Appendix R Land Use and Agricultural Resources Technical Appendix

This appendix documents the land use and agricultural resources technical analysis to support the impact analysis in the Environmental Impact Statement (EIS).

R.1 Background Information

R.1.1 Overview of Land Use and Agricultural Resources

This section describes land use and agricultural resources conditions potentially affected by the implementation of the alternatives considered in this EIS.

The following description of the affected environment is presented at the county-level for agricultural and municipal and industrial 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 *Agricultural Resources*

R.1.1.2.1 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 (DWR) 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 (DWR 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 (DWR 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 [NCWA] 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 (DWR 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 (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 (U.S. Department of the Interior, Bureau of Reclamation [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.1-1, Salinity Tolerance of Selected Crops (as percent of maximum yield), presents EC_e and EC_w values for salinity tolerances of a range of crops grown in the Central Valley.

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

	Crop Tolerance Based on Soil Salinity (measured as EC_e)			Crop Tolerance Based on Water Salinity (measured as EC_w)		
Crops[1, 2]	**100%**	**50%**	**0%[3]**	**100%**	**50%**	**0%[3]**
Alfalfa	2.0	8.8	16	1.3	5.9	10
Almond[4]	1.5	4.1	6.8	1.0	2.8	4.5
Apricot[4]	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[5]	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[5]	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.

[1] 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 (EC_e) than indicated if soils have high gypsum, however the water salinity (EC_w) tolerances do not change.

[2] ECe is average root zone salinity as measured by electrical conductivity of the saturation extract of the soil, and EC_w 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 $EC_e = 1.5\ EC_w$ 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.

[3] The zero yield potential or maximum EC_e indicates the theoretical soil salinity (EC_e) at which crop growth ceases.

[4] Tolerance evaluations are based on tree growth and not on yield.

[5] For beets, which are more sensitive during germination, the EC_e should not exceed 3 dS/m in the seeding area for garden beets and sugar beets.

The most sensitive crops are affected when EC_e 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 (mg/L) 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 (DWR 2013; 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 [CALFED] 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 (DWR 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; DWR 2013; Presser and Schwarzbach 2008; Westlands Water District [WWD] 2013a, 2013b). Some areas of the northern San Joaquin Valley collect and discharge subsurface drainage to the San Joaquin River (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 [USGS] 2008; Westside Resource and Conservation District [WRCD] and Center for Irrigation Technology 2004).

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 (WWD 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).

R.1.1.2.2 Cropping Pattern Changes in Response to Water Supply Availability

Conversion of farm lands 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 (CDOC) since 1988 (CDOC 2004). 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 2006 and 2016 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 perennial crops can range up to $15,000 per acre in total costs (including cash outlays plus noncash and allocated overhead costs). The example establishment costs provided in Table R.1-2, Typical Establishment Costs for Some Perennial Crops in the Central Valley, are for the Central Valley, but are generally representative of establishment costs in other regions.

Table R.1-2. Typical Establishment Costs for Some Perennial Crops in the Central Valley

Example Crop	Establishment Period (years)	Assumed Life of Stand (years)	Accumulated Total Cost during Establishment ($ per acre)	University of California Cooperative Extension Cost of Production Study
Alfalfa Hay	1	4	555	Sacramento Valley, 2013
Almonds	4	25	10,520	San Joaquin Valley North, 2011
Irrigated Pasture	1	20	424	Sacramento Valley, 2003
Walnuts	5	25	14,695	San Joaquin Valley North, 2013
Wine Grapes	3	25	19,231	Cabernet Sauvignon, San Joaquin Valley North, 2012

Sources: University of California Cooperative Extension (UCCE) 2003, 2011, 2012a, 2012b, 2012c, 2013a, 2013b, 2013c
All costs are converted to 2018 dollar equivalent values using the Gross Domestic Product Implicit Price Deflator (U.S. Department of Commerce 2019). 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.

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.1-3, Land Rent, Labor Hours, and Custom Services for Example Crops in the Central Valley.

Table R.1- 3. Land Rent, Labor Hours, and Custom Services for Example Crops in the Central Valley

Example Crop	Typical Rent ($ per acre)	Typical Annual Labor (hours per acre)	Custom Services Purchased ($ per acre)	University of California Cooperative Extension Cost of Production Study
Alfalfa Hay	295	2	382	Sacramento Valley, 2013
Almonds	793	32	860	San Joaquin Valley North, 2011
Corn, Grain	153	3	337	San Joaquin Valley South, 2012
Irrigated Pasture	65	3	165	Sacramento Valley, 2003
Rice	291	5	342	Sacramento Valley, 2012
Walnuts	717	8	1250	San Joaquin Valley North, 2013
Wheat	256	2	59	San Joaquin Valley South, 2013
Wine Grapes	658	71	525	Cabernet Sauvignon, SJ Valley North, 2012

Sources: UCCE 2003, 2011, 2012a, 2012b, 2012c, 2013a, 2013b, 2013c
All costs are converted to 2018 dollar equivalent values using the Gross Domestic Product Implicit Price Deflator (U.S. Department of Commerce 2019).

R.1.1.2.3 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 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 nonharvested 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, and reducing groundwater use and increasing irrigated acreage when CVP and SWP become more available occurs throughout the San Joaquin Valley.

R.1.2 Trinity River Region

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 municipal and industrial land or agricultural uses in the Trinity River area are served by CVP and SWP water supplies.

R.1.2.1 *Land Use*

R.1.2.1.1 Trinity County

Trinity County encompasses approximately 3,206 square miles 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 2012).

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 (Trinity County 2012).

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 2012).

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 2012).

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.

R.1.2.1.2 Humboldt County

Humboldt County encompasses approximately 3,570 square miles 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 25% 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 3% of the land area is within state park lands. The Yurok and Hoopa tribal lands represent about 5.6% of the land within Humboldt County boundaries (Humboldt County 2012).

Most of the population and developed areas are located in western Humboldt County along U.S. Highway 101 (Humboldt County 2012). Incorporated cities and residential lands in unincorporated portions of Humboldt County represent less than 1% of the county. Development of communities is relatively limited in Humboldt County because much of the land is within national forests and tribal lands, characterized by steep slopes, or within the coastal zone, where new, large scale developments are minimized. Timber and agricultural lands are located on over 60% of unincorporated areas of Humboldt County.

Humboldt County's primary industries are lumber manufacturing, retail, and services (Humboldt County 2012). Humboldt County provides over 25% of the lumber in the state.

The portion of Humboldt County in the Trinity River region evaluated in this EIS is located along the Trinity and Klamath Rivers. Most of this area is located within the Hoopa Valley Indian Reservation and Yurok Indian Reservation. 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 (Humboldt County 2012).

R.1.2.1.3 Del Norte County

Del Norte County encompasses 1,070 square miles 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).

Del Norte County's primary industries are retail and services (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. Most of this area is within the Yurok Indian Reservation. This portion of the county includes the communities of Requa and Klamath in the Yurok Tribe Indian Reservation (Del Norte County 2003).

R.1.2.1.4 Tribal Lands in Trinity River Region

Federally recognized tribes and tribal lands in the Trinity River region include the tribal lands of the Hoopa Valley Tribe, Yurok Tribe of the Yurok Reservation, Resighini Rancheria, and Karuk Tribe. Aquatic and wildlife resources associated with the Trinity and Klamath Rivers and the surrounding lands are very important to these tribes (California North Coast Regional Water Quality Control Board [NCRWQCB] et al. 2009; Yurok Tribe 2005; Karuk Tribe 2010).

The Hoopa Valley Indian Reservation includes 93,702.73 acres (Hoopa Valley Tribe 2008). The Trinity River flows through the Hoopa Valley Indian Reservation.

The Yurok Indian Reservation includes about 55,890 acres within Tribal trust, Tribal fee, allotment, Tribal member fee, nonmember fee, federal, state, and county lands (Yurok Tribe 2012). The Yurok Tribe employs over 250 people in the government agency, as well as seasonal workers for fisheries, forestry, fire prevention, and other programs.

The Resighini Rancheria includes about 435 acres of land along the south bank of the lower Klamath River and extends from an inland area to the U.S. Highway 101 bridge along the western boundary of the Rancheria (Reclamation 2010). The Rancheria is surrounded by the Yurok Indian Reservation (Reclamation 2010; Resighini Rancheria 2014). The community includes tribal offices, a casino, campground, residences, agricultural lands, and open space.

The Karuk Ancestral Territory is located to the north of the Trinity River in the vicinity of Trinity County and east of the Trinity River in the vicinity of Humboldt County (Karuk Tribe 2010). The western boundary of the Karuk Ancestral Territory is relatively concurrent with the western boundary of the Six Rivers National Forest. Therefore, changes in the Trinity River flow or water quality that could be affected by the changes in CVP and/or SWP operations considered in the action alternatives in this EIS would not occur within the Karuk Ancestral Territory.

R.1.2.2 *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.1-4, Average Annual Agricultural Acreage and Value of Production in Counties in the Trinity River Region from 2012 through 2016.

Table R.1-4. Average Annual Agricultural Acreage and Value of Production in Counties in the Trinity River Region from 2012 through 2016

	Orchards, Vineyards, and Berries	Field and Forage	Livestock, Dairy, Poultry	Nursery, Other	Vegetable	Total
Acreage[1]	54	102,652	N/A	199	N/A	102.905
Value[2]	$2.05	$9.63	$174.08	$64.66	$1.76	252

Sources: U.S. Department of Agriculture (USDA) 2012, 2013, 2014, 2015, 2016; U.S. Department of Commerce 2019.

[1] 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.
[2] Values in million dollars, 2018 basis.

R.1.3 Sacramento River Region

The Sacramento Valley includes Butte, Colusa, El Dorado, Glenn, Nevada, Placer, Plumas, Shasta, Sutter, Tehama, and Yuba Counties. The counties of Sacramento, Solano, and Yolo are discussed under Section R.1.5, *Bay-Delta 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*

R.1.3.1.1 Butte County

Butte County encompasses 1,680 square miles 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; and more than 750 miles of rivers and streams.

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.

The U.S. Forest Service manages 135,427 acres (12%) within Butte County, including portions of the Plumas and Lassen National Forests. The Bureau of Land Management owns and manages 16,832 acres (1.5%) in the county (Butte County 2010). Agriculture is the dominant land use within unincorporated Butte County, accounting for approximately 599,040 acres (60% of the county area) (Butte County 2010).

Butte County contains five incorporated municipalities: Biggs, Chico, Gridley, Oroville, and Paradise. Each has a general plan that guides development within its limits and larger planning area (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, areas along the Feather River that use the surface waters (including agricultural lands), and CVP and SWP water service areas.

R.1.3.1.2 Colusa County

Colusa County encompasses approximately 1,132 square miles 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); East Park Reservoir; and other federally owned land (Colusa County 2011). State lands in Colusa County include Willow Creek-Lurline, North Central Valley, Colusa Bypass, and Sacramento River wildlife management areas.

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 communities. Colusa and Williams are the only incorporated cities in the county and they encompass about 2,574 acres (Colusa County 2011). 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 2011). The majority of land within the CVP water service area in Colusa County is designated for agricultural use (Colusa County 2011; Reclamation 2005b).

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.

R.1.3.1.3 El Dorado County

El Dorado County encompasses approximately 1,790 square miles 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 2003). The CVP water service area provides water to a large portion of the communities and some agricultural areas along the western slope. El Dorado County includes two incorporated cities, Placerville and South Lake Tahoe, which cover 621 acres of land. Other major communities include El Dorado Hills, Cameron Park, Shingle Springs, Rescue, Diamond Springs, Camino, Coloma and Gold Hill, Cool and Pilot Hill, Georgetown and Garden Valley, Pollock Pines, Pleasant Valley, Latrobe, Somerset, and Mosquito. The rural land uses in the county include over 259,000 acres of private production forests, 153,472 acres of agricultural lands, and 35,282 acres within the waters of Folsom Lake and Lake Tahoe. The county's two largest crops are wine grapes and apples.

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 Lake), areas along the American River that use the surface waters, and CVP water service areas.

R.1.3.1.4 Glenn County

Glenn County encompasses 1,317 square miles 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 (Reclamation 2004). Intensive agriculture provides a major segment of the county's economic base (Glenn County 1993; Reclamation 2005b).

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.

R.1.3.1.5 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 169,686 acres in the Tahoe National Forest; 2,574 acres in the Toiyabe National Forest; and approximately 11,000 acres administered by the Bureau of Land Management (Nevada County 1995). The State Lands Commission manages approximately 4,600 acres; State Parks administers 6,300 acres at several locations, including Malakoff Diggins State Historical Park and Empire Mine State Park; 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 (Nevada County 2012). Approximately 91% of the county is used for agriculture, timber, or open space. Most of the population lives in the three incorporated cities in the county (Grass Valley, Nevada City, and Truckee).

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.

R.1.3.1.6 Placer County

Placer County encompasses approximately 1,506 square miles 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 includes lands within the El Dorado and Tahoe National Forests and other federally owned land (Placer County 2011).

