

Soda Lake Watershed

Hydrologic Unit Name	Water Planning Area	Acreage	Flows to	Groundwater Basin(s)	Jurisdictions
Carrizo Plain 11	Carrizo Plain WPA 10	141,876 total acres with 136,015 acres within San Luis Obispo County	Soda Lake	Carrizo Plain, Big Spring Area (ptn)	County of San Luis Obispo, California Valley, Bureau of Land Management



Photo: Althouse and Meade

Description:

The Soda Lake Watershed lies in the eastern portion of San Luis Obispo’s North County region and includes the northern portion of the Carrizo National Monument. The total watershed area is 141,876 acres with a majority of the acreage located within San Luis Obispo County (136,015 acres). The remaining acreage is located within Kern County to the east. The watershed is bounded by Temblor Range to the east, Caliente Range and San Juan Hills to the west and drains entirely into Soda Lake. The majority of Soda Lake is contained within the watershed, with the other portion contained within the Black Sulphur Springs watershed. The Watershed contains two major drainages: Panorama Hills and West of Soda Lake. The highest elevation in the watershed is approximately 4,100 feet and the lowest elevation is about 1,920 feet. The watershed, combined with the adjacent Black Sulphur Spring watershed, is an alkali closed basin with no outflow beyond Soda Lake. While the lake once contained higher levels of water and supported recreation, recently the Bureau of Land Management prohibits such uses. The watershed is transected by San Andreas Fault. The major groundwater basin underlying the watershed is the Carrizo Plain basin which is recharged from percolation of stream flow and infiltration of precipitation. The dominant land uses are grazing and solar farms.



Existing Watershed Plans:

No existing plans to date

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Characteristics

Physical Setting	
Rainfall	Average Annual: 7-14 in. (NRCS shapefile, 2010).
Air Temperature	Summer Range (August 1996-2012): 64-88°F Winter Range (December 1996-2012): 38-52°F (Branch Mountain, NOAA National Climatic Data Center, viewed 2013)
Geology Description	<p>Carrizo Plain sub-watershed is flat highly infiltrative Quaternary material.</p> <p>Painted Rock, Goodwin Ranch and San Diego Creek are moderate steep moderately infiltrative early to mid-Tertiary headwaters and are flat and highly infiltrative Quaternary inland (Bell, pers. comm., 2013).</p> <p>Groundwater is found in alluvium and the Paso Robles and Morales Formations. Upper Pleistocene to Holocene alluvium consists of unconsolidated to loosely consolidated sands, gravels, and silts with a few beds of compacted clays. Paso Robles Formation. The Pleistocene age Paso Robles Formation consists of poorly sorted, mostly loosely consolidated gravels, sands, and silts. The combined thickness of these deposits is more than 3,000 feet in the eastern portion of the basin along the San Andreas fault and decreases toward the west. The Upper Pliocene Morales Formation consists of sands, gravels, and silts, which generally are more stratified and compacted than in the overlying Paso Robles Formation (Chipping, 1987).</p>
Hydrology	
Stream Gage	None
Hydrology Models	Yes; North Coast Engineering. 2008. Preliminary investigation for the California Valley solar ranch, San Luis Obispo County, CA. Taney Engineering. 2009. Hydrology Report of Topaz Solar Facility.
Peak Flow	No data available
Base Flow	No data available
Flood Reports	None
Flood Control Structures	Bridges: 1 over Carrizo Drain on Soda Lake Road (PWD Bridges GIS Layer)
Areas of Flood Risk	No data available
Biological Setting	
Vegetation Cover	Primarily annual grassland with alkali desert scrub, juniper woodland, semi-desert chaparral, sagebrush, saltbush, barren dry salt flats, as well

