on the SEZ, those areas occupied by the solar projects would be excluded from grazing. The development of other potential solar energy projects within 50 mi (80 km) of the SEZ could result in cumulative impacts on grazing due to the number and relative proximity of several of the potential projects to the proposed SEZ. However, the contribution of such effects from projects within the SEZ would be minimal due to the small area affected.

Portions of four BLM HMAs and HAs occur within the 50 mi (80 km) of the proposed Bullard Wash SEZ (Section 8.2.4.2.1), but none occurs in the proposed SEZ or within the 5-mi (8-km) area of indirect effects. Thus, solar developments in the SEZ would not contribute to cumulative effects on wild horses and burros.

8.2.22.4.4 Recreation

Low levels of backcountry driving, OHV use, hunting, photography, and rockhounding are the most likely recreational uses of the area of the proposed SEZ (Section 8.2.5.1). While there are no current solar applications within the proposed SEZ, construction of utility-scale solar projects on the SEZ would preclude recreational use of the affected lands for the duration of the projects. Road closures and access restrictions within any developed portions of the proposed SEZ would affect OHV use in particular if inventoried routes are affected. However, such effects are expected to be small due to low current use. Potential future actions, mainly pending solar applications, would also affect areas of low recreational use and would have similar minimal effects on current recreational activities individually. However, small cumulative impacts on recreation within the geographic extent of effects might be possible from the aggregate presence of several new solar facilities within the area if a large number of projects with pending applications are ultimately built.

8.2.22.4.5 Military and Civilian Aviation

The entire SEZ is covered by two MTRs with 300-ft (91-m) above-ground-level operating limits, and the SEZ is located 57 mi (92 km) northwest of Luke Air Force Base (Section 8.2.6.1). The military has indicated that construction of solar or transmission facilities in excess of 250 ft (76 m) tall could adversely affect both MTRs (Section 8.2.6.2). Potential new solar facilities and associated new transmission lines outside the SEZ could present additional potential concerns for military aviation, depending on the eventual location of such facilities with respect to training routes, and thus, could result in cumulative impacts on military aviation.

The closest civilian airport, Wickenburg Municipal Airport is 25 mi (40 km) southeast and thus is too far away to be affected by developments in the SEZ.

8.2.22.4.6 Soil Resources

Ground-disturbing activities (e.g., grading, excavating, and drilling) during the construction phase of a solar project, including the construction of any associated transmission line connections and new roads, would contribute to soil loss due to wind erosion. Road use during construction, operations, and decommissioning of the solar facilities would further contribute to soil loss. Programmatic design features would be employed to minimize erosion and loss. Residual soil losses with these mitigation measures in place would be in addition to losses from construction of other potential solar energy facilities and other ongoing activities, including OHV use. Cumulative impacts on soil resources from other foreseeable projects within the geographic extent of effects are possible. Potential new solar facilities outside the SEZ would contribute incremental impacts on soil erosion, the extent of which would depend on the number and location of facilities actually built. Cumulative impacts, including from any development in the SEZ, would be small with required design features in place.

Landscaping of solar energy facility areas in the SEZ could alter drainage patterns and lead to increased siltation of surface water streambeds, in addition to that from other potential solar developments and other activities outside the SEZ. However, with the required design features in place, cumulative impacts likewise would be small.

8.2.22.4.7 Minerals (Fluids, Solids, and Geothermal Resources)

As discussed in Section 8.2.8, there are currently no active oil and gas leases within the proposed Bullard Wash SEZ, and no mining claims or proposals for geothermal energy development are pending. Because of the generally low level of mineral production in the proposed SEZ and surrounding area and the expected low impact on mineral accessibility of other foreseeable actions within the geographic extent of effects, no cumulative impacts on mineral resources are expected.

8.2.22.4.8 Water Resources

Section 8.2.9.2 describes the water requirements for various solar technologies if they were to be employed on the proposed SEZ to develop utility-scale solar energy facilities. The amount of water needed during the peak construction year for all evaluated solar technologies would be 1,228 to 1,816 ac-ft (1.5 million to 2.2 million m^3). During operations, with full development of the SEZ over 80% of its available land area, the amount of water needed for all evaluated solar technologies would range from 33 to 17,390 ac-ft/yr (41,000 to 21 million m^3/yr). The amount of water needed during decommissioning would be similar to or less than the amount used during construction.

As discussed in Section 8.2.22.3.3, water withdrawals in 2005 in Maricopa County were 1.6 million ac-ft/yr (1.9 billion m^3/yr), 84% of which came from groundwater and 16% from surface water. The largest water use category was irrigation at 81%. Therefore, cumulatively the additional water resources needed for solar facilities in the SEZ during operations would constitute from a relatively very small (0.002%) to a small (1.1%) increment in the county (the ratio of the annual operations water requirement to the annual amount withdrawn in Maricopa County), depending on the solar technology used (PV technology at the low end and the wet-cooled parabolic trough technology at the high end). More locally, between 2001 and 2005, water use in the Bill Williams basin was 5,650 ac-ft/yr (7 million m^3/yr); of which 91% came from groundwater and 9% from surface water (Section 8.2.9.1.3). Current groundwater use is below estimates of natural recharge of 32,000 ac-ft/yr (39 million m^3/yr) for the entire Bill Williams basin. For the portion of the basin that contains the proposed Bullard Wash SEZ (the Date Creek basin), the estimated recharge rate is 10,000 ac-ft/yr (12 million m^3/yr). Thus, solar developments on the SEZ alone would have the capacity to exceed local basin recharge using wet-cooling, while full development with dry-cooled solar trough technologies could require 18% of estimated annual recharge beneath the SEZ (Section 8.2.9.2.2).

Solar development of the proposed SEZ with water-intensive technologies might be judged infeasible because of concerns regarding groundwater supplies. Intensive groundwater withdrawals could lower the water table, decrease the volume of stored water, change the direction of groundwater flow, and produce land subsidence (Section 8.2.9.2). Cumulative impacts on groundwater could occur when combined with other future developments in the region. It would be expected that some number of the 17 pending solar applications within 50 mi (80 km) of the proposed SEZ (Section 8.2.22.2.1) will ultimately be built, and that some of these projects could contribute to cumulative effects on groundwater supplies in the Bill Williams basin, as well as on surface ecological habitats from soil erosion, sedimentation, and drainage effects from such large facilities.

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 (11,000 to 91,000 m^3) during the peak construction year and would range from 0.7 to 16 ac-ft/yr (up to 20,000 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-cooling systems, there would also be from 183 to 329 ac-ft/yr (226,000 to 406,000 m^3/yr) of blowdown water from cooling towers. Blowdown water would need either to be treated on-site or sent to an off-site facility. Any on-site treatment of wastewater would have to ensure that treatment ponds are effectively lined in order to prevent any groundwater contamination. Thus, blowdown water would not contribute to cumulative effects on treatment systems or on groundwater.