Placer County is predominantly rural. Most of the population lives in the area along Interstate (I-) 80 from Auburn to the Sutter and Sacramento county boundaries. Incorporated cities and towns include Roseville, Rocklin, Lincoln, Colfax, Loomis, and Auburn (Placer County 2011; Reclamation 2005c; Sacramento Area Council of Governments [SACOG] 2007). 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; although a large concentration of commercial development occurs outside existing urban areas along I-80. Non-urban land uses include agriculture, resource extraction (timber and mining), and public lands and open spaces. The largest amount of public lands within Placer County is located in the eastern half of the county, and is under the jurisdiction of the Bureau of Land Management, U.S. Forest Service, or the Bureau of Reclamation. The CVP water service area within Placer County primarily includes the communities and agricultural areas in the western portion of the county.

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.

R.1.3.1.7 Plumas County

Plumas County encompasses approximately 2,610 square miles 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. State lands include Plumas-Eureka State Park (Plumas County 2012).

Prominent landscape features in Plumas County are the Sierra Valley, the Lake Almanor Basin, and the upper Feather River watershed, which features three SWP lakes (Antelope Lake, Lake Davis, and Frenchman Lake). The largest land uses in the county are agricultural and timber resource lands. Rural and semirural development is scattered throughout the county, with most growth concentrated in several designated planning areas. The county's only incorporated area is the city of Portola.

The most recent Plumas County General Plan was adopted in 1984. The county is in the process of updating its General Plan through 2030 (Plumas County 2012). Approximately 76% of the land in Plumas County is national forest land owned and managed by the U.S. Forest Service. The U.S. Forest Service prepared the *Plumas National Forest Land and Resource Management Plan* in 1988, to guide management and land use planning decisions in the forest. The plan provides a designation for areas based on established priorities for various resources, including wilderness, recreation, wildlife, timber, and visual resources (Plumas County 2012).

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 and along the Feather River downstream of Frenchman Lake.

R.1.3.1.8 Shasta County

Shasta County encompasses approximately 3,793 square miles 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).

The *Shasta County General Plan* identifies four major categories of land use: urban, rural, agricultural, and timber (Shasta County 2004). Of Shasta County's 2,416,440 acres, 613,495 acres (25%) are designated as timber preserve zones pursuant to California's Forest Taxation Reform Act of 1976 (Shasta County 2004). Approximately 169,127 acres (7%), are designated as agricultural preserve lands.

Approximately 1.2% of the lands in the county are within incorporated areas (Shasta County 2004). Urban development is concentrated in the southern central portion of the county in the cities of Redding, Anderson, and Shasta Lake (Reclamation 2005a).

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 Lake, Keswick Reservoir, and Whiskeytown Lake), areas along the Sacramento River and Clear Creek that use the surface waters (including agricultural lands), and CVP water service areas.

R.1.3.1.9 Sutter County

Sutter County encompasses approximately 607 square miles 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 Butte Slough, Feather River, Gray Lodge,

Sutter Bypass, and Butte Sink wildlife management areas; and Sutter Buttes State Park (Sutter County 2010).

Sutter County's *2030 General Plan* was updated in 2011. Approximately 98% of the land in the county is unincorporated, and approximately 98% of the unincorporated land is zoned for agricultural use (Reclamation 2004). The two incorporated cities within the county, Yuba City and Live Oak, encompass approximately 10,600 acres.

Existing land use in Sutter County is rural and dominated by agricultural areas. The county has substantial natural and recreational resources, and a relatively low population density. 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 (Sutter County 2010). The county includes several incorporated rural communities: Meridian, Sutter, Robbins, Rio Oso, Trowbridge, Nicolaus, East Nicolaus, and Pleasant Grove (Sutter County 2010).

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.

R.1.3.1.10 Tehama County

Tehama County encompasses approximately 2,951 square miles 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, or other federally owned land (Tehama County 2008).

Tehama County is predominantly rural, with populations primarily concentrated in the incorporated cities of Corning, Red Bluff, and Tehama or along the major transportation corridors. The incorporated areas include less than 1% of the total land area in the county. 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 2008).

Ranches, timber company holdings, and government land dominate the county. Much of the land use is resource-based, such as cropland, rangeland, pasture land, and timber land (Tehama County 2008). The majority of land within the CVP water service area in Tehama County is designated for agricultural use (Tehama County 2008; Reclamation 2005b).

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.

R.1.3.1.11 Yuba County

Yuba County encompasses approximately 634 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 (Yuba County 2011). The Department of Fish and Wildlife administers the Spenceville Wildlife Area.

Yuba County is predominantly rural. Over 189,500 acres (46% of the county), are designated for agricultural land uses. Most of the population lives in the two incorporated cities in the county (Marysville and Wheatland) and the major unincorporated communities of Brown's Valley, Brownsville, Camptonville, Dobbins, Linda/Olivehurst, Log Cabin, Loma Rica, Oregon House, Rackerby, and River Highlands (Yuba County 2011).

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.1.3.1.12 Tribal Lands in the Sacramento River Region

This section 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.

Tribal Lands within the Boundaries of Butte County

Federally recognized tribes and tribal lands within the boundaries of Butte County include the Tyme Maidu of Berry-Creek Rancheria on approximately 90 acres, and the Concow Maidu of Mooretown Rancheria on approximately 300 acres (Butte County 2010).

Tribal Lands within the Boundaries of Colusa County

Federally recognized tribes and tribal lands within the boundaries of Colusa County include the Cachil Dehe Band of Wintun Indians of the Colusa Indian Community of the Colusa Rancheria, and the Cortina Indian Rancheria of Wintun Indians of California (Colusa County 2011).

Tribal Lands within the Boundaries of El Dorado County

Federally recognized tribes and tribal lands within the boundaries of El Dorado County include the Shingle Springs Band of Miwok Indians.

Tribal Lands within the Boundaries of Glenn County

Federally recognized tribes and tribal lands within the boundaries of Glenn County include the Grindstone Indian Reservation near Elk Creek at the Grindstone Indian Rancheria of Wintun-Wailaki Indians of California, and lands of the Paskenta Band of Nomlaki Indians of California.

Tribal Lands within the Boundaries of Nevada County

Federally recognized tribes and tribal lands within the boundaries of Nevada County include tribal trust lands of the Shingle Springs Band of Miwok Indians.

Tribal Lands within the Boundaries of Placer County

Federally recognized tribes and tribal lands within the boundaries of Placer County include tribal trust lands of the United Auburn Indian Community of the Auburn Rancheria of California.

Tribal Lands within the Boundaries of Shasta County

Federally recognized tribes and tribal lands within the boundaries of Shasta County include the Pit River Tribe and the Redding Rancheria, which is a federal reservation of Wintun, Pit River, and Yana Indians near Redding.

Tribal Lands within the Boundaries of Tehama County

There are approximately 2,000 acres within the total acreage of Tehama County within tribal trust, including land near Corning owned by the Paskenta Band of Nomlaki Indians of California.

R.1.3.2 *Agricultural Resources*

Crops grown in the Sacramento River region include almonds, walnuts, and grapes; and rice, pasture, and grain. Crop establishment and production costs are generally similar to those shown in Tables R.1-2 and R.1-3. In total, the Sacramento River region contains about 4,000,000 acres planted, creating over three billion dollars per year in value of production. Table R.1-5, Average Annual Agricultural Acreage and Value of Production in Counties in the Sacramento River Region from 2012 through 2016, shows the acreage and production value of agricultural activity in the Sacramento River region, 2012–2016.

Table R.1-5. Average Annual Agricultural Acreage and Value of Production in Counties in the Sacramento River Region from 2012 through 2016

	Orchards, Vineyards, Berries	Field and Forage	Livestock, Dairy, Poultry	Nursery, Other	Vegetable	Total
Acreage[1]	401,896	3,662,304	N/A	13,058	27,565	4,104,823
Value[2]	$2,006.54	$1,069.35	$378.15	$133.98	$127.38	$3,715

Sources: USDA 2012, 2013, 2014, 2015, 2016; U.S. Department of Commerce 2019

[1] 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.

[2] Values in million dollars, 2018 basis

Changes in farmland in the Sacramento River region counties are summarized in Table R.1-6, Farmland Mapping and Monitoring Program Acreages in the Sacramento River Region in 2006 and 2016. Overall, the Sacramento River region saw a decrease of approximately 31,000 acres in Important Farmland within the 10-year period 2006–2016.

Table R.1-6. Farmland Mapping and Monitoring Program Acreages in the Sacramento River Region in 2006 and 2016

		Important Farmland[2]			Grazing Land		
County	**Total[1]**	**2006**	**2016**	**Change**	**2006**	**2016**	**Change**
Butte	1.08	242,058	237,438	-4,620	407,678	400,165	-7,513
Colusa	0.72	325,670	320,560	-5,110	9,030	15,835	6,805
El Dorado	1.1	5,404	4,553	-851	195,957	195,201	-756
Glenn	0.84	267,021	264,816	-2,205	229,191	227,081	-2,110
Nevada	0.64	3,833	2,035	-1,798	117,930	133,508	15,578
Placer	0.96	36,337	30,312	-6,025	28,692	30,267	1,575
Plumas[3]	NI	NI	NI	NI	NI	NI	NI
Shasta	2.4	17,214	13,644	-3,570	409,616	414,181	4,565
Sutter	0.39	292,256	281,179	-11,077	51,516	54,460	2,944
Tehama	1.7	99,076	105,223	6,147	1,550,095	1,545,803	-4,292
Yuba	0.41	85,384	83,562	-1,822	142,729	140,185	-2,544

Sources: Butte County 2010; Colusa County 2011; CDOC 2006a, 2006b, 2006c, 2006d, 2006e, 2006f, 2006g, 2006h, 2006i, 2006j, 2016a, 2016b, 2016c, 2016d, 2016e, 2016f, 2016g, 2016h, 2016i, 2016j; El Dorado County 2003; Glenn County 1993; Nevada County 1995; Placer County 2011; Shasta County 2004; Sutter County 2010; Tehama County 2008; Yuba County 2011.

[1] Total acreage of county in million acres

[2] Includes Prime Farmland, Farmland of Statewide Importance, and Unique Farmland

[3] NI = not inventoried

R.1.4 San Joaquin River Region

The San Joaquin Valley includes Fresno, Kern, Kings, Madera, Merced, Stanislaus, and Tulare Counties. San Joaquin County is discussed under Section R.1.5, *Bay-Delta Region*, for this appendix. 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.1.4.1 *Land Use*

R.1.4.1.1 Fresno County

Fresno County encompasses approximately 6,000 square miles 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 includes lands within Millerton Lake, Pine Flat Lake, the Sierra and Sequoia national forests, Sequoia National Monument, and Kings Canyon National Park (Fresno County 2000). State lands within the county include the Millerton Lake State Recreation Area, San Joaquin River Parkway, and Mendota Wildlife Area.

Fresno County is California's sixth-largest county. Agricultural land uses cover over 48% of the county, and resource conservation lands (e.g., forests, parks, and timber preserves) cover approximately 45% of the county. The 15 incorporated cities and unincorporated communities cover approximately 5% of the county (Fresno County 2000). Development constraints within the county are primarily caused by lack of funding for infrastructure improvement, availability of water supplies, air quality regulations, and physical limitations, especially in the mountains and eastern foothills. The incorporated cities are Clovis, Coalinga, Firebaugh, Fowler, Fresno, Huron, Kerman, Kingsburg, Mendota, Orange Cove, Parlier-West Parlier, Reedley, Sanger, San Joaquin, and Selma (Fresno County 2000). Major unincorporated

communities include Biola, Caruthers, Del Rey, Friant, Lanare, Laton, Riverdale, Shaver Lake, and Tranquility.

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).

R.1.4.1.2 Kern County

Kern County encompasses approximately 8,202 square miles 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 (Kern County 2004). State lands within the county include the Tule Elk State Reserve.

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 (Kern County 2010). The major 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.

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.

R.1.4.1.3 Kings County

Kings County encompasses approximately 1,280 square miles 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 2009).

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. Residential land uses in unincorporated areas and special districts cover less than 1% of the county's total acreage, in the communities of Armona, Home Garden, Kettleman City, and Stratford (Kings County 2009).

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.

R.1.4.1.4 Madera County

Madera County encompasses approximately 2,147 square miles 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 (Madera County 1995). State lands within the county include the Millerton Lake State Recreation Area.

Land elevations in Madera County range from 180 feet to over 13,000 feet above mean sea level. 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 (Madera County 1995). Major unincorporated communities in the county include North Fork, South Fork, O'Neals, Oakhurst, Coarsegold, Gunner Ranch, and Rio Mesa.

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.

R.1.4.1.5 Merced County

Merced County encompasses approximately 1,977 square miles 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 (Merced County 2013). 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 has six incorporated cities of Atwater, Dos Palos, Gustine, Livingston, Los Banos, and Merced. The major unincorporated communities include Delhi, Fox Hills, Franklin, Hilmar, LeGrand, Planada, Santa Nella, Laguna San Luis, and Winton (Merced County 2013). Unincorporated land within the county includes approximately 1.2 million acres (98.1% of the land in the county). Agriculture is the primary land use, totaling just over 1 million acres (81.2%). Public and quasi-public land is the next largest use with 131,582 acres or 10.6% of the unincorporated county. Commercial land uses represent 3,025 acres (0.2%), industrial uses represent 2,488 acres (0.2%), and mining represents 3,375 acres (0.3%). Incorporated cities account for 24,138 acres (1.9%) (Merced County 2012a, 2013). The Merced County Local Agency Formation Commission policies discourage annexation of prime agricultural land when substantial areas of non-prime agricultural land are already available. The policies also encourage development of vacant areas in cities before the annexation and development of outlying areas. Local Agency Formation Commission policies encourage city annexations that reflect a planned, logical, and orderly progression of urban expansion and promote efficient delivery of urban services (Merced County 2012b).