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	<p>as mixed chaparral consisting of mainly narrowleaf golden bush (SLO County vegetation shapefile, 1990) <i>Data limited by age of shapefile</i></p> <p>CNPS recently (2013) completed a vegetation survey of the Carrizo Plain National Monument; a portion of the Soda Lake watershed was included in the survey. Mapped vegetation characterized stands to the alliance level. Desert scrub, alkaline/scrub, coastal scrub, chaparral, woodlands, saline and alkali marshes, grasslands and herblands, and arroyo wash alliances were all represented. Grasslands are mapped along the western hills and lower portions of the eastern hills; alkali, desert, and coastal scrub are common on upper eastern hills. Goldfield-plantain-fescue fields and other wildflower alliances are present along the basin floor. Alkali wetlands and marsh vegetation are patchy in near Soda Lake. Many additional alliances are mapped in small patches. The CNPS inventory provides high-resolution vegetation data at fine scale for the south part of this watershed. Private lands have not been inventoried.</p> <p>Vernal pools are present on the plain floor, and become less alkaline in the north part of the watershed. Annual grasslands and recently farmed croplands are common in the north part of the watershed (Althouse and Meade, 2013).</p>
<p>Invasive Species</p>	<p>Slim oat (<i>Avena barbata</i>), Common wild oat (<i>Avena fatua</i>), Black Mustard (<i>Brassica nigra</i>), Bromegrass (<i>Bromus Diandrus</i>), Red brome (<i>Bromus rubens</i>), Italian thistle (<i>Carduus pycnocephalus</i>), Spear thistle (<i>Cirsium vulgare</i>), Cut-leaved cranesbill (<i>Geranium dissectum</i>), Farmer’s foxtail (<i>Hordeum marinum</i>), Italian ryegrass (<i>Lolium multiflorum</i>), Foxtail fescue (<i>Vulpia myuros</i>)</p> <p>Cheat grass (<i>Bromus diandrus</i>), Tamarisk (<i>Tamarix</i> spp.), Tree of heaven (<i>Ailanthus altissima</i>), Russian thistle (<i>Salsola tragus</i>), Perennial pepperweed (<i>Lepidium latifolium</i>), Barbed goat grass (<i>Aegilops triuncialis</i>), Skeleton weed (<i>Chondrilla juncea</i>), Russian knapweed (<i>Acroptilon repens</i>), and Yellowstar thistle (<i>Centaurea solstitialis</i>) (Los Padres Forest Watch, 2011).</p> <p>Several of these species have limited distribution within the watershed and a coordinated effort with landowners could make significant contribution to control of spread. Many of these species were identified and mapped during biological surveys for Topaz Solar Farm, and through personal communications with the County Department of Agriculture. These occurrences pre-date the solar projects (Althouse and Meade, 2013). <i>Data limited to observations, not complete inventory</i></p>
<p>Special Status Wildlife and Plants</p>	<p>Key: FE - Federal endangered, FT - Federal threatened, SE - State endangered, ST - State threatened, SSC - State Species of Special Concern; FP- Fully Protected, SA – Special Animal, CRPR – CA rare plant</p>

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rank (CNDDDB, viewed August, 2013)

Locations listed refer to USGS 7.5' quadrangle names. Only the portion overlapping the watershed boundary was considered.

Data limited to observations, not complete inventory

Species	Status	CALIENTE MTN	CALIFORNIA VALLEY	CARNEROS ROCKS	CHIMINEAS RANCH	LA PANZA NE	LA PANZA RANCH	LAS YEGUAS RANCH	MCKITTRICK SUMMIT	PAINTED ROCK	SIMMLER
Animals											
<i>American badger</i>	SSC		X			X	X		X		
<i>blunt-nosed leopard lizard</i>	FE; SE; FP								X	X	X
<i>Burrowing owl</i>	SSC (Burrow sites ,some wintering sites)				X	X					X
<i>coast horned lizard</i>	SSC										X
<i>giant kangaroo rat</i>	FE; SE		X		X			X	X	X	X
<i>longhorn fairy shrimp</i>	FE		X		X			X			X
<i>mountain plover</i>	SSC - Wintering									X	
<i>Nelson's antelope squirrel</i>	ST		X						X	X	X
<i>pallid bat</i>	SSC		X							X	X
<i>pocket pouch fairy shrimp</i>	SA									X	
<i>prairie falcon</i>	SA (Nesting)	X	X	X	X	X	X	X	X	X	X
<i>San Joaquin kit fox</i>	FE; ST		X		X	X		X	X	X	X
<i>San Joaquin pocket mouse</i>	SA								X		X
<i>San Joaquin whipsnake</i>	SSC					X			X		
<i>Tipton kangaroo rat</i>	FE; SE				X					X	X