8.2.22.4.9 Vegetation

The proposed Bullard Wash SEZ is located within the Sonoran Basin and Range ecoregion, which supports creosotebush-bur sage plant communities with large areas of palo verde-cactus shrub and saguaro cactus communities. Lands within the SEZ are classified primarily as Sonora–Mojave Creosotebush–White Bursage Desert Scrub. Sensitive habitats on the SEZ include desert dry washes, dry wash woodlands, and desert riparian mesquite bosque, which is dependent on accessible groundwater. Three small mapped wetlands occur in the SEZ. In the 5-mi (8-km) area of indirect effects, the predominant cover types are Sonora–Mojave Creosotebush–White Bursage Desert Scrub and Sonoran Paloverde-Mixed Cacti Desert Scrub. Thirty-five wetlands are mapped in the indirect impact area (Section 8.2.10.1). 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. Full development of the SEZ over 80% of its area would result in small impacts on all cover types (Section 8.2.10.2.1). Intermittently flooded areas downgradient from solar projects or access road could be affected by ground-disturbing activities. Alteration of surface drainage patterns or hydrology could adversely affect downstream dry wash communities, including dry-wash woodlands habitat. In addition, mesquite bosque communities that depend on accessible groundwater could be impacted by lowered groundwater levels if solar projects were to draw heavily on this resource.

The fugitive dust generated during construction of solar facilities could increase the dust loading in habitats outside a solar project area, in combination with that from other construction, mining, agriculture, recreation, and transportation. The cumulative dust loading 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. Implementation of programmatic design features would reduce the impacts from solar energy projects and thus the overall cumulative impacts on plant communities and habitats.

While most of the cover types within the SEZ affected area are relatively common in the region, a number of species present represent less than 1% of land area within the region, including: North American Warm Desert Riparian Mesquite Bosque (0.09%), Barren Lands, Non-specific (0.1%), and North American Warm Desert Riparian Woodland and Shrubland (0.1%) (Section 8.2.10.2.1). Thus, other ongoing and reasonably foreseeable future actions could have a cumulative effect on these and other rare cover types, as well as on more abundant species. Such effects would likely be small for foreseeable development due to the abundance of the primary species and the absence of major foreseeable actions within the 50-mi (80-km) geographic extent of effects. However, given the large number of pending solar applications within this area and the large acreages potentially disturbed (Section 8.2.22.2.1), depending on where any eventual projects are located, cumulative effects on some rare cover types are possible. In addition, cumulative effects on wetland species could occur from water use, drainage modifications, and stream sedimentation from these and any other potential future developments in the region. The magnitude of such effects is difficult to predict at this time.

8.2.22.4.10 Wildlife and Aquatic Biota

Wildlife species that could potentially be affected by the development of utility-scale solar energy facilities in the proposed Bullard Wash SEZ include amphibians, reptiles, birds, and mammals. The construction of utility-scale solar energy projects in the SEZ and any associated transmission lines and roads in or near the SEZ would have an impact on wildlife through habitat disturbance (i.e., habitat reduction, fragmentation, and alteration), wildlife disturbance, loss of connectivity between natural areas, and wildlife injury or mortality. In general, species with broad distributions and a variety of habitats would be less affected than species with a narrowly defined habitat within a restricted area. The required 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.

As noted in Section 8.2.22.2, while no major foreseeable actions have been identified within 50 mi (80 km) of the proposed SEZ, 17 pending solar applications are within this distance (Figure 8.2.22.2-1). Impacts from full build-out over 80% of the proposed SEZ would result in small impacts on wildlife species (Section 8.2.11), while impacts from potential development within the 50-mi (80-km) geographic extent of effects would depend on the number of facilities actually built. Many of the wildlife species present within the proposed SEZ that could be affected by other actions have extensive available habitat within the region, while no foreseeable solar or other major projects have been identified within the geographic extent of effects. However, cumulative effects could accrue on some species from some number of the 17 pending solar applications in the region given the large acreages potentially disturbed.

No surface waterbodies or perennial streams are within the proposed Bullard Wash SEZ or within the 5-mi (8-km) area of indirect effects. Several ephemeral streams, including Bullard Wash, and a number of small mapped wetlands are within the SEZ and in the area of indirect effects. However, these areas are expected to be dry except after rainfall and are not expected to support aquatic habitat, with the possible exception of Date Creek, an intermittent stream located north of the SEZ in the area of indirect effects (Section 8.2.11.4.1). Thus, no standing aquatic communities are likely to be present in the proposed SEZ. Aquatic communities do exist within the 50-mi (80-km) geographic extent of effects, including in Alamo Lake, about 18 mi (39 km) northwest of the SEZ (Section 8.2.11.2). However, these habitats are too far away to be affected by solar developments in the SEZ assuming required design features are implemented, and there no pending solar applications north of the proposed SEZ in the direction of these habitats. Thus, there would be no cumulative impacts on aquatic biota and habitats resulting from groundwater drawdown or soil transport to surface streams from solar facilities within the geographic extent of effects.

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

On the basis of recorded occurrences or presence of suitable habitat, as many as 39 special status species could occur within the Bullard Wash SEZ. Eight of these species are known or are likely to occur within the affected area of the SEZ (including the SEZ, the 5-mi [8-km] area of indirect effects, and road and transmission ROWs): desert pupfish, Gila topminnow, lowland leopard frog, Sonoran desert tortoise, Gila monster, Mojave shovel-nosed snake, California leaf-nosed bat, and cave myotis. Section 8.2.12.1 discusses the nature of the special status listing of these eight species. Numerous additional species that may occur on or in the vicinity of the SEZ are listed as threatened or endangered by the State of Arizona or are listed as a sensitive species by the BLM (Section 8.2.12.1). Design features to be used to reduce or eliminate the potential for effects on these species from the construction and operation of utility-scale solar energy projects in the SEZs and related developments (e.g., access roads and transmission line connections) outside the SEZ include avoidance of habitat and minimization of erosion, sedimentation, and dust deposition. Ongoing effects on special status species include those from roads, transmission lines, and recreational activities in the area. While no major foreseeable developments have been identified within the 50-mi (80-km) geographic extent of effects, 17 pending applications for solar projects lie within that area and cover areas much larger than the proposed SEZ. Cumulative impacts on protected species are expected to be relatively low, but could rise if a large number of the pending solar applications are actually built, as applications tend to lie in areas with topography and habitat similar to that in the SEZ. Actual impacts would further depend on the location, and cooling technologies of projects that are built. Projects would employ mitigation measures to limit effects.

