Long-Term Operation – Draft Environmental Impact Statement

Appendix R – Land Use and Agricultural Resources Technical Appendix

July 2024

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Contents

Tables

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Appendix R Land Use and Agricultural Resources Technical Appendix

R.1 Background Information

R.1.1 Overview of Land Use and Agricultural Resources

This appendix describes land use and agricultural resources conditions potentially affected by the implementation of the alternatives considered in this environmental impact statement (EIS).

The following description of the affected environment is presented at the county-level for agricultural and municipal and industrial (M&I) land uses. In addition, an overview of agricultural resources is provided.

R.1.1.1 Land Use

An extensive range of land uses are within this study area. These include forestry, agriculture, water, urban (including industrial, commercial, and residential), rural residential, parks and recreation, and public open spaces.

R.1.1.2 Crop Production Practices

Crop production practices vary by crop and locational differences such as soil, slope, local climate, and water source and reliability. Production practices discussed in this subsection include:

- Crop rotation and fallowing
- Crop water use
- Crop irrigation methods
- Crop responses to water quality
- Crop drainage methods
- Crop adaptation to changes in water supply availability

Crop Rotation and Fallowing

Crop rotation is the planned variation in the crops grown on a given field. Growers rotate annual crops and some forage crops to control plant pests, diseases, and weeds, and to improve soil structure, microbial diversity, and nutrient and mineral availability. Growers select a series of crops that are compatible for rotation that are planned to be grown in a field in a succession of years and plan their operations schedule and build their on-farm infrastructure (e.g., equipment, facilities, and staffing) to a scale that meets the production needs of those crop acreage mixes (Baldwin 2006).

Field fallowing is the practice of not planting a crop in a field for one or more growing seasons. Fallowing can be a planned part of the rotation or may be a consequence of another event such as water supply shortage, flooding, land improvement, or poor crop prices. Rotations are not fixed, so changes in market conditions or federal farm programs can affect crop mix and the pattern and magnitude of fallowing.

Fallowed fields without cover crops can lose topsoil to surface drainage and wind erosion. Loss of topsoil to erosion reduces land productivity and can reduce nearby crop yields and marketability.

Crop Water Use

Crop irrigation water use depends on crop type, stage of crop growth, soil moisture profile from winter rains, soil moisture holding capacity (i.e., total amount of water in the soil potentially available to plants), management of plant pests and diseases, weather conditions (e.g., solar radiation, temperature, and humidity), and irrigation water use efficiency. Irrigation water use efficiency can be defined in different ways. The California Department of Water Resources defines the agronomic water use fraction as the irrigation water beneficially used for necessary agronomic functions (e.g., transpiration, leaching, frost protection, germination) divided by the total applied water (California Department of Water Resources 2012). Applied irrigation water is transpired by plants (crops and weeds), percolates into the groundwater below the root zone (necessary salt leaching component or over-irrigation loss to groundwater), evaporates directly from water or soil surfaces, or runs off the field as surface drainage (Edinger-Marshall and Letey 1997).

Reuse of water from fields to irrigate other fields, often multiple times, occurs throughout California. As a result, relatively low field-level efficiency (agronomic water use fraction) can result in relatively high efficiency from a regional or basin perspective (California Department of Water Resources 2013).

Crop Irrigation

Agricultural irrigation needs vary by season. In the winter, rainfall refills the soil moisture profile that was depleted from the crop root zone the previous summer and fall. If soil moisture is not adequate for planting of annual crops, pre-irrigation water is applied. Pre-irrigation and early growing season irrigations generally occur in the time period of March through May. Peak agricultural irrigation water supply demand generally occurs from the late spring through late summer. Permanent crops are irrigated post-harvest to refill the root zone. Post-harvest irrigation of annual crop land is sometimes used to help break down crop residue and suppress some pests and diseases, especially in rice fields.

Irrigation methods vary by area, soil, crop type, and existing facilities. Annual row crops are often sprinkler irrigated for crop germination and furrow irrigated for the rest of the season. Permanent crops are typically irrigated with drip, sprinkler, furrow, border, or flood irrigation methods. Irrigated pasture and alfalfa are typically irrigated with sprinkler or flood irrigation methods. Rice is generally irrigated with flood irrigation. The following irrigation methods are used in the Central Valley:

- **Flood and Border Irrigation:** Water is released into a leveled field or block that is segmented into "checks" with a small berm to contain the water. Water applied to the check until it is flooded and the water seeps into the ground or some is allowed to drain off the lower elevation end of the field.
- **Furrow Irrigation:** Water is released into furrows at the higher side of the field and flows down to the lower end of the field. To provide adequate water to the low end of the field, surface irrigation requires that a certain amount of water be spilled or drained off as tailwater. Recycling the tailwater to the head of the field or to an adjacent field can considerably increase overall efficiency. Furrow irrigation is used on annual row crops and on some vineyards.
- **Sprinkler Irrigation:** Sprinkler irrigation uses pressurized water through movable or solid set pipe to a sprinkler. Sprinklers lose some irrigation water to evaporation in the air before the water reaches the ground. Sprinklers also apply water to ground that does not have crop roots, and this applied water goes to surface evaporation, weed transpiration, or percolation to groundwater leaching. Sprinklers are often used during the germination stage of vegetables and can also be used for frost control on orchards, especially citrus. Sprinkler irrigation can be used on most crops except those for which direct contact with the water drops could cause fruit cracking, fungal growth, or other issues.
- **Surface Drip and Micro-Sprinkler Irrigation:** Surface drip and micro-sprinkler irrigation also use pressurized water that is delivered through flexible tubes to drip emitters or micro-sprinkler heads. Surface drip irrigation generally applies water only to the crop root areas. Drip irrigation and micro-sprinklers are used on most orchards and vineyards.
- **Subsurface Drip Irrigation:** Subsurface drip irrigation is similar to the drip irrigation described above, but the tubing or drip tape is buried a few inches to several feet, depending on the crop. Subsurface drip irrigation generally applies water only to crop root areas and reduces surface evaporation. Subsurface drip is used on some row crops and vineyards.

Flood and furrow irrigated acreage has declined over time, especially for trees and vines, and been replaced by drip and micro-sprinkler irrigation (Northern California Water Association 2011). Crops that continue to rely upon flood irrigation, such as rice, have improved irrigation efficiency through laser leveling of the fields. The use of furrow and flood irrigation has declined in California from 67% of the total irrigated acreage in 1991 to 43% in 2010 (California Department of Water Resources 2013). During this same time period, the use of drip, micro-sprinkler, and subsurface drip irrigation increased from 16% of total irrigated acreage in 1991 to 42% in 2010.

Crop Response to Water Quality

Water quality of the surface water streams in the Central Valley is generally very suitable for agricultural production with low salinity, neutral acidity/alkalinity (i.e., pH), minerals, nutrients, and dissolved metal concentrations that are appropriate for agricultural uses. However, groundwater quality varies across California, as described in Appendix I, *Groundwater Technical Appendix*.

Agricultural production can be affected by high salinity, minerals, and boron in the irrigation water and the soils. In the Sacramento Valley, water temperature can reduce crop yields; cold water is a particular concern for rice production (Roel et al. 2005). Irrigation water can carry debris and biological contaminants that affect agricultural operations and the value of crop production.

High salinity concerns occur on agricultural lands receiving Central Valley Project (CVP) and State Water Project (SWP) water from the Bay-Delta. As described in Appendix G, *Water Quality Technical Appendix*, surface waters in the Bay-Delta and lower San Joaquin River water frequently are characterized by high salinity. These waters are used by agricultural water users in the Bay-Delta and CVP and SWP water users within and south of the Bay-Delta.

Evaporation and transpiration of irrigation water cause salts to accumulate in soils unless adequate leaching and drainage are provided (Bureau of Reclamation 2006). High water tables with elevated concentrations of salts can draw the salinity vertically through the soil by capillary action into the plant root zone and cause damage to the plant. Excessive salinity in irrigation water and accumulated soil salinity can adversely affect soil structure, reduce water infiltration rates, reduce seed germination, increase seedling mortality, impede root growth, impede water uptake by the plant (from increased osmotic pressure), reduce plant growth rate, and reduce yields.

All irrigation water adds soluble salts to the soil, including sodium, calcium, magnesium, potassium, sulfate, and chlorides (Grattan 2002). Salinity is usually measured either in parts per million of total dissolved solids or by electrical conductivity (EC). Water salinity of irrigation water is measured as EC_w. Accumulated salts in the soil are measured as EC_e. The strength of the electrical conductivity depends upon the water temperature, types of salts, and salt concentrations.

High salinity can affect the amount of irrigation water applied for crop irrigation and necessary soil leaching component (washing soil salts out of the plant root zone) compared to the total quantity of irrigation water applied (Bureau of Reclamation 2006). Irrigation in the San Joaquin Valley typically includes a salt leaching component. The leaching water generally conveys the salts into installed drains in the fields or into the groundwater. Therefore, in locations where adequate drainage does not exist, continued irrigation with high-salinity water has increased groundwater salinity.

Table R-1 presents EC_e and EC_w values for salinity tolerances of a range of crops grown in the Central Valley.

Table R-1. Salinity Tolerance of Selected Crops (as percent of maximum yield)

Crops [a, b]	Crop Tolerance Based on Soil Salinity (measured as ECe)			Crop Tolerance Based on Water Salinity (measured as ECw)		
	100%	50%	0% [c]	100%	50%	0% [c]
Alfalfa	2.0	8.8	16	1.3	5.9	10
Almond [d]	1.5	4.1	6.8	1.0	2.8	4.5
Apricot [d]	1.6	3.7	5.8	1.1	2.5	3.8
Bean	1.0	3.6	6.3	0.7	2.4	4.2
Corn, sweet	1.7	5.9	10	1.1	3.9	6.7
Cucumber	2.5	6.3	10	1.7	4.2	6.8
Grape	1.5	6.7	12	1.0	4.5	7.9
Peach	1.7	4.1	6.5	1.1	2.7	4.3
Rice (paddy)	3.0	7.2	11	2.0	4.8	7.6
Squash, Zucchini	4.7	10	15	3.1	6.7	10
Sudan Grass	2.8	14	26	1.9	9.6	17
Sugar Beet [e]	7.0	15	24	4.7	10	16
Tomato	2.5	7.6	13	1.7	5.0	8.4

Sources: Ayers and Westcot 1985; Grattan 2002; Maas and Hoffman 1977.
[a] These data should be used as a guide to relative tolerances among crops. Absolute tolerances will change based upon climate, soil conditions, and cultural practices. Plants will tolerate about 2 deciSiemens per meter (dS/m) higher soil salinity (ECe) than indicated if soils have high gypsum, however the water salinity (ECw) tolerances do not change.
[b] ECe is average root zone salinity as measured by electrical conductivity of the saturation extract of the soil, and ECw is electrical conductivity of the irrigation water, both reported in dS/m) at 25°C. The data is based upon a relationship between soil salinity and water salinity of ECe = 1.5 ECw with a 15 to 20% leaching fraction and a 40-30-20-10% water use pattern for the upper to lower quarters of the root zone.
[c] The zero-yield potential or maximum ECe indicates the theoretical soil salinity (ECe) at which crop growth ceases.
[d] Tolerance evaluations are based on tree growth and not on yield.
[e] For beets, which are more sensitive during germination, the ECe should not exceed 3 dS/m in the seeding area for garden beets and sugar beets.

The most sensitive crops are affected when ECe values exceed 1 deciSiemens per meter (dS/m), and include the following crops with threshold values: beans (1.0 dS/m); walnuts 1.1 dS/m), bulb onions (1.2 dS/m); grapes, peppers and almonds (1.5 dS/m); apricots (1.6 dS/m); corn and peaches (1.7 dS/m); alfalfa (2.0 dS/m); and cucumbers and tomatoes (2.5 dS/m).

In addition to an excess of salinity, depletion of boron is also a concern in some areas in California (Chang and Page 2000). Dry beans are one of the more boron-sensitive crops with a

threshold value of 0.75 to 1.0 milligrams per liter in the soil water within the crop root zone (Ayers and Westcot 1985).

Crop Drainage Methods

Agricultural crop surface and subsurface drainage is important for the suitability of agricultural production (California Department of Water Resources 2013; Bureau of Reclamation 2006; Presser and Schwarzbach 2008). Drainage of most agricultural fields occurs by a combination of surface drainage and subsurface drainage. Poor drainage can lead to crop loss or damage from lack of soil oxygen availability for plant roots, pest infestations (e.g., pathogenic root fungi, such as phytophthora), and salt accumulation in the root zone. High water tables, high salinity, and poor drainage can limit crop selection and limit the ability of farmers to use irrigation water to leach excess salts out of the crop root zone.

Surface water drainage from agricultural fields is collected in on-farm drainage ditches that are typically connected to larger drainage facilities. The drainage water either flows by gravity or is pumped into adjacent water bodies. Water quality issues related to disposal of surface water drainage can include high concentrations of sediment; nutrients from fertilizers; or residual organic carbon constituents from herbicides, pesticides, or nematicides. On-farm surface drainage systems sometimes include local methods to remove sediment or nutrients, such as the inclusion of vegetative strips to remove sediment and improve drain water quality (CALFED Bay-Delta Program 2000). During the irrigation season, surface drainage water collected from irrigation can be recirculated for subsequent irrigation; however, this can lead to a long-term increase in soil salinity (California Department of Water Resources 2013).

Subsurface drainage is used to control groundwater depth to avoid or limit its encroachment into the root zone of crops (Panuska 2011). For example, in the Bay-Delta, subsurface and surface drainage is used not only to control groundwater depths related to irrigation practices, but also to control groundwater that seeps into the soils from the surface water that surrounds the islands and tracts. Areas in the western and southern San Joaquin Valley are affected by shallow, saline groundwater that accumulates because of irrigation; and the shallow groundwater is underlain by soils with poor drainage (Strock et al. 2010; California Department of Water Resources 2013; Presser and Schwarzbach 2008; Westlands Water District 2013a, 2013b). Some areas of the northern San Joaquin Valley collect and discharge subsurface drainage to the San Joaquin River (Bureau of Reclamation 2013). Areas in the central and southern San Joaquin Valley manage poor drainage conditions by careful and integrated management of crop patterns, land retirement, irrigation methods and application rates, and/or drainage water reuse and blending, (U.S. Geological Survey 2008; Westside Resource and Conservation District and Center for Irrigation Technology 2004).

R.1.1.4 Crop Adaptation in Response to Changes in Water Supply Availability

Farmers and water suppliers can react to changes in water supply in a range of ways. Some farmers adapt to variability by maintaining a mix of crops that can be shifted or fallowed in response to water supply changes. Some farmers have groundwater wells that can be used to replace surface water in times of shortage. Short term responses can also include reducing irrigation water application below what is needed to maintain full crop yield (water stressing). Over the long term, irrigation systems and management can be changed to apply less water.

Decisions that farmers make in response to changes in water supply affect other aspects of their operations and affect the economy of the surrounding community. For example, crop mix and irrigation methods affect the kinds of tractors and other equipment used on the farm.

Some types of on-farm infrastructure also are specialized for the crops grown, such as grain driers and storage, hullers, fruit sorting and packing, fruit driers, cotton gins, and cold storage plants. Crop-specific equipment, infrastructure, and marketing agreements may prevent a grower from changing crops quickly due to changes in water supply availability.

Input suppliers, equipment dealers, the labor force, and processing facilities are also dependent on, and affected by, cropping decisions. As crop types change, the mix of these related economic activities also change. This can happen over a period of time but is difficult to achieve in the short term.

Response to Variability in CVP and SWP Water Supplies

Water availability provided by the CVP and SWP varies each year based upon hydrologic conditions and regulatory requirements, as described in Appendix H, *Water Supply Technical Appendix*. The CVP and SWP water supply allocations are initially announced in the late winter. The allocations can be revised throughout the spring months as the hydrologic conditions become more certain. Growers often delay finalizing some of their crop decisions until water supply allocations are announced as late as April or May. Delays in finalizing crop decisions also can result in delays in finalizing crop financing and orders to suppliers (e.g., seed, fertilizer), and contracting with labor suppliers and crop processors. Responses to variations in water allocations depend on many factors, including feasibility of alternative water supplies (availability, suitability of water quality, cost); types of crops grown and need for changes in equipment, processing, and labor; and long-term crop supply contracts and obligations (Westlands Water District 2013a, 2013b). A study of changes that occurred during the 1986–1992 drought indicated that implementation of the changes will probably occur over a longer period of time and not necessarily during the water supply shortage, especially if groundwater or other surface water supplies can be obtained within the growing season (Dale and Dixon 1998).

The effects on the surrounding communities of the variability of CVP and SWP water supplies are discussed in Appendix Q, *Regional Economics Technical Appendix*, and Appendix T, *Environmental Justice Technical Appendix*.

Typical responses of a farmer or water supplier to increasing shortage of water supplies include the following actions:

- **Increase the use of groundwater:** Reduction in surface water supplies can induce substitution with groundwater using new or existing wells. Water supplies are used conjunctively in some areas with groundwater storage so that during surface water shortages, water historically used to recharge groundwater can be used for applied irrigation uses.
- **Use alternative/supplemental surface water supplies:** Alternative water supplies may include local exchanges or transfers of surface water, water transfers/purchases from more distant areas, and/or use of water stored in surface water reservoirs or groundwater

banks. These all depend on the infrastructure to convey the water and the financial ability to pay for the alternatives water supplies.

- **Increased water use efficiency:** Reduced use of irrigation water may be achieved by on-farm system and irrigation management improvements, water reuse, water source blending, and delivery system improvements. Specific on-farm and delivery system improvements can include irrigation scheduling, field leveling, application system changes, and conveyance system loss reduction measures such as canal lining, spill reduction, and automation. Some of the changes require only management changes, such as irrigation scheduling, and can occur within the growing season. Other changes, such as conveyance system modifications, require capital investments and generally require several years to implement.

- **Field fallowing or changing to lower-water-use crops:** Fallowing, or temporary idling, reduces gross water use by the entire applied water amount, and reduces net water use by at least the evapotranspiration of the crop not planted. Typically, fields with higher water use crops or lower value rotation crops would be the first fields to be fallowed. Farmers generally would avoid or minimize fallowing permanent crops or crops with long-term obligations (e.g., cannery contracts). A farmer receiving a partial allocation of water could decide to reduce irrigated acreage and transfer that acreage's water allocation to the remaining fields in production or sell the water to other water users. A smaller reduction in water use can be achieved by switching from a crop using more water to one using less water (Dale and Dixon 1998). Permanent crops, such as trees and vines, that are the least economically viable or that are approaching the end of their lifespan can be removed or abandoned, and the land fallowed until adequate water is available. In extreme dry periods, such as 2014 when there were no deliveries of CVP water to San Joaquin Valley water supply agencies with CVP water service contracts, permanent crops were removed because the plants would not survive the stress of no water or saline groundwater.

- **Stress Irrigation:** Farmers generally try to irrigate to achieve maximum economic yield. For some permanent crops, severe pruning could reduce water use, but could reduce yield over multiple years (AgAlert 2010).

Cropping Pattern Changes in Response to Water Supply Availability

Conversion of farmlands to other land uses has occurred historically and continues to occur. Agricultural lands have been converted to different crop patterns, urban areas, habitat restoration, off-farm infrastructure (e.g., utilities and transportation), and on-farm infrastructure (e.g., storage, maintenance, and processing facilities). Crop conversions occur in response to changes in water supply reliability, changes in market demand for specific crops, and decisions to convert lands to urban or infrastructure land uses.

One method used to indicate changes in California agricultural acreage is related to a loss of the value of production on "Important Farmland" and "Grazing Land" acreages, as reported by the California Department of Conservation. The comparison of the acreage of lands within each category can be used to identify trends in agricultural land conversions. This information is provided in the following subsections for the years 2008 and 2018 for counties within the study area.

Another factor to be considered prior to crop conversion is the costs related to crop establishment. Costs of irrigated crop production include labor, purchased inputs (e.g., seed, fertilizer, chemicals), custom services, investment in growing stock, other capital (including machinery and structures), and other overhead costs.

Reliability of water supply can be especially important for maintaining substantial investments in growing stock of perennial and multi-year crops. Perennial crops include orchards and vineyards that may have useful lives of 25 years or more. Multiyear forage crops, such as alfalfa and irrigated pasture, also may be in production for years. Investment in growing stock may be expressed as the accumulated costs incurred during the period when the crop is planted and brought to bearing age, called the establishment period. Establishment costs for example perennial crops can range up to $32,000 per acre in total costs (including cash outlays plus noncash and allocated overhead costs). The example establishment costs provided in Table R-2 are for the Central Valley but are generally representative of establishment costs in other regions.

Table R-2. Typical Establishment Costs for Some Perennial Crops in the Central Valley

Example Crop	Establishment Period (years)	Assumed Life of Stand (years) [a]	Accumulated Total Cost during Establishment (per acre) [b]	University of California Cooperative Extension Cost of Production Study
Alfalfa Hay	1	4	$843	Sacramento Valley and Northern San Joaquin Valley, flood irrigation, 2020
Almonds	6	25	$18,008	Sacramento Valley, micro-sprinkler irrigation, 2019
Irrigated Pasture	1	20	$527	Sacramento Valley, flood irrigation, 2015
Walnuts	7	25	$26,767	San Joaquin Valley North, 2017
Wine Grapes	3	25	$31,879	San Joaquin Valley North, cabernet sauvignon, quadrilateral trellis, 2021

Sources: University of California Cooperative Extension 2015a, 2017, 2019, 2020, 2022.
[a] Assumed stand life is the financial life used for the cost and budget analysis. Individual growers may decide to keep stands in production longer or to remove them sooner.
[b] All costs are converted to 2022 dollar equivalent values to account for inflation (Bureau of Labor Statistics 2023).

Farm expenditures are largely spent in the surrounding community in the form of input purchases, hired labor, rents paid to landlords, well drilling, and custom consulting services. Total labor in the agricultural production sector is discussed in relation to the regional economy in Appendix Q, *Regional Economics Technical Appendix*. Labor hours and input purchases vary substantially among crops, as shown in Table R-3.