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<i>Tulare grasshopper mouse</i>	SSC								X		X
<i>vernal pool fairy shrimp</i>	FT										X
<i>western spadefoot</i>	SSC		X								X
Plants											
<i>Coulter's goldfields</i>	CRPR 1B.1							X		X	
<i>diamond-petaled California poppy</i>	CRPR 1B.1							X			X
<i>Eastwood's larkspur</i>	CRPR 1B.2				X					X	
<i>heartscale</i>	CRPR 1B.2									X	X
<i>Jared's pepper-grass</i>	CRPR 1B.2				X					X	X
<i>Kern mallow</i>	FE		X						X		X
<i>Lemmon's jewel-flower</i>	CRPR 1B.2				X	X			X	X	
<i>Lost Hills crownscale</i>	CRPR 1B.2		X		X	X			X	X	X
<i>Munz's tidy-tips</i>	CRPR 1B.2					X			X	X	X
<i>oval-leaved snapdragon</i>	CRPR 4.2				X					X	X
<i>recurved larkspur</i>	CRPR 1B.2		X		X				X	X	X
<i>round-leaved filaree</i>	CRPR 1B.1	X	X		X	X					X
<i>San Joaquin woollythreads</i>	FE										X
<i>shining navarretia</i>	CRPR 1B.2		X								
<i>showy golden madia</i>	CRPR 1B.1					X					
<i>spiny-sepaled button-celery</i>	CRPR 1B.2		X								
Steelhead Streams	None										
Stream Habitat Inventory	No source identified, not historically fish habitat										

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Fish Passage Barriers	None identified
Designated Critical Habitat	Yes; Longhorn Fairy Shrimp and Vernal Pool Fairy Shrimp (USFWS Critical Habitat Portal, viewed 2013)
Habitat Conservation Plans	Yes; Carrizo Plain Natural Area Plan, Stewardship Council Land Conservation Plan
Other Environmental Resources	Carrizo Plains National Monument and Ecological Reserve and Soda Lake, San Andreas Fault Zone of Eastern San Luis Obispo County (SLO County Flood Control and Water Conservation District, 2007)
Land Use	
Jurisdictions and Local Communities	County of San Luis Obispo, California Valley Community Services District, BLM (Carrizo Plains National Monument)
% Urbanized	14% (Residential Suburban) (SLO County LUC)
% Agricultural	80% (SLO County LUC)
% Other	9% (5% Rural; 1% Open Space; 0.1% Recreational, commercial retail or public facility; 3% Industrial solar farms) (SLO County LUC)
Planning Areas	Carrizo Plain, Los Padres National Forest
Potential growth areas	California Valley
Facilities Present	Goodwin Education Center within the Carrizo Plain National Monument, Soda Lake, Chimineas Ranch, Carrizo Plain Ecological Reserve, California Valley Solar Ranch, Topaz Solar Farms, Elementary School, microwave station operated by the U.S. Navy, oil well operations
Commercial Uses	California Valley Solar Ranch (includes the remediation of Farm Camp Quarry/California Gypsum), Topaz Solar Farms, oil well drilling, cattle ranching, dry land farming, retail stores
Other Notable Land Use characteristics	As part of conditions for approval of California Valley Solar Ranch and Topaz Solar Farm, the county required the development of a program to retire lots within California Valley sub-division. For TSF, the county required habitat to be preserved through the use of permanent open space easements within the Carrizo Plain (North Coast Engineering, 2008).
Demographics	
Population	464 in watershed (US Census Block, 2010)
Race and Ethnicity	Watershed: Caucasian, representing 76%. Latinos represent 18% in City. The remaining races each represent less than 4%, including African American, American Indian, Pacific Islander, and Asian (US Census Bock, 2010).
Income	MHI \$60,676 in watershed (US Census Tract, 2010)