8.2.22.4.12 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 nearby projects outside the proposed Bullard Wash SEZ 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 $\mu g/m^3$. Dust generation by construction activities can be controlled by implementing aggressive dust control measures, such as increased watering frequency or road paving or treatment.

Because the area proposed for the SEZ is rural and undeveloped land, there are no significant industrial sources of air emissions in the area. The only type of air pollutant of concern is dust generated by winds. While there are a number of potential solar projects that could produce fugitive dust emissions within the geographic extent of effects, few such projects are likely to overlap in both time and affected area with any projects within the SEZ. Thus, cumulative air quality effects due to dust emissions during any overlapping construction periods would be small.

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 by use of coal, oil, and natural gas. As discussed in Section 8.2.13.2.2, air emissions from operating solar energy facilities are relatively minor, while the displacement of criteria air pollutants, VOCs, TAPs, and GHG emissions currently produced from fossil fuels could be significant. For small SEZs, such offsets are fairly modest. For example, if the Bullard Wash SEZ was fully developed (80% of its acreage) with solar facilities, the quantity of pollutants avoided could be up to 2.9% of all emissions from the current electric power systems in Arizona.

8.2.22.4.13 Visual Resources

The proposed Bullard Wash SEZ lies within the flat plain of a valley floor bounded by mountain ranges to the north and southwest, with open views to the east and northwest and is fairly well vegetated (Section 8.2.14.1). The area is sparsely inhabited, remote, and rural in character. Existing cultural modifications detract very slightly from the scenic quality of the SEZ. Construction of utility-scale solar facilities on the SEZ and associated transmission lines outside the SEZ would significantly alter the natural scenic quality of the area. Other potential solar projects and related roads and transmission lines outside the proposed SEZ would cumulatively affect the visual resources in the area.

There are currently no identified major foreseeable actions in the area, but there are 17 pending solar applications within 50 mi (80 km) of the SEZ (Figure 8.2.22.2-1). While the contribution to cumulative impacts in the area of potential projects would depend on the locations of facilities that are actually built, it may be concluded that the general visual character of the landscape within the region could be significantly altered by the presence of solar facilities, transmission lines, and other new infrastructure. Because of the topography of the region, such developments, located in basin flats, would be visible at great distances from surrounding mountains, which include sensitive viewsheds. Given the proximity of several of the pending solar applications to the proposed SEZ and to each other, it is possible that two or more facilities would be viewable from a single location. In addition, facilities would be located near major roads and thus would be viewable by motorists, who would also be viewing transmission lines, towns, and other infrastructure, as well as the road system itself.

As additional facilities are added, several projects might become visible from one location, or in succession, as viewers move through the landscape, such as by driving on local roads. In general, the new developments would be expected to 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. Considering the above and the large number of pending solar applications in the region, moderate cumulative visual impacts could occur within the geographic extent of effects from future solar and other existing and future developments.

8.2.22.4.14 Acoustic Environment

The areas around the proposed Bullard Wash SEZ are relatively quiet. The existing noise sources include road traffic, railroad traffic, private/commercial/military aircraft flyover, and cattle grazing. The construction of solar energy facilities could increase the noise levels periodically for up to 3 years per facility, but there would be little or no noise during operation of solar facilities, except from solar dish engine facilities and from parabolic trough or power tower facilities using TES.

Other ongoing and reasonably foreseeable and potential future activities in the general vicinity of the SEZs are described in Section 8.2.22.2. Because proposed projects and nearest residents are relatively far from the SEZ with respect to noise impacts, and because the area is sparsely populated, cumulative noise effects during the construction or operation of solar facilities are unlikely.

8.2.22.4.15 Paleontological Resources

The proposed Bullard Wash SEZ has unknown potential for the occurrence of significant fossil material over its entire extent and would require further investigation prior to project approval (Section 8.2.16.1). Any paleontological resources encountered during a paleontological survey would be mitigated to the extent possible. Cumulative impacts on paleontological resources would be dependent on whether significant resources are found within the SEZ and in additional project areas in the region.

8.2.22.4.16 Cultural Resources

No surveys have been conducted within the boundaries of the proposed Bullard Wash SEZ, but some sites have been recorded within 5 mi (8 km) of the SEZ (Section 8.2.17.1.5). The proposed SEZ has potential for containing both prehistoric sites and historic sites (Section 8.2.17.2). It is possible, but unlikely, that the development of utility-scale solar energy projects in the SEZ, when added to other potential projects likely to occur in the area, could contribute cumulatively to cultural resource impacts occurring in the region. The amount of foreseeable development is low within the 25-mi (40-km) geographic extent of effects; however, several potential solar developments with pending applications lie within this distance (Section 8.2.22.2). While any future solar projects would disturb large areas, the specific sites selected for future projects would be surveyed; historic properties encountered would be avoided or mitigated to the extent possible. Through ongoing consultation with the Arizona SHPO and appropriate Native American governments, it is likely that most adverse effects on significant resources in the region could be mitigated to some degree. While avoidance of all NRHP-eligible sites and mitigation of all impacts may not be possible, it is unlikely that any sites recorded in the SEZ would be of such individual significance that development would cumulatively cause an irretrievable loss of information about a significant resource type, but this would depend on the results of the future surveys and evaluations.

8.2.22.4.17 Native American Concerns

Government-to-government consultation is underway with federally recognized Native American Tribes, including several Yavapai tribes, with possible traditional ties to the Bullard Wash area. All such Tribes have been contacted and provided an opportunity to comment or consult regarding this PEIS. To date, no specific concerns have been raised to the BLM regarding the proposed Bullard Wash SEZ. However, the Quechan Indian Tribe of Fort Yuma has expressed concerns for landscapes as a whole, and specifically with respect to the intrusion of industrial development on cultural landscapes and traditional trails. In addition, impacts on game and wild plant resources have been a concern of the Yavapai in the past. Potential impacts on existing water supplies, ecological fragmentation, and land disturbance are also of concern to tribes (Section 8.2.18). The development of solar energy facilities in combination with the development of other planned and foreseeable projects in the area would likely reduce the traditionally important plant and animal resources available to the Tribes. Such effects would likely be small for foreseeable development due to the abundance of the most culturally important plant species and the relatively small number of foreseeable actions within the geographic extent of effects. Continued discussions with the area Tribes through government-to-government consultation is necessary to effectively consider and address the Tribes' concern tied to solar energy development in the Bullard Wash SEZ.

8.2.22.4.18 Socioeconomics

Solar energy development projects in the proposed Bullard Wash 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 developments in the area, including other renewable energy developments. The number of workers involved in the construction of solar projects in the peak construction year (including the transmission lines) could range from about 130 to 1,700, 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 about 480 (solar PV) to as high as 5,500 (solar trough). 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 occasionally would occur within a 50-mi (80-km) radius of the SEZ over the 20-year or more 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 developments in the area, including from some number of the 17 pending solar applications within 50 mi (80 km) of the proposed SEZ. The number of workers needed at the solar facilities in the SEZ would be in the range of 13 to 250, with about 18 to 410 total jobs created in the region, assuming full build-out of the SEZ (Section 8.2.19.2.2). Population increases would contribute to general upward growth 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.