Table R-3. Cultural, Harvest, and Other Costs for Example Crops in the Central Valley

Example Crop	Cultural Costs (per acre) [a]	Harvest Costs (per acre)	Other Costs (per acre) [b]	University of California Cooperative Extension Cost of Production Study
Alfalfa Hay	$870	$316	$440	Sacramento Valley and Northern San Joaquin Valley, flood irrigation, 2020
Almonds	$2,513	$487	$28	Sacramento Valley, micro-sprinkler irrigation, 2019
Corn, Grain	$1,104	$90	$822	San Joaquin Valley South, 2015
Irrigated Pasture	$191	$202	$308	Sacramento Valley, flood irrigation, second year-till, 2015
Rice	$734	$358	$476	Sacramento Valley, medium grain, 2021
Walnuts	$2,211	$1,044	$38	San Joaquin Valley North, 2017
Wheat	$184	$114	$337	Sacramento Valley, irrigated, 2016
Wine Grapes	$2,732	$690	$94	San Joaquin Valley North, cabernet sauvignon, quadrilateral trellis, 2021

Sources: University of California Cooperative Extension 2015a, 2015b, 2016, 2017, 2019, 2020, 2021, 2022.
All costs are converted to 2022 dollar equivalent values to account for inflation (Bureau of Labor Statistics 2023).
[a] Cultural costs include application of fertilizer and herbicides, pre-plant costs, as well as irrigation costs.
[b] Other costs are cash overhead and interest on operating capital.

Water Supply and Crop Acreage Relationships in the San Joaquin Valley

Most publicly available information on irrigated acreage and crop types is compiled at the county level, not the water district level. Water availability for CVP and SWP water is provided at a smaller geographic level, such as a water supply entity or several adjacent entities. Therefore, it is difficult to analyze the correlation of water supply availability, irrigated acreage, and crop types. However, the Westlands Water District (WWD) does provide more detailed information related to water availability, irrigated acreage, and crop types in their publicly available reports, as summarized in this technical appendix. The purpose of this summary is to describe the relationships between cropping patterns, irrigation methods, and water supply availability. Due to the increased frequency of water supply reductions, especially in drier years, the amount of fallowed and non-harvested lands has increased as a percentage of total lands within WWD. The trend observed in WWD of using additional groundwater and crop idling land when CVP and SWP water supplies are reduced; reducing groundwater use and increasing irrigated acreage when CVP and SWP water becomes more available occurs throughout the San Joaquin Valley.

R.1.2 Trinity River

The Trinity River region includes the area in Trinity County along the Trinity River from Trinity Lake to the confluence with the Klamath River, and in Del Norte and Humboldt Counties along the lower Klamath River from the confluence with the Trinity River.

No M&I land or agricultural uses in the Trinity River area are served by CVP and SWP water supplies.

R.1.2.1 Land Use

Trinity County

Trinity County encompasses approximately 2,051,840 acres in northwestern California. It is bounded on the north by Siskiyou County, on the east by Shasta and Tehama counties, on the south by Mendocino County, and on the west by Humboldt County. About 76% of the land area is within a national forest (Shasta-Trinity, Six Rivers, and Mendocino) and in four wilderness areas (Yolla Bolly-Middle Eel Reserve, Trinity Alps, Chanchellula, and North Fork). Another 14% is zoned for timber use or held in agriculture land conservation contracts (Trinity County 2020).

The headwaters of the Trinity River are in the northeastern part of the county at an elevation of 6,200 feet in the southern Siskiyou Mountains. Trinity Reservoir and Lewiston Reservoir are located along the middle reach of the mainstem Trinity River. Downstream of Lewiston Dam, the river flows northwest to join the Klamath River in Humboldt County. Development of communities is relatively limited in Trinity County because much of the land is within national forests and tribal lands or is characterized by steep slopes. The largest communities in Trinity County include Lewiston, Weaverville, and Hayfork (Trinity County 2020).

Trinity County's primary industries are tourism and timber and it is the sixth largest timber producer in the state, with substantial acreage in national forest and private holdings. There is one operating mill in the county. Recreational opportunities are also important in this area (Trinity County 2020).

The portion of Trinity County in the Trinity River region that could be affected by the changes in CVP and/or SWP operations evaluated in this EIS includes areas in the vicinity of CVP facilities (Trinity Reservoir and Lewiston Reservoir) and areas along the Trinity River between Trinity Reservoir and Lewiston Reservoir.

Humboldt County

Humboldt County encompasses approximately 2,286,720 acres in northwestern California. It is bounded on the north by Del Norte County, on the east by Siskiyou and Trinity counties, on the south by Mendocino County, and on the west by the Pacific Ocean. About 35% of the land area is within the Six Rivers National Forest, Trinity Alps Wilderness Area, Redwood National and State Parks, national wildlife refuges, or other public land. About 50% of the land is used for private commercial timberland. Most of the population and developed areas are located in western Humboldt County along U.S. Highway 101 (Humboldt County 2017).

Humboldt County's economy has become more diverse. While resource production overall has declined, timber, dairy farming, cattle ranching, and fishing are still significant components of the economy, while habitat restoration, sustainable forest management, organic milk production, and computer network services are newer local industries. Humboldt County has long been the state's leading timber producer, contributing more than 20% of it since 2000 (Humboldt County 2017).

The portion of Humboldt County in the Trinity River region evaluated in this EIS is located along the Trinity and Klamath rivers. This portion of the county includes the communities of Willow Creek and Orleans within Humboldt County; Hoopa in the Hoopa Valley Indian Reservation; and the communities of Weitchpec, Cappell, Pecwan, and Johnson's in the Yurok Tribe Indian Reservation.

Del Norte County

Del Norte County encompasses 684,800 acres in northwestern California. It is bounded on the north by the State of Oregon, on the east by Siskiyou County, on the south by Humboldt County, and on the west by the Pacific Ocean. Del Norte County includes lands within national forests (Six Rivers and Rogue River-Siskiyou), Smith River National Recreation Area, Redwood National and State Parks, or other federally owned land. State lands include units of the Redwoods State Park and the Lake Earl Wildlife Area. The Yurok tribal lands are located along the lower Klamath River between the Del Norte and Humboldt County boundaries to the Pacific Ocean (Del Norte County 2003).

The portion of Del Norte County in the Trinity River region evaluated in this EIS is located along the lower Klamath River. This portion of the county includes the communities of Requa and Klamath in the Yurok Tribe Indian Reservation.

R.1.2.2 Tribal Lands in the Trinity River Region

Table R-4 summarizes the tribal lands that could be affected by the changes in CVP and/or SWP operations and that are located within the county boundaries.

Table R-4. Federally Recognized Tribes and Tribal Lands in the Trinity River Region

County	Federally Recognized Tribe or Tribal Lands
Del Note	Yurok Indian Reservation, Resighini Rancheria, Elk Valley Rancheria, Tolowa Dee-ni' Nation
Humboldt	Hoopa Valley Indian Reservation, Yurok Indian Reservation, Cher-Ae Heights Indian Community of the Trinidad Rancheria, Big Lagoon Rancheria, Blue Lake Rancheria, Wiyot Tribe, Bear River Band of the Rohnerville Rancheria
Trinity	Round Valley Indian Tribes Reservation

Source: Bureau of Indian Affairs 2023.

R.1.2.3 Agricultural Resources

Agriculture in the Trinity River region is primarily related to timber products and cattle ranching which generally do not rely upon irrigation. Small farms and vineyards located adjacent to or near the Trinity River rely primarily upon groundwater that is recharged by precipitation and infiltration from local streams. No lands in Trinity River region are irrigated with water supplies delivered through the CVP or SWP.

Total value of production and acreage by crop category in the counties that include portions of the Trinity River region are listed in Table R-5.[1]

Table R-5. Approximate Average Annual Agricultural Acreage and Value of Production in Counties in the Trinity River Region from 2016 through 2019

Crop Category	Acreage [a]	Value [b]
Orchards, Vineyards, Berries	44	$2,243,765
Field and Forage	161,379	$12,831,125
Livestock, Dairy, Poultry	0	$259,267,500
Nursery, Other	340	$76,127,620
Vegetable	0	$3,037,265
Total	**161,763**	**$353,507,275**

Sources: U.S. Department of Agriculture 2016, 2017, 2018, 2019.
[a] Not all acreages and/or production values are reported for every crop in every county. Therefore, the implied value of production per acre may be misleading for some crop categories.
[b] Values in inflation-adjusted 2022 dollars (Bureau of Labor Statistics 2023).

Trinity, Humboldt, and Del Norte counties are not within the Farmland Mapping and Monitoring Program survey area.

R.1.3 Sacramento River

The Sacramento Valley includes Butte, Colusa, El Dorado, Glenn, Nevada, Placer, Plumas, Sacramento, Shasta, Sutter, Tehama, Yuba, and Yolo counties. Solano County is discussed in Section R.1.8, *San Francisco Bay Area Region*. Other counties in Sacramento Valley are not anticipated to be affected by changes in CVP and SWP operations: Alpine, Sierra, Lassen, and Amador counties; therefore, they are not discussed here.

R.1.3.1 Land Use

Butte County

Butte County encompasses 1,075,200 acres in Northern California. It is bounded on the north by Tehama County, on the east by Plumas County, on the west by Glenn and Colusa counties, and on the south by Sutter and Yuba counties. Butte County includes lands within national forests (Plumas and Lassen) and Sacramento National Wildlife Refuge (Butte County 2010). State lands in Butte County include Big Chico Creek and Butte Creek ecological preserves; Table Mountain Ecological Reserve; Gray Lodge, Sacramento River, and Oroville Wildlife Areas; SWP facilities at Lake Oroville and Thermalito Reservoir. Agriculture is the dominant land use within

[1] Trinity, Humboldt, and Del Norte Counties have not released county crop data reports since 2015 and 2016. The counties are therefore not included in the California County Agricultural Commissioners' Reports starting in 2020. Previous versions of the California County Agricultural Commissioners' Report used 2015 data for Del Norte County and 2016 data for Humboldt and Trinity Counties.

unincorporated Butte County, accounting for approximately 474,282 acres (46% of the county area) (Butte County 2023).

The county comprises three general topographical areas: valley region, foothills east of the valley, and mountain region east of the foothills. Each of these regions contains distinct environments with unique wildlife and natural resources. Butte County contains five incorporated municipalities: Biggs, Chico, Gridley, Oroville, and Paradise (Butte County 2010).

The portion of Butte County that could be affected by the changes in CVP and/or SWP operations evaluated in this EIS includes wildlife refuges, SWP facilities, CVP facilities, and CVP and SWP water service areas.

Colusa County

Colusa County encompasses approximately 725,120 acres in Northern California. It is bounded on the north by Glenn County, on the east by Butte and Sutter counties, on the west by Lake County, and on the south by Yolo County. Colusa County includes lands within the Mendocino National Forest, Sacramento National Wildlife Refuge complex (Colusa, Delevan, and Sacramento national wildlife refuges); Willow Creek-Lurline and North Central Valley wildlife areas; and East Park Reservoir. State lands in Colusa County include Colusa Bypass and Sacramento River wildlife areas (Colusa County 2010).

Existing land uses in Colusa County are predominantly agricultural. Approximately 76% of the county's total land area is cropland or undeveloped rangeland. National forest and national wildlife refuge land makes up 12% of the county. Less than 1% is covered by urban and rural residential uses. Colusa and Williams are the only incorporated cities in the county, and they encompass about 2,574 acres. Arbuckle is the largest unincorporated town of the county's unincorporated communities, which include Arbuckle, College City, Century Ranch, Grimes, Maxwell, Princeton, and Stonyford. Together, these established incorporated and unincorporated towns cover a total area in "urban" uses of about 5,451 acres (Colusa County 2010).

The portion of Colusa County that could be affected by the changes in CVP and/or SWP operations evaluated in this EIS includes wildlife refuges and CVP facilities, areas along the Sacramento River that use the surface waters (including agricultural lands), and CVP water service areas.

El Dorado County

El Dorado County encompasses approximately 1,145,600 acres in Northern California along the American River. It is bounded on the north by Placer County, on the east by California-Nevada boundaries, on the west by Sacramento County, and on the south by Amador and Alpine counties. El Dorado County includes about 521,210 acres (45.5% of the total county), under federal ownership or trust, including lands within the El Dorado and Tahoe National Forests. About 9,751 acres (8.5% of the county), is under state jurisdiction (El Dorado County 2003).

The county includes two specific regions: the Lake Tahoe Basin and the western slopes of the Sierra Nevada. El Dorado County includes two incorporated cities, Placerville, and South Lake Tahoe. Other major communities include El Dorado Hills, Cameron Park, Shingle Springs, and Pollock Pines. The rural land uses in the county include 377,000 acres of federally controlled

timberland, 259,000 acres of private production forests, 153,472 acres of agricultural lands, and 35,282 acres within the waters of Folsom Reservoir and Lake Tahoe (El Dorado County 2003).

The portion of El Dorado County that could be affected by the changes in CVP and/or SWP operations evaluated in this EIS includes CVP water facilities (Folsom Reservoir), areas along the American River that use the surface waters, and CVP water service areas.

Glenn County

Glenn County encompasses 842,880 acres in Northern California. It is bounded on the north by Tehama County, on the east by Butte County, on the west by Lake and Mendocino counties, and on the south by Colusa County. Glenn County includes lands within the Mendocino National Forest, Sacramento National Wildlife Refuge, and other federally owned land (Glenn County 1993). Approximately two-thirds (583,974 acres) of this county are croplands and pasture. The two incorporated towns in the county are Willows, the county seat, and Orland. Intensive agriculture provides a major segment of the county's economic base (Glenn County 1993).

The portion of Glenn County that could be affected by the changes in CVP and/or SWP operations evaluated in this EIS includes wildlife refuges, and CVP facilities, areas along the Sacramento River that use the surface waters (including agricultural lands), and CVP water service areas.

Nevada County

Nevada County encompasses approximately 634,880 acres in Northern California. It is bounded on the north by Sierra County, on the northwest by Yuba County, and on the south by Placer County. Federally owned lands in Nevada County include 169,045 acres in the Tahoe National Forest and approximately 20,000 acres administered by the Bureau of Land Management; and the Department of Fish and Wildlife administers approximately 11,000 acres at the Spenceville Wildlife Management and Recreation Area. Nevada County is predominantly rural. Approximately 56% of the county is forest. Most of the population lives in the three incorporated cities in the county, which are Grass Valley, Nevada City, and Truckee (Nevada County 1996).

The portion of Nevada County that could be affected by the changes in CVP and/or SWP operations evaluated in this EIS includes CVP water service areas.

Placer County

Placer County encompasses approximately 963,840 acres in Northern California. It is bounded on the north by Nevada County, on the east by the California-Nevada boundary, on the west by Yuba and Sutter counties, and on the south by Sacramento and El Dorado counties (Placer County 2023a). Placer County includes lands within the El Dorado and Tahoe National Forests and other federally owned land (Placer County 2013).

Placer County is predominantly rural or open space. Most of the population lives in the area along Interstate (I)-80 from Auburn to the Sutter and Sacramento County boundaries (Placer County 2013). Incorporated cities and towns include Roseville, Rocklin, Lincoln, Colfax, Loomis, and Auburn (Placer County 2023b). Residential land uses range from rural residential areas to medium and high-density dwelling units in urbanized areas. Commercial land uses are primarily located in the urbanized portions of the county. Non-urban land uses include

agriculture, resource extraction (e.g., timber), and public lands and open spaces (Placer County 2013).

The portion of Placer County that could be affected by the changes in CVP and/or SWP operations evaluated in this EIS includes CVP water facilities (Folsom Lake), areas along the American River that use the surface waters (including agricultural lands), and CVP water service areas.

Plumas County

Plumas County encompasses approximately 1,672,320 acres in Northern California. It is bounded on the north by Shasta County, on the east by Lassen County, on the west by Tehama and Butte counties, and on the south by Sierra County. Plumas County includes lands within national forests (Plumas, Lassen, Toiyabe, and Tahoe), Lassen Volcanic National Park, or other federally owned land. Approximately 65% of the land in Plumas County is national forest land owned and managed by the U.S. Forest Service. The county's only incorporated area is the city of Portola. The largest land uses in the county are dedicated to timberland or other managed resource uses (Plumas County 2013).

The portion of Plumas County that could be affected by the changes in CVP and/or SWP operations evaluated in this EIS is located at the SWP Antelope Lake, Lake Davis, and Frenchman Lake.

Sacramento County

Sacramento County encompasses approximately 636,160 acres in Northern California. It is bounded on the north by Sutter and Placer counties, on the east by El Dorado and Amador counties, on the south by Contra Costa and San Joaquin counties, and on the west by Yolo and Solano counties. Sacramento County includes federally owned lands within Folsom Reservoir and Lake Natoma (Sacramento County 2010).

Residential areas in Sacramento County primarily occur in northern and central Sacramento County. Sacramento County has seven incorporated cities: Sacramento, Elk Grove, Citrus Heights, Folsom, Galt, Isleton, and Rancho Cordova. The County includes several unincorporated communities including Antelope, Arden-Arcade, Carmichael, South Natomas, North Natomas, North Highlands-Foothill Farms, Orangevale, Rancho Murieta, and Rio Linda-Elverta. Agricultural uses are focused in the southwestern, eastern, and southern areas of the county (Sacramento County 2010).

The portion of Sacramento County that could be affected by the changes in CVP and/or SWP operations evaluated in this EIS includes CVP facilities (Folsom Reservoir and Lake Natoma), areas along the American and Sacramento rivers and Bay-Delta channels that use the surface waters (including agricultural lands), and CVP water service areas.

Shasta County

Shasta County encompasses approximately 2,416,640 acres in Northern California. It is bounded on the north by Siskiyou County, on the east by Lassen County, on the south by Tehama County, and on the west by Trinity County. Shasta County includes lands within national forests (Shasta-

Trinity, Whiskeytown-Shasta-Trinity, and Lassen), Lassen Volcanic National Park, or other federally owned land. State lands include state forest and state parks (Shasta County 2004).

Of Shasta County's 2,416,440 acres, 613,495 acres (25%) are designated as timber preserve lands pursuant to California's Forest Taxation Reform Act of 1976. Approximately 169,127 acres (7%), are designated as agricultural preserve lands. Approximately 1.2% of the lands in the county are within incorporated areas. Urban development is concentrated in the southern central portion of the county in the cities of Redding, Anderson, and Shasta Reservoir (Shasta County 2004).

The portion of Shasta County that could be affected by the changes in CVP and/or SWP operations evaluated in this EIS includes CVP facilities (Shasta Reservoir, Keswick Reservoir, and Whiskeytown Reservoir), areas along the Sacramento River and Clear Creek that use the surface waters (including agricultural lands), and CVP water service areas.

Sutter County

Sutter County encompasses approximately 388,538 acres in Northern California. It is bounded on the north by Butte County, on the east by Yuba and Placer counties, on the west by Colusa and Yolo counties, and on the south by Sacramento County. Sutter County includes lands within the Sutter National Wildlife Refuge. State lands in Sutter County include Gray Lodge, Sutter Bypass, and Butte Sink wildlife areas; and Sutter Buttes State Park (not open to the general public) (Sutter County 2008).

Approximately 98% of the land in the county is unincorporated, and approximately 98% of the unincorporated land is zoned for agricultural use (Bureau of Reclamation 2004). The two incorporated cities within the county, Yuba City and Live Oak, encompass approximately 10,130 acres. Existing land uses in Yuba City and Live Oak contain the bulk of the county’s urban land uses, such as residences, commercial and industrial uses, parks, and public facilities. The county includes several incorporated rural communities: Meridian, Sutter, Robbins, Rio Oso, Trowbridge, Nicolaus, East Nicolaus, and Pleasant Grove (Sutter County 2008).

The portion of Sutter County that could be affected by the changes in CVP and/or SWP operations evaluated in this EIS includes wildlife refuges, CVP facilities, areas along the Sacramento River that use the surface waters (including agricultural lands), and CVP and SWP water service areas.

Tehama County

Tehama County encompasses approximately 1,892,500 acres in Northern California. It is bounded on the north by Shasta County, on the east by Plumas County, on the west by Trinity and Mendocino counties, and on the south by Glenn and Butte counties. Tehama County includes lands within national forests (Lassen, Mendocino, and Shasta-Trinity), Lassen Volcanic National Park, and other federally owned land (Tehama County 2009).

Tehama County is predominantly rural, with about 34% of the population concentrated in the incorporated cities of Corning and Red Bluff. Much of the land use is resource-based, such as cropland, rangeland, pasture land, and timber land. The primary incorporated and unincorporated developed areas in the county are adjacent to major transportation centers, with most adjacent to I-5 and State Route 99. Clustered commercial land uses are located primarily along the major

state and county roadways, most of which are near Red Bluff, Corning, and the unincorporated community of Los Molinos. Residential land uses in the developed portions of the county tend to be located behind or beyond the commercial and service uses adjacent to the major street network (Tehama County 2009).

The portion of Tehama County that could be affected by the changes in CVP and/or SWP operations evaluated in this EIS includes CVP facilities, areas along the Sacramento River that use the surface waters (including agricultural lands), and CVP water service areas.

Yolo County

Yolo County encompasses approximately 418,271,360 acres in Northern California. It is bounded on the north by Colusa County, on the east by Sutter and Sacramento counties, on the south by Solano County, and on the west by Lake and Napa counties. Yolo County includes federally owned lands in the Yolo Bypass and state lands within the Yolo Bypass (Yolo County 2009a).

More than 85% of the county area is used for agriculture. Residential areas in Yolo County primarily occur in the county's four incorporated cities (Davis, West Sacramento, Winters, and Woodland) that comprise approximately 32,325 acres (5%) of county lands. The unincorporated portion of the county encompasses 35 community areas, including Capay, Clarksburg, Dunnigan, Esparto, Guinda, Knights Landing, Madison, Monument Hills, Rumsey, Yolo, and Zamora (Yolo County 2009a).

The 59,000-acre Yolo Bypass is primarily located within Yolo County and includes a portion of the Sacramento River Flood Control Project. The upper section of the Yolo Bypass is defined as the area between Fremont Weir and I-80 and is located within Yolo County. The lower section is defined as the area between I-80 and the southern boundary of Egbert Tract at the Sacramento River (CALFED Bay-Delta Program et al. 2001). Agricultural uses are located in the Yolo Bypass, and approximately 16,770 acres in the southern Yolo Bypass is within the Yolo Bypass Wildlife Area (Yolo County 2009b).