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	Disadvantaged Communities	No; 7.0% of individuals are below poverty level in watershed (U.S. Census Tract, 2010).
Water Supply		
	Water Management Entities	None; area residents and commercial uses served by Individual wells (Carollo, 2012)
	Groundwater	Yes; Carrizo Plains and Big Spring Area (ptn) Basins (Carollo, 2012) Users of the basin include small public water system serving local school, agricultural and residential purposes, and solar farms.
	Surface Water	No public reservoirs.
	Imported Water	None
	Recycled/Desalinated Water	As of 2013 there is under construction a brine pond and reverse osmosis system at California Valley Solar Ranch on the north-east Carrizo to serve the solar plant's needs (North Coast Engineering, 2008).
	Key groundwater percolation area(s)	None Identified - Recharge to the basin is largely by percolation of stream flow and infiltration of rainfall to the valley floor (Ca. Dept. of Water Resources, 2003).
	Water Budget	Yes; Aspen Environmental Group, 2011, for Topaz Solar Project
Water Uses		
	Beneficial Uses	<i>San Diego Creek</i> - Municipal & Domestic Supply (MUN), Agricultural Supply (AGR), Ground Water Recharge (GWR), Water Contact Recreation (REC-1), Non-Contact Water Recreation (REC-2), Wildlife Habitat (WILD), Warm Fresh Water Habitat (WARM), Significance (BIOL), Rare, Threatened, or Endangered Species (RARE), Freshwater Replenishment (FRSH) and Commercial and Sport Fishing (COMM). <i>Soda Lake</i> - Industrial Service Supply (IND), Non-Contact Water Recreation (REC-2), Wildlife Habitat (WILD), Warm Fresh Water Habitat (WARM), Significance (BIOL), Rare, Threatened, or Endangered Species (RARE) and Commercial and Sport Fishing (COMM). (CCRWQCB, 2011)
Other Unique Characteristics		
	Carrizo Plain National Monument	A cooperative effort since 1985 between Bureau of Land Management, California Fish and Wildlife, and the Nature Conservancy. 250,000 acres of relatively undisturbed habitat.
	Soda Lake	A 13,000 acre ephemeral alkaline lake at the center of the Carrizo Plain. Provides an important habitat for migratory birds and is one of the largest undisturbed alkali wetlands in California. Without an outlet, water from the lake evaporates leaving behind residual sulfates and

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	carbonates. Wintering area for sandhill cranes. The alkaline conditions support one of the most highly localized plant species in the world, alkaline peppergrass (<i>Lepidium jaredii</i>)
Painted Rock	The single largest individual pictograph site in the country, Painted Rock is an isolated rock formation which Yokut, Salinan, and Chumash Indians decorated with unique rock paintings (“pictographs”) and figures scratched into rocks (“petroglyphs”). These rock paintings have almost been entirely vandalized. Part of the Carrizo Plain Rock Art Discontiguous National Register District dating to circa 400 to 800 years before present.
California Valley	An undeveloped village settlement encompassing 24,083 acres located on the Carrizo Plain, about 60 miles east of San Luis Obispo. It came into being in 1960, when part of the El Chicote Ranch was subdivided into more than 7,200 2.5-acre "ranchos" and sold through nationwide advertising as "the geographic center of this spectacular California growth area with unbounded future." This proposed new town has never developed and each year many of the subdivided parcels are sold at tax auctions.
San Andreas Fault Zone	One of the most seismically active faults in North America. Important from a biological and geological standpoint. The San Andres Fault in the Carrizo Plain has the largest post-early Miocene offset and is the oldest reach of the entire active fault system (Pollard et. al., 1995). Sag ponds have special ecological significance due to scarcity of water in this region. Much of the fault zone has agricultural preserve status.
Hubbard Hill Freeborn Mountain	These ridges along the westerly border of the Carrizo Plains, include 7,000 acres under Bureau of Land Management control. Diverse native species are found in the area, with no single dominant plant association
Wildflower Fields	Mid-March to mid-April is the usual time for wildflower season, but it is dependent on the weather and varies from season to season. Temperature and rainfall affect which flowers bloom. Every year is not spectacular and only a few flowers may prevail in some years. Typical species include: gold fields, valley phacelia, goldenbush shrubs, bush lupine, pale yellow astragalus, locoweed, filaree, yellow tropidocarpum, white popcorn flower, orange fiddleneck, poppies, hillside daises, sun cups and baby-blue eyes. One of the three remaining locations known to support extant populations for the California jewelflower as well as other special status plants (BLM, 2013)
Climate Change Considerations	
	Saltbrush and other native shrubs are expected to decline and marginal farmland may become less productive and retired in the Carrizo Plain area (ClimateWise, 2010). See IRWMP, 2014 Section H, Climate Change <i>Information is general for County, not watershed specific</i>