8.2.22.4.19 Environmental Justice

Any impacts from solar development could have cumulative impacts on minority and low-income populations within 50 mi (80 km) of the proposed SEZ in combination with other development in the area. Such impacts could be both positive, such as from increased economic activity, and negative, such as from visual impacts, noise, and exposure to fugitive dust (Section 8.2.20.2). Actual impacts would depend on where low-income populations are located relative to solar and other proposed facilities and on the geographic range of effects. Overall, effects from facilities within the SEZ are expected to be small, while other foreseeable and potential actions would not likely combine with negative effects from the SEZ on minority or low-income populations, with the possible exception of visual impacts from solar development in the region. Thus, it is not expected that the proposed Bullard Wash SEZ would contribute to cumulative impacts on minority and low-income populations.

8.2.22.4.20 Transportation

State Route 71 is 5 mi (8 km) southeast and U.S. 93 is 5.5 mi (9 km) northeast of the proposed Bullard Wash SEZ. The nearest public airport is the Wickenburg Municipal Airport, 22 mi (35 km) southeast of the SEZ. The closest rail stop is in Congress, about 16 mi (26 km) east of the SEZ. During construction of utility-scale solar energy facilities, there could be up to 1,000 workers commuting to the construction site at the SEZ, which could increase the AADT on these roads by 2,000 vehicle trips for each facility under construction. Traffic on State Route 71 could more than triple, while U.S. 93 could experience minor slowdowns near the SEZ (Section 8.2.21.2). This increase in highway traffic from construction workers could likewise have small cumulative impacts in combination with existing traffic levels and increases from additional future developments in the area, including from construction of potential solar facilities in the region with pending applications, should construction schedules overlap. Local road improvements may be necessary on portions of U.S. 93 near the existing gravel road access. Any impacts during construction activities would be temporary. The impacts could also be mitigated to some degree by staggered work schedules and ride-sharing programs. Traffic increases during operation would be relatively small because of the low number of workers needed to operate the solar facilities and would have little contribution to cumulative impacts.

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8.2.23 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.

ADEQ (Arizona Department of Environmental Quality), 2009, *2009 Air Quality Annual Report*. Available at http://www.azdeq.gov/function/forms/download/2009_Annual_Report-AQD.pdf. Accessed July 24, 2010.

ADEQ, 2010, *Water Quality: Permits: Stormwater*. Available at http://www.azdeq.gov/environ/water/permits/stormwater.html. Accessed July 12, 2010.

ADOT (Arizona Department of Transportation), 2010a, *State Highway Traffic Log*, March. Available at http://www.azdot.gov/mpd/data/Reports/PDF/SHStrafficLog2006-2008ver2-Rounded.pdf. Accessed Aug. 5, 2010.

ADOT, 2010b, *Average Annual Daily Traffic (AADT) AADT Reports (Traffic Counts), Current AADTs, 2006 to 2008*, Multimodal Planning Division. Available at http://mpd.azdot.gov/mpd/data/aadt.asp. Accessed July 16, 2010.

ADWR (Arizona Department of Water Resources), 1999, *Section III: Future Conditions and Directions,* Third Management Plan for Phoenix Active Management Area 2000–2010, December 1999.

ADWR, 2010a, *Arizona Water Atlas*. Available at http://www.azwater.gov/AzDWR/StatewidePlanning/WaterAtlas/default.htm. Accessed July 8, 2010.

ADWR, 2010b, *Bill Williams Basin*. Available at http://www.azwater.gov/azdwr/StatewidePlanning/RuralPrograms/OutsideAMAs_PDFs_for_web/Upper_Colorado_River_Planning_Area/Bill_Williams_Basin.pdf. Accessed June 15, 2010.

ADWR, 2010c, *Overview of the Arizona Groundwater Management Code*. Available at http://www.azwater.gov/AzDWR/WaterManagement/documents/Groundwater_Code.pdf. Accessed Jun 21, 2010.

ADWR, 2010d, *A Practical Guide to Drilling a Well in Arizona*. Available at http://www.azwater.gov/AzDWR/WaterManagement/Wells/documents/wellguide.pdf. Accessed July 12, 2010.

ADWR, 2010e, *Water Management Requirements for Solar Power Plants in Arizona.* Available at http://www.azwater.gov/azdwr/WaterManagement/solar/documents/Solar_Regulation_Summary_FINAL.pdf. Accessed June 21, 2010.

ADWR, 2010f, *About ADWR,* Available at http://www.adwr.state.az.us/azdwr/PublicInformationOfficer/About_ADWR.htm. Accessed June 21, 2010.

ADWR, 2010g, *Active Management Areas (AMAs) & Irrigation Non-expansion Areas (INAs)*. Available at http://www.azwater.gov/AzDWR/WaterManagement/AMAs/. Accessed June 22, 2010.

ADWR, 2010h, *Colorado River Management*. Available at http://www.azwater.gov/AzDWR/StateWidePlanning/CRM/Overview.htm. Accessed July 21, 2010.

ADWR, 2010i, *Overview of the Arizona Groundwater Management Code*. Available at http://www.azwater.gov/AzDWR/WaterManagement/documents/Groundwater_Code.pdf. Accessed June 21, 2010.

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.

AGS (Arizona Geological Survey), 2010, *Locations of Mapped Earth Fissure Traces in Arizona, Digital Information 39 (DI-39), Version 6.22.09*. Available at http://www.azgs.az.gov/efresources.shtml. Accessed July 22, 2010.

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.

Anderson, T.W., 1995, *Summary of the Southwest Alluvial Basins, Regional Aquifer-system Analysis, South-central Arizona and Parts of Adjacent States*, U.S. Geological Survey Professional Paper 1406-A.

Anduze, R.A., et al., 2003, *Prehistory in West Prescott, Arizona*, SWCA Anthropological Research Paper Number 9.

ANHP (Arizona National Heritage Program), 2010, *Arizona's Natural Heritage Program: Heritage Data Management System (HDMS)*. Available at http://www.azgfd.gov/w_c/edits/species_concern.shtml. Accessed July 20, 2010.

Arizona Department of Commerce, 2010, *Arizona Population Projections*. Available at http://www.azcommerce.com/EconInfo/Demographics/Population+Projections.htm.

Arizona Field Ornithologists, 2010, *Field Checklist of the Birds of La Paz County*. Available at http://azfo.org/documents/LaPaz.pdf. Accessed July 25, 2010.