The portion of Yolo County that could be affected by the changes in CVP and/or SWP operations evaluated in this EIS includes areas in the Yolo Bypass and along the Bay-Delta channels that use the surface waters (including agricultural lands), and CVP water service areas.

Yuba County

Yuba County encompasses approximately 412,160 acres in Northern California. It is bounded on the north by Butte County, on the east by Sierra and Nevada counties, on the west by Sutter County, and on the south by Placer County. Federally owned lands in Yuba County include Tahoe and Plumas National Forests, and the 22,944-acre Beale Air Force Base. The Department of Fish and Wildlife administers the Spenceville Wildlife Refuge (Yuba County 2011a).

Yuba County is predominantly rural. About 226,588 acres (55% of the county) are considered agricultural land (Yuba County 2011b). There are two incorporated cities in the county (Marysville and Wheatland) and several major unincorporated communities (e.g., Loma Rica/Brown's Valley, Brownsville, Camptonville, Dobbins, Log Cabin, Oregon House, and Rackerby) (Yuba County 2011b).

The portion of Yuba County that could be affected by the changes in CVP and/or SWP operations evaluated in this EIS includes areas within Yuba County Water Agency facilities that provide water for environmental and water supply purposes within the Central Valley.

R.1.3.2 Tribal Lands in the Sacramento River Region

Table R-6 summarizes the tribal lands that could be affected by the changes in CVP and/or SWP operations and that are located within the county boundaries.

Table R-6. Federally Recognized Tribes and Tribal Lands in the Sacramento River Region

County	Federally Recognized Tribe or Tribal Lands
Butte	Berry Creek Rancheria of Maidu Indians, Mooretown Rancheria of Maidu Indians, Mechoopda Indian Tribe of Chico Rancheria and Enterprise Rancheria of Maidu Indians of California
Colusa	Cachil Dehe Band of Wintun Indians of the Colusa Indian Community of the Colusa Rancheria, the Kletsel Dehe Band of Wintun Indians
El Dorado	Shingle Springs Band of Miwok Indians
Glenn	Grindstone Indian Rancheria of Wintun-Wailaki Indians of California and Paskenta Band of Nomlaki Indians of California
Nevada	None
Placer	United Auburn Indian Community of the Auburn Rancheria of California
Plumas	Greenville Rancheria
Sacramento	Wilton Rancheria and the Buena Vista Rancheria of Me-Wuk Indians of California
Shasta	Pit River Tribe and Redding Rancheria
Sutter	None
Tehama	Paskenta Band of Nomlaki Indians of California
Yolo	Yocha Dehe Wintun Nation
Yuba	Enterprise Rancheria

Sources: Bureau of Indian Affairs 2023; Paskenta Band of Nomlaki Indians 2023.

R.1.3.3 Agricultural Resources

Crops grown in the Sacramento River region include almonds, walnuts, rice, pasture, and grain. Crop establishment and production costs are generally similar to those shown in Table R-2 and Table R-3. In total, the Sacramento River region contains about 4,000,000 acres planted, creating nearly six billion dollars per year in value of production. Table R-7 shows the acreage and production value of agricultural activity in the Sacramento River region, 2016–2021.

Table R-7. Average Annual Agricultural Acreage and Value of Production in Counties in the Sacramento River Region from 2016 through 2021

Crop Category	Acreage [a]	Value [b]
Orchards, Vineyards, Berries	589,688	$2,880,945,589
Field and Forage	3,641,703	$1,410,225,258
Livestock, Dairy, Poultry	0	$496,894,106
Nursery, Other	62,855	$470,236,489
Vegetable	148,103	$441,537,921
Total	**4,442,348**	**$5,699,839,363**

Sources: U.S. Department of Agriculture 2016, 2017, 2018, 2019, 2020, 2021.
[a] Not all acreages and/or production values are reported for every crop in every county. Therefore, the implied value of production per acre may be misleading for some crop categories.
[b] Values in inflation-adjusted 2022 dollars (Bureau of Labor Statistics 2023).

Changes in farmland in the Sacramento River region counties are summarized in Table R-8. Overall, the Sacramento River region saw a decrease of approximately 96,000 acres in Important Farmland within the 10-year period from 2008–2018.

Table R-8. Farmland Mapping and Monitoring Program Acreages in the Sacramento River Region in 2008 and 2018

		Important Farmland [b]			Grazing Land		
County	Total [a]	2008	2018	Change	2008	2018	Change
Butte	**1.1**	240,561	238,871	-1,690	401,859	398,764	-3,095
Colusa	**0.7**	555,718	543,608	-12,110	9,111	15,869	6,758
El Dorado	**0.5**	65,106	62,814	-2,292	194,778	195,162	384
Glenn	**0.8**	348,158	349,444	1,286	227,391	225,287	-2,104
Nevada	**0.3**	25,963	7,760	-18,203	116,866	133,393	16,527
Placer	**0.4**	133,923	120,332	-13,591	24,448	33,967	9,519
Plumas	**NI**	NI	NI	NI	NI	NI	NI
Sacramento	**0.6**	201,596	213,118	-11,522	156,144	149,987	-6,157
Shasta	**1.0**	22,189	18,930	-3,259	412,731	414,283	1,552

County	Total [a]	Important Farmland [b]			Grazing Land		
		2008	2018	Change	2008	2018	Change
Sutter	**0.4**	291,068	278,010	-13,058	52,571	54,110	1,539
Tehama	**1.8**	230,931	233,262	2,331	1,549,800	1,543,357	-6,443
Yolo	**0.6**	378,081	356,944	-21,137	157,963	165,921	7,958
Yuba	**0.4**	84,952	81,838	-3,114	141,639	139,557	-2,082

Source: California Department of Conservation 2023.
[a] Total inventoried acreage of county in million acres.
[b] Includes Prime Farmland, Farmland of Statewide Importance, and Unique Farmland.
NI = not inventoried

R.1.4 Clear Creek

The Clear Creek region is located within Shasta County. Shasta County is discussed in Section R.1.3, *Sacramento River*.

R.1.5 American River

The American River Region is located within El Dorado, Placer, and Sacramento counties. These counties are considered in Sections R.1.3, *Sacramento River*.

R.1.6 Stanislaus River

Alpine, Calaveras, and Tuolumne counties are not expected to be affected by changes in CVP and SWP operation. San Joaquin County and Stanislaus County are discussed in Section R.1.7, *San Joaquin River*.

R.1.7 San Joaquin River

The San Joaquin Valley includes Fresno, Kern, Kings, Madera, Merced, San Joaquin, Stanislaus, and Tulare counties. Calaveras, Mariposa, and Tuolumne counties are not anticipated to be affected by changes in CVP and SWP operations and are not discussed in this appendix.

R.1.7.1 Land Use

Fresno County

Fresno County encompasses approximately 3,840,000 acres in central California. It is bounded on the north by Merced and Madera counties, on the east by Mono and Inyo counties, on the south by Kings and Tulare counties, and on the west by San Benito and Monterey counties (Fresno County 2021).

Fresno County includes lands within Millerton Lake, Pine Flat Reservoir, the Sierra and Sequoia national forests, and Kings Canyon Sequoia National Park. State lands within the county include

the Millerton Lake State Recreation Area, San Joaquin River Parkway, and Mendota Wildlife Area (Fresno County 2021).

A substantial amount of the county is used for agricultural land. Development constraints within the county are primarily caused by agricultural preservation policies, natural hazards like earthquakes and flooding, water availability, expanding oil field operations, and sensitive species protections. The incorporated cities are Clovis, Coalinga, Firebaugh, Fowler, Fresno, Huron, Kerman, Kingsburg, Mendota, Orange Cove, Parlier, Reedley, Sanger, San Joaquin, and Selma. Unincorporated communities include Friant, Laton, Riverdale, Easton, and Tranquillity (Fresno County 2021).

The portion of Fresno County that could be affected by the changes in CVP and/or SWP operations evaluated in this EIS includes CVP water facilities (Millerton Lake and the Friant-Kern Canal), areas along the San Joaquin River that use the surface waters, and CVP water service areas (including agricultural lands).

Kern County

Kern County encompasses approximately 5,249,280 acres in south central California. It is bounded on the north by Kings, Tulare, and Inyo counties; on the east by San Bernardino County; on the south by Ventura and Los Angeles counties; and on the west by San Luis Obispo County. Kern County includes lands within the Sequoia National Forest, Kern and Bitter Creek National Wildlife Refuges, Lake Isabella, China Lake Naval Air Weapons Station, and Edwards Air Force Base. State lands within the county include the Tule Elk State Preserve (Kern County 2004).

The county's geography includes mountainous regions, agricultural lands, and deserts. There are 11 incorporated cities in the county: Arvin, Bakersfield, California City, Delano, Maricopa, McFarland, Ridgecrest, Shafter, Taft, Tehachapi, and Wasco. Unincorporated communities include Kernville, Lake Isabella, Inyokern, Mojave, Boron, Rosamond, Golden Hills, Stallion Springs, and Buttonwillow. Agricultural land uses are designated for approximately 85% of the unincorporated lands that are under the jurisdiction of the county (not including lands under the jurisdiction of the federal, state, tribes, or incorporated cities). Less than 6% of the unincorporated lands under county jurisdiction are designated for residential uses (Kern County 2004).

The portion of Kern County that could be affected by the changes in CVP and/or SWP operations evaluated in this EIS includes CVP and SWP water service areas.

Kings County

Kings County encompasses approximately 890,240 acres in south central California. It is bounded on the north by Fresno County, on the east by Tulare County, on the south by Kern County, and on the west by Monterey County. Kings County includes lands within Naval Air Station Lemoore (Kings County 2010).

Land use is predominantly agricultural, with more than 90% of the county designated for agricultural uses. Incorporated cities in Kings County are Avenal, Corcoran, Hanford, and

Lemoore, and population in unincorporated areas is concentrated in the communities of Armona, Home Garden, Kettleman City, and Stratford (Kings County 2010).

The portion of Kings County that could be affected by the changes in CVP and/or SWP operations evaluated in this EIS includes CVP and SWP water service areas.

Madera County

Madera County encompasses approximately 1,374,080 acres in central California. It is bounded on the north by Merced and Mariposa counties, on the east by Mono County, and on the south and west by Fresno County. Madera County includes lands within the Sierra and Inyo National Forests. State lands within the county include the Millerton Lake State Recreation Area (Madera County 1995).

Madera County can be divided generally into three regions: the San Joaquin Valley in the west, the foothills between the Madera Canal and the 3,500-foot elevation contour, and the mountains from the 3,500-foot contour to the crest of the Sierra Nevada. The county has two incorporated cities: Madera and Chowchilla. Unincorporated communities in the county include North Fork, Oakhurst, and Coarsegold (Madera County 1995).

The portion Madera County that could be affected by the changes in CVP and/or SWP operations evaluated in this EIS includes CVP water facilities (Millerton Lake and the Madera Canal), areas along the San Joaquin River that use the surface waters (including agricultural lands), and CVP water service areas.

Merced County

Merced County encompasses approximately 1,238,974 acres in central California. It is bounded on the north by Stanislaus County, on the east by Mariposa County, on the south by Fresno and Madera counties, and on the west by Santa Clara and San Benito counties. Merced County includes federally owned lands within the San Luis National Wildlife Refuge. State lands within the county include San Luis Reservoir State Recreation Area; Great Valley Grasslands State Park; and the Los Banos, North Grasslands, and Volta Wildlife Areas (Merced County 2013).

Merced County has six incorporated cities of Atwater, Dos Palos, Gustine, Livingston, Los Banos, and Merced. Unincorporated communities include Delhi, Hilmar, Le Grand, Planada, Santa Nella, and Winton. Agriculture is the primary land use, at over 90% of all land in the county (Merced County 2013).

The portion of Merced County that could be affected by the changes in CVP and/or SWP operations evaluated in this EIS includes wildlife refuges, CVP and SWP water facilities (San Luis Reservoir, Delta-Mendota Canal, and San Luis Canal/California Aqueduct), areas along the San Joaquin River that use the surface waters (including agricultural lands), and CVP water service areas.

San Joaquin County

San Joaquin County encompasses approximately 920,000 acres in central California. It is bounded on the north by Sacramento County, on the east by Calaveras and Amador counties, on

the south by Stanislaus County, and on the west by Contra Costa and Alameda counties (San Joaquin County 2016).

Most of the county's land is in agricultural production. Residential development in the county is concentrated in existing cities and in adjacent unincorporated communities. San Joaquin County has seven incorporated cities: Stockton, Tracy, Manteca, Escalon, Ripon, Lodi, and Lathrop. The major unincorporated areas in the county include French Camp, Linden, Lockeford, Morada, Mountain House, Thornton, and Woodbridge (San Joaquin County 2016).

The portion of San Joaquin County that could be affected by the changes in CVP and/or SWP operations evaluated in this EIS includes CVP and SWP facilities (including facilities associated with Rock Slough Pumping Plant, Jones Pumping Plant, Clifton Court, and Banks Pumping Plant), areas along the Bay-Delta channels that use the surface waters (including agricultural lands), and CVP water service areas.

Stanislaus County

Stanislaus County encompasses approximately 960,000 acres in central California. It is bounded on the north by San Joaquin County, on the east by Calaveras and Tuolumne counties, on the west by Santa Clara County, and on the south by Merced County. Stanislaus County includes lands within the Turlock State Recreation Area (Stanislaus County 2016).

Land use in the county is primarily agricultural, but it is considered an agricultural county in transition due to its proximity to the San Francisco Bay Area and relatively lower cost of living. Unprecedented population growth throughout the 1990s increased pressure to convert productive agricultural lands to non-agricultural uses. Incorporated cities are Ceres, Hughson, Modesto, Newman, Oakdale, Patterson, Riverbank, Turlock, and Waterford. Stanislaus County has adopted community plans for most of its unincorporated towns, including Crows Landing, Del Rio, Denair, Hickman, Keyes, Knights Ferry, La Grange, Westley, and Salida (Stanislaus County 2016).

The portion of Stanislaus County that could be affected by the changes in CVP and/or SWP operations evaluated in this EIS includes wildlife refuges, CVP water facilities (New Melones Reservoir, Delta-Mendota Canal, and San Luis Canal/California Aqueduct), areas along the Stanislaus and San Joaquin rivers that use the surface waters (including agricultural lands), and CVP water service areas.

Tulare County

Tulare County encompasses approximately 3,096,960 acres in south central California. It is bounded on the north by Fresno County, on the east by Inyo County, on the south by Kern County, and on the west by Kings County. Tulare County includes federally owned lands within the Sequoia National Forest, Sequoia and Kings Canyon National Parks, several wilderness areas, Lake Kaweah, and Lake Success (Tulare County 2012).

Federal land makes up about 52% of the county, while agricultural uses cover about 43% of the County. The remaining portion of the County has land uses such as County parks, communities, hamlets, and rights of way. Less than 2% of the county is designated for unincorporated residential areas, including the major communities of Alpaugh, Cutler, Ducor, Earlimart, East

Oros, Goshen, Ivanhoe, Lemoncove, London, Oros, Pixley, Plainview, Poplar-Cotton Center, Richgrove, Springville, Strathmore, Terra Bella, Three Rivers, Tipton, Traver, and Woodville (Tulare County 2012).

The portion of Tulare County that could be affected by the changes in CVP and/or SWP operations evaluated in this EIS includes CVP water service areas.

R.1.7.2 Tribal Lands in the San Joaquin River Region

Table R-9 summarizes the tribal lands that could be affected by the changes in CVP and/or SWP operations and that are located within the county boundaries described above.

Table R-9. Federally Recognized Tribes and Tribal Lands in the San Joaquin River Region

County	Federally Recognized Tribe or Tribal Lands
Fresno	Picayune Rancheria of Chukchansi Indians of California, Table Mountain Rancheria, Big Sandy Rancheria of Western Mono Indians of California, Cold Springs Rancheria of Mono Indians of California, California Valley Miwok Tribe
Kern	Tejon Indian Tribe
Kings	Santa Rosa Indian Community of Santa Rosa Rancheria
Madera	Northfork Rancheria of Mono Indians and Picayune Rancheria of Chukchansi Indians
Merced	None
San Joaquin	None
Stanislaus	None
Tulare	Tule River Indian Tribe of the Tule River Reservation

Source: Bureau of Indian Affairs 2023.

R.1.7.3 Agricultural Resources

Crops grown in the San Joaquin River region include almonds, alfalfa, silage, and wine grapes. Crop establishment and production costs are generally similar to those shown in Table R-2 and Table R-3. In total, the San Joaquin River region contains about 9,500,000 acres planted, creating over forty-one billion dollars per year in value of production. Table R-10 shows the acreage and production value of agricultural activity in the San Joaquin River region, 2016–2021.

Table R-10. Average Annual Agricultural Acreage and Value of Production in Counties in the San Joaquin River Region from 2016 through 2021

Crop Category	Acreage [a]	Value [b]
Orchards, Vineyards, Berries	2,673,813	$22,785,422,350
Field and Forage	6,065,373	$2,268,219,579
Livestock, Dairy, Poultry	-	$11,418,838,222
Nursery, Other	14,450	$1,537,213,024
Vegetable	700,931	$3,286,818,635
Total	**9,454,566**	**$41,296,511,810**

Sources: U.S. Department of Agriculture 2016, 2017, 2018, 2019, 2020, 2021.
[a] Not all acreages and/or production values are reported for every crop in every county. Therefore, the implied value of production per acre may be misleading for some crop categories.
[b] Values in inflation-adjusted 2022 dollars (Bureau of Labor Statistics 2023).

Changes in farmland in the San Joaquin River region counties are summarized in Table R-11. Overall, the San Joaquin River region saw a decrease of approximately 166,000 acres in Important Farmland within the 10-year period from 2008–2018.

Table R-11. Farmland Mapping and Monitoring Program Acreages in the San Joaquin River Region in 2008 and 2018

		Important Farmland [b]			Grazing Land		
County	Total [a]	2008	2018	Change	2008	2018	Change
Fresno	**2.4**	1,376,278	1,355,142	-21,136	826,953	822,455	-4,498
Kern	**2.7**	939,221	874,026	-65,195	1,807,069	1,854,641	47,572
Kings	**0.9**	568,104	459,031	-109,073	257,746	358,341	100,595
Madera	**0.9**	374,909	362,743	12,166	399,501	380,326	-19,175
Merced	**1.3**	593,491	589,190	-4,301	567,392	557,711	-9,681
San Joaquin	**0.9**	615,785	615,690	95	142,460	126,902	-15,558
Stanislaus	**1.0**	400,141	428,450	28,309	434,137	400,541	-33,596
Tulare	**1.6**	864,435	858,013	-6,422	439,851	440,213	362

Source: California Department of Conservation 2023.
[a] Total surveyed acreage of county in million acres.
[b] Includes Prime Farmland, Farmland of Statewide Importance, and Unique Farmland.

R.1.8 San Francisco Bay Area Region

The San Francisco Bay Area region includes portions of Alameda, Contra Costa, Napa, San Benito, Santa Clara, and Solano counties that are within the CVP and SWP service areas.

R.1.8.1 Land Use

Alameda County

Alameda County encompasses approximately 472,320 acres in Northern California (Alameda County 2014). It is bounded on the north by Contra Costa County, on the east by San Joaquin County, on the south by Santa Clara County, and on the west by San Francisco Bay.

Western Alameda County and the portions of the Livermore-Amador Valley are heavily urbanized. The incorporated cities include Oakland, which is the county seat, Alameda, Albany, Berkeley, Dublin, Emeryville, Fremont, Hayward, Livermore, Newark, Piedmont, Pleasanton, San Leandro, and Union City. The unincorporated area of the county covers approximately includes the Castro Valley and Eden Area (Alameda County 2014). Large portions of the unincorporated areas located to the east of Castro Valley and within the Livermore-Amador Valley hills have agricultural lands and open spaces that are not served by the CVP or SWP water supplies.

The portion of Alameda County that could be affected by the changes in CVP and/or SWP operations evaluated in this EIS includes CVP and SWP facilities (including the SWP South Bay Aqueduct), reservoirs that store CVP or SWP water, and CVP and SWP water service areas.

Contra Costa County

Contra Costa County encompasses approximately 515,200 acres in Northern California. It is bounded on the north by Solano and Sacramento counties, on the east by San Joaquin County, on the south by Alameda County, and on the west by San Francisco Bay. Contra Costa County includes federally owned and state-owned lands throughout the county, including approximately Mount Diablo State Park (Contra Costa County 2005).

Residential land encompasses approximately 67,910 acres (14.1% of the county), while about 122,110 acres (25.4% of the county) in total are developed land. Approximately 43,520 acres are water (Contra Costa County 2005).

Residential development is concentrated in existing cities and adjacent unincorporated communities. The Contra Costa County incorporated cities include Antioch, Brentwood, Clayton, Danville, El Cerrito, Hercules, Lafayette, Martinez, Moraga, Oakley, Orinda, Pinole, Pleasant Hill, Pittsburg, Richmond, San Pablo, San Ramon, and Walnut Creek. The major unincorporated areas in the county include Alamo, Bethel Island, Byron, Crockett, Discovery Bay, Kensington, Knightsen, North Richmond, Pacheco, Port Costa, and Rodeo (Contra Costa County 2005). Portions of the cities of Pittsburg, Antioch, Oakley, and Brentwood and eastern Contra Costa County are located within the Bay-Delta.

The portion of Contra Costa County that could be affected by the changes in CVP and/or SWP operations evaluated in this EIS includes CVP facilities (including facilities associated with Rock Slough), areas along the Bay-Delta channels that use the surface waters (including agricultural lands), and CVP water service areas.

Napa County

Napa County encompasses approximately 507,520 acres in Northern California. It is bounded on the north by Lake County, on the east by Yolo County, on the south by Solano County, and on the west by Sonoma County. Napa County has 62,865 acres of federally owned lands and 40,307 acres of state-owned lands throughout the county, including approximately 28,000 acres associated with Lake Berryessa and the State Cedar Rough Wilderness and Wildlife Area (Napa County 2007).

Approximately 479,000 acres (95%) of the county are unincorporated. The five incorporated cities are American Canyon, Calistoga, Napa, and St. Helena, and the town of Yountville. Land use in the county is predominantly agricultural (Napa County 2007, 2013).

The portion of Napa County that could be affected by the changes in CVP and/or SWP operations evaluated in this EIS includes SWP water service areas.