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.

R.1.4.1.6 Stanislaus County

Stanislaus County encompasses approximately 1,521 square miles 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 San Joaquin River National Wildlife Refuge (Stanislaus Council of Governments 2007).

Land use in the county is primarily agricultural, with nearly 80% of the land zoned for general agriculture or in agricultural production (Stanislaus Council of Governments 2007). Over the past 40 years, some portions of the county have been changing from a rural agricultural region to semi-urbanized, especially along major highways and freeways. There are nine incorporated cities in the county: 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 2010, 2012).

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.

R.1.4.1.7 Tulare County

Tulare County encompasses approximately 4,840 square miles 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, Sequoia National Monument, several wilderness areas, Lake Kaweah, Lake Success, and Pixley National Wildlife Refuge (Tulare County 2010).

Agricultural land uses cover more than 2,150 square miles (approximately 44%) of the county. Lands classified as open space (i.e., national forests, monuments, and parks; wilderness areas; and county parks) make up 25% of the land use in the county. Less than 3% of the county lands are in the incorporated cities of Dinuba, Exeter, Farmersville, Lindsay, Porterville, Tulare, Visalia, and Woodlake (Tulare County 2010). 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.

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.1.4.1.8 Tribal Lands in the San Joaquin River Region

This section 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.

Tribal Lands within the Boundaries of Fresno County

Federally recognized tribes and tribal lands within the boundaries of Fresno County include the lands of the Big Sandy Rancheria of the Western Mono Indians of California and Table Mountain Rancheria of California.

Tribal Lands within the Boundaries of Kings County

Federally recognized tribes and tribal lands within the boundaries of Kings County includes the lands of the Santa Rosa Indian Community of Santa Rosa Rancheria near the town of Lemoore (San Diego State University [SDSU] 2013).

Tribal Lands within the Boundaries of Madera County

Federally recognized tribes and tribal lands within the boundaries of Madera County include the Picayune Rancheria of the Chuckchansi Indians of California near the community of Coarsegold and the Northfork Rancheria of the Mono Indians of California near Northfork (SDSU 2013).

Tribal Lands within the Boundaries of Tulare County

Federally recognized tribes and tribal lands within the boundaries of Tulare County includes the Tule River Indian Tribe of the Tule River Reservation of the Yokut Indians about 20 miles east of Porterville and covers 55,356 acres (SDSU 2013).

R.1.4.2 *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 Tables R.1-2 and R.1-3. In total, the San Joaquin River region contains about 6,900,000 acres planted, creating over thirty billion dollars per year in value of production. Table R.1-7, Average Annual Agricultural Acreage and Value of Production in Counties in the San Joaquin River Region from 2012 through 2016, shows the acreage and production value of agricultural activity in the San Joaquin River region, 2012–2016.

Table R.1-7. Average Annual Agricultural Acreage and Value of Production in Counties in the San Joaquin River Region from 2012 through 2016

	Orchards, Vineyards, Berries	Field and Forage	Livestock, Dairy, Poultry	Nursery, Other	Vegetable	Total
Acreage[1]	2,031.931	6,893,215	N/A	7,480	382.736	6,903,110
Value[2]	$14,977.79	$2,752.91	$10,107.68	$498.36	$2,232.94	$30,570

Sources: USDA 2012, 2013, 2014, 2015, 2016; U.S. Department of Commerce 2019

[1] 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.

[2] Values in million dollars, 2018 basis

Changes in farmland in the San Joaquin River region counties are summarized in Table R.1-8, Farmland Mapping and Monitoring Program Acreages in the San Joaquin River Region in 2006 and 2016. Overall, the San Joaquin River region saw a decrease of approximately 280,000 acres in Important Farmland within the 10-year period 2006–2016.

Table R.1-8. Farmland Mapping and Monitoring Program Acreages in the San Joaquin River Region in 2006 and 2016

		Important Farmland[2]			Grazing Land		
County	**Total[1]**	**2006**	**2016**	**Change**	**2006**	**2016**	**Change**
Fresno	3.8	1,289,908	1,167,758	-122,150	827,114	822,697	-4,417
Kern	5.3	962,181	880,102	-82,079	1,792,928	1,849,266	56,338
Kings	0.82	585,616	468,855	-116,761	243,183	338,243	95,060
Madera	1.4	348,020	363,997	15,977	399,724	386,729	-12,995
Merced	1.3	529,764	538,687	8,923	569,828	552,632	-17,196
Stanislaus	0.94	361,974	399,349	37,375	441,435	404,405	-37,030
Tulare	3.1	724,139	700,182	-23,957	440,135	439,934	-201

Sources: CDOC 2006k, 2006l, 2006m, 2006n, 2006o, 2006p, 2006q, 2016k, 2016l, 2016m, 2016n, 2016o, 2016p, 2016q; Fresno County 2000; Kern County 2004; Kings County 2009; Madera County 1995; Merced County 2012a; Stanislaus County 2010; Tulare County 2010.

[1] Total acreage of county in million acres

[2] Includes Prime Farmland, Farmland of Statewide Importance, and Unique Farmland

R.1.5 Bay-Delta Region

The Bay-Delta region in this analysis includes Contra Costa, Sacramento, San Joaquin, Solano, and Yolo Counties. These counties include some of the leading agricultural areas in the state. In addition to agriculture, this area includes important transportation infrastructures including inland shipping ports (Port of West Sacramento and Port of Stockton); major employment centers (cities of Sacramento, West Sacramento, Fairfield, Stockton, and Concord); and water-based recreation activities (e.g., boating, fishing, and water skiing).

R.1.5.1 *Land Use*

R.1.5.1.1 Contra Costa County

Contra Costa County encompasses approximately 805 square miles 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 20,000 acres within Mount Diablo State Park (Contra Costa County 2005).

Over 40% of the county's land is in agricultural production, or about 200,370 acres. Residential land is the second largest use in the county, encompassing approximately 122,100 acres (25.4% of the county). Approximately 46,700 acres (9% of the land within the county), are within surface waters (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.

R.1.5.1.2 Sacramento County

Sacramento County encompasses approximately 1,769 square miles 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 Lake and Lake Natoma.

Residential areas in Sacramento County primarily occur in northern and central Sacramento County. Sacramento County includes areas within the Bay-Delta, including the southwestern portion of the City of Sacramento, City of Isleton and the communities of Locke, Ryde, Courtland, Freeport, Hood, and Walnut Grove; and areas located to the east of the Delta (Sacramento County 2011). Sacramento County has seven incorporated cities located in about 56% of the county: Sacramento, Elk Grove, Citrus Heights, Folsom, Galt, Isleton, and Rancho Cordova. The County includes several unincorporated communities including Antelope, Arden-Arcade, Carmichael, Cordova, Elverta, Foothill Farms, Fair Oaks, Herold, Natomas, North Highlands, Orangevale, Rancho Murieta, Rio Linda, Sloughhouse, and Wilton.

The leading agricultural crops in Sacramento County include dairy, wine grapes, Bartlett pears, field corn, and turkeys (Sacramento County 2010). Agricultural acreage has declined as urban development has continued. Between 1989 and 2004, the portion of the county designated as agriculture declined from 40% to 34%. The southeastern portion of the county remains primarily rural with smaller communities, such as Herald (Sacramento County 2011).

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 Lake 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.

R.1.5.1.3 San Joaquin County

San Joaquin County encompasses approximately 1,426 square miles 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 includes about 6,000 acres of federally owned lands (San Joaquin County 2009).

San Joaquin County is currently in the process of updating its General Plan. Most of the county's land is in agricultural production. Agriculture, the predominant land use, covers 686,109 acres (75%) of the county. Residential land is the second largest use in the unincorporated lands, encompassing 40,410 acres (4.4% of the county). 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. Stockton and Tracy are the largest cities in the county. The major unincorporated areas in the county include French Camp, Linden, Lockeford, Morada, Mountain House, New Jerusalem, Thornton, and Woodbridge (San Joaquin County 2009). The incorporated cities account for 90,191 acres (approximately 10% of the county).

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.

R.1.5.1.4 Solano County

Solano County encompasses approximately 910 square miles 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). State lands include areas within Suisun Marsh and the Cache Slough area of Yolo Bypass.

Solano County's General Plan was adopted in 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 under the Yolo County subsection, 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.

R.1.5.1.5 Yolo County

Yolo County encompasses approximately 1,021 square miles 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 Cache Creek areas and state lands within the Yolo Bypass.

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 (Yolo County 2009). Yolo County includes areas within the Bay-Delta, including the City of West Sacramento and the community of Clarksburg. 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 adopted its *2030 General Plan* in 2011. The general plan designates more than 92% of the county area for agricultural and open space uses. The major crops are tomatoes, alfalfa, wine grapes, rice, seed crops, almonds, organic production, walnuts, cattle, and wheat (Yolo County 2009).

The 59,000-acre Yolo Bypass is primarily located within Yolo County and includes a portion of the Sacramento River Flood Control Project, as described in Chapter 5, Surface Water Resources and Water Supplies (CALFED et al. 2001). 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. The portion of the

southern area located to the north of the upper Holland Tract and upper Liberty Island is within Yolo County. In the northern area, agricultural crops include rice, corn, and safflower with melons and tomatoes planted in years when the bypass is not inundated with flood waters. The southern bypass crops include corn, milo, safflower, beans, and sudan grass. Approximately 16,770 acres in the southern Yolo Bypass is within the Yolo Bypass Wildlife Area (Yolo County 2009).

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.

R.1.5.1.6 Tribal Lands in the Bay-Delta Region

This section 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.

Tribal Lands within the Boundaries of Sacramento County

Federally recognized tribes and tribal lands within the boundaries of Sacramento County include lands of the Wilton Miwok Indians of the Wilton Rancheria near Elk Grove (SACOG 2007).

Tribal Lands within the Boundaries of Yolo County

Federally recognized tribes and tribal lands within the boundaries of Yolo County include lands of the Yocha Dehe Wintun Nation (previously called the Rumsey Indian Rancheria of Wintun Indians of California) (Yolo County 2009).

R.1.5.2 *Agricultural Resources*

Crops grown in the Bay-Delta region include grapes, field crops, grain, alfalfa, and pasture. Crop establishment and production costs are generally similar to those shown in Tables R.1-2 and R.1-3. In total, the Bay-Delta region contains about 1,900,000 acres planted, creating more than four million dollars per year in value of production. Table R.1-9, Average Annual Agricultural Acreage and Value of Production in Counties in the Bay-Delta Region from 2012 through 2016, shows the acreage and production value of agricultural activity in the Bay-Delta region, 2012–2016.

Table R.1-9. Average Annual Agricultural Acreage and Value of Production in Counties in the Bay-Delta Region from 2012 through 2016

	Orchards, Vineyards, Berries	Field and Forage	Livestock, Dairy, Poultry	Nursery, Other	Vegetable	Total
Acreage[1]	376,418	1,431,337	N/A	13,977	127,195	1,948,927
Value[2]	$2,089.21	$714.65	$858.41	$215.80	$590.74	$4,469

Sources: USDA 2012, 2013, 2014, 2015, 2016; U.S. Department of Commerce 2019

[1] 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.

[2] Values in million dollars, 2018 basis

Changes in farmland in the Bay-Delta region counties are summarized in Table R.1-10, Farmland Mapping and Monitoring Program Acreages in the San Francisco Bay Area Region in 2006 and 2016. Overall, the Bay-Delta region saw a decrease of approximately 60,000 acres in Important Farmland within the 10-year period 2006–2016.

Table R.1-10. Farmland Mapping and Monitoring Program Acreages in the San Francisco Bay Area Region in 2006 and 2016

		Important Farmland[2]			Grazing Land		
County	**Total[1]**	**2006**	**2016**	**Change**	**2006**	**2016**	**Change**
Contra Costa	0.52	41,619	37,457	-4,162	168,662	157,701	-10,961
Sacramento	1.1	173,152	149,573	-23,579	156,977	153,174	-3,803
San Joaquin	0.91	560,113	546,172	-13,941	144,933	129,760	-15,173
Solano	0.58	157,736	147,863	-9,873	202,826	208,189	5,363
Yolo	0.65	325,079	316,182	-8,897	150,339	166,413	16,074

Sources: Contra Costa County 2005; CDOC 2006r, 2006s, 2006t, 2006u, 2006v, 2016r, 2016s, 2016t, 2016u, 2016v; Sacramento County 2010; San Joaquin County 2009; Yolo County 2009

[1] Total acreage of county in million acres

[2] Includes Prime Farmland, Farmland of Statewide Importance, and Unique Farmland

R.1.6 San Francisco Bay Area Region

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

R.1.6.1 *Land Use*

R.1.6.1.1 Alameda County

Alameda County encompasses approximately 738 square miles in Northern California. 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. Alameda County includes federally owned and state-owned lands throughout the county (Alameda County 2009).