AZDA (Arizona Department of Agriculture), 2010, *Prohibited, Regulated, and Restricted Noxious Weeds,* Plant Services Division.

AZSITE, 2009, *AZSITE: Arizona's Cultural Resource Inventory*, data search run by Arizona State Museum, Dec. 11, 2009.

AZSITE, 2010, *AZSITE: Arizona's Cultural Resource Inventory*, data search run by Arizona State Museum, July 15, 2010.

Bailie, A. et al., 2005, *Final Arizona Greenhouse Gas Inventory and Reference Case Projections 1990–2020*, Arizona Department of Environmental Quality (ADEQ) and Center for Climate Strategies (CCS), June. Available at http://azmemory.lib.az.us/cdm4/item_viewer.php?CISOROOT=/statepubs&CISOPTR=2347&CISOBOX=1&REC=4. Accessed July 20, 2010.

Baker, L., and Bickauskas, T., 2010, personal communication from Baker and Bickauskas (Bureau of Land Management, Hassayampa Field Office, Phoenix, Ariz.) to J. May (Argonne National Laboratory, Denver, Colo.), July 29, 2010.

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.

Bean, L.J., et al., 1978, *Persistence and Power: A Study of Native American Peoples in the Sonoran Desert and the Devers-Palo Verde High Voltage Transmission Line*, prepared by Cultural Systems Research, Incorporated, Menlo Park, Calif., for the Southern California Edison Company.

Beranek, L.L., 1988, *Noise and Vibration Control*, rev. ed., Institute of Noise Control Engineering, Washington, D.C.

Bischoff, M.C., 2000, *The Desert Training Center/California–Arizona Maneuver Area, 1942–1944: Historic and Archaeological Contexts*, Technical Series 75, Statistical Research, Inc., Tucson, Ariz., prepared for the Bureau of Land Management, California Desert District.

Bisdorf, R.J., 1982, *Schlumberger Sounding Investigations in the Date Creek Basin, Arizona*, U.S. Geological Survey Open File Report 82-953.

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, 1993, *Kingman Resource Area Proposed Resource Management Plan and Final Environmental Impact Statement*, U.S. Department of the Interior, Kingman Resource Area, Ariz., 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, 2000, *Tres Alamos Wilderness Management Plan and Environmental Assessment*, U.S. Department of the Interior, Kingman Field Office, Ariz., Sept.

BLM, 2001, *Arizona Water Rights Fact Sheet*. Available at http://www.blm.gov/nstc/WaterLaws/arizona.html.

BLM, 2006, *Lake Havasu Field Office Proposed Resource Management Plan and Final Environmental Impact Statement*, Bureau of Land Management, Lake Havasu Field Office, Lake Havasu City, Ariz., Sept.

BLM, 2007a, *Lake Havasu Field Office Record of Decision and Approved Management Plan,* Lake Havasu City, Ariz., May. Available at http://www.blm.gov/az/st/en/info/nepa/environmental_library/arizona_resource_management/LHFO_ROD_07.html.

BLM, 2007b, *Potential Fossil Yield Classification (PFYC) System for Paleontological Resources on Public Lands*, Instruction Memorandum No. 2008-009, with attachments, Washington, D.C., Oct. 15.

BLM, 2008a, *Assessment and Mitigation of Potential Impacts to Paleontological Resources*, Instruction Memorandum No. 2009-011, with attachments, Washington, D.C., Oct. 10.

BLM, 2008b, *Agua Fria National Monument and Bradshaw-Harquahala Planning Area Proposed Resource Management Plans and Final Environmental Impact Statement,* Phoenix District Office, Phoenix, Ariz., June.

BLM, 2008c, *Special Status Species Management*, BLM Manual 6840, Release 6-125, U.S. Department of the Interior, Dec. 12.

BLM, 2009a, *Rangeland Administration System*. Available at http://www.blm.gov/ras/index.htm. Last updated Aug. 24, 2009. Accessed March 14, 2010.

BLM, 2009b, *Harcuvar Mountains Wilderness Management Plan and Environmental Assessment*, U.S. Department of the Interior, Lake Havasu Field Office, Ariz., March.

BLM, 2010a, *Sonoran Solar Energy Project: Draft Environmental Impact Statement*. Available at http://www.blm.gov/az/st/en/prog/energy/solar/sonoran_solar/maps/DEIS.html.

BLM, 2010b, *Bradshaw–Haquahala Record of Decision-Approved Resource Management Plan,* Hassayapa Field Office, Phoenix, April 22. Available at https://www.blm.gov/epl-front-office/eplanning/planAndProjectSite.do?methodName=dispatchToPatternPage&currentPageId=10422.

BLM, 2010c, *Wild Horse and Burro Statistics and Maps*, Washington, D.C. Available at http://www.blm.gov/wo/st/en/prog/wild_horse_and_burro/wh_b_information_center/statistics_and_maps/ha_and_hma_data.html. Accessed June 25, 2010.

BLM, 2010d, *Record of Decision and Approved Resource Management Plan*, Bradshaw–Harquahala Planning Area.

BLM, 2010e, *Visual Resource Inventory*, prepared for U.S. Department of the Interior Bureau of Land Management, Needles Field Office, Needles, Calif., Sept.

BLM, 2010f, *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 and USFS (U.S. Forest Service), 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.

BLM and USFS, 2010c, *GeoCommunicator: Public Land Survey System.* Available at http://www.geocommunicator.gov/ GeoComm/index.shtm. Accessed April 29, 2010.

Brennan, T.C., 2008, *Online Field Guide to the Reptiles and Amphibians of Arizona*. Available at http://www.reptilesofaz.org/index.html. Accessed July 16, 2010.

BTS (Bureau of Transportation Statistics), 2009, *Air Carriers: T-100 Domestic Segment (All Carriers)*, Research and Innovative Technology Administration, U.S. Department of Transportation, Dec. Available at http://www.transtats.bts.gov/Fields.asp?Table_ID=311. Accessed March 5, 2010.

CalPIF (California Partners in Flight), 2009, *The Desert Bird Conservation Plan: A Strategy for Protecting and Managing Desert Habitats and Associated Birds in California, Ver. 1.0*. Available at http://www.prbo.org/calpif/plans.html. Accessed March 3, 2010.

CAP (Central Arizona Project), 2010, *Central Arizona Project*. Available at http://www.cap-az.com/. Accessed July 15, 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.

CDFG (California Department of Fish and Game), 2008, *Life History Accounts and Range Maps—California Wildlife Habitat Relationships System*, Sacramento, Calif. Available at http://dfg.ca.gov/biogeodata/cwhr/cawildlife.aspx. Accessed Feb. 19, 2010.

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.