San Benito County

San Benito County encompasses approximately 890,240 acres in central California. It is bounded on the north by Santa Clara County, on the east by Merced and Fresno Counties, and on the south and west by Monterey County (San Benito County 2015a). San Benito County includes federally owned and state-owned lands throughout the county, including approximately 26,000 acres within Pinnacles National Monument, over 105,990 acres owned by Bureau of Land Management, and over 7,100 acres associated with the Hollister Hills State Vehicular Recreation Area and San Juan Bautista State Historic Park (San Benito County 2015b).

San Benito County has approximately 882,675 acres of unincorporated lands (nearly 99.5% of the total land area). The incorporated cities of Hollister and San Juan Bautista account for approximately 4,044 acres (0.5% of the county land area). Agriculture is the predominant land use, totaling 747,409 acres (85% of the county) (San Benito County 2015a).

The portion of San Benito County that could be affected by the changes in CVP and/or SWP operations evaluated in this EIS includes CVP and SWP facilities (including San Justo Reservoir and other facilities to convey water from San Luis Reservoir) and CVP water service areas.

Santa Clara County

Santa Clara County encompasses approximately 835,200 acres in Northern California. It is bounded on the north by Alameda County, on the east by Stanislaus and Merced Counties, on the south by San Benito County, and on the west by San Mateo and Santa Cruz Counties. Santa Clara County includes federally owned and state-owned lands throughout the county, including approximately 86,000 acres within Henry W. Coe State Park (Santa Clara County 2012).

Approximately 92% of the county's population resides in the 15 incorporated cities. The incorporated cities include Campbell, Cupertino, Gilroy, Los Altos, Los Altos Hills, Los Gatos, Milpitas, Monte Sereno, Morgan Hill, Mountain View, Palo Alto, San Jose, Santa Clara, Saratoga, and Sunnyvale. The southern portion of the county near Gilroy and Morgan Hill is predominantly rural, with low-density residential developments scattered though the valley and foothill areas (Santa Clara County 2012).

The portion Santa Clara County that could be affected by the changes in CVP and/or SWP operations evaluated in this EIS includes CVP and SWP facilities (including the SWP South Bay Aqueduct and CVP facilities that convey water from San Luis Reservoir) and CVP and SWP water service areas.

Solano County

Solano County encompasses approximately 582,400 acres in Northern California. It is bounded on the north by Yolo County, on the east by Sutter and Sacramento counties, on the south by Contra Costa County, and on the west by Napa County. Solano County includes federally owned lands within Travis Air Force Base (Solano County 2008).

Approximately 81,678 acres of the county (14% of the total land area), lies within seven incorporated cities: Benicia, Dixon, Fairfield, Rio Vista, Suisun City, Vacaville, and Vallejo. Urban development is generally concentrated within the incorporated cities or surrounding suburban communities. Travis Air Force Base is located on approximately 7,100 acres (1% of the land within the county). In 2006, agriculture accounted for 56.5% of the total land use in Solano County (Solano County 2008). The southern section of the Yolo Bypass, as described in, *Yolo County*, is located within Solano County.

The portion of Solano County that could be affected by the changes in CVP and/or SWP operations evaluated in this EIS includes SWP facilities (North Bay Aqueduct intakes at Barker Slough), areas in the Yolo Bypass and along the Bay-Delta channels that use the surface waters (including agricultural lands), and CVP and SWP water service areas.

Tribal Lands in the San Francisco Bay Area Region

No federally recognized tribal lands are in the San Francisco Bay Area region (Bureau of Indian Affairs 2023).

R.1.8.2 Agricultural Resources

Crops grown in the San Francisco Bay Area Region include berries, vegetables, orchards, nursery plants, and irrigated and non-irrigated pasture. Crop establishment and production costs are generally similar to those shown in Table R-2 and Table R-3, except that land costs and rent may be substantially higher in this region. In total, the San Francisco Bay Area Region contains about 1,600,000 acres planted, creating over two billion dollars per year in value of production. Table R-12 shows the acreage and production value of agricultural activity in the San Francisco Bay Area Region, 2016–2021.

Table R-12. Average Annual Agricultural Acreage and Value of Production in Counties in the San Francisco Bay Area Region from 2012 through 2021

Crop Category	Acreage [a]	Value [b]
Orchards, Vineyards, Berries	96,255	$1,205,141,881
Field and Forage	1,443,452	$138,581,646
Livestock, Dairy, Poultry	0	$146,486,542
Nursery, Other	11,024	$208,907,243
Vegetable	77,968	$703,016,573
Total	**1,628,699**	**$2,402,133,884**

Sources: U.S. Department of Agriculture 2016, 2017, 2018, 2019, 2020, 2021.
[a] Not all acreages and/or production values are reported for every crop in every county. Therefore, the implied value of production per acre may be misleading for some crop categories.
[b] Values in inflation-adjusted 2022 dollars (Bureau of Labor Statistics 2023).

Changes in farmland in the San Francisco Bay Area Region counties are summarized in Table R-13. Overall, the San Francisco Bay Area Region saw an increase of approximately 7,000 acres in Important Farmland within the 10-year period 2008–2018.

Table R-13. Farmland Mapping and Monitoring Program Acreages in the San Francisco Bay Area Region in 2008 and 2018

		Important Farmland [b]			Grazing Land		
County	Total [a]	2008	2018	Change	2008	2018	Change
Alameda	**0.5**	7,689	6,499	-1,190	244,252	240,719	-3,533
Contra Costa	**0.5**	90,918	97,073	6,155	168,904	157,424	-11,480
Napa	**0.5**	76,356	75,880	-476	178,957	179,013	56
San Benito	**0.9**	60,921	53,285	-7,636	612,455	617,365	4,910
Santa Clara	**0.8**	31,288	44,962	13,674	390,091	374,836	-15,255
Solano	**0.6**	153,299	149,747	-3,552	204,519	205,997	1,478

California Department of Conservation 2023.
[a] Total acreage of county in million acres.
[b] Includes Prime Farmland, Farmland of Statewide Importance, and Unique Farmland.

R.1.9 Central Coast Region

The Central Coast Region includes San Luis Obispo and Santa Barbara counties served by the SWP.

R.1.9.1 Land Use

San Luis Obispo County

San Luis Obispo County encompasses approximately 2,122,240 acres in central California, (San Luis Obispo County 1980). It is bounded on the north by Monterey County, on the east by Kern County, on the south by Santa Barbara County, and on the west by the Pacific Ocean. Federally owned land in San Luis Obispo County includes Los Padres National Forest, Carrizo Plain National Monument, several wilderness areas, and Guadalupe-Nipomo Dunes National Wildlife Refuge. State-owned lands include Hearst-San Simeon State Historical Monument, Montaña de Oro State Park, and state beaches and marine conservation areas (San Luis Obispo County 2006).

Land uses in the county are predominantly rural (San Luis Obispo County 1980). Incorporated cities include Arroyo Grande, Atascadero, Grover Beach, Morro Bay, Paso Robles, Pismo Beach, and San Luis Obispo. Unincorporated communities include Avila Beach, Cambria, Los Osos, Nipomo, Oceano, San Miguel, San Simeon, and Templeton (San Luis Obispo County 2023).

The portion of San Luis Obispo County that could be affected by the changes in CVP and/or SWP operations evaluated in this EIS includes SWP facilities (including facilities associated with the Central Coast Water Authority) and SWP water service areas.

Santa Barbara County

Santa Barbara County encompasses approximately 1,756,160 acres in central California. It is bounded on the north by San Luis Obispo, on the east by Ventura County, and on the south and west by the Pacific Ocean. Federally owned land in Santa Barbara County includes the Los Padres National Forest, Vandenberg Air Force Base, Channel Islands National Park, and Guadalupe-Nipomo Dunes National Wildlife Refuge. The state-owned lands include the University of California at Santa Barbara, Ocean Beach State Park, and La Purisima Mission State Park (Santa Barbara County 1979a, 1980).

Agricultural is a predominant land use in the county (Santa Barbara County 1979b). Santa Barbara County has eight incorporated cities: Buellton, Carpinteria, Goleta, Guadalupe, Lompoc, Santa Barbara, Santa Maria, and Solvang (Santa Barbara County 2023). Unincorporated communities include Cuyama, Los Olivos, Montecito, Summerland, and Vandendberg Village (Santa Barbara County Citizens Independent Redistricting Commission 2021).

The portion of Santa Barbara County that could be affected by the changes in CVP and/or SWP operations evaluated in this EIS includes SWP facilities (including facilities associated with the Central Coast Water Authority), recreation facilities at Cachuma Lake, which stores SWP water, and SWP water service areas.

R.1.9.2 Tribal Lands in the Central Coast Region

Table R-14 summarizes the tribal lands that could be affected by the changes in CVP and/or SWP operations and that are located within the county boundaries described above.

Table R-14. Federally Recognized Tribes and Tribal Lands in the Central Coast Region

County	Federally Recognized Tribe or Tribal Lands
San Luis Obispo County	None
Santa Barbara	Ynez Band of Chumash Mission Indians of the Santa Ynez Reservation

Source: Bureau of Indian Affairs 2023.

R.1.9.3 Agricultural Resources

Crops grown in this region include orchards and vineyards, berries, vegetables, and irrigated pasture. Crop establishment and production costs are generally similar to those shown in Tables R-2 and R-3, except that land costs and rent may be higher in this region. On average, the Central Coast region contains about 1.8 million acres planted and about two and a half billion dollars per year in value of production. Table R-15 shows the acreage and production value of agricultural activity in the Central Coast region, 2016–2021.

Table R-15. Central Coast Region Average Annual Agricultural Acreage and Value from 2016 through 2021

Crop Category	Acreage [a]	Value [b]
Orchards, Vineyards, Berries	92,139	$1,826,039,350
Field and Forage	1,451,405	$34,777,474
Livestock, Dairy, Poultry	0	$94,377,578
Nursery, Other	1,187	$263,733,708
Vegetable	85,835	$843,507,323
Total	**1,630,566**	**$3,062,435,433**

Sources: U.S. Department of Agriculture 2016, 2017, 2018, 2019, 2020, 2021.
[a] Not all acreages and/or production values are reported for every crop in every county. Therefore, the implied value of production per acre may be misleading for some crop categories.
[b] Values in inflation-adjusted 2022 dollars (Bureau of Labor Statistics 2023).

Changes in farmland in the Central Coast region between 2008 and 2018 are summarized in Table R-16. Overall, the Central Coast region saw an increase of approximately 13,000 acres in Important Farmland within the 10-year period from 2008–2018.

Table R-16. Farmland Mapping and Monitoring Program Acreages in the Central Coast Region in 2008 and 2018

County	Total [a]	Important Farmland [b]			Grazing Land		
		2008	2018	Change	2008	2018	Change
San Luis Obispo	**1.9**	410,536	395,382	-15,154	1,183,042	1,190,197	7,155
Santa Barbara	**1.0**	125,353	127,524	2,171	581,985	577,032	-4,953

Sources: California Department of Conservation 2023.
[a] Total surveyed acreage of county in million acres.
[b] Includes Prime Farmland, Farmland of Statewide Importance, and Unique Farmland.

R.1.10 Southern California Region

The Southern California region includes portions of Los Angeles, Orange, Riverside, San Bernardino, San Diego, and Ventura counties served by the SWP.

R.1.10.1 Land Use

Los Angeles County

Los Angeles County encompasses approximately 2,597,760 acres in Southern California (U.S. Census 2021a). It is bounded on the north by Kern County, on the east by San Bernardino County, on the south by Orange County, and on the west by Ventura County and the Pacific Ocean (Los Angeles County 2015). Los Angeles County includes federally owned lands throughout the county, including almost 650,000 acres in the Los Padres and Angeles National Forests, portions of Edwards Air Force Base, and state-owned land, including Malibu Creek and Topanga State Park About half of Los Angeles County is designated as an unincorporated open space resource land use category. Incorporated cities make up 36% of the land area in the county (Los Angeles County 2015).

The portion of Los Angeles County that could be affected by the changes in CVP and/or SWP operations evaluated in this EIS includes SWP facilities and SWP water service areas.

Orange County

Orange County encompasses 507,520 acres in Southern California (U.S. Census 2021b). It is bounded on the north by Los Angeles County, on the east by San Bernardino and Riverside counties, on the south by San Diego County, and on the west by the Pacific Ocean. Orange County includes federally owned lands, such as the Cleveland National Forest (Orange County 2022).

There are 34 incorporated cities in Orange County. The unincorporated lands cover approximately 176,309 acres. Land zoned as open space forms the largest land use type in the unincorporated county (130,433 acres) (Orange County 2022).

The portion of Orange County that could be affected by the changes in CVP and/or SWP operations evaluated in this EIS includes SWP facilities and SWP water service areas.

Riverside County

Riverside County encompasses approximately 4,612,480 acres in Southern California (U.S. Census 2021c). It is bounded on the north by San Bernardino County, on the east by the state of Nevada, on the south by San Diego and Imperial counties, and on the west by Orange County. Riverside County includes federally owned lands throughout the county, including Santa Rosa-San Jacinto Mountains National Monument, Coachella Valley National Wildlife Refuge, March Air Reserve Base, Joshua Tree National Park, San Bernardino and Cleveland National Forests, and numerous wilderness areas. State-owned lands in Riverside County include Lake Perris State Recreation Area and Mount San Jacinto State Park (Riverside County 2023a).

The County is predominantly rural and natural. About 83% of western unincorporated Riverside County and over 96% of eastern unincorporated Riverside County is agricultural, rural, rural community, or open space (Riverside County 2021).

Most of the population is concentrated in the 23 incorporated cities of Banning, Beaumont, Calimesa, Canyon Lake, Cathedral City, Coachella, Corona, Desert Hot Springs, Hemet, Indian Wells, Indio, Lake Elsinore, La Quinta, Moreno Valley, Murrieta, Norco, Palm Desert, Palm Springs, Perris, Rancho Mirage, Riverside, San Jacinto, and Temecula (Riverside County 2021). The major unincorporated communities in the county include Warm Springs, Lake Matthews, Good Hope, Lakeland Village, El Sobrante, Woodcrest, Mead Valley, Temescal Valley, Coronita, Highgrove, Home Gardens, El Cerrito, and Mountain Center (Riverside County 2023b).

The portion of Riverside County that could be affected by the changes in CVP and/or SWP operations evaluated in this EIS includes SWP facilities, reservoirs that store SWP water (including Diamond Valley Lake and Lake Skinner), and SWP water service areas.

San Bernardino County

San Bernardino County encompasses approximately 12,843,520 acres in Southern California. It is bounded on the north by Inyo County, on the east by the state of Nevada, on the south by Riverside County, and on the west by Kern, Los Angeles, and Orange counties. Most of the land in San Bernardino County is under management of the federal government. These lands include Bureau of Land Management lands, Mojave National Preserve, portions of Joshua Tree and Death Valley National Parks, and four military bases (Edwards Air Force Base, Twentynine Palms Marine Corps Air Ground Combat Training Center, Fort Irwin, and China Lake Naval Weapons Center). There are also state-owned lands (San Bernardino County 2019).

San Bernardino County has 24 incorporated cities, but most of the county is undeveloped, followed by residential uses, transportation uses, and industrial uses (San Bernardino County 2019). Unincorporated communities include Bear Valley, Bloomington, Crest Forest, Hilltop, Homestead Valley, Joshua Tree, Lake Arrowhead, Lucerne Valley, Lytle Creek, Moronga Valley, Muscoy, Oak Glen, Oak Hills, and Phelan/Pinon Hills (San Bernardino County 2019).

The portion of San Bernardino County that could be affected by the changes in CVP and/or SWP operations evaluated in this EIS includes SWP water service areas.

San Diego County

San Diego County encompasses approximately 2,900,000 acres in Southern California. It is bounded on the north by Orange and Riverside counties, on the east by Imperial County, on the south by Mexico, and on the west by the Pacific Ocean. San Diego County includes federally owned land, including Camp Pendleton Marine Corps Base and Cleveland National Forest. State-owned lands in the county include Cuyamaca Rancho State Park and Anza-Borrego Desert State Park (San Diego County 2011).

The incorporated cities include Carlsbad, Chula Vista, Coronado, Del Mar, El Cajon, Encinitas, Escondido, Imperial Beach, La Mesa, Lemon Grove, National City, Oceanside, Poway, San Marcos, Santee, Solano Beach, and Vista. Unincorporated communities include Alpine, Lakeside, Ramona, San Dieguito, Spring Valley, and Valle de Oro (San Diego County 2011).

The portion of San Diego County that could be affected by the changes in CVP and/or SWP operations evaluated in this EIS includes SWP facilities, non-SWP reservoirs that store SWP water (including Dixon Lake, San Vicente, Lower Otay, and Sweetwater Reservoir), and CVP water service areas.

Ventura County

Ventura County encompasses approximately 1,200,000 acres in Southern California. It is bounded on the north by Kern County, on the east and south by Los Angeles County, and on the west by Santa Barbara County and the Pacific Ocean. Ventura County includes federally owned and state-owned lands throughout the county, including the Los Padres National Forest (574,000 acres or 47% of the County's land area), Channel Islands National Park, Naval Base Ventura County Point Mugu, (Ventura County 2020).

About 10% of land is located in cities. Ventura County has ten incorporated cities: Ventura, Camarillo, Fillmore, Moorpark, Ojai, Oxnard, Port Hueneme, Santa Paula, Simi Valley, and Thousand Oaks. Unincorporated communities within the county include Del Norte, El Rio, Hidden Valley, Lake Sherwood, Oak Park, Ojai Valley, Piru, and Saticoy (Ventura County 2020).

The portion of Ventura County that could be affected by the changes in CVP and/or SWP operations evaluated in this EIS includes Lake Piru, which stores SWP water, and SWP water service areas.

R.1.10.2 Tribal Lands in the Southern California Region

Table R-17 summarizes the tribal lands that could be affected by the changes in CVP and/or SWP operations and that are located within the county boundaries described above.

Table R-17. Federally Recognized Tribes and Tribal Lands in the Southern California Region

County	Federally Recognized Tribe or Tribal Lands
Los Angeles	None
Riverside	Pechanga Band of Indians, Soboba Band of Luiseno Indians, Morongo Band of Mission Indians, Cahuilla Band of Indians, Ramona Band of Cahuilla, Agua Caliente Band of Cahuilla Indians of the Agua Caliente Indian Reservation, Cabazon Band of Mission Indians, Twenty-Nine Palms Band of Mission Indians of California, Augustine Band of Cahuilla Indians, Torres Martinez Desert Cahuilla Indians, Colorado River Indian Tribes of the Colorado River Indian Reservation, and Santa Rosa Band of Cahuilla Indians
San Bernardino	Chemehuevie Indian Tribe of the Chemehuevi Reservation; the Fort Mojave Indian Tribe of Arizona, California, and Nevada; the Colorado River Indian Tribes of the Colorado River Indian Reservation; the Yuhaaviatam of San Manuel Nation; and the Twenty-Nine Palms Band of Mission Indians are located in San Bernardino County
San Diego	Pala Band of Mission Indians, Rincon Band of Luiseno Mission Indians of the Rincon Reservation, Pauma Band of Luiseno Mission Indians of the Pauma & Yuima Reservation, La Jolla Band of Luiseno Indians, San Pasqual Band of Diegueno Mission Indians of California, Inaja Band of Diegueno Mission Indians of the Inaja and Cosmit Reservation, Mesa Grande Band of Diegueno Mission Indians of the Mesa Grande Reservation, Los Coyotes Band of Cahuilla and Cupeno Indians, Capitan Grande Band of Diegueno Mission Indians of California, Capitan Grande Band of Diegueno Mission Indians of California: Viejas (Baron Long) Group of Capitan Grande Band of Mission Indians of the Viejas Reservation, Ewiiaapaayp Band of Kumeyaay Indians, Sycuan Band of the Kumeyaay Nation, Jamul Indian Village of California, Campo Band of Diegueno Mission Indians of the Campo Indian Reservation, La Posta Band of Diegueno Mission Indians of the La Posta Indian Reservation, Manzanita Band of Diegueno Mission Indians of the Manzanita Reservation, and Iipay Nation of Santa Ysabel

Source: Bureau of Indian Affairs 2023.

R.1.10.3 Agricultural Resources

Crops planted in the Southern California region include orchards, vineyards, and berries; field and forage; and vegetables. Crop establishment and production costs are generally similar to those shown in Table R-2 and Table R-3, except that land costs and rent may be higher in parts of this region. In total, Southern California contains over 2 million acres irrigated and generates over five and a half billion dollars per year in value of production. Table R-18 shows the acreage and production value of agricultural activity in the Southern California region, 2016–2021.

Table R-18. Average Annual Agricultural Acreage and Value of Production in Counties in the Southern California Region from 2016 through 2021

Crop Category	Acreage [a]	Value [b]
Orchards, Vineyards, Berries	125,053	$2,231,862,455
Field and Forage	1,660,993	$186,200,017
Livestock, Dairy, Poultry	0	$636,224,731
Nursery, Other	24,950	$2,077,481,277
Vegetable	83,313	$1,120,995,232
Total	**1,894,308**	**$6,252,763,712**

Sources: U.S. Department of Agriculture 2016, 2017, 2018, 2019, 2020, 2021.
[a] Not all acreages and/or production values are reported for every crop in every county. Therefore, the implied value of production per acre may be misleading for some crop categories.
[b] Values in inflation-adjusted 2022 dollars (Bureau of Labor Statistics 2023).

Changes in farmland in the Southern California region between 2008 and 2018 are summarized in Table R-19. Overall, Southern California saw a decrease of approximately 60,000 acres in Important Farmland within the 10-year period from 2008–2018.

Table R-19. Farmland Mapping and Monitoring Program Acreages in the Southern California Region in 2008 and 2018

		Important Farmland [b]			Grazing Land		
County	Total [a]	2008	2018	Change	2008	2018	Change
Los Angeles	**1.8**	42,004	27,465	-14,539	229,474	260,697	31,223
Orange	**0.5**	8,422	5,040	-3,382	37,554	36,303	-1,251
Riverside	**1.9**	433,877	413,858	-20,019	111,219	109,857	-1,362
San Bernardino	**1.4**	25,326	19,704	-5,622	901,666	897,398	-4,268
San Diego	**2.2**	223,327	211,452	-11,875	126,871	126,756	-115
Ventura	**0.6**	122,493	118,272	-4,221	195,674	197,714	2,040

Source: California Department of Conservation 2023.
[a] Total surveyed acreage in millions of acres.
[b] Includes Prime Farmland, Farmland of Statewide Importance, and Unique Farmland.