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, Pleasant, San Leandro, and Union City. The unincorporated area of the county covers approximately 277,760 acres (59%) of the total land area; this includes the Castro Valley and Eden Area (Alameda County Community Development Agency 2010; Alameda County 2000, 2009). 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.

R.1.6.1.2 Napa County

Napa County encompasses approximately 793 square miles 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, 2008).

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.

R.1.6.1.3 San Benito County

San Benito County encompasses approximately 1,386 square miles 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 includes federally owned and state-owned lands throughout the county, including approximately 26,000 acres within Pinnacles National Monument, over 105,403 acres owned by Bureau of Land Management, and over 8,800 acres associated with the Hollister Hills State Vehicular Recreation Area and San Juan Bautista State Historic Park (San Benito County 2010, 2013).

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 (84% of the county) (San Benito County 2010, 2013).

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.

R.1.6.1.4 Santa Clara County

Santa Clara County encompasses approximately 1,306 square miles 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 87,000 acres within Henry W. Coe State Park (Santa Clara County 1994, 2012).

Approximately 83% 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 1994, 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.

R.1.6.1.5 Tribal Lands in the San Francisco Bay Area Region

No federally recognized tribal lands are in the San Francisco Bay Area region (BIA et al. 2011).

R.1.6.2 *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 Tables R.1-2 and R.1-3, except that land costs and rent may be substantially higher in this region. In total, the San Francisco Bay Area Region contains about 1 million acres planted, creating over one billion dollars per year in value of production. Table R.1-11, Average Annual Agricultural Acreage and Value of Production in Counties in the San Francisco Bay Area Region from 2012 through 2016, shows the acreage and production value of agricultural activity in the Sacramento River region, 2012–2016.

Table R.1-11. Average Annual Agricultural Acreage and Value of Production in Counties in the San Francisco Bay Area Region from 2012 through 2016

	Orchards, Vineyards, Berries	Field and Forage	Livestock, Dairy, Poultry	Nursery, Other	Vegetable	Total
Acreage[1]	57,156.4	1,044,136	N/A	1,110	40,193	1,142,595
Value[2]	$738.53	$25.94	$52.59	$170.52	$340.19	$1,328

Sources: USDA 2012, 2013, 2014, 2015, 2016; U.S. Department of Commerce 2019.
[1] 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.
[2] Values in million dollars, 2018 basis

Changes in farmland in the San Francisco Bay Area Region counties are summarized in Table R.1-12, Farmland Mapping and Monitoring Program Acreages in the San Francisco Bay Area Region in 2006 and 2016. Overall, the San Francisco Bay Area Region saw a decrease of approximately 16,000 acres in Important Farmland within the 10-year period 2006–2016.

Table R.1-12. Farmland Mapping and Monitoring Program Acreages in the San Francisco Bay Area Region in 2006 and 2016

		Important Farmland[2]			Grazing Land		
County	Total[1]	2006	2016	Change	2006	2016	Change
Alameda	0.47	8,439	6,672	-1,767	244,947	240,986	-3,961
Napa	0.51	58,036	57,015	-1,021	179,299	179,202	-97
San Benito	0.89	42,118	36,352	-5,766	605,731	618,326	12,595
Santa Clara	0.84	27,678	20,409	-7,269	388,510	394,061	5,551

Sources: Alameda County 2000; CDOC 2006w, 2006x, 2006y, 2006z, 2016w, 2016x, 2016y, 2016z; Napa County 2007; San Benito County 2013; Santa Clara County 1994
[1] Total acreage of county in million acres
[2] Includes Prime Farmland, Farmland of Statewide Importance, and Unique Farmland

R.1.7 Central Coast Region

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

R.1.7.1 *Land Use*

R.1.7.1.1 San Luis Obispo County

San Luis Obispo County encompasses approximately 3,594 square miles in central California, including over 200,000 acres of surface waters (San Luis Obispo County 2013). 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, Carizzo Plain National Monument, several wilderness areas, and Guadalupe-Nipomo Dunes National Wildlife Refuge. State-owned lands include Hearst-San Simeon State Historical Monument, Montano de Oro State Park, and state beaches and marine conservation areas.

Land uses in the county are predominantly rural and agricultural with over 1,672,000 acres in agricultural and rural land uses (83% of the total county lands). Incorporated cities include Arroyo Grande, Atascadero, Grover Beach, Morro Bay, Paso Robles, Pismo Beach, and San Luis Obispo. Major unincorporated communities include Avila, California Valley, Creston Village, Edna Village, Heritage Ranch, Los Ranchos, Nipoma, Oak Shores, Oceano, San Miguel, Santa Margarita, and Templeton (San Luis Obispo County 2013).

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.

R.1.7.1.2 Santa Barbara County

Santa Barbara County encompasses approximately 2,744 square miles 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 629,120 acres in the Los Padres National Forest, 98,560 acres in the 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, Sedgwick Reserve, La Purisima Mission State Park and other state parks, and Burton Mesa Ecological Reserve (Santa Barbara County 2009; SBCAG 2013).

Agricultural is the predominant land use in the county with over 1,440,000 acres (82% of the land) (Santa Barbara County 2009; Santa Barbara County Association of Goverments [SBCAG] 2013). Santa Barbara County has eight incorporated cities: Buellton, Carpinteria, Goleta, Guadalupe, Lompoc, Santa Barbara, Santa Maria, and Solvang. Less than 3% of the county is within incorporated cities. The major unincorporated communities are Cuyama, Los Alamos, Los Olivos, Mission Hills, Montecito, New Cayamu, Orcutt, Summerland, and Vandendberg Village.

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.1.7.2 *Tribal Lands in the Central Coast Region*

This section 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.

R.1.1.1.1 Tribal Lands within the Boundaries of Santa Barbara County

Federally recognized tribes and tribal lands within the boundaries of Santa Barbara County include the Santa Ynez Reservation, which is home to the Santa Ynez Band of Chumash Mission Indians of the Santa Ynez Reservation near Santa Barbara (SDSU 2013).

R.1.7.3 *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.1-2 and R.1-3, except that land costs and rent may be higher in this region. On average, the Central Coast region contains almost 1.8 million acres planted and over two billion dollars per year in value of production. Table R.1-13, Central Coast Region Average Annual Agricultural Acreage and Value from 2012 through 2016, shows the acreage and production value of agricultural activity in the Central Coast region, 2012–2016.

Table R.1-13. Central Coast Region Average Annual Agricultural Acreage and Value from 2012 through 2016

	Orchards, Vineyards, Berries	Field and Forage	Livestock, Dairy, Poultry	Nursery, Other	Vegetable	Total
Acreage[1]	92,366	1,642,667	N/A	1,233	96,714	1,832,980
Value[2]	$1,178.43	$31.02	$124.85	$282.67	$701.52	$2,318

Sources: USDA 2012, 2013, 2014, 2015, 2016; U.S. Department of Commerce 2019
[1] 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.
[2] Values in million dollars, 2018 basis

Changes in farmland in the Central Coast region between 2000 and 2010 are summarized in Table R.1-14, Farmland Mapping and Monitoring Program Acreages in the Central Coast Region in 2006 and 2016. Overall, the Central Coast region saw an increase of approximately 17,000 acres in Important Farmland within the 10-year period 2006–2016.

Table R.1-14. Farmland Mapping and Monitoring Program Acreages in the Central Coast Region in 2006 and 2016

		Important Farmland[2]			Grazing Land		
County	Total[1]	2006	2016	Change	2006	2016	Change
San Luis Obispo	2.3	95,857	109,060	13,203	742,004	1,189,168	447,164
Santa Barbara	1.8	113,903	117,497	3,594	584,449	579,054	-5,395

Sources: CDOC 2006aa, 2006ab, 2016aa, 2016ab; San Luis Obispo County 2013; Santa Barbara County 2009.
[1] Total acreage of county in million acres
[2] Includes Prime Farmland, Farmland of Statewide Importance, and Unique Farmland

R.1.8 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.1.8.1 *Land Use*

R.1.8.1.1 Los Angeles County

Los Angeles County encompasses approximately 4,083 square miles in Southern California. 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 includes federally owned lands throughout the county, including nearly 650,000 acres in Los Padres and Angeles National Forests, portions of Edwards Air Force Base, over 29,000 acres of other federally owned open space (including wilderness areas), and approximately 50,893 acres of state-owned land, including Hungry Valley State Vehicular Recreation Area (Los Angeles County 2011).

More than half of Los Angeles County's 1,698,240 acres of unincorporated land area is designated a natural resources land use category. The next highest land use is rural, which accounts for 39% of the unincorporated areas, followed by residential, which accounts for 3% of the unincorporated areas. The remaining land area is in the county's 88 incorporated cities, the most populous of which is the City of Los Angeles (Los Angeles County 2012). The County has approximately 140 unincorporated areas (Los Angeles County 2013).

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.

R.1.8.1.2 Orange County

Orange County encompasses 948 square miles in Southern California. 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 has 34 incorporated cities in Orange County. The unincorporated lands cover approximately 192,758 acres (Orange County 2005). Land zoned as open space forms the largest land use type in the county (143,313 acres).

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.

R.1.8.1.3 Riverside County

Riverside County encompasses approximately 7,295 square miles in Southern California. 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 March Air Reserve Base, Chocolate Mountains Naval Gunnery Range, Joshua Tree National Park, San Bernardino and Cleveland National Forests, numerous wilderness areas, and Coachella Valley National Wildlife Refuge. State-owned lands in Riverside County include San Jacinto and Santa Rosa Wildlife Areas and Mount San Jacinto State Park (Riverside County Integrated Project [RCIP] 2000).

Residential land use accounts for approximately 184,000 acres, nearly 57% of which are within incorporated cities. Approximately 1,313,000 acres (28%) is open space, recreation land, agriculture, and wildland preservation (RCIP 2000).

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. The major unincorporated communities in the county are Banning Bench, Bermuda Dunes, Cabazon, Cherry Valley, Cleveland Ridge, Desert Center, Eagle Mountain, El Cerrito, Lakeview/Nuevo, Meadowbrook, Mecca, Menifee Valley, North Palm Springs, Ripley, Sun City, Temescal Canyon, Tenaja, Thermal, Thousand Palms, Warm Springs, and Wildomar.

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.

R.1.8.1.4 San Bernardino County

San Bernardino County encompasses approximately 20,106 square miles 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 federally owned and state-owned lands: approximately 10,500,000 acres (81% of the county) (San Bernardino County 2007, 2012). The federally owned lands include 28 Bureau of Land Management wilderness areas (approximately 47% of the total county), San Bernardino and Angeles National Forests (676,666 and 655,387 acres, respectively), Mojave National Preserve, 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). State-owned lands include Silverwood Lake State Recreation Area at the SWP reservoir, Wildwood Canyon State Park, and Providence Mountain and Chino Hills State Recreation Areas.

San Bernardino County has 24 incorporated cities: Adelanto, Apple Valley, Barstow, Big Bear Lake, Chino, Chino Hills, Colton, Fontana, Grand Terrace, Hesperia, Highland, Loma Linda, Montclair, Needles, Ontario, Rancho Cucamonga, Redlands, Rialto, San Bernardino, Twentynine Palms, Upland, Victorville, Yucaipa, and Yucca Valley. Major unincorporated communities in the county are Amboy, Baker, Bear Valley, Bloomington, Crest Forest, Earp, Essex, Fontana suburbs, Goffs, Harvard, Havasu Lake, Helendale, Hilltop, Hinckley, Homestead Valley, Joshua Tree, Kelso, Kramer Junction, Lake Arrowhead, Landers, Lucerne Valley, Ludlow, Lytle Creek, Mentone, Moronga Valley, Muscoy, Newberry Springs, Nipton, Oak Glen, Oak Hills, Parker, Phelan/Pinon Hills, Pioneertown, Red Mountain, Rimrock, Silver Lake, Trona, Vidal, and Yerno.

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.

R.1.8.1.5 San Diego County

San Diego County encompasses approximately 4,525 square miles 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, Cleveland National Forest, and San Diego Bay and San Diego National Wildlife Refuges. State-owned lands in the county include Cuyamaca Rancho State Park, Anza-Borrego Desert State Park, Felipe Wildlife Area, and Ocotillo Wells State Vehicular Recreation Area (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 San Diego (San Diego County 2011). The unincorporated communities include Lakeside, Ramona, San Dieguito, Spring Valley, and Valle de Oro.

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.

R.1.8.1.6 Ventura County

Ventura County encompasses approximately 1,873 square miles 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 550,211 acres in Los Padres National Forest, Chumash and Sespe wilderness area, 4,331 acres at the Point Mugu Naval Air Station, 670 acres at the California State University Channel Islands, and over 410 acres in state beach parks (Ventura County 2013).

Ventura County has 10 incorporated cities: Camarillo, Fillmore, Moorpark, Ojai, Oxnard, Port Hueneme, Santa Paula, San Buenaventura, Simi Valley, and Thousand Oaks (Ventura County 2013). Major unincorporated communities within the county include Bell Canyon, Box Canyon, Camarillo Heights, Del Norte, El Rio, Hidden Valley, Lake Sherwood, Matilija Canyon, Montalvo, Oak Park, Ojai Valley, Piru, Saticoy, and Somis (Ventura County 2005).