Chase, M.K., and G.R. Geupel, 2005, "The Use of Avian Focal Species for Conservation Planning in California," pp. 130–142 in *Bird Conservation Implementation and Integration in the Americas: Proceedings of the Third International Partners in Flight Conference*, March 20–24, 2002, Asilomar, Calif., Vol. 1, Gen. Tech. Rep. PSW-GTR-191, C.J. Ralph and T.D. Rich (editors), U.S. Department of Agriculture, Forest Service, Pacific Southwest Research Station, Albany, Calif.

City of Prescott, 2010, *Passengers—Book a Flight*. Available at http://www.cityofprescott.net/services/airport/flight.php. Accessed July 26, 2010.

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.

CSC (Coastal Services Center), 2010, *Historical Hurricane Tracks*, National Oceanic and Atmospheric Administration. Available at http//csc-s-maps-q.csc.noaa.gov/hurricanes/. Accessed July 20, 2010.

Desert Tortoise Council, 1994 (Revised 1999), *Guidelines for Handling Desert Tortoises during Construction Projects*, E.L. LaRue, Jr. (editor), Wrightwood, Calif.

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.

DOE, 2010, *DSIRE: Database of State Incentives for Renewables & Efficiency.* Available at http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=AZ03R&re=1&ee=1. Accessed July 14, 2010.

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.

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, 2002, *Primary Distinguishing Characteristics of Level III Ecoregions of the Continental United States, Draft*. Available at http://www.epa.gov/wed/ecoregions/us/useco_desc.doc. Accessed Oct. 2, 2008.

EPA, 2007, *Level III Ecoregions*, Western Ecology Division, Corvalis, Ore. Available at http://www.epa.gov/wed/pages/ecoregions/level_iii.htm. Accessed Oct. 2, 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, *Preferred/Recommended Models—AERMOD Modeling System.* Available at http://www.epa.gov/scram001/dispersion_prefrec.htm. Accessed Nov. 8, 2009.

EPA, 2009c, *eGRID.* Available at http://www.epa.gov/cleanenergy/energy-resources/egrid/index.html, last updated Oct. 16, 2008. Accessed Jan. 12, 2009.

EPA, 2009d, *National Primary Drinking Water Regulations and National Secondary Drinking Water Regulation*. Available at http://www.epa.gov/safewater/standard/index.html.

EPA, 2010a, *National Ambient Air Quality Standards (NAAQS)*. Available at http://www.epa.gov/air/criteria.html, last updated June 3, 2010. Accessed June 4, 2010.

EPA, 2010b, *AirData: Access to Air Pollution Data.* Available at http://www.epa.gov/oar/data/. Accessed July 20, 2010.

FAA (Federal Aviation Administration), 2010, *Airport Data (5010) & Contact Information, Information Current as of 06/03/2010*. Available at http://www.faa.gov/airports/airport_safety/airportdata_5010. Accessed July 19, 2010.

Farish, T.E., 1915, *History of Arizona,* Filmer Brothers Electrotype Company, San Francisco, Calif.

Fellows, L.D., 2000, "Volcanism in Arizona," *Arizona Geology* 30(4):1–4. Available at http://www.azgs.az.gov/hazards_volcanoes.shtml. Accessed July 22, 2010.

FEMA (Federal Emergency Management Agency), 2009, *FEMA Map Service Center*. Available at http://msc.fema.gov/webapp/wcs/stores/servlet/FemaWelcomeView?storeId=10001&catalogId=10001&langId=-1. Accessed Nov. 20, 2009.

Field, K.J., et al. 2007, "Return to the Wild: Translocation as a Tool in Conservation of the Desert Tortoise (*Gopherus agassizii*)," *Biological Conservation* 136: 232–245.

Fire Departments Network, 2009, *Fire Departments by State*. Available at http://www.firedepartments.net.

Freeport-McMoRan, 2010, *Freeport McMoRan Copper and Gold.* Available at http://www.fcx.com/operations/USA_Arizona_Bagdad.htm. Accessed July 28, 2010.

Freethy, G.W., and T.W. Anderson, 1986, *Predevelopment Hydrologic Conditions in the Alluvial Basins of Arizona and Adjacent Parts of California and New Mexico*, USGS Hydrologic Investigations Atlas HA-664.

Galloway, D., et al., 1999, *Land Subsidence in the United States*, U.S. Geological Survey Circular 1182.

GCRP (U.S. Global Change Research Program), 2009, *Global Climate Change Impacts in the United States: A State of Knowledge Report from the U.S. Global Change Research Program.* Cambridge University Press, Cambridge, Mass. Available at http://downloads.globalchange.gov/usimpacts/pdfs/climate-impacts-report.pdf. Accessed Jan. 25, 2010.

Giffen, R., 2009, "Rangeland Management Web Mail," personal communication from R. Giffen (USDA Forest Service, Rangelands Management, Washington, D.C.) to W. Vinikour (Argonne National Laboratory, Argonne, Ill.), Sept. 22.

Gifford, E.W., 1936, "The Northeastern and Western Yavapai," *University of California Publications in American Archaeology and Anthropology* 34:247–354, University of California Press, Berkeley.

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.

Hoffmeister, D.F., 1986, *Mammals of Arizona*, University of Arizona Press, Tucson, Ariz.

Holden, J., 2010, personal communication from Holden (Bureau of Land Management, Hassayampa Field Office, Phoenix, Ariz.) to J. May (Argonne National Laboratory, Lakewood, Colo.), July 29, 2010.

Jackson, M., Sr., 2009, "Quechan Indian Tribe's Comments on Programmatic Environmental Impact Statement for Solar Energy Development," letter from Jackson (President, Quechan Indian Tribe, Fort Yuma, Ariz.) to Argonne National Laboratory (Argonne, Ill.), Sept. 3.

Jeter, M.D., 1977, *Archaeology in Copper Basin, Yavapai County, Arizona: Model Building for the Prehistory of the Prescott Region.* Arizona State University, Anthropological Research Paper No. 11.

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.

Kessell, J.L., 2002, *Spain in the Southwest,* University of Oklahoma Press, Norman, Okla.

Khera, S., and P.S. Mariella, 1983, "Yavapai," pp. 38–54 in *Handbook of North American Indians, Vol. 10, Southwest*, A. Ortiz (editor), Smithsonian Institution, Washington D.C.

Lavelle, J., 2006, *Arizona Water Resources and Issues*, Border Governor's Conference-Water Table, May 8.

Lee, J.M., et al., 1996, *Electrical and Biological Effects of Transmission Lines: A Review*, Bonneville Power Administration, Portland, Ore., Dec.

Levick, L., et al., 2008, *The Ecological and Hydrological Significance of Ephemeral and Intermittent Streams in the Arid and Semi-arid American Southwest*. U.S. Environmental Protection Agency and USDA/ARS Southwest Watershed Research Center, EPA/600/R-08/134, ARS/233046.