R.2 Evaluation of Alternatives

This section describes the technical background for the evaluation of environmental consequences associated with the action alternatives and the No Action Alternative.

R.2.1 Methods and Tools

The impact assessment considers changes in land use and agricultural resources related to changes in CVP and SWP operations under the alternatives as compared to the No Action Alternative. This section details methods and tools used to evaluate those effects. It should be noted that Alternative 2 consists of four phases that could be utilized under its implementation. All four phases are considered in the assessment of Alternative 2 to bracket the range of potential impacts.

Both the land use and agricultural resources analyses rely in part on modeling of water deliveries as projected by CalSim 3. CalSim 3 is the model used to simulate CVP and SWP operations and much of the water resources infrastructure in the Central Valley and the Delta region (California Department of Water Resources 2023). CalSim 3 model output includes minor fluctuations of up to 5% due to model assumptions and approaches. Therefore, if quantitative changes between a specific alternative and the No Action Alternative are less than 5%, conditions under the specific alternative would be considered to be "similar" to conditions under the No Action Alternative.

CalSim 3 reports seasonal patterns from long-term averages and water year-type averages. The Land Use and Agricultural Resources analysis presents long-term averages and dry and critical year results. Average annual results present changes under the range of typical conditions, while dry and critically dry year results present changes under the most severe conditions when the water system is stressed. Additional details, including CalSim 3 results by water year type, are included in Appendix F, Modeling.

R.2.1.1 Land Use

Land uses in 2040 are assumed to be consistent with the future projections included in existing general plans. The general plans were developed assuming adequate water supplies to support the projected land uses. Changes in CVP and SWP operations under the No Action Alternative and Alternatives 1 through 4 could change the availability of CVP and SWP water supplies. If the CVP and SWP water supplies were reduced compared to the No Action Alternative to a level that would not support planned M&I water demands, development of future land uses may not occur. Potential changes to agricultural land uses are described in Section R.2.1.2, *Agricultural Resources.*

Availability of CVP and SWP water supplies were analyzed using CalSim 3 model output (see Appendix F, *Numeric Modeling*). Most of the CVP and SWP M&I water users prepared urban water management plans that project availability of water supplies to support land uses in 2040. Urban water management plans are updated every five years in accordance with the Urban Water Management Planning Act (California Water Code, Division 6, Part 2.6). Information from the plans was used with projected CVP and SWP water supply availability under each of the alternatives to determine if projected M&I water demands could be met in 2040 using the California Water Economics Spreadsheet Tool (CWEST) model, as described in Appendix Q,

Regional Economics Technical Appendix. The CWEST model was used to evaluate M&I water demands of CVP and SWP water users in the Central Valley, San Francisco Bay Area, Central Coast, and Southern California regions. For impacts outside the area modeled by CalSim 3 and CWEST as well as impacts from actions that were not modeled, impacts on land use were evaluated qualitatively.

It is assumed that existing programs to protect floodways would continue to be implemented, including federal and state requirements as implemented by the U.S. Army Corps of Engineers, Central Valley Flood Protection Board, and DWR. Within the Bay-Delta, the floodways are further regulated by the Delta Protection Commission and Delta Stewardship Council to preserve and protect the natural resources of the Bay-Delta; and prevent encroachment into Bay-Delta floodways, including the Delta Stewardship Council's Delta Plan (Delta Stewardship Council 2023). These regulations would continue to be implemented in the No Action Alternative and Alternatives 1 through 4. Therefore, future development would be prevented from occurring within the Bay-Delta floodplains and floodways; and in the Sacramento, American, and San Joaquin river corridors upstream of the Bay-Delta. The potential changes in land use are analyzed qualitatively in this appendix.

The No Action Alternative and Alternatives 1 through 4 include the Coordinated Operation Agreement, CVP Water Contracts, SWP Water Contracts, Allocations and Forecasting, Agricultural Barriers, and the Suisun Marsh Preservation Agreement. Land uses in 2040 due to implementation of these programs would be consistent among all action alternatives. Therefore, this EIS does not analyze changes due to these programs.

R.2.1.2 Agricultural Resources

Changes in Irrigated Agricultural Acreage and Total Production Value

Changes in CVP and SWP operations under the action alternatives could change the extent of irrigated acreage and total production value over the average water year condition and in dry and critical dry water year conditions compared to the No Action Alternative.

The impact analysis compares the typical changes that would occur between alternatives by 2040. The impact analysis does not represent changes in response to emergency flood or drought conditions.

For impacts within the area modeled, agricultural impacts were evaluated using both CalSim 3 and a regional agricultural production model developed for large-scale analysis of irrigation water supply and cost changes. The Statewide Agricultural Production (SWAP) model is a regional model of irrigated agricultural production and economics that simulates the decisions of producers (farmers) in 27 agricultural subregions in the Central Valley, as described in Appendix Q, Attachment 3, *Statewide Agricultural Production (SWAP) Model Documentation*. The model selects the crops, water supplies, and other inputs that maximize profit subject to constraints on water and land, and subject to economic conditions regarding prices, yields, and costs. In each SWAP model run, results are presented as the change in irrigated acreage for a given flow scenario for the crop categories modeled. The SWAP model does not match precisely to the study area regions. The modeled results therefore begin with different areas of irrigated acreage for

various crop categories than reported in the environmental setting. The actions modeled for each alternative are described in Appendix Q, Attachment 3.

The SWAP model incorporates CVP and SWP water supplies, other local water supplies represented in the CalSim 3 model and groundwater. As conditions change within a SWAP subregion (e.g., the quantity of available project water supply declines), the model optimizes production by adjusting the crop mix, water sources and quantities used, and other inputs. The model also fallows land when that appears to be the most cost-effective response to resource conditions.

SWAP was used to compare the long-run agricultural economic responses to potential changes in CVP and SWP irrigation water delivery and to changes in groundwater conditions associated with the alternatives. Results from the surface water analysis that used the CalSim 3 model, as described in Appendix F, *Numeric Modeling Appendix*, were provided as inputs into SWAP through a standardized data linkage procedure. Results from the groundwater analysis that used the California Central Valley Groundwater-Surface Water Simulation Model, as described in Appendix I, *Groundwater Technical Appendix*, were used to develop changes in pumping lift in SWAP. SWAP produces estimates of the change in value and costs of agricultural production.

The analysis only reduces groundwater withdrawals based upon an optimization of agricultural production costs given groundwater availability specified by Subbasin-specific Sustainable Yields and GSA-specific allocations. The current analysis is based on comparisons of alternatives at 2040 conditions in which the sustainability requirements of SGMA are assumed to be in effect. Regions receiving project water affected by changes in deliveries under different alternatives are constrained by the Sustainable Yield in each Subbasin, so little or no changes in groundwater pumping costs result. For the analysis in this EIS, results are estimated for both below normal (used as a proxy for overall average) and dry conditions, defined according to the yearly Sacramento River Index values associated with the water deliveries from the CalSim 3 operations model.

Some SWAP regions span multiple geographic regions as defined in this document. In this case, analysis considered the SWAP region to belong to the geographic region containing the largest proportion of the SWAP region.

For impacts outside the area modeled, specifically the Trinity River, San Francisco Bay Area, Central Coast, and Southern California regions, as well as impacts from actions that were not modeled in SWAP, impacts on agricultural resources were evaluated qualitatively using the results of CalSim 3 modeling for M&I and agricultural water deliveries.

Effects Related to Cross-Delta Transfers

Historically, water transfer programs have been developed on an annual basis. The demand for water transfers is dependent upon the availability of water supplies to meet water demands. Water transfer transactions have increased over time as CVP and SWP water supply availability has decreased, especially during drier water years.

Parties seeking water transfers generally acquire water from sellers who have available surface water who can make the water available through releasing previously stored water, pump

groundwater instead of using surface water (groundwater substitution), idle crops, or substitute crops that uses less water to reduce normal consumptive use of surface water.

Water transfers using CVP and SWP Bay-Delta pumping plants and south-of-Delta canals generally occur when there is unused capacity in these facilities. These conditions generally occur in drier water year types when the flows from upstream reservoirs plus unregulated flows are adequate to meet the Sacramento Valley water demands and the CVP and SWP export allocations. In non-wet years, the CVP and SWP water allocations would be less than full contract amounts; therefore, capacity may be available in the CVP and SWP conveyance facilities to move water from other sources.

Projecting future agricultural resources conditions related to water transfer activities is difficult because specific water transfer actions required to make the water available, convey the water, and/or use the water would change each year due to changing hydrological conditions, CVP and SWP water availability, specific local agency operations, and local cropping patterns. The Bureau of Reclamation prepared a long-term regional water transfer environmental document which evaluated potential changes in agricultural resources conditions related to water transfer actions from 2015 through 2024 (Bureau of Reclamation 2019). Future environmental documents would be prepared for water transfers, and any potential impacts to land use would be discussed in forthcoming environmental documents.

R.2.2 No Action Alternative

Under the No Action Alternative, Reclamation would continue with current operation of the CVP, as described in the 2020 Record of Decision and subject to the 2019 Biological Opinions. The 2020 Record of Decision for the CVP and the 2020 Incidental Take Permit for the SWP represent current management direction or intensity pursuant to 43 CFR §46.30.

Although the No Action Alternative included habitat restoration projects at a programmatic level, the 2020 ROD did not provide environmental coverage for these projects, and all of the habitat projects considered under the No Action required or will require additional environmental documentation. Thus, ground disturbance for habitat restoration projects did not materialize as a result of implementing the No Action Alternative. For the purpose of the analysis, these habitat restoration projects are considered independent projects that will be considered under cumulative effects.

The No Action Alternative is based on 2040 conditions. The changes to land use and agricultural resources that are assumed to occur by 2040 under the No Action Alternative conditions would be different from existing conditions because of the following factors:

- Climate change and sea-level rise
- General plan development throughout California, including increased water demands in portions of the Sacramento Valley

Flows and reservoir levels would remain as under current conditions and M&I and Agricultural deliveries would continue to vary according to available water supply. Because current CVP and SWP operations would continue, land uses in 2040 would occur in accordance with the general plans for Counties and cities within the Central Valley, tribal lands, and regulations of state and

regional agencies, including Central Valley Flood Protection Board, Delta Protection Commission, and Delta Stewardship Council.

It is anticipated that climate change would result in more short-duration, high-rainfall events and less snowpack in the winter and early spring months. Under the No Action Alternative, land uses in 2040 would occur in accordance with adopted general plans. The general plans were developed assuming adequate water supplies to support the projected land uses. Changes in CVP and SWP operations under the No Action Alternative could change the availability of CVP and SWP water supplies. If the CVP and SWP water supplies were reduced compared with the No Action Alternative to a level that would not support planned M&I water demands, development of future land uses may not occur. The No Action Alternative, thus, is expected to result in potential changes in land use and agricultural resources. These changes were described and considered in the 2020 Record of Decision.

The No Action Alternative would also rely upon increased use of Livingston-Stone National Fish Hatchery during droughts to increase production of winter-run Chinook salmon. However, this component requires no physical changes to the facility nor operational changes to water supply.

The No Action Alternative was modeled using CalSim 3, CWEST, and a regional agricultural production model developed for large-scale analysis of irrigation water supply and cost changes. The analysis includes annual water deliveries, water supply, annual costs, and crop differences and is provided in the Alternative sections below for comparison.

R.2.3 Alternative 1

Under Alternative 1, there would be an up to 43% increase in project M&I and agricultural deliveries, with the exception of the Sacramento River Region. Table R-20 and Table R-21 show the change in CVP and SWP M&I and agricultural water deliveries by region as modeled by CalSim 3 for the long-term average and dry/critical year average, respectively.

Table R-20. Alternative 1 CalSim 3 Water Deliveries Report by Region and Type, Long-Term Average (thousand acre-feet/year) [a, b]

Regions Modeled	Water Delivery Type	No Action	Alternative 1	Alternative 1 minus No Action	Percent Change [c]
Sacramento River	M&I	142	143	1	1%
	Agriculture	326	331	5	2%
San Joaquin River [d]	M&I	84	110	26	31%
	Agriculture	2,324	2,811	487	21%
San Francisco Bay Area	M&I	442	486	44	10%
	Agriculture	43	48	5	12%
Central Coast	M&I	36	46	10	28%
	Agriculture				
Southern California	M&I	1,461	2,000	539	37%

Regions Modeled	Water Delivery Type	No Action	Alternative 1	Alternative 1 minus No Action	Percent Change [c]
	Agriculture	7	10	3	43%

[a] The totals do not include deliveries for CVP Settlement/Exchange or SWP Feather River Service Area.
[b] Long Term is the average quantity for the period of Oct 1921 – Sep 2021; simulated at 2022 Median climate.
[c] CalSim 3 model output includes minor fluctuations of up to 5% due to model assumptions and approaches. Changes less than 5% are considered "similar" to conditions under the No Action Alternative.
[d] Does not include Friant-Kern Canal or Madera Canal water users.
M&I = Municipal and Industrial

Table R-21. Alternative 1 CalSim 3 Water Deliveries Report by Region and Type, Dry and Critical Average (thousand acre-feet/year) [a, b]

Regions Modeled	Water Delivery Type	No Action	Alternative 1	Alternative 1 minus No Action	Percent Change [c]
Sacramento River	M&I	134	134	0	0%
	Agriculture	207	220	13	6%
San Joaquin River [d]	M&I	45	62	17	38%
	Agriculture	1,065	1,468	403	38%
San Francisco Bay Area	M&I	362	399	37	10%
	Agriculture	17	24	7	41%
Central Coast	M&I	20	29	9	45%
	Agriculture	-	-	-	-
Southern California	M&I	755	1,101	346	46%
	Agriculture	3	5	2	67%

[a] The totals do not include deliveries for CVP Settlement/Exchange or SWP Feather River Service Area.
[b] Dry and Critical Years Average is the average quantity for the combination of the SWRCB D-1641 40-30-30 Dry and Critical Dry years for the period of Oct 1921 – Sep 2021; simulated at 2022 Median climate.
[c] CalSim 3 model output includes minor fluctuations of up to 5% due to model assumptions and approaches. Changes less than 5% are considered "similar" to conditions under the No Action Alternative.
[d] Does not include Friant-Kern Canal or Madera Canal water users.
M&I = Municipal and Industrial

R.2.3.1 Potential Changes in Land Use

As shown in Table R-20 and Table R-21, Alternative 1 would result in an up to 43% in M&I deliveries across all regions, with a smaller increase (10%) in the San-Francisco Bay Area. Under Alternative 1, M&I deliveries would be similar to the existing conditions for the Sacramento River Region. Table R-22 shows the modeled changes in the average annual CVP and SWP

deliveries and the associated average annual cost in thousands of 2023 dollars as compared to the No Action Alternative.

Table R-22. Differences in Water Supply and Costs Between the No Action Alternative and Alternative 1

Regions Modeled	Average Annual CVP/SWP Deliveries (TAF)	Average Annual Cost ($1,000) [a]
Sacramento Valley	0.1	$578
San Joaquin	27.6	-$11,596
San Francisco Bay Area	43.3	-$35,280
Central Coast	9.6	-$2,198
Southern California	467.8	-$336,646
Total	**548.3**	**-$355,865**

[a] Benefits are shown as negative costs.
CVP = Central Valley Project; SWP = State Water Project; TAF = Thousand-acre feet

As discussed previously, deliveries in the Sacramento River Region would be similar to those under the No Action Alternative but would come with an increase in annual costs that is anticipated to be affordable. Deliveries would increase for the San Joaquin River Region, San Francisco Bay Area Region, Central Coast Region, and Southern California Region. The total reduction in cost compared to the No Action Alternative would be 355 million dollars. It is anticipated that additional water supplies would not result in changes in the general plan development plans without subsequent environmental documentation. Adequate water supplies would be available to support future municipal and industrial land uses projected in existing general plans and urban water supply management plans. Therefore, there would be no change in land use compared to the No Action.

No M&I land uses in the Trinity River Region are served by CVP and SWP water supplies. Therefore, the M&I land uses would be the same under Alternative 1 and the No Action Alternative in this region.

R.2.3.2 Potential Changes in Irrigated Agricultural Acreage

As shown by CalSim 3 modeling (Table R-20 and Table R-21), deliveries for agricultural uses in the Sacramento River Region would be similar to the No Action Alternative. Deliveries for agricultural uses in the San Joaquin Region, San Francisco Bay Area Region, and Southern California Region would all increase under the long-term average and dry/critical conditions in this region, so no conversion of agricultural land to nonagricultural use is anticipated for these regions.

Table R-23 shows the difference in acreage planted in the long-term average year condition with respect to water availability between the No Action Alternative and Alternative 1, and Table R-24 shows the difference in productivity in the average water year condition in millions of 2023 dollars. Table R-25 shows the difference in acreage planted in the dry and water year condition

with respect to water availability between the No Action Alternative and Alternative 1, and Table R-26 shows productivity in the average dry water year condition in millions of dollars.

Table R-23. Difference in Crops in the SWAP Regions (acres) in the Average Water Year Condition between the No Action Alternative and Alternative 1

	Crop Acreage [a]					
Regions Modeled	Grains	Field Crops	Forage Crops	Vegetable, Truck, Specialty	Orchards and Vineyards	Total
Sacramento River	953	60	69	-349	222	**955**
San Joaquin River	55	20,869	35,123	24,045	11,280	**91,372**
Total	**1,008**	**20,929**	**35,192**	**23,696**	**11,502**	**92,327**

[a] Values are the annual change in acreage between the No Action Alternative and Alternative 1 under 2040 conditions.

Table R-24. Difference in Crop Productivity in the SWAP Regions (millions of 2023 dollars) in the Average Water Year Condition between the No Action Alternative and Alternative 1 [a]

Regions Modeled	All Other Crop Farming	Fruit Farming	Grain Farming	Vegetable and Melon Farming	Total
Sacramento River	-10.5	-10.3	2.6	-11.3	**-29.5**
San Joaquin River	160.7	39.6	0.1	136.6	**337.0**
Total	**150.2**	**29.3**	**2.7**	**125.3**	**307.5**

[a] Values are the annual change in crop productivity between the No Action Alternative and Alternative 1 under 2040 conditions.

Table R-25. Difference in Crops in the SWAP Regions (acres) in the Dry Water Year Condition between the No Action Alternative and Alternative 1

	Crop Acreage [a]					
Regions Modeled	Grains	Field Crops	Forage Crops	Vegetable, Truck, Specialty	Orchards and Vineyards	Total
Sacramento River	407	1,814	1,133	-253	1,278	**4,379**
San Joaquin River	65	7,765	25,242	40,231	13,861	**87,164**
Total	**472**	**9,579**	**26,375**	**39,978**	**15,139**	**91,543**

[a] Values are the annual change in acreage between the No Action Alternative and Alternative 1 under 2040 conditions.

Table R-26. Difference in Crop Productivity in the SWAP Regions (millions of 2023 dollars) in the Dry Water Year Condition between the No Action Alternative and Alternative 1 [a]

Regions Modeled	All Other Crop Farming	Fruit Farming	Grain Farming	Vegetable and Melon Farming	Total
Sacramento River	-8.6	-4.9	-4.7	-17.6	**-26.5**
San Joaquin River	106.3	48.4	0.2	257.1	**411.9**
Total	**97.6**	**43.4**	**4.9**	**239.4**	**385.4**

[a] Values are the average annual change in crop productivity between the No Action Alternative and Alternative 1 under 2040 conditions.

As shown in Table R-23, there would be approximately 955 more acres of irrigated farmland in the Sacramento River region and approximately 91,372 more acres in the San Joaquin River region under Alternative 1 compared to the No Action. As shown in Table R-24, the Sacramento River region would have a decreased productivity of approximately $29.5 million compared to the No Action Alternative. The San Joaquin River region would have an increased productivity of approximately $337 million compared to the No Action Alternative.

As shown in Table R-25, in the dry water year condition, there would be an increase in irrigated crops of 4,379 acres in the Sacramento River region and 87,164 acres in the San Joaquin River region compared to the No Action Alternative. As shown in Table R-26, the Sacramento River region would see a decrease in productivity of $26.5 million compared to the No Action Alternative, while the San Joaquin River region would see an increase in productivity of $411.9 million.

In both the average and dry year conditions there would be a decrease in vegetable crops compared to the No Action Alternative, however, overall irrigated acreage would increase under both conditions. Therefore, no conversion of agricultural land to nonagricultural is expected to occur in both regions under both conditions.

The Trinity River and Central Coast regions were not modeled under SWAP. Because there are no CVP/SWP agricultural water deliveries in this region, no conversion of agricultural land to nonagricultural use is anticipated.

R.2.4 Alternative 2

As discussed in Section R.2.1, *Methods and Tools*, there are multiple phases that make up Alternative 2. Implementation of Alternative 2 may include the Alternative 2 Without Temporary Urgency Change Petition (TUCP) Delta Voluntary Agreements (VA) phase, Alternative 2 Without TUCP and Without VA phase, Alternative 2 Without TUCP Systemwide VA phase, or Alternative 2 With TUCP Without VA phase. The Alternative 2 With TUCP Without VA phase would only be implemented as a backstop during drought.

Tables present all four phases of Alternative 2. Naming conventions for each phase of the alternative are shown in Table R-27.

Table R-27. Alternative 2 Phases

Name in Tables	Narrative Name
Alt2woTUCPDeltaVA	Alternative 2 Without TUCP Delta VA
Alt2woTUCPwoVA	Alternative 2 Without TUCP Without VA
Alt2woTUCPAllVA	Alternative 2 Without TUCP Systemwide VA
Alt2wTUCPwoVA	Alternative 2 With TUCP Without VA

TUCP = Temporary Urgency Change Petition; VA = Voluntary Agreement; W = with; Wo = without

Under Alternative 2, there would be a slight increase (7%) in M&I deliveries in some regions, a slight decrease in agricultural deliveries in the long-term average (-6%), and a larger decrease in agricultural deliveries in dry/critical average years (-12%). Table R-24 through Table R-35 present the change in CVP and SWP M&I and agricultural water deliveries (thousand acre-feet/year) by region as modeled by CalSim 3 compared to the No Action Alternative for the long-term average and dry/critical year average, respectively, for each phase of Alternative 2.