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.1.8.2 *Tribal Lands in the Southern California Region*

This section 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.

R.1.1.1.2 Tribal Lands within the Boundaries of San Diego County

Federally recognized tribes and tribal lands within the boundaries of San Diego County include the following: lands of the Capitan Grande Band of Diegueno Mission Indians of California (Barona Reservation and Viejas Reservation), Cahuilla Band of Mission Indians of the Cahuilla Reservation, Campo Band of Diegueno Mission Indians of the Campo Indian Reservation, Ewiiaapaayp Band of Kumeyaay Indians, Inaja Band of Diegueno Mission Indians of the Inaja and Cosmit Reservation, Jamul Indian Village of California, La Jolla Band of Luiseno Indians, La Posta Band of Diegueno Mission Indians of the La Posta Indian Reservation, Los Coyotes Band of Cahuilla and Cupeno Indians, Manzanita Band of Diegueno Mission Indians of the Manzanita Reservation, Mesa Grade Band of Diegueno Mission Indians of the Mesa Grande Reservation, Pala Band of Luiseno Mission Indians of the Pala Reservation, Pauma Band of Luiseno Mission Indians of the Pauma and Yuima Reservation, Rincon Band of Luiseno Indians of the Rincon Reservation, San Pasqual Band of Diegueno Mission Indians of California, Iipay Nation of Santa Ysabel, and Sycuan Band of Kumeyaay Nation.

Tribal Lands within the Boundaries of Riverside County

Federally recognized tribes and tribal lands within the boundaries of Riverside County include the following: lands of the Agua Caliente Band of Cahuilla Indians of the Agua Caliente Reservation, Augustine Band of Cahuilla Indians, Cabazon Band of Mission Indians, Cahuilla Band of Mission Indians of the Cahuilla Reservation, Morango Band of Mission Indians, Pechanga Band of Luiseno Mission Indians of the Pechanga Reservation, Ramona Band of Cahuilla, Santa Rosa Band of Cahuilla Indians, Soboba Band of Luiseno Indians, Torres-Martinez Desert Cahuilla Indians, Twenty-Nine Palms Band of Mission Indians of California, and Colorado River Indian Tribes of the Colorado River Indian Reservation (RCIP 2000).

Tribal Lands within the Boundaries of San Bernardino County

Federally recognized tribes and tribal lands within the boundaries of San Bernardino County include the lands of the San Manual Band of Mission Indians and the Twenty-Nine Palms Band of Mission Indians of California (SDSU 2013). The Chemehuevi Indian Tribe of the Chemehuevi Reservation is also located in San Bernardino County near the Colorado River.

R.1.8.3 *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 Tables R.1-2 and R.1-3, except that land costs and rent may be higher in parts of this region. In total, Southern California contains almost 2 million acres irrigated and generates over five billion dollars per year in value of production. Table R.1-15, Average Annual Agricultural Acreage and Value of Production in Counties in the Southern California Region from 2012 through 2016, shows the acreage and production value of agricultural activity in the Southern California region, 2012–2016.

Table R.1-15. Average Annual Agricultural Acreage and Value of Production in Counties in the Southern California Region from 2012 through 2016

	Orchards, Vineyards, Berries	Field and Forage	Livestock, Dairy, Poultry	Nursery, Other	Vegetable	Total
Acreage[1]	132,358	1,880,727	N/A	14,293	84,254	2,111,632
Value[2]	$2,087.08	$219.50	$730.76	$1,772.32	$996.81	$5,806

Sources: USDA 2012, 2013, 2014, 2015, 2016; U.S. Department of Commerce 2019.
[1] 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.
[2] Values in million dollars, 2018 basis

Changes in farmland in the Southern California region between 2006 and 2016 are summarized in Table R.1-16, Farmland Mapping and Monitoring Program Acreages in the Southern California Region in 2006 and 2016. Overall, Southern California saw a decrease of approximately 65,000 acres in Important Farmland within the 10-year period 2006–2016.

Table R.1-16. Farmland Mapping and Monitoring Program Acreages in the Southern California Region in 2006 and 2016

		Important Farmland[2]			Grazing Land		
County	**Total[1]**	**2006**	**2016**	**Change**	**2006**	**2016**	**Change**
Los Angeles	2.6	34,658	24,345	-10,313	228,730	239,037	10,307
Orange	0.61	11,915	5,715	-6,200	35,656	37,114	1,458
Riverside	4.7	213,370	193,806	-19,564	111,695	110,203	-1,492
San Bernardino	12.9	28,134	19,831	-8,303	902,853	898,633	-4,220
San Diego	2.9	72,460	57,362	-15,098	106,680	127,183	20,503
Ventura	1.2	108,242	102,918	-5,324	199,004	197,859	-1,145

Sources: CDOC 2006ac, 2006ad, 2006ae, 2006af, 2006ag, 2006ah, 2016ac, 2016ad, 2016ae, 2016af, 2016ag, 2016ah; Los Angeles County 2011; Orange County 2005; RCIP 2000; San Bernardino County 2007; San Diego County 2011; Ventura County 2005.

[1] Total acreage of area inventoried in county in million acres; this may be less than the total acreage of the county

[2] 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

Both the land use and agricultural resources analyses rely in part on modeling of water deliveries as projected by CalSim II. CalSim II is a generalized water resources modeling system for evaluating operational alternatives of large, complex river basins (DWR 2019a). Table R.2-1, CalSim II Water Deliveries Report by Region and Type, Average Year Averages (thousand acre feet/year), and Table R.2-2, CalSim II Water Deliveries Report by Region and Type, Dry/Critical Year Averages (thousand acre feet/year), show the change in CVP and SWP municipal and industrial (M&I) and agricultural water deliveries (thousands of acre-feet) by region as modeled by CalSim II for Alternatives 1, 2, 3, and 4 for the average and dry/critical conditions, respectively.

Table R.2-1. CalSim II Water Deliveries Report by Region and Type, Average Year Averages (thousand acre feet/year)[1]

Regions Modeled	Water Delivery Type	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Sacramento River Region	M&I	7	5	4	-8
	Agriculture	24	24	22	-4
San Joaquin River Region	M&I	10	25	24	-6
	Agriculture	309	662	644	-57
San Francisco Bay-Delta Region	M&I	32	56	53	-17
	Agriculture	9	15	14	-2
Central Coast Region	M&I	4	12	12	-3
	Agriculture	–	–	–	–
Southern California Region	M&I	226	469	453	-71
	Agriculture	1	3	3	0

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

Table R.2-2. CalSim II Water Deliveries Report by Region and Type, Dry/Critical Year Averages (thousand acre feet/year)[1]

Regions Modeled	Water Delivery Type	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Sacramento River Region	M&I	5	2	2	-14
	Agriculture	26	16	13	-20
San Joaquin River Region	M&I	6	18	18	-8
	Agriculture	195	432	414	-129
San Francisco Bay-Delta Region	M&I	15	40	36	-29
	Agriculture	6	10	9	-4
Central Coast Region	M&I	2	9	8	-4
	Agriculture	--	--	--	--
Southern California Region	M&I	84	363	345	-137
	Agriculture	0	2	2	0

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

R.2.1.1 *Land Use*

Land uses in 2030 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 3 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 II model output (see Appendix H). Most of the CVP and SWP M&I water users prepared urban water management plans (UWMPs) that project availability of water supplies to support land uses in 2030. That information 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 2030 using the 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 II 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 (USACE), Central Valley Flood Protection Board, and California Department of Water Resources (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 recently adopted *Delta Plan* (Delta Stewardship Council 2013). These regulations would continue to be implemented in the No Action Alternative and Alternatives 1 through 3. Therefore, future development would be prevented from occurring within the Bay-Delta floodplains and floodways; and in the Sacramento, Feather, American, and San Joaquin river corridors upstream of the Bay-Delta. The potential changes in land use are analyzed qualitatively in this chapter.

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 2030 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*

R.2.1.2.1 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 long-term average condition and in dry and critical dry years compared to the No Action Alternative.

The impact analysis compares the typical changes that would occur between alternatives by 2030. 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 II 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 F, *Modeling*. 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 F. Actions that were not modeled, such as the Shasta Dam raising, water transfers, and program actions, are analyzed qualitatively.

The SWAP model incorporates CVP and SWP water supplies, other local water supplies represented in the CalSim II 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 II model, as described in Appendix H, were provided as inputs into SWAP through a standardized data linkage procedure. Results from the groundwater analysis that used the Central Valley Hydrologic Model (CVHM model), as described in Appendix I, 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. The analysis does not restrict groundwater withdrawals based upon groundwater overdraft or groundwater quality conditions. The Sustainable Groundwater Management Act requires preparation of groundwater sustainability plans (GSPs) by 2020 or 2022 for most of the groundwater basins in the Central Valley. The GSPs will identify methods to implement measures that will achieve sustainable groundwater operations by 2040 or 2042. The analysis in this chapter is focused on conditions that would occur through 2030. If local agencies fully implement GSPs prior to the regulatory deadline, increasing groundwater use would be less of an option for agricultural water users. However, to achieve sustainable conditions, some measures could require several years to design and construct new water supply facilities, and sustainable groundwater conditions are not required until 2040 or 2042. Therefore, it was assumed that Central Valley agriculture water users would not reduce groundwater use by 2030, and that groundwater use would change in response to changes in CVP and SWP water supplies. The Sustainable Groundwater Management Act (SGMA) could affect quantities of groundwater available for beneficial uses. Modeling in this analysis does not incorporate possible effects of SGMA implementation because the future effects are both uncertain and highly variable, depending on location conditions.

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 and using the results of CalSim II modeling for M&I and agricultural water deliveries.

R.2.1.2.2 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. Reclamation recently prepared two long-term regional water transfer environmental documents which evaluated potential changes in agricultural resources conditions related to water transfer actions (Reclamation 2015, 2018a). Results from these analyses were used to inform the impact assessment of potential effects of water transfers under the action alternatives compared to the No Action Alternative and are incorporated here by reference.

R.2.2 No Action Alternative

Under the No Action Alternative, current CVP and SWP operations would continue. Flows and reservoir levels would remain as under current conditions. No additional habitat restoration or fish intervention actions are proposed, and thus no new construction is proposed.

R.2.2.1 *Land Use*

The No Action Alternative was modeled using CalSim II and CWEST, and the results are discussed here. Under the No Action Alternative, because current CVP and SWP operations would continue and no new construction is proposed, land uses in 2030 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.

Development along the river corridors in the Central Valley would continue to be limited by the state regulations to protect floodways. The Central Valley Flood Protection Board adopts floodway boundaries and approves uses within those floodways (DWR 2010, 2017). Various uses are permitted in the floodways: agriculture, canals, low dikes and berms, parks and parkways, golf courses, sand and gravel mining, structures that are not used for human habitation, and other facilities and activities that will not be substantially damaged by the base flood event and will not cause adverse hydraulic impacts that will raise the water surface in the floodway.

Within the Bay-Delta, future development also is subject to the requirements of the Delta Protection Commission and Delta Stewardship Council. The general plans within the Bay-Delta are required by state laws to be consistent with the Delta Protection Commission's *Land Use and Resource Management Plan for the Primary Zone of the Delta* (Delta Protection Commission 2010; Delta Stewardship Council 2017). This plan does not allow development within the Primary Zone of the Delta unless proponents can demonstrate that their projects would preserve and protect natural resources of the Bay-Delta, promote protection of remnants of riparian and aquatic habitat, not result in loss of wetlands or riparian habitat, not degrade water quality, not interfere with migratory birds or public access, not harm agricultural operations, and not degrade levees or expose the public to increased flood hazards. Farmers are encouraged to implement management practices to maximize habitat values for migratory birds and wildlife.

The Delta Plan, adopted by the Delta Stewardship Council in May 2013 and amended in 2018 (Delta Stewardship Council 2013), included a policy that protects floodways within the entire Bay-Delta that are not regulated by other federal or state agencies (23 California Code of Regulations Section 5014). This policy prevents encroachment into floodways that would impede the free flow of water in the floodway or jeopardize public safety.

Water supply, including CVP and SWP deliveries, in the action area regions was modeled by CWEST, as discussed in Appendix F. Table R.2-3, Water Supply and Costs under the No Action Alternative, shows the modeled water supply and costs under the No Action Alternative.