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Watershed Codes

CalWater / DWR Number	HA	Hydrologic Area Name	HSA	Hydrologic Sub-area Name	SWRCB Number	CDF Super Planning	Sub-watersheds (CDF Watershed Name)
3311.000101	0	Undefined	0	Undefined	311.00	Panorama Hills	East of Simmler
3311.000102	0	Undefined	0	Undefined	311.00	Panorama Hills	San Diego Creek
3311.000104	0	Undefined	0	Undefined	311.00	Panorama Hills	North of California Valley
3311.000401	0	Undefined	0	Undefined	311.00	West of Soda Lake	Painted Rock
3311.000402	0	Undefined	0	Undefined	311.00	West of Soda Lake	Goodwin Ranch
3311.000403	0	Undefined	0	Undefined	311.00	West of Soda Lake	East of Freeborn Mtn
3311.000500	0	Undefined	0	Undefined	311.00	Soda Lake	Soda Lake / Carrizo Plain (ptn)

Major Changes in the Watershed

- 4000-8000 years before present – The Carrizo Plains were a meeting place for Salinan, Yokut, Chumash and other Indian tribes. Vaqueros Formation rock monoliths are decorated with art that is being protected today.
- 1780 – First contact by Europeans. Large herds of sheep, horse and cattle brought into the area by Spanish. Introduce non-native species to the Carrizo grasslands
- 1857 – Major earthquake that shaped much of the natural landscape of the Carrizo Plains area (Pollard et. al., 1995)
- 1876 – First homesteads established on Carrizo Plains. Dry grain farming was intensive after invention of mechanized agricultural equipment in 1912, resulting in as much as 2 feet of top soil loss in some field margins
- 1939 to Post World War II – A combination of good weather and post War expansion led to increased profitability and productivity of the areas farms and ranches.
- 1964 – Creation of California Valley. Chicote Ranch, a 7,500 acre ranch just south of 58, was divided into two-and-a half acre parcels which were promoted all over the state as retirement homes.
- 2001 – Carrizo Plain National Monument created by President Clinton under the authority of the Antiquities Act of 1906.
- 2013 – Large solar farms established in the watershed

Source: Santa Margarita Historical Society, http://www.santamargaritahistoricalsociety.org/pages/carrisa_plains.html unless otherwise noted

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Watershed Health by Major Tributary

Tributary Name	Ephemeral / Perennial	303d Listed/ TMDLs	Pollution Sources NP (non-point) MP (Major Point)
Soda Lake	Ephemeral	Ammonia	Unknown Source
Carrizo Plain	Unknown	None	n/a
Goodwin Ranch	Unknown	None	n/a
Painted Rock	Unknown	None	n/a
San Diego Creek	Unknown	None	n/a

Watershed Health by Major Groundwater Basin

Groundwater Basin	Estimated Safe Yield	Water Availability Constraints (Master Water Report)	Drinking Water Standard Exceedance	Water Quality Objective Exceedance
Carrizo Plain	8000-11,000 AF (Carollo, 2012)	Physical limitations and water quality issues (Carollo, 2012).	Yes; see description below.	Exceeds usable mineral quality for total dissolved solids, chloride, sulfate, boron, sodium, and nitrogen (SLO County Flood Control and Water Conservation District, 2007).
Big Spring Area (ptn)	No data available (Carollo, 2012)	Constraints on water availability in this basin are primarily based on physical limitations. (Carollo, 2012)	No data available	No data available

Groundwater Quality Description: Analyses of groundwater from 79 wells in this basin during 1957 through 1985 show Total Dissolved Solids (TDS) content ranging from 161 to 94,750 ppm. A highly mineralized groundwater zone is found in the lower part of the alluvium and the upper part of the Paso Robles Formation where they underlie Soda Lake. Water in a deeper zone Paso Robles Formation is of

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higher quality and confined in the vicinity of Soda Lake. Groundwater in the Morales Formation is likely to be brackish. There are areas with locally high nitrate and salinity concentrations based on well water sampling (Carollo, 2012).

Primary Issues

Issue	Potential Causes	Referenced from
Groundwater quality		Carollo, 2012
Groundwater Quantity	Physical Limitations	Carollo, 2012
Outdated Studies of the GW basins		Carollo, 2012
Soda Lake 303(d) listed for ammonia		Carollo, 2012

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Significant Studies in Progress:

The compliance reporting required of the developing solar ranches has generated many studies informing water quality, listed species, and restoration schema and groundwater quantity.