Table R-28. Alternative 2 Without TUCP Delta VA CalSim 3 Water Deliveries Report by Region and Type, Long-Term Average (thousand acre-feet/year) [a, b]

Regions Modeled	Water Delivery Type	No Action	Alt2woTUCPDeltaVA	Alt2woTUCPDeltaVA minus No Action	Percent Change [c]
Sacramento River	M&I	142	152	10	7%
	Agriculture	326	312	-14	-4%
San Joaquin River [d]	M&I	84	85	1	1%
	Agriculture	2,324	2,178	-146	-6%
San Francisco Bay Area	M&I	442	448	6	1%
	Agriculture	43	40	-3	-7%
Central Coast	M&I	36	37	1	3%
	Agriculture				
Southern California	M&I	1,461	1,507	46	3%
	Agriculture	7	7	0	0%

[a] The totals do not include deliveries for CVP Settlement/Exchange or SWP Feather River Service Area

[b] Long Term is the average quantity for the period of Oct 1921 - Sep 2021; simulated at 2022 Median climate.
[c] CalSim 3 model output includes minor fluctuations of up to 5% due to model assumptions and approaches. Changes less than 5% are considered "similar" to conditions under the No Action Alternative.
[d] Does not include Friant-Kern Canal or Madera Canal water users.
Alt2woTUCPDeltaVA = Alternative 2 Without TUCP Delta VA; M&I = Municipal and Industrial

Table R-29. Alternative 2 Without TUCP Delta VA CalSim 3 Water Deliveries Report by Region and Type, Dry and Critical Average (thousand acre-feet/year) [a, b]

Regions Modeled	Water Delivery Type	No Action	Alt2woTUCPDeltaVA	Alt2woTUCPDeltaVA minus No Action	Percent Change [c]
Sacramento River	M&I	134	142	8	6%
	Agriculture	207	184	-23	-11%
San Joaquin River [d]	M&I	45	44	-1	-2%
	Agriculture	1,065	937	-128	-12%
San Francisco Bay Area	M&I	362	369	7	2%
	Agriculture	17	15	-2	-12%
Central Coast	M&I	20	21	1	5%
	Agriculture				
Southern California	M&I	755	770	15	2%
	Agriculture	3	3	0	0%

[a] The totals do not include deliveries for CVP Settlement/Exchange or SWP Feather River Service Area
[b] Dry and Critical Years Average is the average quantity for the combination of the SWRCB D-1641 40-30-30 Dry and Critical Dry years for the period of Oct 1921 - Sep 2021; simulated at 2022 Median climate.
[c] CalSim 3 model output includes minor fluctuations of up to 5% due to model assumptions and approaches. Changes less than 5% are considered "similar" to conditions under the No Action Alternative.
[d] Does not include Friant-Kern Canal or Madera Canal water users.
Alt2woTUCPDeltaVA = Alternative 2 Without TUCP Delta VA; M&I = Municipal and Industrial

Table R-30. Alternative 2 Without TUCP Without VA CalSim 3 Water Deliveries Report by Region and Type, Long-Term Average (thousand acre-feet/year) [a, b]

Regions Modeled	Water Delivery Type	No Action	Alt2woTUCPwoVA	Alt2woTUCPwoVA minus No Action	Percent Change [c]
Sacramento River	M&I	142	142	0	0%
	Agriculture	326	312	-14	-4%
San Joaquin River [d]	M&I	84	86	2	2%

Regions Modeled	Water Delivery Type	No Action	Alt2woTUCPwoVA	Alt2woTUCPwoVA minus No Action	Percent Change [c]
	Agriculture	2,324	2,302	-22	-1%
San Francisco Bay Area	M&I	442	449	7	2%
	Agriculture	43	41	-2	-5%
Central Coast	M&I	36	37	1	3%
	Agriculture				
Southern California	M&I	1,461	1,521	60	4%
	Agriculture	7	7	0	0%

[a] The totals do not include deliveries for CVP Settlement/Exchange or SWP Feather River Service Area
[b] Long Term is the average quantity for the period of Oct 1921 - Sep 2021; simulated at 2022 Median climate.
[c] CalSim 3 model output includes minor fluctuations of up to 5% due to model assumptions and approaches. Changes less than 5% are considered "similar" to conditions under the No Action Alternative.
[d] Does not include Friant-Kern Canal or Madera Canal water users.
Alt2woTUCPwoVA = Alternative 2 Without TUCP Without VA; M&I = Municipal and Industrial

Table R-31. Alternative 2 Without TUCP Without VA CalSim 3 Water Deliveries Report by Region and Type, Dry and Critical Average (thousand acre-feet/year) [a, b]

Regions Modeled	Water Delivery Type	No Action	Alt2woTUCPwoVA	Alt2woTUCPwoVA minus No Action	Percent Change [c]
Sacramento River	M&I	134	134	0	0%
	Agriculture	207	182	-25	-12%
San Joaquin River [d]	M&I	45	45	0	0%
	Agriculture	1,065	1,001	-64	-6%
San Francisco Bay Area	M&I	362	368	6	2%
	Agriculture	17	15	-2	-12%
Central Coast	M&I	20	21	1	5%
	Agriculture				
Southern California	M&I	755	762	7	1%
	Agriculture	3	3	0	0%

[a] The totals do not include deliveries for CVP Settlement/Exchange or SWP Feather River Service Area

[b] Dry and Critical Years Average is the average quantity for the combination of the SWRCB D-1641 40-30-30 Dry and Critical Dry years for the period of Oct 1921 - Sep 2021; simulated at 2022 Median climate.
[c] CalSim 3 model output includes minor fluctuations of up to 5% due to model assumptions and approaches. Changes less than 5% are considered "similar" to conditions under the No Action Alternative.
[d] Does not include Friant-Kern Canal or Madera Canal water users.
Alt2woTUCPwoVA = Alternative 2 Without TUCP Without VA; M&I = Municipal and Industrial

Table R-32. Alternative 2 Without TUCP Systemwide VA CalSim 3 Water Deliveries Report by Region and Type, Long-Term Average (thousand acre-feet/year) [a, b]

Regions Modeled	Water Delivery Type	No Action	Alt2woTUCPAllVA	Alt2woTUCPAllVA minus No Action	Percent Change [c]
Sacramento River	M&I	142	149	7	5%
	Agriculture	326	312	-14	-4%
San Joaquin River [d]	M&I	84	85	1	1%
	Agriculture	2,324	2,188	-136	-6%
San Francisco Bay Area	M&I	442	449	7	2%
	Agriculture	43	41	-2	-5%
Central Coast	M&I	36	37	1	3%
	Agriculture	-	-	-	-
Southern California	M&I	1,461	1,507	46	3%
	Agriculture	7	7	0	0%

[a] The totals do not include deliveries for CVP Settlement/Exchange or SWP Feather River Service Area.
[b] Long Term is the average quantity for the period of Oct 1921 - Sep 2021; simulated at 2022 Median climate.
[c] CalSim 3 model output includes minor fluctuations of up to 5% due to model assumptions and approaches. Changes less than 5% are considered "similar" to conditions under the No Action Alternative.
[d] Does not include Friant-Kern Canal or Madera Canal water users.
Alt2woTUCPAllVA = Alternative 2 Without TUCP Systemwide VA; M&I = Municipal and Industrial

Table R-33. Alternative 2 Without TUCP Systemwide VA CalSim 3 Water Deliveries Report by Region and Type, Dry and Critical Average (thousand acre-feet/year) [a, b]

Regions Modeled	Water Delivery Type	No Action	Alt2woTUCPAllVA	Alt2woTUCPAllVA minus No Action	Percent Change [c]
Sacramento River	M&I	134	134	0	0%
	Agriculture	207	185	-22	-11%
San Joaquin River [d]	M&I	45	44	-1	-2%
	Agriculture	1,065	951	-114	-11%

Regions Modeled	Water Delivery Type	No Action	Alt2woTUCPAllVA	Alt2woTUCPAllVA minus No Action	Percent Change [c]
San Francisco Bay Area	M&I	362	373	11	3%
	Agriculture	17	15	-2	-12%
Central Coast	M&I	20	21	1	5%
	Agriculture	-	-	-	-
Southern California	M&I	755	767	12	2%
	Agriculture	3	3	0	0%

[a] The totals do not include deliveries for CVP Settlement/Exchange or SWP Feather River Service Area.
[b] Dry and Critical Years Average is the average quantity for the combination of the SWRCB D-1641 40-30-30 Dry and Critical Dry years for the period of Oct 1921 - Sep 2021; simulated at 2022 Median climate.
[c] CalSim 3 model output includes minor fluctuations of up to 5% due to model assumptions and approaches. Changes less than 5% are considered "similar" to conditions under the No Action Alternative.
[d] Does not include Friant-Kern Canal or Madera Canal water users.
Alt2woTUCPAllVA = Alternative 2 Without TUCP Systemwide VA; M&I = Municipal and Industrial

Table R-34. Alternative 2 With TUCP Without VA CalSim 3 Water Deliveries Report by Region and Type, Long-Term Average (thousand acre-feet/year) [a, b]

Regions Modeled	Water Delivery Type	No Action	Alt2wTUCPwoVA	Alt2wTUCPwoVA minus No Action	Percent Change [c]
Sacramento River	M&I	142	142	0	0%
	Agriculture	326	316	-10	-3%
San Joaquin River [d]	M&I	84	86	2	2%
	Agriculture	2,324	2,309	-15	-1%
San Francisco Bay Area	M&I	442	447	5	1%
	Agriculture	43	41	-2	-5%
Central Coast	M&I	36	38	2	6%
	Agriculture	-	-	-	-
Southern California	M&I	1,461	1,529	68	5%
	Agriculture	7	7	0	0%

[a] The totals do not include deliveries for CVP Settlement/Exchange or SWP Feather River Service Area.
[b] Long Term is the average quantity for the period of Oct 1921 - Sep 2021; simulated at 2022 Median climate.

[c] CalSim 3 model output includes minor fluctuations of up to 5% due to model assumptions and approaches. Changes less than 5% are considered "similar" to conditions under the No Action Alternative.
[d] Does not include Friant-Kern Canal or Madera Canal water users.
Alt2wTUCPwoVA = Alternative 2 With TUCP Without VA; M&I = Municipal and Industrial

Table R-35. Alternative 2 With TUCP Without VA CalSim 3 Water Deliveries Report by Region and Type, Dry and Critical Average (thousand acre-feet/year) [a, b]

Regions Modeled	Water Delivery Type	No Action	Alt2wTUCPwoVA	Alt2wTUCPwoVA minus No Action	Percent Change [c]
Sacramento River	M&I	134	133	-1	-1%
	Agriculture	207	185	-22	-11%
San Joaquin River [d]	M&I	45	45	0	0%
	Agriculture	1,065	969	-96	-9%
San Francisco Bay Area	M&I	362	362	0	0%
	Agriculture	17	14	-3	-18%
Central Coast	M&I	20	21	1	5%
	Agriculture	-	-	-	-
Southern California	M&I	755	781	26	3%
	Agriculture	3	3	0	0%

[a] The totals do not include deliveries for CVP Settlement/Exchange or SWP Feather River Service Area.
[b] Dry and Critical Years Average is the average quantity for the combination of the SWRCB D-1641 40-30-30 Dry and Critical Dry years for the period of Oct 1921 - Sep 2021; simulated at 2022 Median climate.
[c] CalSim 3 model output includes minor fluctuations of up to 5% due to model assumptions and approaches. Changes less than 5% are considered "similar" to conditions under the No Action Alternative.
[d] Does not include Friant-Kern Canal or Madera Canal water users.
Alt2wTUCPwoVA = Alternative 2 With TUCP Without VA; M&I = Municipal and Industrial

R.2.4.1 Potential Changes in Land Use

As shown in Table R-28 through Table R-35, M&I water deliveries would slightly increase between 5% and 7% for some regions, depending on the phase, compared to the No Action, while other regions would be considered similar to the No Action. Table R-36 shows the modeled changes in the average annual CVP and SWP deliveries and the associated average annual cost in thousands of 2023 dollars as compared to the No Action Alternative for each phase of Alternative 2.

Table R-36. Differences in Water Supply and Costs Between the No Action Alternative and Alternative 2

Regions Modeled	Average Annual CVP/SWP Deliveries (TAF)	Average Annual Cost ($1,000) [a]
Alt2woTUCPDeltaVA		
Sacramento Valley	9.8	-$4,184
San Joaquin	1.2	-$3,493
San Francisco Bay Area	6.1	-$8,160
Central Coast	1.4	-$311
Southern California	43.7	-$1,955
Total	**62.2**	**-$18,103**
Alt2woTUCPwoVA		
Sacramento Valley	0	-$873
San Joaquin	2.4	-$3,807
San Francisco Bay Area	5.9	-$7,807
Central Coast	1.4	-$316
Southern California	53.1	$33,190
Total	**62.8**	**$20,387**
Alt2woTUCPAllVA		
Sacramento Valley	6.2	-$1,520
San Joaquin	1.4	-$3,540
San Francisco Bay Area	7.1	-$9,131
Central Coast	1.3	-$294
Southern California	43.4	-$747
Total	**59.5**	**-$15,232**
Alt2wTUCPAllVA		
Sacramento Valley	-0.3	-$309
San Joaquin	2.7	-$2,460
San Francisco Bay Area	3.1	$3,074
Central Coast	1.6	-$360
Southern California	64.3	-$19,106
Total	**71.5**	**-$19,161**

[a] Benefits are shown as negative costs.

Alt2woTUCPDeltaVA = Alternative 2 Without TUCP Delta VA;
Alt2woTUCPwoVA = Alternative 2 Without TUCP Without VA;
Alt2woTUCPAllVA = Alternative 2 Without TUCP Systemwide VA;
Alt2wTUCPwoVA = Alternative 2 With TUCP Without VA; CVP = Central Valley Project; SWP = State Water Project;
TAF = Thousand-acre feet

As shown in Table R-36, there would be an increase in average annual deliveries for all modeled regions across all four phases of Alternative 2 compared to the No Action, with the exception of the Sacramento Region under Alternative 2 Without TUCP Without VA which would have no change from the No Action, and under Alternative 2 With TUCP Without VA which would have a slight decrease in average annual deliveries of 0.3 TAF from the No Action Alternative. The Southern California region sees the greatest increase in annual deliveries across all four phases of Alternative 2.

Under Alternative 2 Without TUCP Delta VA and Alternative 2 Without TUCP Systemwide VA, there would be reduced costs across all regions, with total reductions in costs of 18 million dollars and 15 million dollars, respectively. Under Alternative 2 Without TUCP Without VA, the modeled regions would experience reductions in average annual costs while the Southern California region would see increased annual costs, with a total cost of 20 million compared to the No Action Alternative. Under Alternative 2 With TUCP Without VA, which would be implemented in times of drought, most of the regions would see reductions in average annual costs, with the Southern California region receiving the greatest reduction in cost; however, the Bay Area region would see an increase in average annual costs compared to the No Action Alternative. The total reduction in cost under Alternative 2 With TUCP Without VA compared to the No Action would be 19 million dollars.

It is anticipated that any additional water supplies would not result in changes in the general plan development plans without subsequent environmental documentation. The increased annual costs associated with receiving additional water supplies are anticipated to be afforded with implementation of Mitigation Measure AG-1, therefore, adequate water supplies would be available to support future municipal and industrial land uses projected in existing general plans and urban water supply management plans. There would be no change in land use compared to the No Action Alternative.

No M&I land uses in the Trinity River Region are served by CVP and SWP water supplies. Therefore, the M&I land uses would be the same under Alternative 2 and the No Action Alternative in this region.

R.2.4.2 Potential Changes in Irrigated Agricultural Acreage

As shown by CalSim 3 modeling (Table R-28 through Table R-35), the long-term average deliveries for agricultural uses would decrease by 5% to 7% across the four phases for the Sacramento River region, San Joaquin River region, and San Francisco Bay Area region. The critical/dry year averages would decrease by 6% to 18%. These decreases across the four phases may result in the conversion of agricultural land to nonagricultural uses. The implementation of Mitigation Measure AG-1, would reduce agricultural land use conversion by encouraging water users to develop alternative sources of water.

The agricultural deliveries for the Southern California region would be considered similar to the No Action Alternative. Therefore, there would be no changes in agricultural land use compared to the No Action Alternative.

Table R-37 shows the difference in acreage planted in the average year condition with respect to water availability between the No Action Alternative and the different phases of Alternative 2 and Table R-38 shows the difference in productivity in the average year condition in millions of 2023 dollars. Table R-39 shows the difference in acreage planted in the dry year condition with respect to water availability between the No Action Alternative and Alternative 2 phases, and Table R-40 shows productivity in the dry water year condition in millions of dollars.

Table R-37. Difference in Crops in the SWAP Regions (acres) in the Average Year Water Condition between the No Action Alternative and Alternative 2

Regions Modeled	Crop Category [a]					
	Grains	Field Crops	Forage Crops	Vegetable, Truck, Specialty	Orchards and Vineyards	Total
Alt2woTUCPDeltaVA						
Sacramento River	-1,892	-709	-1,252	84	-1,308	**-5,076**
San Joaquin River	-39	41	-9,907	-29,137	-8,690	**-47,732**
Total	**-1,931**	**-667**	**-11,159**	**-29,053**	**-9,998**	**-52,808**
Alt2woTUCPwoVA						
Sacramento River	-1,497	-673	-976	-232	-1,262	**-4,640**
San Joaquin River	-10	987	-1,872	-11,607	-2,492	**-14,994**
Total	**-1,507**	**314**	**-2,847**	**-11,839**	**-3,754**	**-19,633**
Alt2woTUCPAllVA						
Sacramento River	-3,473	-683	-2,185	127	-824	**-7,038**
San Joaquin River	-26	21	-9,608	-30,710	-7,447	**-47,769**
Total	**-3,499**	**-662**	**-11,793**	**-30,583**	**-8,270**	**-54,807**
Alt2wTUCPwoVA						
Sacramento River	-112	-56	-277	-32	-173	**-650**
San Joaquin River	4	1771	3,238	-720	408	**4,701**
Total	**-108**	**1715**	**2,961**	**-753**	**235**	**4,050**

[a] Values are the change in annual acreage between the No Action Alternative and Alternative 2 under 2040 conditions.
Alt2woTUCPDeltaVA = Alternative 2 Without TUCP Delta VA;
Alt2woTUCPwoVA = Alternative 2 Without TUCP Without VA;
Alt2woTUCPAllVA = Alternative 2 Without TUCP Systemwide VA;
Alt2wTUCPwoVA = Alternative 2 With TUCP Without VA

Table R-38. Difference in Crop Productivity in the SWAP Regions (millions of 2023 dollars) in the Average Water Year Condition between the No Action Alternative and Alternative 2 [a]

Regions Modeled	All Other Crop Farming	Fruit Farming	Grain Farming	Vegetable and Melon Farming	Total
Alt2woTUCPDeltaVA					
Sacramento River	0.7	1.8	-5.5	12.1	**9.1**
San Joaquin River	-23.9	-28.5	-0.1	-177.7	**-230.1**
Total	**-23.1**	**-26.7**	**-5.6**	**-165.6**	**-221.0**
Alt2woTUCPwoVA					
Sacramento River	-0.6	-4.2	-4.4	2.9	**-6.3**
San Joaquin River	-1.3	-6.5	0.0	-70.1	**-77.9**
Total	**-1.9**	**-10.7**	**-4.4**	**-67.1**	**-84.2**
Alt2woTUCPAllVA					
Sacramento River	-0.5	1.5	-8.8	13.1	**5.3**
San Joaquin River	-22.7	-24.8	-0.1	-187.5	**-235.1**
Total	**-23.2**	**-23.3**	**-8.8**	**-174.4**	**-229.8**
Alt2wTUCPwoVA					
Sacramento River	-1.7	-0.9	-0.3	0.1	**-2.8**
San Joaquin River	14.6	0.6	0.0	-4.7	**10.5**
Total	**12.9**	**-0.3**	**-0.3**	**-4.5**	**7.7**

[a] Values are the change in crop productivity between the No Action Alternative and Alternative 2 under 2040 conditions.
Alt2woTUCPDeltaVA = Alternative 2 Without TUCP Delta VA;
Alt2woTUCPwoVA = Alternative 2 Without TUCP Without VA;
Alt2woTUCPAllVA = Alternative 2 Without TUCP Systemwide VA;
Alt2wTUCPwoVA = Alternative 2 With TUCP Without VA

Table R-39. Difference in Crops in the SWAP Regions (acres) in the Dry Water Year Condition between the No Action Alternative and Alternative 2

Regions Modeled	Crop Category [a]					
	Grains	Field Crops	Forage Crops	Vegetable, Truck, Specialty	Orchards and Vineyards	Total
Alt2woTUCPDeltaVA						
Sacramento River	-137	-3,052	-878	331	-584	**-4,320**
San Joaquin River	-36	-117	-2,763	-33,968	-10,617	**-47,500**
Total	**-172**	**-3,170**	**-3,640**	**-33,637**	**-11,201**	**-51,820**
Alt2woTUCPwoVA						
Sacramento River	-191	-3,292	-1,232	-41	-834	**-5,589**
San Joaquin River	-27	35	-1,011	-20,542	-4,625	**-26,171**
Total	**-218**	**-3,257**	**-2,243**	**-20,583**	**-5,459**	**-31,759**
Alt2woTUCPAllVA						
Sacramento River	-411	-3,025	-1,762	292	-187	**-5,093**
San Joaquin River	-42	-79	-2,002	-30,323	-9,081	**-41,527**
Total	**-453**	**-3,104**	**-3,765**	**-30,030**	**-9,267**	**-46,619**
Alt2wTUCPwoVA						
Sacramento River	-174	-3,109	-1,111	-12	-688	**-5,094**
San Joaquin River	-24	76	-792	-18,003	-3,843	**-22,585**
Total	**-198**	**-3,034**	**-1,902**	**-18,014**	**-4,531**	**-27,679**

[a] Values are the annual change in acreage between the No Action Alternative and Alternative 2 under 2040 conditions.
Alt2woTUCPDeltaVA = Alternative 2 Without TUCP Delta VA;
Alt2woTUCPwoVA = Alternative 2 Without TUCP Without VA;
Alt2woTUCPAllVA = Alternative 2 Without TUCP Systemwide VA;
Alt2wTUCPwoVA = Alternative 2 With TUCP Without VA

Table R-40. Difference in Crop Productivity in the SWAP Regions (millions of 2023 dollars) in the Dry Water Year Condition between the No Action Alternative and Alternative 2 [a]

Regions Modeled	All Other Crop Farming	Fruit Farming	Grain Farming	Vegetable and Melon Farming	Total
Alt2woTUCPDeltaVA					
Sacramento River	-0.7	8.2	-6.2	16.1	**17.4**
San Joaquin River	-9.4	-40	0	-228.7	**-278.1**
Total	**-10.2**	**-31.8**	**-6.1**	**-212.5**	**-260.6**
Alt2woTUCPwoVA					
Sacramento River	-2.7	-53.9	-6.2	8	**-1.0**
San Joaquin River	-3.3	-16.3	0.1	-137.5	**-157**
Total	**-6**	**-16.3**	**-6.1**	**-129.5**	**-158**
Alt2woTUCPAllVA					
Sacramento River	-2	7.8	-6.8	14.5	**13.5**
San Joaquin River	-7	-35	0	-203.8	**-245.7**
Total	**-9**	**-27.1**	**-6.8**	**-189.3**	**-232.2**
Alt2wTUCPwoVA					
Sacramento River	-2.1	0	-6.2	7.2	**-1.1**
San Joaquin River	-2.4	-13.7	0.1	-120.5	**-136.5**
Total	**-4.5**	**-13.7**	**-6**	**-113.3**	**-137.5**

[a] Values are the change in crop productivity between the No Action Alternative and Alternative 2 under 2040 conditions.
Alt2woTUCPDeltaVA = Alternative 2 Without TUCP Delta VA;
Alt2woTUCPwoVA = Alternative 2 Without TUCP Without VA;
Alt2woTUCPAllVA = Alternative 2 Without TUCP Systemwide VA;
Alt2wTUCPwoVA = Alternative 2 With TUCP Without VA

As shown in Table R-37, for the phases of Alternative 2 without TUCPs there would be decreases in irrigated acreage, with reductions of 5,076 acres and 7,038 acres in the Sacramento River region, and 47,732 acres and 47,769 acres in the San Joaquin River region for the phases of the alternative with VAs. Alternative 2 without TUCP Without VA would have a slightly lower decrease in irrigated acreage from the No Action Alternative with 4,640 acres in the Sacramento Region and 14,994 acres in the San Joaquin River region. Under Alternative 2 With TUCP Without VA there would be a very slight decrease in irrigated acreage of 650 acres in the Sacramento River region, and an increase of 4,701 acres in the San Joaquin River region when compared to the No Action Alternative under the long-term average year condition. As shown in Table R-38, for the phases of Alternative 2 with VAs, there would be an increase in crop productivity of $5.3 million to $9.1 million in the Sacramento River region, and a decrease in

productivity of $230.1 million to $235.1 million in the San Joaquin River region compared to the No Action Alternative. Under Alternative 2 Without TUCP Without VA, there would be a decrease in crop productivity of $6.3 million in the Sacramento River region, and $77.9 million in the San Joaquin River region. Under Alternative 2 With TUCP Without VA there would be a decrease in productivity of $2.8 million in the Sacramento River region, and an increase of $10.5 million in the San Joaquin River region.