Table R.2-3. Water Supply and Costs under the No Action Alternative

	Trinity River	Sacramento River	San Joaquin River	Bay-Delta	San Francisco Bay Area	Central Coast	Southern California	Total
Average Annual CVP/SWP Deliveries (TAF)	0	235	228	419	266	41	1750	2939
Delivery Cost ($1,000)	$0	$4,118	$16,306	$10,304	$9,471	$7,394	$255,406	$303,000
New Supply (TAF)	0	0	1	0	8	0	86	94
Annualized New Supply Costs ($1,000)	$0	$0	$286	$0	$710	$0	$30,621	$31,616
Surface/ Groundwater Storage Costs ($1,000)	$0	$0	$0	$1,116	$1,882	$0	$10,018	$13,015
Lost Water Sales Revenues ($1,000)	$0	$225	$522	$2,051	$4,524	$0	$28,403	$35,725
Transfer Costs ($1,000)	$0	$500	$9,536	$2,286	$7,276	$0	$14,880	$34,479
Shortage Costs ($1,000)	$0	$75	$170	$685	$1,508	$0	$34,067	$36,507
Groundwater Pumping Savings ($1,000)	$0	-$1,472	-$20,191	-$3,496	-$415	-$9,201	-$61,010	-$95,785
Excess Water Savings ($1,000)	$0	-$447	-$3,726	-$1,948	-$1,291	-$3,207	-$1,975	-$12,593
Average Annual Cost ($1,000)	$0	$3,000	$2,904	$10,998	$23,665	-$5,013	$310,410	$345,964

TAF = thousand acre-feet

R.2.2.2 *Irrigated Agricultural Acreage and Total Production Value*

The No Action Alternative was modeled using CalSim II and SWAP, and the results are discussed here. Agricultural acreage and productivity conditions were modeled for the Sacramento River and San Joaquin River regions. As CalSim II modeling results show, flows and reservoir storage would increase in the Sacramento River and San Joaquin River regions. Note that counties in the Bay-Delta are reported under the Sacramento River and San Joaquin River regions because the relevant SWAP regions span the Bay-Delta region and the Sacramento and San Joaquin River regions.

Table R.2-4, Crops in the SWAP Regions (acres) in the Average Condition under the No Action Alternative, shows the acreage planted in the average baseline condition under the No Action Alternative with respect to water availability, and Table R.2-5, Crop Productivity in the SWAP Regions (millions of dollars) in the Average Condition under the No Action Alternative, shows productivity in the average baseline condition in millions of dollars (2018 basis). Table R.2-6, Crops in the SWAP Regions (acres) in the Dry Condition under the No Action Alternative, shows the acreage planted in the dry baseline condition under the No Action Alternative, and Table R.2-7, Crop Productivity in the SWAP Regions

(millions of dollars) in the Average Condition under the No Action Alternative, shows the productivity in the dry baseline condition in millions of dollars (2018 basis).

Table R.2-4. Crops in the SWAP Regions (acres) in the Average Condition under the No Action Alternative

Crop Category	Grains	Field crops	Forage crops	Vegetable, truck, specialty	Orchards and vineyards	Total
Sacramento River	710,988	63,015	240,346	144,658	636,755	1,795,761
San Joaquin River	981,750	825,639	721,371	607,052	1,667,071	4,802,883
Total Irrigated Acreage (Acres)	1,692,737	888,655	961,716	751,709	2,303,826	6,598,644

Table R.2-5. Crop Productivity in the SWAP Regions (millions of dollars) in the Average Condition under the No Action Alternative

Crop Category	Grains	Field crops	Forage crops	Vegetable, truck, specialty	Orchards and vineyards	Total
Sacramento River	1,260	85	327	1,140	4,557	7,369
San Joaquin River	1,357	1,465	1,508	4,537	13,454	22,320
Total Irrigated Acreage (Acres)	2,617	1,549	1,835	5,677	18,011	29,689

Table R.2-6. Crops in the SWAP Regions (acres) in the Dry Condition under the No Action Alternative

Crop Category	Grains	Field crops	Forage crops	Vegetable, truck, specialty	Orchards and vineyards	Total
Sacramento River	708,590	63,030	236,740	144,592	636,299	1,789,251
San Joaquin River	972,122	823,385	699,966	606,875	1,666,510	4,768,857
Total Irrigated Acreage (Acres)	1,680,712	886,415	936,706	751,467	2,302,808	6,558,108

Table R.2-7. Crop Productivity in the SWAP Regions (millions of dollars) in the Average Condition under the No Action Alternative

Crop Category	Grains	Field crops	Forage crops	Vegetable, truck, specialty	Orchards and vineyards	Total
Sacramento River	1,249	85	324	1,140	4,553	7,351
San Joaquin River	1,345	1,464	1,484	4,538	13,449	22,279
Total Irrigated Acreage (Acres)	2,594	1,548	1,808	5,678	18,003	29,630

As shown in Table R.2-4 (average condition) and Table R.2-6 (dry condition), SWAP analysis indicates that approximately 6.5 million acres of irrigated agricultural land are productive in the Sacramento River and San Joaquin River regions. The average year in the No Action Alternative has about 40,000

more acres planted than the dry year. As shown in Table R.2-5 (average condition) and Table R.2-7 (dry condition), crop productivity is approximately $29,000 million annually for these three regions as modeled by SWAP. The average year produces approximately $60 million more than the dry year.

Although the SWAP regions and study area regions do not match perfectly, the areas covered by SWAP cover much of the study area regions. Therefore, the values of crop acreages and productivity are taken as a proxy for all agriculture in these regions.

For these regions, because CVP and SWP operations would continue and no new construction is proposed, no changes to agricultural land are anticipated under the No Action Alternative.

In addition, for other regions not modeled by SWAP, because CVP and SWP operations would continue and no new construction is proposed, no changes to agricultural land are anticipated under the No Action Alternative.

R.2.2.3 *Cross-Delta Transfers*

Under the No Action Alternative, the timing of cross-Delta water transfers would be limited to July through September and annual volumetric limits would remain as under current conditions, in accordance with the 2008 U.S. Fish and Wildlife Serve (USFWS) Biological Opinion and 2009 National Marine Fisheries Service (NMFS) Biological Opinion (USFWS 2008; NMFS 2009). No changes to water transfers are anticipated under the No Action Alternative.

R.2.3 Alternative 1

R.2.3.1 *Project-Level Effects*

Project-level action alternatives would change operations of the CVP and SWP, as described in Appendix F. The changes to CVP and SWP operations would change river flows and reservoir levels, which in turn could, if flows and levels are decreased, affect the ability of local jurisdictions to fulfill plans described in their general plans, affect productivity of agricultural land to the extent that land is converted from agricultural to nonagricultural use, and change water transfer patterns.

R.1.1.1.3 Potential changes in land use

Effects Modeled by CWEST

As described in Appendix F and in Tables R.2-1 and R.2-2, CVP and SWP water deliveries to M&I water users would be greater overall under Alternative 1 than under the No Action Alternative. The increased CVP and SWP water supply availability would allow water users to reduce other water supplies overall, including groundwater. 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 under Alternative 1 and the No Action Alternative. Table R.2-8, Differences in Water Supply and Costs Between the No Action Alternative and Alternative 1, shows the modeled changes in average annual CVP/SWP deliveries, delivery costs, new supply, annualized new supply costs, surface and groundwater storage costs, lost water sales revenues, transfer costs, shortage costs, groundwater pumping savings, excess water savings, and average annual cost by region for Alternative 1 as compared to the No Action Alternative.

Table R.2-8. Differences in Water Supply and Costs Between the No Action Alternative and Alternative 1

	Trinity River	Sacramento River	San Francisco Bay Area	San Joaquin River	Bay-Delta	Central Coast	Southern California	Total
Average Annual CVP/SWP Deliveries (TAF)	0	2	32	21	0	3	263	321
Delivery Cost ($1,000)	$0	$42	$1,156	$1,976	$29	$535	$38,019	$41,756
New Supply (TAF)	0	0	7	-1	0	0	-58	-52
Annualized New Supply Costs ($1,000)	$0	$0	$4,251	-$267	$0	$0	-$21,299	-$17,315
Surface/ Groundwater Storage Costs ($1,000)	$0	$0	$1,026	$0	$321	$0	-$393	$954
Lost Water Sales Revenues ($1,000)	$0	$0	-$2,339	-$4	-$92	$0	-$7,825	-$10,260
Transfer Costs ($1,000)	$0	-$108	-$5,793	-$307	-$1,001	$25	-$4,088	-$11,273
Shortage Costs ($1,000)	$0	$0	-$841	-$3	-$31	$0	-$8,984	-$9,859
Groundwater Pumping Savings ($1,000)	$0	-$34	-$570	-$74	$1	$40	-$19,126	-$19,763
Excess Water Savings ($1,000)	$0	-$27	-$89	-$1,812	$18	-$562	-$1,886	-$4,357
Average Annual Cost ($1,000)	$0	-$127	-$3,199	-$490	-$755	$37	-$25,583	-$30,116

TAF = thousand acre-feet

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

Table R.2-8 shows that the average annual cost would be less in all regions except for the Central Coast compared to the No Action Alternative. The increased average annual cost in the Central Coast is small spread over the entire region. Therefore, it is expected that local jurisdictions would afford to have adequate water to implement their general plans, and that land use in 2030 would not change under Alternative 1 compared to the No Action Alternative.

In addition to project actions that were modeled, Alternative 1 includes project actions that were not modeled. These are described by region below and their effects are compared to those of the No Action Alternative.

R.1.1.1.4 Effects Not Modeled by CWEST

Sacramento River Region

The Rice Decomposition Smoothing project action would not change overall water deliveries but instead would change the timing of deliveries. Therefore, the action would not result in local jurisdictions being unable to implement general plans because of lack of water. No changes in land use are likely to result, as compared to the No Action Alternative.

The Spring Management of Spawning Locations project action would involve coordination between Reclamation and NMFS as part of adaptive management to establish experiments to determine if keeping water colder earlier induces earlier spawning or if keeping April to May Sacramento River temperatures warmer induces later spawning and to refine the state of the science. This action would change timing of flows but would not result in an overall change in quantity of water deliveries. Therefore, the action would not result in local jurisdictions being unable to implement general plans because of lack of water. Changes in land use as a result of this action are unlikely, as compared to the No Action Alternative.

San Joaquin River Region

The Dissolved Oxygen Requirement project action is a water quality objective for spawning beneficial uses for water bypassed through or released from New Melones Reservoir. It requires that applicable dissolved oxygen standards be maintained through maintenance of cold water in the Stanislaus River. This action would result in more water being available downstream for beneficial uses than under the No Action Alternative. Therefore, the action would not result in local jurisdictions being unable to implement general plans because of lack of water. Changes in land use as a result of this action are unlikely, as compared to the No Action Alternative.

Bay-Delta Region

The Minimum Export Rate project action would ensure minimum flows not ensured under the No Action Alternative. This action would not result in reduced water deliveries for M&I uses. Therefore, the action would not result in local jurisdictions being unable to implement general plans because of lack of water. Changes in land use as a result of this action are unlikely, as compared to the No Action Alternative.

The Delta Cross Channel Operations project action could change flows to the Jones Pumping Plant in comparison to the No Action Alternative. In dry years, water quality could approach trigger levels. In this case, Reclamation and DWR would meet to determine what to do based on a risk assessment. Because there is a process for ensuring that water quality levels are adequate for M&I purposes, it is unlikely that this action would result in local jurisdictions being unable to implement general plans because of lack of water. Changes in land use as a result of this action are unlikely, as compared to the No Action Alternative.

The Clifton Court Aquatic Weed Removal project action under Alternative 1 would involve application of aquatic herbicides and algaecides and operation of the Clifton Court Forebay intake gates to control flow of the water in and out of the Clifton Court Forebay. Because this action does not include changes in flows, it is unlikely that this action would result in local jurisdictions being unable to implement general plans because of lack of water. Changes in land use as a result of this action are unlikely, as compared to the No Action Alternative.

As discussed under No Action Alternative, the Tracy Fish Collection Facility and the Skinner Fish Facility project actions involve fish screening and hauling salvaged fish by truck to release sites. None of these activities affect flow or reservoir levels or surrounding land. It is unlikely that this action would result in local jurisdictions being unable to implement general plans because of lack of water. Changes in land use as a result of this action are unlikely, as compared to the No Action Alternative.

The Suisun Marsh Salinity Control Gates Operation project action would involve operations of the Suisun Marsh Salinity Control Gates to meet required characteristics of Delta Smelt habitat in June through September in below-normal and above-normal Sacramento Valley Index year types. The increased flows would be managed adaptively. Modeling suggests that the action would be achievable in all but drought or wet years (DWR n.d.). Because the flows would be increased with respect to the No Action Alternative, no reduction in M&I water is anticipated, and changes in land use as a result of this action are unlikely, as compared to the No Action Alternative.

The Fall Delta Smelt Habitat project action would involve managing for Delta Smelt habitat in normal and wet years, when adequate water is available for such activities. This action is not part of the No Action Alternative. Because the action assumes adequate water is available for these activities, no reduction in M&I water is anticipated, and changes in land use as a result of this action are unlikely, as compared to the No Action Alternative.

In addition, Alternative 1 includes some elements in the Summer-Fall Delta Smelt Habitat action that could vary year-to-year. The action could include operations of the Suisun Marsh Salinity Control Gates in some years or a fall action to maintain the X2 position at 80 km in some above normal and wet years. Both of these actions would require water and affect CVP and SWP operations, but the frequency of these actions is not specifically defined. CalSim and CWEST modeling do not include these actions. Generally, potential effects and benefits of Alternative 1 with respect to this action could range between modeled results and the No Action Alternative, which includes a Fall X2 action. If the Summer-Fall Delta Smelt Habitat action includes operations of the Suisun Marsh Salinity Control Gates or a Fall X2 action, the water requirements in summer and fall could be greater than shown for Alternative 1. Alternative 1 indicates that average annual CVP/SWP deliveries would be greater than under the No Action Alternative (Table R.2-8). In years with summer or fall actions, the deliveries could be less than indicated in Alternative 1 modeling. However, other water supplies are available, e.g., groundwater pumping and water transfers, so changes in land use as a result of this action are unlikely.