Lovich, J., and D. Bainbridge, 1999, "Anthropogenic Degradation of the Southern California Desert Ecosystem and Prospects for Natural Recovery and Restoration," *Environmental Management* 24(3):309–326.

Lynch, D.J., 1982, "Volcanic Processes in Arizona," *Fieldnotes from the Arizona Bureau of Geology and Mineral Technology* 12(3):1–8. Available at http://www.azgs.az.gov/hazards_volcanoes.shtml. Accessed July 22, 2010.

Ludington, S. et al., 2007, *Preliminary Integrated Geologic Map Databases for the United States – Western States: California, Nevada, Arizona, Washington, Oregon, Idaho, and Utah*, U.S. Geological Survey Open File Report 2005-1305, Version 1.3, original file updated Dec. 2007. Available at http://pubs.usgs.gov/of/2005/1305/index.htm.

Manci, K.M., et al., 1988, *Effects of Aircraft Noise and Sonic Booms on Domestic Animals and Wildlife: A Literature Synthesis*, NERC-88/29, U.S. Fish and Wildlife Service National Ecology Research Center, Ft. Collins, Colo.

Mao, F., 2010, personal communication from F. Mao (Arizona Department of Environmental Quality, Phoenix, Ariz.) to Y.-S. Chang (Argonne National Laboratory, Argonne, Ill.), July 17.

Martin, P.S., and F. Plog, 1973, *The Archaeology of Arizona: A Study of the Southwest Region*, Doubleday/Natural History Press, Garden City, N.Y.

Matson, R.G., 1991, *The Origins of Southwest Agriculture*, University of Arizona Press, Tucson, Ariz.

McGuire, R., and M. Schiffer, 1982, *Hohokam and Patayan: Prehistory of Southwestern Arizona*, Academic Press, New York, N.Y.

MIG (Minnesota IMPLAN Group), Inc., 2010, *State Data Files*, Stillwater, Minn.

Miller, N.P., 2002, "Transportation Noise and Recreational Lands," in *Proceedings of Inter-Noise 2002*, Dearborn, Mich., Aug. 19–21. Available at http://www.hmmh.com/cmsdocuments/N011.pdf. Accessed Aug. 30, 2007.

Moose, V., 2009, "Comments on Solar Energy Development Programmatic EIS," letter from Moose (Tribal Chairperson, Big Pine Paiute Tribe of the Owens Valley, Big Pine, Calif.) to Argonne National Laboratory (Argonne, Ill.), Sept. 14.

Morgan, G.S., and R.S. White, Jr., 2005, "Miocene and Pliocene Vertebrates from Arizona," pp 114–135 in *Vertebrate Paleontology in Arizona*, Heckert, A.B., and S.G. Lucas (editors), New Mexico Museum of Natural History and Science Bulletin No. 29.

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 Academies Press, Washington, D.C.

NatureServe, 2010, *NatureServe Explorer: An Online Encyclopedia of Life*. Available at http://www.natureserve.org/explorer/. Accessed March 4, 2010.

NCDC (National Climatic Data Center), 2010a, *Climates of the States (CLIM60): Climate of Arizona*, National Oceanic and Atmospheric Administration, Satellite and Information Service. Available at http://cdo.ncdc.noaa.gov/cgi-bin/climatenormals/climatenormals.pl. Accessed July 10, 2010.

NCDC, 2010b, *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 July 20, 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.

Neusius, S.W., and G.T. Gross, 2007, "Mobility, Flexibility, and Persistence in the Great Basin," in *Seeking Our Past,* Oxford University Press, New York, N.Y.

Ninyo and Moore, 2007, *Geotechnical Evaluation – Bullard Wash Basins, McDowell Road Commercial Corridor, Goodyear, Arizona*, prepared for Wood/Patel and Associates, Inc., June 4.

NRCS (Natural Resources Conservation Service), 2008, *Soil Survey Geographic (SSURGO) Database for Maricopa County, Arizona*. Available at: http://SoilDataMart.nrcs.usds.gov.

NRCS, 2010, *Custom Soil Resource Report for Maricopa County* (covering the proposed Bullard Wash SEZ), Arizona, U.S. Department of Agriculture, Washington, D.C., Oct. 7.

NROSL (Northwest Regional Obsidian Sourcing Laboratory), 2009, *Nevada Obsidian Sources*. Available at http://www.obsidianlab.com/image_maps/map_obsidian_arizona.jpg.

Nussear, K.E., et al., 2009, *Modeling Habitat for the Desert Tortoise (Gopherus agassizii) in the Mojave and Parts of the Sonoran Deserts of California*, *Nevada, Utah, and Arizona,* U.S. Geological Survey Open-File Report 2009-1102.

Otton, J.K., and W.E. Brooks, Jr., 1978, "Tectonic History of the Colorado Plateau Margin, Date Creek Basin and Adjacent Areas, West-Central Arizona," pp. 31–33 in papers presented to the Conference on Plateau Uplift: Mode and Mechanism. Available at http://www.adsabs.harvard.edu/. Accessed July 27, 2010.

Otton, J.K., and J.C. Wynn, 1978, *Geologic Interpretation of Gravity Data from the Date Creek Basin and Adjacent Area, West-Central Arizona*, U.S. Geological Survey Open File Report 78-845.

Pearthree, P.A. (compiler), 1998, *Fault Number 951–Big Chino Fault (Class A)*, in Quaternary Fault and Fold Database of the United States, U.S. Geological Survey Web site. Available at http://earthquakes.usgs.gov/regional/qfaults. Accessed July 27, 2010.

RailAmerica, 2010, *Arizona and California Railroad*. http://www.railamerica.com/RailServices/ARZC.aspx. Accessed Feb. 26, 2010.

Reid, J., and S. Whittlesey, 1997, *The Archaeology of Ancient Arizona*, University of Arizona Press, Tucson, Ariz.

Richard, S.M., et al., 2000, *Geologic Map of Arizona (Scale 1:1,000,000),* Arizona Geological Survey Map M-35. Available at http://www.azgs.state.az.us/services_azgeomapve.shtml. Accessed Oct. 20, 2010.

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.

Royster, J., 2008, "Indian Land Claims," pp. 28–37 in *Handbook of North American Indians, Vol. 2, Indians in Contemporary Society,* G.A. Bailey (editor), Smithsonian Institution, Washington, D.C.

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.

Schwartz, S., 2009, “Arizona TES Data Request,” personal communication from Schwartz (HDMS Program Supervisor, Arizona Game and Fish Department, Phoenix, Ariz.) to L. Walston (Argonne National Laboratory, Argonne, Ill.), July 29.

SES (Stirling 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. 1, 2008.