As shown in Table R-39, under dry water year conditions, across all phases there would be decreases in irrigated acreage compared to the No Action Alternative, with decreases from 4,320 acres to 5,589 acres for the Sacramento River region and 22,585 acres to 26,171 acres for phases without VAs and 41,527 acres to 47,500 acres for phases with VAs. As shown in Table R-40, the Sacramento River region would see an increase in crop productivity compared to the No Action under the phases with VAs of $13.5 million to $17.4 million, and a decrease in productivity for phases without VAs of approximately $1 million. The San Joaquin River region would see decreases in productivity from $136.5 million to $260.6 million across all four phases of Alternative 2, with the phases with VAs resulting in greater decreases in productivity than the phases without VAs.

In both the average and dry water year conditions, overall crop acreage would primarily decrease in the San Joaquin River and Sacramento River regions under Alternative 2 when compared to the No Action Alternative. Crop productivity would primarily decrease for the San Joaquin River region under both conditions. Crop productivity in the Sacramento Region would be more variable, with smaller increases and decreases in productivity compared to the No Action Alternative. Therefore, conversion of agricultural land to nonagricultural use is expected to occur in both regions. Mitigation Measure AG-1 would help reduce some of the anticipated conversion of agricultural land.

The Trinity River and Central Coast regions were not modeled under SWAP. Because there are no CVP/SWP agricultural water deliveries in this region, no conversion of agricultural land to nonagricultural use is anticipated.

R.2.5 Alternative 3

Under Alternative 3, there would be a substantial decrease (up to 82%) in project M&I and agricultural deliveries, with the exception of M&I deliveries in the Sacramento River Region for the long-term average (-4%). Table R-41 and Table R-42 show the change in CVP and SWP M&I and agricultural water deliveries by region as modeled by CalSim 3 for the long term average and dry/critical year average, respectively.

Table R-41. Alternative 3 CalSim 3 Water Deliveries Report by Region and Type, Long-Term Average (thousand acre-feet/year) [a, b]

Regions Modeled	Water Delivery Type	No Action	Alternative 3	Alternative 3 minus No Action	Percent Change [c]
Sacramento River	M&I	142	136	-6	-4%
	Agriculture	326	288	-38	-12%
San Joaquin River [d]	M&I	84	42	-42	-50%
	Agriculture	2,324	870	-1,454	-63%
San Francisco Bay Area	M&I	442	331	-111	-25%
	Agriculture	43	12	-31	-72%
Central Coast	M&I	36	17	-19	-53%
	Agriculture	-	-	-	-
Southern California	M&I	1,461	677	-784	-54%
	Agriculture	7	3	-4	-57%

[a] The totals do not include deliveries for CVP Settlement/Exchange or SWP Feather River Service Area.
[b] Long Term is the average quantity for the period of Oct 1921 - Sep 2021; simulated at 2022 Median climate.
[c] CalSim 3 model output includes minor fluctuations of up to 5% due to model assumptions and approaches. Changes less than 5% are considered "similar" to conditions under the No Action Alternative.
[d] Does not include Friant-Kern Canal or Madera Canal water users.
M&I = Municipal and Industrial

Table R-42. Alternative 3 CalSim 3 Water Deliveries Report by Region and Type, Dry and Critical Average (thousand acre-feet/year) [a, b]

Regions Modeled	Water Delivery Type	No Action	Alternative 3	Alternative 3 minus No Action	Percent Change [c]
Sacramento River	M&I	134	126	-8	-6%
	Agriculture	207	145	-62	-30%
San Joaquin River [d]	M&I	45	22	-23	-51%
	Agriculture	1,065	375	-690	-65%

Regions Modeled	Water Delivery Type	No Action	Alternative 3	Alternative 3 minus No Action	Percent Change [c]
San Francisco Bay Area	M&I	362	288	-74	-20%
	Agriculture	17	3	-14	-82%
Central Coast	M&I	20	9	-11	-55%
	Agriculture	-	-	-	-
Southern California	M&I	755	339	-416	-55%
	Agriculture	3	2	-1	-33%

[a] The totals do not include deliveries for CVP Settlement/Exchange or SWP Feather River Service Area.
[b] Dry and Critical Years Average is the average quantity for the combination of the SWRCB D-1641 40-30-30 Dry and Critical Dry years for the period of Oct 1921 - Sep 2021; simulated at 2022 Median climate.
[c] CalSim 3 model output includes minor fluctuations of up to 5% due to model assumptions and approaches. Changes less than 5% are considered "similar" to conditions under the No Action Alternative.
[d] Does not include Friant-Kern Canal or Madera Canal water users.
M&I = Municipal and Industrial

R.2.5.1 Potential Changes in Land Use

As shown in Table R-41 and Table R-42, Alternative 3 would result in a substantial decrease (up to 55%) in M&I deliveries across all regions, with the exception of the Sacramento region long-term average which would be considered similar to existing conditions under the No Action Alternative. Table R-43 shows the modeled changes in the average annual CVP and SWP deliveries and the associated average annual cost in thousands of 2023 dollars as compared to the No Action Alternative.

Table R-43. Differences in Water Supply and Costs Between the No Action Alternative and Alternative 3

Regions Modeled	Average Annual CVP/SWP Deliveries (TAF)	Average Annual Cost ($1,000) [a]
Sacramento Valley	-15.6	$7,903
San Joaquin	-54.2	$16,108
San Francisco Bay Area	-115.4	$35,548
Central Coast	-18.9	$4,286
Southern California	-736.1	$1,098,094
Total	**-940.1**	**$1,161,939**

[a] Benefits are shown as negative costs.
CVP = Central Valley Project; SWP = State Water Project; TAF = Thousand-acre feet

As shown in Table R-43, there would be a significant decrease in deliveries for M&I land uses compared to the No Action Alternative. The Sacramento, San Joaquin, San Francisco Bay Area, and Central Coast regions may be able to afford the increased annual cost to meet water demands and thereby still develop M&I land uses in accordance with applicable general plans. The increase in average annual cost for the Southern California region is substantial at 1 billion dollars. While it is possible that local jurisdictions would be able to replace this deficit in deliveries through other surface water sources, recycling or desalination, or groundwater pumping, the increased cost would be substantial. Therefore, in the Southern California region, local jurisdictions might have difficulty meeting future water demands which may impede future M&I land use development. Local jurisdictions would incorporate decreased deliveries into future urban water supply management plans and explore alternative supplies. Mitigation Measure AG-1 could reduce effects by encouraging water agencies to diversify their water portfolios, thus increasing likelihood that water users would have adequate water and land use and development in the regions would continue as projected by general plans.

No M&I land uses in the Trinity River region are served by CVP and SWP water supplies. Therefore, the M&I land uses would be the same under Alternative 3 and the No Action Alternative in this region.

R.2.5.2 Potential Changes in Irrigated Agricultural Acreage

As shown by CalSim 3 modeling (Table R-41 and Table R-42), long-term average year deliveries for agricultural uses in the Sacramento River region would be similar to the No Action Alternative, while deliveries would decrease in critical/dry years. Deliveries for agricultural uses in the San Joaquin region, San Francisco Bay Area region, and Southern California region would all substantially decrease (up to 82%) under the long-term average and dry/critical conditions, which may result in the conversion of agricultural land to nonagricultural use. Implementation of Mitigation Measure AG-1 would reduce this effect by encouraging water users to develop alternative sources of water.

Table R-44 shows the difference in acreage planted in the average year condition with respect to water availability between the No Action Alternative and Alternative 3, and Table R-45 shows the difference in productivity in the average year condition in millions of 2023 dollars. Table R-46 shows the difference in acreage planted in the dry year condition with respect to water availability between the No Action Alternative and Alternative 3, and Table R-47 shows productivity in the dry year condition in millions of dollars.

Table R-44. Difference in Crops in the SWAP Regions (acres) in the Average Water Year Condition between the No Action Alternative and Alternative 3

Regions Modeled	Crop Acreage [a]					
	Grains	Field crops	Forage crops	Vegetable, truck, specialty	Orchards and vineyards	Total
Sacramento River	-4,672	-5,839	-9,464	1,069	-3,912	**-22,818**
San Joaquin River	-1,322	-8,648	-48,688	-65,783	-179,323	**-303,764**
Total	**-5,994**	**-14,487**	**-58,152**	**-64,714**	**-183,235**	**-326,582**

[a] Values are the annual change in acreage between the No Action Alternative and Alternative 3 under 2040 conditions.

Table R-45. Difference in Crop Productivity in the SWAP Regions (millions of 2023 dollars) in the Average Water Year Condition between the No Action Alternative and Alternative 3 [a]

Regions Modeled	All other Crop Farming	Fruit Farming	Grain Farming	Vegetable and Melon Farming	Total
Sacramento River	5.8	-1.5	-22	60.5	**42.9**
San Joaquin River	-145.1	-1,273.40	-2.7	-168.6	**-1,589.9**
Total	**-139.3**	**-1,274.90**	**-24.7**	**-108.1**	**-1,547.0**

[a] Values are the annual change in crop productivity between the No Action Alternative and Alternative 3 under 2040 conditions.

Table R-46. Difference in Crops in the SWAP Regions (acres) in the Dry Water Year Condition between the No Action Alternative and Alternative 3

Regions Modeled	Crop Acreage [a]					
	Grains	Field Crops	Forage Crops	Vegetable, Truck, Specialty	Orchards and Vineyards	Total
Sacramento River	-959	-3,507	-7,764	-2,900	-5,992	**-21,123**
San Joaquin River	-1,519	-2,509	-22,514	-19,698	-16,4394	**-210,633**
Total	**-2,478**	**-6,016**	**-30,278**	**-22,598**	**-170,386**	**-231,756**

[a] Values are the annual change in acreage between the No Action Alternative and Alternative 3 under 2040 conditions.

Table R-47. Difference in Crop Productivity in the SWAP Regions (millions of 2023 dollars) in the Dry Water Year Condition between the No Action Alternative and Alternative 3 [a]

Regions Modeled	All Other Crop Farming	Fruit Farming	Grain Farming	Vegetable and Melon Farming	Total
Sacramento River	-1.4	-29.8	-8.9	10.7	**-29.5**
San Joaquin River	-55.0	-1,212.3	-3.3	91.8	**-1,178.90**
Total	**-56.5**	**-1,242.1**	**-12.2**	**102.5**	**-1,208.40**

[a] Values are the annual change in crop productivity between the No Action Alternative and Alternative 3 under 2040 conditions.

As shown in Table R-44, there would be approximately 22,818 fewer acres of irrigated farmland in the Sacramento River region and approximately 303,764 fewer acres in the San Joaquin River region under Alternative 3 compared to the No Action in the long-term average. As shown in Table R-45, the Sacramento River region would see an increase of $42.9 million in productivity while the San Joaquin River region would see a decrease of $1.6 billion compared to the No Action Alternative.

As shown in Table R-46, in dry years, there would be a slightly lower decrease than the long-term average relative to the No Action Alternative. The Sacramento River region would have approximately 21,123 fewer irrigated acres and the San Joaquin River region would have 210,633 fewer irrigated acres compared to the No Action Alternative. As shown in Table R-47, the Sacramento River region would see a decrease in crop productivity of $29.5 million and the San Joaquin River region would see a decrease of $1.2 billion compared to the No Action Alternative.

In both the long-term average and during dry years, there would be a decrease in irrigated crops compared to the No Action Alternative. Therefore, conversion of agricultural land to non-agricultural use is anticipated. The implementation of Mitigation Measure AG-1 would reduce agricultural land use conversion by encouraging water users to develop alternative sources of water.

The Trinity River and Central Coast regions were not modeled under SWAP. Because there are no CVP/SWP agricultural water deliveries in this region, no conversion of agricultural land to nonagricultural use is anticipated.

R.2.6 Alternative 4

Under Alternative 4, there would be a slight increase in project M&I deliveries in the Central Coast region and Southern California region (6% and 5%, respectively) and a slight decrease in agricultural deliveries in the Sacramento River Region and San Francisco Bay Area region during average dry/critical years (-6% and -12%, respectively). Table R-48 and Table R-49 show the change in CVP and SWP M&I and agricultural water deliveries by region as modeled by CalSim 3 for the long-term average and dry/critical year average, respectively.

Table R-48. Alternative 4 CalSim 3 Water Deliveries Report by Region and Type, Long-Term Average (thousand acre-feet/year) [a, b]

Regions Modeled	Water Delivery Type	No Action	Alternative 4	Alternative 4 minus No Action	Percent Change [c]
Sacramento River	M&I	142	142	0	0%
	Agriculture	326	322	-4	-1%
San Joaquin River [d]	M&I	84	87	3	4%
	Agriculture	2,324	2,350	26	1%
San Francisco Bay Area	M&I	442	448	6	1%
	Agriculture	43	42	-1	-2%
Central Coast	M&I	36	38	2	6%
	Agriculture	-	-	-	-
Southern California	M&I	1,461	1,531	70	5%
	Agriculture	7	7	0	0%

[a] The totals do not include deliveries for CVP Settlement/Exchange or SWP Feather River Service Area
[b] Long Term is the average quantity for the period of Oct 1921 - Sep 2021; simulated at 2022 Median climate.
[c] CalSim 3 model output includes minor fluctuations of up to 5% due to model assumptions and approaches. Changes less than 5% are considered "similar" to conditions under the No Action Alternative.
[d] Does not include Friant-Kern Canal or Madera Canal water users.
M&I = Municipal and Industrial

Table R-49. Alternative 4 CalSim 3 Water Deliveries Report by Region and Type, Dry and Critical Average (thousand acre-feet/year) [a, b]

Regions Modeled	Water Delivery Type	No Action	Alternative 4	Alternative 4 minus No Action	Percent Change [c]
Sacramento River	M&I	134	133	-1	-1%
	Agriculture	207	194	-13	-6%
San Joaquin River [d]	M&I	45	46	1	2%
	Agriculture	1,065	1,033	-32	-3%
San Francisco Bay Area	M&I	362	364	2	1%
	Agriculture	17	15	-2	-12%
Central Coast	M&I	20	21	1	5%
	Agriculture	-	-	-	-

Regions Modeled	Water Delivery Type	No Action	Alternative 4	Alternative 4 minus No Action	Percent Change [c]
Southern California	M&I	755	804	49	6%
	Agriculture	3	3	0	0%

[a] The totals do not include deliveries for CVP Settlement/Exchange or SWP Feather River Service Area
[b] Dry and Critical Years Average is the average quantity for the combination of the SWRCB D-1641 40-30-30 Dry and Critical Dry years for the period of Oct 1921 - Sep 2021; simulated at 2022 Median climate.
[c] CalSim 3 model output includes minor fluctuations of up to 5% due to model assumptions and approaches. Changes less than 5% are considered "similar" to conditions under the No Action Alternative.
[d] Does not include Friant-Kern Canal or Madera Canal water users.
M&I = Municipal and Industrial

R.2.6.1 Potential Changes in Land Use

As shown in Table R-44 and Table R-45 project M&I deliveries would be similar to the No Action Alternative in the Sacramento River region, San Joaquin River region, and San Francisco Bay Area region. There would be a slight increase (up to 6%) in M&I deliveries in the Central Coast and Southern California regions. Table R-50 shows the modeled changes in the average annual CVP and SWP deliveries and the associated average annual cost in thousands of 2023 dollars as compared to the No Action Alternative.

Table R-50. Differences in Water Supply and Costs Between the No Action Alternative and Alternative 4

Regions Modeled	Average Annual CVP/SWP Deliveries (TAF)	Average Annual Cost ($1,000) [a]
Sacramento Valley	-0.4	$67
San Joaquin	3.3	-$2,615
San Francisco Bay Area	4	$2,925
Central Coast	1.6	-$370
Southern California	66.6	-$50,233
Total	**75.2**	**-$50,227**

[a] Benefits are shown as negative costs.
CVP = Central Valley Project; SWP = State Water Project; TAF = Thousand-acre feet

As shown in Table R-50, there would be a slight increase in deliveries for M&I land uses compared to the No Action Alternative. There would be a slight increase in average annual costs for the San Francisco Bay Area of 3 million dollars. The Southern California region would see a substantial reduction in costs compared to the No Action Alternative. The total reduction in costs for Alternative 4 compared to the No Action Alternative is 50 million dollars. It is anticipated that the Sacramento Valley and San Francisco Bay Area would be able to afford annual costs and

that any additional water supplies would not result in changes in the general plan development plans without subsequent environmental documentation. Adequate water supplies would be available to support future municipal and industrial land uses projected in existing general plans and urban water supply management plans.

R.2.6.2 Potential Changes in Irrigated Agricultural Acreage

As shown by CalSim 3 modeling (Table R-44 and Table R-45), agricultural deliveries would be similar to the No Action Alternative for all regions, except for the slight decrease in agricultural deliveries in the Sacramento River region and San Francisco Bay Area region during average dry/critical years (-6% and -12%, respectively). Fallowing may occur in these regions in the short term if water users and providers cannot afford the additional costs associated with alternative water supplies. Implementation of Mitigation Measure AG-1 could reduce this potential effect by encouraging water users to develop alternative sources of water.

Table R-51shows the long term average difference in acreage planted with respect to water availability between the No Action Alternative and Alternative 4, and Table R-52 shows the long-term average difference in productivity in in millions of 2023 dollars. Table R-53 shows the difference in acreage planted in the dry water year condition with respect to water availability between the No Action Alternative and Alternative 4, and Table R-54 shows productivity in the dry water year condition in millions of dollars.

Table R-51. Difference in Crops in the SWAP Regions (acres) in the Average Water Year Condition between the No Action Alternative and Alternative 4

	Crop Acreage [a]					
Regions Modeled	Grains	Field Crops	Forage Crops	Vegetable, Truck, Specialty	Orchards and Vineyards	Total
Sacramento River	101	12	1,440	-50	-188	**1,316**
San Joaquin River	12	1,548	6,507	3,307	2,720	**14,094**
Total	**113**	**1,560**	**7,947**	**3,257**	**2,532**	**15,410**

[a] Values are the annual change in acreage between the No Action Alternative and Alternative 4 under 2040 conditions.

Table R-52. Difference in Crop Productivity in the SWAP Regions (millions of 2023 dollars) in the Average Water Year Condition between the No Action Alternative and Alternative 4 [a]

Regions Modeled	All Other Crop Farming	Fruit Farming	Grain Farming	Vegetable and Melon Farming	Total
Sacramento River	1.2	-2.3	0.2	-1.7	**-2.6**
San Joaquin River	22.5	8.8	0.0	19.7	**51.0**
Total	**23.7**	**6.5**	**0.2**	**18.1**	**48.4**

[a] Values are the annual change in crop productivity between the No Action Alternative and Alternative 4 under 2040 conditions.

Table R-53. Difference in Crops in the SWAP Regions (acres) in the Dry Water Year Condition between the No Action Alternative and Alternative 4

	Crop Acreage [a]					
Regions Modeled	Grains	Field Crops	Forage Crops	Vegetable, Truck, Specialty	Orchards and Vineyards	Total
Sacramento River	-44	-654	-172	133	-77	**-814**
San Joaquin River	-6	316	-161	-9,283	-1,208	**-10,343**
Total	**-50**	**-337**	**-333**	**-9,150**	**-1,285**	**-11,156**

[a] Values are the annual change in acreage between the No Action Alternative and Alternative 4 under 2040 conditions.