The San Joaquin Basin Steelhead Telemetry Study project action would continue a telemetry study for the migration and survival of San Joaquin Origin Central Valley Steelhead. This action is not part of the No Action Alternative. This action would not change flows or reservoir levels. Therefore, no reduction in M&I water is anticipated, and changes in land use as a result of this action are unlikely, as compared to the No Action Alternative.

R.1.1.1.5 Potential changes in irrigated agricultural acreage and total production value

Effects Modeled by SWAP

Sacramento River and San Joaquin River Regions as Modeled under SWAP

The Sacramento River Seasonal Operations, Spring Pulse Flows, Shasta Cold Water Pool Management, Fall and Winter Redd Federal Energy Regulatory Commission (FERC) Project #2100-134, and Seasonal Operations of the American River project actions in the Sacramento River region; the San Joaquin River

Restoration Program and Stanislaus Stepped Release Plan project actions in the San Joaquin River region; and the Delta Seasonal Operations, Contra Costa Water District Rock Slough Operations, North Bay Aqueduct, and Old and Middle River (OMR) Management project actions in the Bay-Delta were modeled under CalSim II. These actions were also modeled under SWAP and are discussed here.

Assumptions in the SWAP model do not account for any change in groundwater use under SGMA implementation, which requires that local public agencies and Groundwater Sustainability Agencies (GSAs) in high- and medium-priority basins develop and implement GSPs or Alternatives to GSPs in order to map how groundwater basins will reach long term sustainability. However, because in-stream flows are expected to increase with Alternative 1, no reduction in groundwater is anticipated. The additional surface water supply is expected to reduce the reliance of those areas on groundwater, no reduction in groundwater is anticipated.

As CalSim II modeling results show (Appendix F), flows and reservoir storage would increase in the Sacramento River, San Joaquin River, and Bay-Delta regions. In addition, deliveries for agricultural uses would increase (Tables R.2-1 and R.2-2). Note that counties in the Bay-Delta are reported under the Sacramento River and San Joaquin River regions because the relevant SWAP regions span the Bay-Delta region and the Sacramento River and San Joaquin River regions. These actions are discussed under the SWAP modeling discussion and are not discussed further.

Table R.2-9, Difference in Crops in the SWAP Regions (acres) in the Average Year Condition between the No Action Alternative and Alternative 1, shows the difference in acreage planted in the average year condition with respect to water availability between the No Action Alternative and Alternative 1, and Table R.2-10, Difference in Crop Productivity in the SWAP Regions (millions of dollars) in the Average Year Condition between the No Action Alternative and Alternative 1, shows the difference in productivity in the average year condition in millions of dollars. Table R.2-11, Difference in Crops in the SWAP Regions (acres) in the Dry and Critical Year Condition between the No Action Alternative and Alternative 1, shows the difference in acreage planted in the dry and critical year condition with respect to water availability between the No Action Alternative and Alternative 1, and Table R.2-12, Difference in Crop Productivity in the SWAP Regions (millions of dollars) in the Dry and Critical Year Condition between the No Action Alternative and Alternative 1, shows productivity in the dry and critical year condition in millions of dollars.

Table R.2-9. Difference in Crops in the SWAP Regions (acres) in the Average Year Condition between the No Action Alternative and Alternative 1

Crop Category	Grains	Field crops	Forage crops	Vegetable, truck, specialty	Orchards and vineyards	Total
Sacramento River	0	0	0	0	0	0
San Joaquin River	1,147	397	444	68	713	2,770
Total Irrigated Acreage (Acres)	1,147	397	444	68	713	2,770

Table R.2-10. Difference in Crop Productivity in the SWAP Regions (millions of dollars) in the Average Year Condition between the No Action Alternative and Alternative 1

Crop Category	Grains	Field crops	Forage crops	Vegetable, truck, specialty	Orchards and vineyards	Total
Sacramento River	0	0	0	0	0	0
San Joaquin River	2	1	1	0	6	10
Total Irrigated Acreage (Acres)	2	1	1	0	6	10

Table R.2-11. Difference in Crops in the SWAP Regions (acres) in the Dry and Critical Year Condition between the No Action Alternative and Alternative 1

Crop Category	Grains	Field crops	Forage crops	Vegetable, truck, specialty	Orchards and vineyards	Total
Sacramento River	0	0	0	0	0	0
San Joaquin River	16,517	2,164	2,406	242	2,339	23,668
Total Irrigated Acreage (Acres)	16,517	2,164	2,406	242	2,339	23,668

Table R.2-12. Difference in Crop Productivity in the SWAP Regions (millions of dollars) in the Dry and Critical Year Condition between the No Action Alternative and Alternative 1

Crop Category	Grains	Field crops	Forage crops	Vegetable, truck, specialty	Orchards and vineyards	Total
Sacramento River	0	0	0	0	0	0
San Joaquin River	23	4	5	1	16	50
Total Irrigated Acreage (Acres)	23	4	5	1	16	50

As shown in Table R.2-9, SWAP modeling shows that in the average year condition, there would be approximately 2,770 more acres of irrigated farmland in the San Joaquin River region under Alternative 1 compared to the No Action Alternative. Acreage of irrigated farmland in the Sacramento River region would be the same as under the No Action Alternative. As shown in Table R.2-10, the San Joaquin River region would have an increased productivity of approximately $10 million. Agricultural productivity in the Sacramento River region would be the same as under the No Action Alternative. Crop acreage and productivity in the Sacramento River region would remain the same because deliveries to this region in the average year condition would not change under Alternative 1 compared to the No Action Alternative.

As shown in Table R.2-11, in the dry and critical year condition, there would be approximately 23,668 more acres of irrigated farmland in the San Joaquin River region under Alternative 1 compared to the No Action Alternative. Acreage of irrigated farmland in the Sacramento River region would be the same as under the No Action Alternative. As shown in Table R.2-12, the San Joaquin River regions would have an increased productivity of approximately $550 million. Agricultural productivity in the Sacramento River region would be the same as under the No Action Alternative. Crop acreage and productivity in the Sacramento River region would remain the same because deliveries to this region in the dry and critical year condition would not change under Alternative 1 compared to the No Action Alternative.

In both the average and dry/critical year conditions, overall crop acreage and crop productivity in the San Joaquin River region would be greater under Alternative 1 compared to the No Action Alternative and would remain the same in the Sacramento River region. Therefore, no conversion of agricultural land to nonagricultural is expected to occur in these regions.

In addition to project actions modeled under CalSim II and SWAP, Alternative 1 includes project actions that were not modeled. These are described by region in the following sections and their effects are compared to those of the No Action Alternative.

Effects Not Modeled by SWAP

Trinity River Region

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.

Sacramento River Region

As shown by CalSim II modeling (Tables R.2-1 and R.2-2), deliveries for agricultural uses would increase under the average and dry/critical conditions in this region, so no conversion of agricultural land to nonagricultural use is anticipated.

The Rice Decomposition Smoothing project action would not change overall water deliveries but instead would change the timing of deliveries with respect to the No Action Alternative. Because the water delivery timing change would not occur during the growing season but rather during the rice decomposition season, no conversion of agricultural land to nonagricultural use is likely to result, as compared to the No Action Alternative.

The Spring Management of Spawning Locations project action would involve coordination between Reclamation and NMFS as part of adaptive management to establish experiments to determine if keeping water colder earlier induces earlier spawning or if keeping April to May Sacramento River temperatures warmer induces later spawning and to refine the state of the science. Water temperatures below 69°F are known to impede rice development, particularly during the early stages of the growing season (Raney 1963). Specifically, water temperatures below 69°F retard rice germination and emergence from water in the flooded fields, prevent or delay heading, prevent filling of the grains, and delay maturity. Temperature management on the Sacramento River would differ from the No Action Alternative only in other uses of Shasta cold water pool for Winter-Run Chinook salmon survival. No Action Alternative temperature targets on the Sacramento River are established by Water Rights Order (WRO) 90-5, which require a temperature of 56°F at Red Bluff Diversion Dam throughout the temperature season (Reclamation 2018b). Temperature management on Clear Creek would differ from the No Action Alternative only in that daily water temperature in below normal and wetter years would be temperatures 56°F or less from September 15 to October 31, whereas in the No Action Alternative, the target temperature is 56°F. Temperature management on the American River would differ from the No Action Alternative only in that if the target temperature at Watt Avenue Bridge of 65°F cannot be met because of limited cold water availability in Folsom Reservoir, then the target daily average water temperature at this site may be increased. This management regime differs from the temperature management regime under the No Action Alternative in only minor ways. Therefore, while low water temperature releases could affect rice production, the difference between the No Action Alternative and Alternative 1 would be small. It is

unlikely that effects on rice fields would lead to permanent conversion of agricultural land to nonagricultural use.

San Joaquin River Region

As shown by CalSim II modeling (Tables R.2-1 and R.2-2), deliveries for agricultural uses would increase under the average and dry/critical conditions in this region, so no conversion of agricultural land to nonagricultural use is anticipated.

The Dissolved Oxygen Requirement project action is a water quality objective for spawning beneficial uses for water bypassed through or released from New Melones Reservoir. It requires that applicable dissolved oxygen standards be maintained through maintenance of cold water in the Stanislaus River. This action would move the compliance location from Ripon to Orange Blossom Bridge but would not change amount of water available downstream for beneficial uses from the No Action Alternative. Therefore, agricultural productivity would not decline, as compared to the No Action Alternative, and no conversion of agricultural land to nonagricultural uses is anticipated.

Bay-Delta Region

The counties that constitute the Bay-Delta region do not correspond exactly to SWAP regions; rather, these counties span multiple SWAP regions. For this reason, the SWAP modeling analysis of the Bay-Delta region has been reported in the Sacramento River region and the San Joaquin River region in Tables R.2-9, R.2-10, R.2-11, and R.2-12 above.

As shown by CalSim II modeling (Tables R.2-1 and R.2-2), deliveries for agricultural uses would increase under the average and dry/critical conditions in this region, so no conversion of agricultural land to nonagricultural use is anticipated.

The Minimum Export Rate project action would ensure minimum flows not ensured under the No Action Alternative. This action would not result in reduced water deliveries for agricultural purposes, as compared to the No Action Alternative. Therefore, no conversion of agricultural land to nonagricultural uses is anticipated.

The Delta Cross Channel Operations project action could change flows to the Jones Pumping Plant in comparison to the No Action Alternative. In dry years, water quality could approach trigger levels. In this case, Reclamation and DWR would meet to determine what to do based on a risk assessment. Because there is a process for ensuring that water quality levels are adequate for agricultural purposes, it is unlikely that this action would result in conversion of agricultural land to nonagricultural purposes.

The Clifton Court Aquatic Weed Removal project action under Alternative 1 would involve application of aquatic herbicides and algaecides and operation of the Clifton Court Forebay intake gates to control flow of the water in and out of the Clifton Court Forebay. Because this action does not include changes in flows or reservoir levels or construction on agricultural land, this action is unlikely to result in conversion of agricultural land to nonagricultural purposes.

As discussed under No Action Alternative, the Tracy Fish Collection Facility and the Skinner Fish Facility project actions involve fish screening and hauling salvaged fish by truck to release sites. In addition, Reclamation would install a carbon dioxide injection device to allow remote controlled anesthetization of predators in the secondary channels of the Tracy Fish Collection Facility. Addition of

the carbon dioxide injection device would not affect flow or reservoir levels or surrounding land. This action would not result in conversion of agricultural land to nonagricultural purposes.

The Suisun Marsh Salinity Control Gates Operation project action would involve operations of the Suisun Marsh Salinity Control Gates to meet required characteristics of Delta Smelt habitat in June through September in below-normal and above-normal Sacramento Valley Index year types. The increased flows would be managed adaptively. Modeling suggests that the action would be achievable in all but drought or wet years (DWR n.d.). Because agricultural water deliveries would be increased with respect to the No Action Alternative, no reduction in agricultural productivity is anticipated, as compared to the No Action Alternative, and no conversion of agricultural land to nonagricultural use would result.

The Fall Delta Smelt Habitat project action would involve managing for Delta Smelt habitat in normal and wet years, when adequate water is available for such activities. This action is not part of the No Action Alternative. Because the action assumes adequate water available for these activities, no reduction in agricultural productivity is anticipated, as compared to the No Action Alternative, and no conversion of agricultural land to nonagricultural use would result.

In addition, Alternative 1 includes some elements in the Summer-Fall Delta Smelt Habitat action that could vary year-to-year. The action could include operations of the Suisun Marsh Salinity Control Gates in some years or a fall action to maintain the X2 position at 80 km in some above normal and wet years. Both of these actions would require water and affect CVP and SWP operations, but the frequency of these actions is not specifically defined. CalSim and CWEST modeling do not include these actions. Generally, potential effects and benefits of Alternative 1 with respect to this action could range between modeled results and the No Action Alternative, which includes a Fall X2 action. If the Summer-Fall Delta Smelt Habitat action includes operations of the Suisun Marsh Salinity Control Gates or a Fall X2 action, the water requirements in summer and fall could be greater than shown for Alternative 1. Analysis for Alternative 1 indicates that agricultural crop acreage and productivity would be the same as or greater than under the No Action alternative (Tables R.2-9 through R-2.12). In years with summer or fall actions, crop acreage or productivity could be less than indicated in Alternative 1 modeling, including a reduction in crop acreage and productivity with respect to the No Action Alternative in the part of the Sacramento River region that would be affected by these actions. 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 in years with these actions.