Shafroth, P.B., and V.B. Beauchamp, 2006, *Defining Ecosystem Flow Requirements for the Bill Williams River, Arizona*, U.S. Geological Survey Open File Report 2006-1314. Available at http://www.fort.usgs.gov/products/publications/21745/21745.pdf.

Sharp, 2008, *Sharp Solar Power System Installed for Arizona Public Service.* Available at http://docs.google.com/viewer?a=v&q=cache:CyU42NfkdwAJ:www.sharpusa.com/SolarElectricity/SolarForCommercial/~/media/Files/Solar/Solar_CaseStudy/sol_dow_Arizona_Case_Study.ashx+prescott+airport+solar&hl=en&gl=us&pid=bl&srcid=ADGEESgkeMEnksYTJd5s00gnJ9gomJstbZBXP55SkJ8AzzPMjciMeqiSoE4gluWrM_0BQ6qwxYVvsFpeJVrK3Fd1lEq2y0KyUa5pIM5jUAF0FDZSJ2uFvgavy-C6BYh5bxVY_u7pVW0i&sig=AHIEtbT-NaytLpb_8V9_cJz1ShDC8y9xcQ. Accessed July 28, 2010.

Sheridan, T.E., 1995, *Arizona: A History*, University of Arizona Press, Tucson, Ariz.

Shipman, T.C., and M. Diaz, 2008, *Arizona’s Earth Fissure Mapping Program: Protocols, Procedures, and Products*, Arizona Geological Survey Open File Report 08-03.

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.

Stebbins, R.C., 2003, *A Field Guide to Western Reptiles and Amphibians*, Houghton Mifflin Company, Boston and New York.

Stoffle, R.W., et al., 1990, *Native American Cultural Resource Studies at Yucca Mountain, Nevada,* University of Michigan, Ann Arbor, Mich.

Stone, C.L., 1982, “Historical Overview of Central Western Arizona: Non-aboriginal Use of the Desert,” In *Granite Reef, A Study in Desert Archaeology*, P.E. Brown and C.L. Stone (editors), Anthropological Research Paper No. 28, Arizona State University, Tempe, Ariz.

Stone, C.L., 1986, *Deceptive Desolation: Prehistory of the Sonoran Desert in West Central Arizona, Cultural Resource Series No. 1,* Bureau of Land Management, Phoenix, Ariz.

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.

Turner, R.M., and D.E. Brown, 1994, "Sonoran Desertscrub," in *Biotic Communities: Southwestern United States and Northwestern Mexico*, D.E. Brown (editor), University of Utah Press, Salt Lake City, Utah.

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. 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), 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, 2009a, *2007 Census of Agriculture: Arizona State and County Data, Vol. 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/Arizona/index.asp.

USDA, 2009b, *Western Irrigated Agriculture, Data Sets*. Available at http://www.ers.usda.gov/data/westernirrigation. Accessed Nov. 20, 2009.

USDA, 2010a, *National Agricultural Statistics Service–Quick Stats, Arizona County Data (Crops and Animals)*. Available at http://www.nass.usda.gov/QuickStats/Create_County_Indv.jsp. Accessed July 23, 2010.

USDA, 2010b, *Plants Database*, Natural Resources Conservation Service. Available at: http://plants.usda.gov/. Accessed June 23, 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_10.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 for States*, 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.

USFS (U.S. Forest Service), 2007, *Wild Horse and Burro Territories*, U.S. Forest Service, Rangelands, Washington, D.C. Available at http://www.fs.fed.us/rangelands/ecology/wildhorseburro//territories/index.shtml. Accessed Oct. 20, 2009.

USFWS (U.S. Fish and Wildlife Service), 1994, *Desert Tortoise (Mojave Population) Recovery Plan*, U.S. Fish and Wildlife Service, Portland, Ore.

USFWS, 2009, *National Wetlands Inventory.* Available at http://www.fws.gov/wetlands.

USFWS, 2010a, *Environmental Conservation Online System (ECOS)*, U.S. Fish and Wildlife Service. Available at http://www.fws.gov/ecos/ajax/ecos/indexPublic.do. Accessed May 28, 2010.

USFWS, 2010b, "Endangered and Threatened Wildlife and Plants; 12-Month Finding on a Petition to List the Sonoran Desert Population of the Bald Eagle as a Threatened or Endangered Distinct Population Segment," *Federal Register* 75:8601–8621.

USGS (U.S. Geological Survey), 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. Available at http://earth.gis.usu.edu/swgap/landcover.html. Accessed March 15, 2010.

USGS, 2005a, *National Gap Analysis Program, Southwest Regional GAP Analysis Project—Land Cover Descriptions*, RS/GIS Laboratory, College of Natural Resources, Utah State University. Available at http://earth.gis.usu.edu/swgap/legend_desc.html. Accessed March 15, 2010.

USGS, 2005b*, Southwest Regional GAP Analysis Project,* U.S. Geological Survey National Biological Information Infrastructure. Available at http://fws-nmcfwru.nmsu.edu/swregap/habitatreview/Review.asp.

USGS, 2007, *National Gap Analysis Program, Digital Animal-Habitat Models for the Southwestern United States*, Ver. 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 March 15, 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 Aug. 4, 2010.

USGS, 2010a, *National Earthquake Information Center (NEIC)–Circular Area Search (within 100-km of the center of the proposed Millers SEZ)*. Available at http://earthquake.usgs.gov/earthquakes/eqarchives/epic/epic_circ.php. Accessed July 22, 2010.

USGS, 2010b, *Glossary of Terms on Earthquake Maps—Magnitude*. Available at http://earthquake.usgs.gov/earthquakes/glossary.php#magnitude. Accessed Aug. 8, 2010.

USGS, 2010c, *Water Resources of the United States—Hydrologic Unit Maps*. Available at http://water.usgs.gov/GIS/huc.html. Accessed April 12, 2010.

USGS, 2010d, *National Water Information System*. Available at http://wdr.water.usgs.gov/nwisgmap. Accessed July 12, 2010.

USGS and AZGS (Arizona Geological Survey), 2010, *Quaternary Fault and Fold Database for the United States*. Available at http://earthquake.usgs.gov/regional/qfaults/. Accessed Oct. 7, 2010.

WildEarth Guardians and Western Watersheds Project, 2008, *Petition to List the Sonoran Desert Tortoise (Gopherus agassizii) under the U.S. Endangered Species Act*, petition to the U.S. Fish and Wildlife Service, Oct. 9, 2008.

Wood, C.A., and J. Kienle (editors), 1992, *Volcanoes of North America*, Cambridge University Press.

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), 2010, *Western U.S. Climate Historical Summaries.* Available at http://www.wrcc.dri.edu/Climsum.html. Accessed July 10, 2010.