Table R-54. Difference in Crop Productivity in the SWAP Regions (millions of 2023 dollars) in the Dry Water Year Condition between the No Action Alternative and Alternative 4 [a]

Regions Modeled	All Other Crop Farming	Fruit Farming	Grain Farming	Vegetable and Melon Farming	Total
Sacramento River	-0.4	1.3	-1.4	4.7	**4.2**
San Joaquin River	0.5	-5.3	0.0	-62.4	**-67.1**
Total	**0.1**	**-4.0**	**-1.4**	**-57.6**	**-62.9**

[a] Values are the annual change in crop productivity between the No Action Alternative and Alternative 4 under 2040 conditions.

As shown in Table R-54, there would be approximately 1,316 more acres of irrigated farmland in the Sacramento River region and approximately 14,094 more acres in the San Joaquin River region under Alternative 4 compared to the No Action Alternative in the long-term average year condition. As shown in Table R-52, the Sacramento River region would see a decrease in productivity of $2.6 million while the San Joaquin River region would see an increase of $51 million compared to the No Action Alternative.

As shown in Table R-53, in the dry water year condition there would be approximately 814 fewer acres of irrigated farmland in the Sacramento River region and approximately 10,343 fewer acres in the San Joaquin River region compared to the No Action Alternative. As shown in Table R-54, the Sacramento River region would see an increase in productivity of $4.2 million while the San Joaquin River region would see a decrease of $67.1 million compared to the No Action Alternative.

Under Alternative 4, long-term average irrigated acreage would increase,, there would be no conversion of agricultural land to nonagricultural uses in the Sacramento and San Joaquin River regions. Under dry year conditions there would be decreases in irrigated acreage in the Sacramento and San Joaquin River regions. However, with implementation of Mitigation Measure AG-1, the conversion of agricultural land to nonagricultural uses could be reduced.

The Trinity River and Central Coast regions were not modeled under SWAP. Because there are no CVP/SWP agricultural water deliveries in this region, no conversion of agricultural land to nonagricultural use is anticipated.

R.2.7 Mitigation Measures

Following is a description of mitigation measures identified for land use and agricultural resources per alternative. These mitigation measures include avoidance and minimization measures that are part of each alternative and, where appropriate, additional mitigation to lessen impacts of the alternatives.

R.2.7.1 Avoidance and Minimization Measures

No avoidance and minimization measures have been identified.

R.2.7.2 Additional Mitigation Measures

The mitigation measure below relies on entities other than Reclamation to implement the measures. Because Reclamation does not have authority to implement this measure, Reclamation cannot ensure that it will be implemented. If it is implemented, it will reduce impacts on agricultural land.

Mitigation Measure AG-1: Diversify Water Portfolios

Water agencies should diversify their water portfolios. Diversification could include the sustainable conjunctive use of groundwater and surface water, water transfers, water conservation and efficiency upgrades, and increased use of recycled water or water produced through desalination where available.

R.2.8 Summary of Impacts

Table R-55 presents a summary of impacts, the magnitude and direction of those impacts, and potential mitigation measures for consideration.

Table R-55. Impact Summary

Impact	Alternative	Magnitude and Direction of Impacts [a]	Potential Mitigation Measures
Potential Changes in Land Use	No Action	Flows and reservoir levels would remain as under current conditions and M&I and Agricultural deliveries would continue to vary according to available water supply. [b]	-
	Alternative 1	Deliveries in the Sacramento River region would be similar to those under the No Action but would come with an increase in annual costs that is anticipated to be affordable. Deliveries would increase for the San Joaquin River, San Francisco Bay Area, Central Coast region, and the Southern California regions. It is anticipated that any additional water supplies would not result in changes in the general plan development plans without subsequent environmental documentation. Adequate water supplies would be available to support future municipal and industrial land uses projected in existing general plans and urban water supply management plans. Therefore, there would be no change in land use compared to the No Action. No M&I land uses in the Trinity River region are served by CVP and SWP water supplies. Therefore, the M&I land uses would be the same under Alternative 1 and the No Action Alternative in this region.	-
	Alternative 2	There would be an increase in average annual deliveries for all modeled regions across all four phases of Alternative 2 with the exception of the Sacramento region under Alternative 2 Without TUCP Without VA which would have no change from the No Action and under Alternative 2 With TUCP Without VA which would have a slight decrease (0.3 TAF) in average annual deliveries from the No Action Alternative. Under Alternative 2 Without TUCP Delta VA and Alternative 2 Without TUCP Systemwide VA, there would be an average annual reduction in cost across all regions. Under Alternative 2 Without TUCP Without VA, the Southern California region would see increased annual costs while the other regions would experience a reduction in cost. Under Alternative 2 With TUCP Without VA, which would be implemented in times of drought, most of the regions would see a reduction in costs, with the Southern California region receiving the greatest reduction, however, the San Francisco Bay Area region would see an increase in average annual costs compared to the No Action Alternative.	MM AG-1

Impact	Alternative	Magnitude and Direction of Impacts [a]	Potential Mitigation Measures
		It is anticipated that any additional water supplies would not result in changes in the general plan development plans without subsequent environmental documentation. The increased annual costs associated with receiving additional water supplies are anticipated to be afforded with implementation of MM AG-1, therefore, adequate water supplies would be available to support future municipal and industrial land uses projected in existing general plans and urban water supply management plans. No M&I land uses in the Trinity River region are served by CVP and SWP water supplies. Therefore, the M&I land uses would be the same under Alternative 2 and the No Action Alternative in this region. There would be no change in land use compared to the No Action Alternative for this alternative.	
	Alternative 3	There would be a significant decrease in deliveries for M&I land uses compared to the No Action Alternative across all regions. The Sacramento, San Joaquin, San Francisco Bay Area, and Central Coast regions may be able to afford the increased annual cost to replace water not delivered with other sources and thereby still develop M&I land uses in accordance with applicable general plans. The increased costs in Southern California would be significant. Therefore, in the Southern California region, reduced CVP/SWP deliveries could result in local jurisdictions being unable to implement their general plans. No M&I land uses in the Trinity River region are served by CVP and SWP water supplies. Therefore, the M&I land uses would be the same under Alternative 3 and the No Action Alternative in this region.	MM AG-1

Impact	Alternative	Magnitude and Direction of Impacts [a]	Potential Mitigation Measures
	Alternative 4	There would be a slight increase (up to 6%) in M&I deliveries in the Central Coast and Southern California regions. The Sacramento, San Joaquin, San Francisco Bay Area, and Central Coast regions may be able to afford the increased annual cost to meet water demands and thereby still develop M&I land uses in accordance with applicable general plans, resulting in no land use changes. The Southern California region would see a substantial decrease in average annual costs (50 million dollars). Adequate water supplies would be available to support future municipal and industrial land uses projected in existing general plans and urban water supply management plans. No M&I land uses in the Trinity River region are served by CVP and SWP water supplies. Therefore, the M&I land uses would be the same under Alternative 4 and the No Action Alternative in this region.	MM AG-1
Potential Changes in Irrigated Acreage	No Action Alternative	Flows and reservoir levels would remain as under current conditions and M&I and Agricultural deliveries would continue to vary according to available water supply.	
	Alternative 1	Deliveries for agricultural uses in the San Joaquin Region, San Francisco Bay Area Region, and Southern California Region would all increase under the long-term average and dry/critical conditions in this region, so no conversion of agricultural land to nonagricultural use is anticipated for these regions. In both the average and dry water year conditions overall irrigated acreage would increase in the Sacramento River region and San Joaquin River region compared to the No Action Alternative, so no conversion of agricultural land to nonagricultural uses is expected to occur. The Trinity River region was not modeled under SWAP. Because there are no CVP/SWP agricultural water deliveries in this region, no conversion of agricultural land to nonagricultural use is anticipated.	-

Impact	Alternative	Magnitude and Direction of Impacts [a]	Potential Mitigation Measures
	Alternative 2	The long-term average and dry and critical year average deliveries for agricultural uses would decrease across the four phases for the Sacramento River region, San Joaquin River region, and San Francisco Bay Area region. These decreases may result in the conversion of agricultural land to nonagricultural uses. The implementation of Mitigation Measure AG-1, would reduce agricultural land use conversion by encouraging water users to develop alternative sources of water. The agricultural deliveries for the Southern California region would be considered similar to the No Action Alternative. Therefore, there would be no changes in agricultural land use compared to the No Action Alternative. In both the average and dry water year conditions, overall crop acreage would primarily decrease in the San Joaquin River and Sacramento River regions under Alternative 2 when compared to the No Action Alternative. Crop productivity would primarily decrease for the San Joaquin River region under both conditions. Crop productivity in the Sacramento Region would be more variable, with smaller increases and decreases in productivity compared to the No Action Alternative. Therefore, some conversion of agricultural land to nonagricultural is expected to occur in both regions. MM AG-1 would help reduce some of the anticipated conversion of agricultural land. The Trinity River region was not modeled under SWAP. Because there are no CVP/SWP agricultural water deliveries in this region, no conversion of agricultural land to nonagricultural use is anticipated.	MM AG-1
	Alternative 3	Long-term average year deliveries for agricultural uses in the Sacramento River region would be similar to the No Action Alternative, while deliveries would decrease in critical/dry years. Deliveries for agricultural uses in the San Joaquin Region, San Francisco Bay Area Region, and Southern California Region would all substantially decrease (up to 82%) under the long-term average and dry water year conditions, which may result in the conversion of agricultural land to nonagricultural use. Implementation of MM AG-1 would reduce this effect by encouraging water users to develop alternative sources of water. In the both the average and dry water year conditions in the Sacramento and San Joaquin River regions there would be a decrease in irrigated crops compared to the No Action Alternative. Therefore, conversion of agricultural land to non-agricultural use is anticipated.	MM AG-1

Impact	Alternative	Magnitude and Direction of Impacts [a]	Potential Mitigation Measures
		The implementation of MM AG-1 would reduce agricultural land use conversion by encouraging water users to develop alternative sources of water. The Trinity River region and Central Coast region were not modeled under SWAP. Because there are no CVP/SWP agricultural water deliveries in this region, no conversion of agricultural land to nonagricultural use is anticipated.	
	Alternative 4	Agricultural deliveries would be similar to the No Action Alternative for the Sacramento River, San Joaquin River, San Francisco Bay Area, and Southern California regions, except for the slight decrease in agricultural deliveries in the Sacramento River Region and San Francisco Bay Area Region during average dry/critical years (-6% and -12%, respectively). Potential changes in agricultural land use due to fallowing would be reduced with the implementation of MM AG-1. Irrigated acreage would increase in the average, water year, therefore, there would be no conversion of agricultural land to nonagricultural uses in the Sacramento and San Joaquin River regions. Under the dry water year condition there would be decreases in irrigated acreage in the Sacramento and San Joaquin River regions. However, with implementation of MM AG-1, the conversion of agricultural land to nonagricultural uses would be reduced. The Trinity River region and Central Coast region were not modeled under SWAP. Because there are no CVP/SWP agricultural water deliveries in this region, no conversion of agricultural land to nonagricultural use is anticipated.	MM AG-1

[a] For the evaluation of alternatives, operation of the action alternatives is compared to the No Action Alternative.

[b] Under the No Action Alternative, Reclamation would operate the CVP consistent with the 2020 Record of Decision implementing the Proposed Action consulted upon for the 2019 Biological Opinions and the reasonable and prudent measures in the incidental take statements. DWR would operate the SWP consistent with the 2020 Record of Decision and the 2020 Incidental Take Permit for the SWP. Reclamation and DWR would operate consistent with authorizing legislation, water rights, contracts, and agreements as described by common components. The evaluation under the No Action Alternative is compared to existing conditions.

R.2.9 Cumulative Impacts

Past, present, and reasonably foreseeable projects, described in Appendix Y, *Cumulative Impact Technical Appendix* may have cumulative effects on land uses, to the extent that they could affect potential changes in irrigated agricultural acreage.

Past and present actions contribute to the existing condition of the affected environment in the project area while reasonably foreseeable actions are those that are likely to occur in the future that are not speculative. Past, present, and reasonably foreseeable projects include actions to develop water storage capacity, water conveyance infrastructure, water recycling capacity, the reoperation of existing water supply infrastructure, including surface water reservoirs and conveyance infrastructure, and habitat restoration actions. The projects identified in Appendix Y that have the most potential to contribute to cumulative impact on land use and agricultural resources are:

- B.F. Sisk Dam Raise and Reservoir Expansion Project
- Sites Reservoir Project

The No Action Alternative would continue with current operations of the CVP. Changes in CVP and SWP operations under the No Action Alternative could change the availability of CVP and SWP water supplies. If the CVP and SWP water supplies were reduced to a level that would not support planned M&I water demands, development of future land uses may not occur. Reductions in agricultural water supplies may result in the conversion of agricultural land to nonagricultural uses. These changes may potentially contribute to cumulative impacts and were described and considered in the 2020 Record of Decision.

R.2.9.1 Changes in Land Use

Alternatives 1 and 2 would not result in changes to land use compared with the No Action. Therefore Alternatives 1 and 2 are not evaluated further in this section.

There would be a decrease in deliveries for M&I land uses compared with the No Action Alternative across all regions under Alternative 3. The Sacramento, San Joaquin, San Francisco Bay Area, and Central Coast regions may be able to afford the increased annual cost to replace water not delivered with other sources and thereby still develop M&I land uses in accordance with applicable general plans. There would be increased costs in Southern California in the amount of 1 billion dollars. Therefore, in the Southern California region, reduced CVP/SWP deliveries could result in local jurisdictions being unable to implement their general plans.

Under Alternative 4, there would be a slight increase in M&I deliveries in the Central Coast and Southern California regions (5% and 6%, respectively). The Sacramento, San Joaquin, San Francisco Bay Area, and Central Coast regions may be able to afford the increased annual cost to meet water demands and thereby still develop M&I land uses in accordance with applicable general plans, resulting in no land use changes. The Southern California region would see a decrease in average annual costs of 50 million dollars. Adequate water supplies would be available to support future municipal and industrial land uses projected in existing general plans and urban water supply management plans.

Appendix Y lists past, present, and reasonably foreseeable future projects that have or may potentially effect the ability of local jurisdictions to implement their general plans due to M&I water availability. Implementation of Alternatives 3 and 4 could contribute to cumulative impacts on local jurisdictions' ability to implement their general plans. Mitigation Measure AG-1 could reduce effects by encouraging water agencies to diversify their water portfolios, thus increasing likelihood that water users would have adequate water. However, despite implementation of mitigation, the contribution of Alternatives 3 and 4 to cumulative impacts may result in an inability of local jurisdictions to implement their general plans.

R.2.9.2 Changes in Irrigated Agriculture

In both the average and dry water year conditions irrigated acreage would increase under Alternative 1 in the Sacramento River region and San Joaquin River region compared with the No Action Alternative, so no conversion of agricultural land to nonagricultural uses is expected to occur.

In both the average and dry water year conditions, overall crop acreage would decrease in the San Joaquin River and Sacramento River regions under Alternatives 2, 3, and 4 when compared with the No Action Alternative. Therefore, conversion of agricultural land to nonagricultural use is anticipated. Appendix Y lists past, present, and reasonably foreseeable projects, that have or may potentially result in effects on irrigated agriculture. Collectively these projects would both benefit agriculture by improving agricultural water supply reliability and potentially adversely affect agriculture by increasing water flows for fish, which can simultaneously decrease water availability for agriculture. In addition, these projects would potentially impact agriculture by locating ecosystem restoration projects on land currently used for agricultural purposes, thus resulting in conversion of agricultural land to nonagricultural uses if the restoration does not allow continued agricultural activities.

At the same time, there is increasing pressure on agricultural land in California from other sources.

- Expanding urban areas is exerting pressure to convert agricultural land to urban and semiurban uses. From 1984 to 2018 urban and built-up land has increased with an annual average of 36,527 acres (California Department of Conservation 2018).
- Projected climate change is anticipated to affect agricultural productivity (Pathak et al. 2018) and could lead to conversion of irrigated farmland to nonagricultural uses.
- In some areas of the San Joaquin Valley, agricultural drainage combined with selenium-rich soil and a perched groundwater layer resulted in an agreement with the federal government to retire up to 200,000 acres of irrigated farmland (San Joaquin River Exchange Contractors Water Authority et al. 2003), that is, to remove them voluntarily from agriculture for the purpose of minimizing the contribution to poor-quality perched groundwater.
- SGMA would constrain the amount of groundwater that is pumped for all uses, including agriculture (Downey-Brand 2014). In years when surface water supplies for agriculture are constrained due to shortage, limits on groundwater pumping can lead to fallowing of agricultural land.

According to the most recent California Farmland Conversion Report, which reports on agricultural land conversions, between 2016 and 2018, California's irrigated farmlands decreased by 88 square miles, or approximately 56,186 net acres (California Department of Conservation 2018). Prime farmland constituted 69% of the decrease, or approximately 38,683 acres. Land idling, where irrigated land was converted to nonirrigated land due to a lack of irrigation over time, conversion to dry farming, or in advance of a planned use for urbanization, was responsible for the conversion of 117,927 acres or 77% of the land removed from irrigation for uses aside from urban. The regions that were most affected by idling are the San Joaquin River, Sacramento River, and Southern California regions. At the same time, urban land increased by approximately 37,583 net acres. The urbanization rate is still relatively low in the Farmland Mapping and Monitoring Program's recent history, reflecting the impact of the economic recession of the period. Nonetheless, in general, Southern California, the San Joaquin Valley and the Sacramento Valley have been areas of rapid urban and suburban growth. As discussed above in Section R.1, *Background Information*, conversion of irrigated farmland to nonagricultural uses has continued in recent years in areas affected by the alternatives.

Climate change is anticipated to affect California's crop productivity through a range of mechanisms (Pathak et al. 2018). CalSim 3 modeling, which provides input to SWAP modeling for surface water availability, considers some water supply effects of climate change. An increase in average water temperatures is projected to result in, among other effects, higher demand for water because of increased evapotranspiration; a decline in winter chill hours required for many fruit and nut trees to properly set fruit; increased frequency and intensity of heat waves that could affect temperature-sensitive crops; an increase in weeds and expanded ranges of existing weeds as weed populations migrate north; and an increase in insect pests because of earlier emergence, longer persistence and potential migration of new pests from warmer climates, and survival and increased reproduction rate of frost-sensitive insects. An increase in heat waves is anticipated to lead to yield losses for multiple crops, including rice, corn, sunflower, and tomato; reduced photosynthesis and increased respiration which would lessen plant growth and decrease the quality of the agricultural product; early bolting in annual crops; and reduced pollination success. Changes in precipitation patterns and temperature are anticipated to result in more rain and less snow falling in the Sierra. Reduction in snowmelt will lead to shallower snowpack, earlier snowmelt with associated increase in winter floods, and loss of snowpack as a reservoir to store water. As a result, water availability during the growing season is expected to decrease and lead to an associated reduction in crop productivity. Flood and unseasonal rains (discussed below) may result in increased risk of soil-borne and rot diseases and potential washing away of pollen during flowering.

Increased incidence of drought resulting from climate change is anticipated to result in crop yield losses due to water stress, reduced root growth, exacerbated insect and disease problems, and surface water shortages. Climate change might also result in increased flood risk in northern California due to warmer storms that will drop rain rather than snow at higher elevations, with a proportional increase in runoff compared with colder storms. Increased flood risk is anticipated to result in water logging where soil is saturated with water; low oxygen, light, and rates of gas exchange that could affect some crops, and changes in timing for both sowing and harvesting (fields that are unseasonably wet limit access by farm machinery at crucial times in the growing cycle). While adaptation strategies such as planting different crops and adopting different irrigation and cultivation practices might improve the chances that California agriculture can

continue its productivity in the face of changing climate, it remains likely that some climate change effects could result in conversion of irrigated farmland to nonagricultural uses.

Poor soil, groundwater, and drainage conditions in agricultural areas have resulted in the retirement of irrigated land and water transferred to other land. Soils can be high in selenium, an element that is essential in minute quantities for human health but that is an environmental toxin when concentrated (Presser and Schwartzback 2008; Presser et al. 2009). Conditions can also include a layer of hardpan clay near ground surface that is impermeable to water, leading to a perched or shallow groundwater table. Agricultural runoff containing selenium and other materials from agricultural activities, specifically fertilizer and pesticides, can accumulate in this perched groundwater, resulting in both water quality issues and a saturated root zone. Both these factors limit agricultural productivity. Accordingly, the federal government and local water agencies can retire land to minimize the accumulation of agricultural drainage in the shallow groundwater.

SGMA, enacted in 2014, requires local agencies to form groundwater sustainability agencies for high and medium priority basin and develop groundwater sustainability plans to avoid undesirable results and mitigate overdraft by 2040 and 2042 (DWR 2024). Through SGMA, groundwater basins are intended to be managed by the GSAs on a county or regional level to maintain the "safe yield" of the basin, as defined by existing case law, at the same time that economic, social, and environmental effects of limiting withdrawals from groundwater basins are addressed (Downey-Brand 2014). Implementation of SGMA is expected to slow or arrest groundwater depletion, reduce subsidence, and maintain or improve groundwater quality levels. To achieve this result, implementation of the groundwater sustainability plans prepared under SGMA will reduce the amount of groundwater that users currently withdraw, including agricultural water users. As a result, large areas of agricultural land are predicted to come out of agricultural production to be retired (Kelsey et al. 2018, Hanak et al. 2017). This includes lands that receive surface water and depend on groundwater as a supplemental source, and those that are solely dependent on groundwater for their water supply.

Implementation of Alternatives 2, 3 and 4 could have cumulative operational impacts related to changes in agricultural water deliveries resulting to conversion of agricultural land to nonagricultural use. Due to the increasing pressure on agricultural land and the factors discussed above, there would likely be increased conversion of agricultural land to nonagricultural use, especially in the San Joaquin Valley where SGMA would limit groundwater substitution. The implementation of Mitigation Measure AG-1 could help reduce the anticipated agricultural land conversion. However, despite implementation of mitigation, the contribution of Alternatives 3 and 4 to cumulative impacts may result in an inability of local jurisdictions to implement their general plans.

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