The San Joaquin Basin Steelhead Telemetry Study project action would continue a telemetry study for the migration and survival of San Joaquin Origin Central Valley Steelhead. This action is not part of the No Action Alternative. This action would not change flows or reservoir levels or involve construction, as compared to the No Action Alternative. No conversion of agricultural land to nonagricultural uses is anticipated.

San Francisco Bay Area Region

This region was not modeled under SWAP. As shown by CalSim II modeling (Tables R.2-1 and R.2-2), deliveries for agricultural uses would increase under the average and dry/critical conditions in this region, so no conversion of agricultural land to nonagricultural use is anticipated.

Central Coast Region

This region was not modeled under SWAP. Because there are no CVP/SWP agricultural water deliveries in this region (Tables R.2-1 and R.2-2), no conversion of agricultural land to nonagricultural use is anticipated.

Southern California Region

This region was not modeled under SWAP. As shown by CalSim II modeling (Tables R.2-1 and R.2-2), deliveries for agricultural uses would increase under the average and dry/critical conditions in this region, so no conversion of agricultural land to nonagricultural use is anticipated.

R.1.1.1.6 *Potential changes in land use related to cross-Delta transfers*

Alternative 1 would allow the same volume of water transfers as the No Action Alternative to take place over a longer period of time (from July to November rather than July to September) than under the No Action Alternative, providing for more flexibility in timing of water transfers. Environmental analysis for water supply for the increased period of water transfers would be analyzed separately, apart from this document. Because the amount of water available in flows and reservoirs would change with respect to the No Action Alternative, modeling indicates that water transfers would also change. Table R.2-8 shows the projected changes in water transfer costs across the regions. Water transfer costs in all regions other than the Central Coast region would either remain the same or decrease. In the Central Coast, the increase in water transfer costs would be small when considered across the entire region. It is unlikely that changes in water transfers would result in changes in land use or conversion of agricultural land.

Further, because Alternative 1 would allow for a longer period of time when transfers can take place than under the No Action Alternative, growers who want to participate in a water transfer contract would have more flexibility in their operations in the home region. Therefore, it is likely, because the same volume of water would be allowed for transfers under Alternative 1 as under the No Action Alternative, that growers would be able to participate in cross-Delta transfers without choosing cropland idling as the method of making water available for transfer. Alternative 1 is unlikely to result in conversion of agricultural land to nonagricultural uses in the Sacramento River region as a result of cross-Delta water transfers.

Similarly, growers in the regions that receive transferred water (i.e., San Joaquin River, San Francisco Bay Area, Central Coast, and Southern California) would be able to rely on water transfers during the additional months, which would provide them more flexibility in their operations, potentially allowing for an elective change in crop planting or an improvement in irrigation, depending on the crop. Therefore, Alternative 1 is unlikely to result in conversion of agricultural land to nonagricultural uses in these regions as a result of cross-Delta water transfers.

R.2.3.2 *Program-Level Effects*

R.1.1.1.7 *Potential changes in land use*

Sacramento River Region

The Spawning and Rearing Habitat Restoration program action, which is not included under the No Action Alternative, would involve injecting 40 to 55 tons of gravel into the Sacramento River to create additional spawning habitat, and creating 40 to 60 acres of side channel habitat at approximately 10 sites to create additional rearing habitat by 2030. The creation of spawning habitat would not affect flows or

reservoir levels. Because this action would not decrease water deliveries, local jurisdictions would not be hindered in their ability to implement their general plans, and no change in land use is anticipated.

The Small Screen Program program action in the Sacramento River region would continue to work within existing authorities to screen small diversions throughout CVP and SWP streams and the Bay-Delta. This action would not change flows or reservoir levels. Because this action would not decrease water deliveries, local jurisdictions would not be hindered in their ability to implement their general plans, and no change in land use is anticipated.

The Winter-Run Chinook Salmon Conservation Hatchery Production program action, which is not part of the No Action Alternative, would involve use of a different stock for augmenting conservation hatchery stock to improve genetic stock. This action would not affect flow or reservoir levels or agricultural land. Because this action would not decrease water deliveries, local jurisdictions would not be hindered in their ability to implement their general plans, and no change in land use is anticipated.

The Adult Rescue program action, which is not part of the No Action Alternative, would trap and haul adult salmonids and sturgeon from Yolo and Sutter Bypasses during droughts and after periods of bypass flooding and move them up the Sacramento River to spawning grounds. The program action would involve placement of temporary juvenile collection weirs at key feasible locations, downstream of spawning areas in the Sacramento River, and transport of collected fish to a safe release location(s) in the Bay-Delta upstream of Chipps Island. These actions would not affect flow or reservoir levels or agricultural land. Because this action would not decrease water deliveries, local jurisdictions would not be hindered in their ability to implement their general plans, and no change in land use is anticipated.

The Trap and Haul program action, which is not part of the No Action Alternative, would capture and transport juvenile Chinook Salmon and Steelhead in the Sacramento River watershed in drought years when low flows and resulting high water temperatures are unsuitable for volitional downstream migration and survival. Reclamation would place temporary juvenile collection weirs at key feasible locations, downstream of spawning areas in the Sacramento River. This action would not involve changes in flows or use of agricultural land. Because this action would not decrease water deliveries, local jurisdictions would not be hindered in their ability to implement their general plans, and no change in land use is anticipated.

The Spawning and Rearing Habitat Restoration program action, which is not part of the No Action Alternative, would increase woody material and gravel augmentation and floodplain work along the American River. Flow and reservoir levels would not change. Because this action would not decrease water deliveries, local jurisdictions would not be hindered in their ability to implement their general plans, and no change in land use is anticipated.

The Drought Temperature Management program action, which is not part of the No Action Alternative, would evaluate and implement alternative shutter configurations at Folsom Dam to allow temperature flexibility as part of adaptive management. While flows could change, they would be increased in some conditions but not decreased. Sufficient water would be available for local jurisdictions to implement their general plans. No change in land use is anticipated.

San Joaquin River Region

The Lower San Joaquin River Habitat program action would implement the San Joaquin River Restoration Program, as described in the No Action Alternative. In addition, this action would implement

rearing habitat restoration on the lower San Joaquin River not included in the No Action Alternative. This would involve a large-scale floodplain habitat restoration effort in the lower San Joaquin River. This action would not change flows, although it would involve connecting a floodplain to its river. Because the action would not change water deliveries, local jurisdictions would continue to have adequate water for implementing their general plans, and no change in land use is anticipated.

The Spawning and Rearing Habitat Restoration program action, which is not part of the No Action Alternative, would place 4,500 tons of gravel annually in the Stanislaus River for spawning habitat. It would also construct an additional 50 acres of rearing habitat adjacent to the Stanislaus River by 2030. Further, it would study approaches to temperature management for listed species. Placement of gravel would not change flow levels or affect agricultural land directly. Temperature management studies, while they would involve studies of flow regime, would not substantially affect flows. Therefore, local jurisdictions would continue to have adequate water for implementing their general plans, and no change in land use is anticipated.

Bay-Delta Region

The Removing Predator Hot Spots program action, which is not part of the No Action Alternative, would not involve changes in flows or construction on agricultural land but rather would involve minimizing lighting at fish screens and bridges and possibly removing abandoned structures. Because the action would not change flows, local jurisdictions would continue to have adequate water for implementing their general plans, and no change in land use is anticipated.

The Small Screen Program action, which is not part of the No Action Alternative, could involve construction on agricultural land. The action does not involve changes in flows. Because the action would not change water deliveries, local jurisdictions would continue to have adequate water for implementing their general plans, and no change in land use is anticipated.

The Sacramento Deepwater Ship Channel program action, which is not part of the No Action Alternative, would involve repairing and/or replacing the West Sacramento lock system to hydraulically reconnect the ship channel with the mainstem of the Sacramento River. The action would not involve changes in flows or reservoir levels. Because the action would not change water deliveries, local jurisdictions would continue to have adequate water for implementing their general plans, and no change in land use is anticipated.

The North Delta Food Subsidies/Colusa Basin Drain Study program action would increase food entering the north Delta through flushing nutrients from the Colusa Basin into the Yolo Bypass and north Delta. DWR, Reclamation, and water users would work with partners to flush agricultural drainage (i.e., nutrients) from the Colusa Basin Drain through Knight's Landing Ridge Cut and Tule Canal to Cache Slough, improving the aquatic food web in the north Delta for fish species. Reclamation would work with DWR and partners to augment flow in the Yolo Bypass in July and/or September by closing Knights Landing Outfall Gates and routing water from Colusa Basin into Yolo Bypass to promote fish food production. This action would involve increasing flows into the Bay-Delta. Because the action would not reduce water deliveries, local jurisdictions would continue to have adequate water for implementing their general plans, and no change in land use is anticipated.

The Tracy Fish Facility Improvements program action, which is not part of the No Action Alternative, would involve (1) incorporating additional fish exclusion barrier technology into the primary fish removal barriers, (2) incorporating additional debris removal systems at each trash removal barrier, screen, and

fish barrier, (3) constructing additional channels to distribute the fish collection and debris removal among redundant paths through the facility, (4) constructing additional fish handling systems and holding tanks to improve system reliability, and (5) incorporating remote operation into the design and construction of the facility. Construction activities, depending on where they are located, could involve use of agricultural land. This action would not involve changes in water deliveries, and therefore local jurisdictions would continue to have adequate water for implementing their general plans. No change in land use is anticipated.

The Skinner Fish Facility Improvements program action, which is not part of the No Action Alternative, would involve (1) electroshocking and relocating predators, (2) controlling aquatic weeds, (3) developing a fishing incentives or reward program for catching predators, and (4) operational changes when listed species are present. None of these activities would involve reduction of water deliveries. Therefore, local jurisdictions would continue to have adequate water for implementing their general plans. No change in land use is anticipated.

The Delta Fish Species Conservation Hatchery program action, which is not part of the No Action Alternative, would involve construction and operation of a conservation hatchery for Delta Smelt. Depending on where this facility is sited, it could cause use of agricultural land. This action would not involve changes in water deliveries, and therefore local jurisdictions would continue to have adequate water for implementing their general plans. No change in land use is anticipated.

The Reintroduction Efforts from Fish Conservation and Culture Laboratory program action would supplement populations of Delta Smelt, focusing on capturing existing genetic diversity. The action would not affect water deliveries, and therefore local jurisdictions would continue to have adequate water for implementing their general plans. No change in land use is anticipated.

R.1.1.1.8 *Potential changes in irrigated agricultural acreage and total production value*

Sacramento River Region

The Spawning and Rearing Habitat Restoration program action, which is not included under the No Action Alternative, would involve injecting 40 to 55 tons of gravel into the Sacramento River to create additional spawning habitat, and creating 40 to 60 acres of side channel habitat at approximately 10 sites to create additional rearing habitat by 2030. While the creation of spawning habitat would not affect flows, reservoir levels, or agricultural land, creation of the side channel habitat could result in use of agricultural land, depending on where the habitat is sited. As a result, agricultural land could be converted to nonagricultural uses. Mitigation Measure AG-2 could reduce effects by encouraging agencies with discretionary land approval powers to require land or conservation easements or in-lieu fees to mitigate for conversion of agricultural land.

The Small Screen Program programmatic action in the Sacramento River region would continue to work within existing authorities to screen small diversions throughout CVP and SWP streams and the Bay-Delta. This action would not change flows or reservoir levels. However, a small amount of land may be needed to construct these screens, and some of this land may be agricultural. It is possible that a small amount of agricultural land could be converted to nonagricultural uses compared to the No Action Alternative. Mitigation Measure AG-2 could reduce effects by encouraging agencies with discretionary land approval powers to require land or conservation easements or in-lieu fees to mitigate for conversion of agricultural land.

The Winter-Run Chinook Salmon Conservation Hatchery Production program action, which is not part of the No Action Alternative, would involve use of a different stock for augmenting conservation hatchery stock to improve genetic stock. This action would not affect flow or reservoir levels or agricultural land. Accordingly, no land would be converted from agricultural to nonagricultural uses.

The Adult Rescue program action, which is not part of the No Action Alternative, would trap and haul adult salmonids and sturgeon from Yolo and Sutter Bypasses during droughts and after periods of bypass flooding and move them up the Sacramento River to spawning grounds. The Adult Rescue program action would involve placement of temporary juvenile collection weirs at key feasible locations, downstream of spawning areas in the Sacramento River, and transport of collected fish to a safe release location(s) in the Bay-Delta upstream of Chipps Island. These actions would not affect flow or reservoir levels or agricultural land. Accordingly, no land would be converted from agricultural to nonagricultural use.

The Trap and Haul program action, which is not part of the No Action Alternative, would capture and transport juvenile Chinook Salmon and Steelhead in the Sacramento River watershed in drought years when low flows and resulting high water temperatures are unsuitable for volitional downstream migration and survival. Reclamation would place temporary juvenile collection weirs at key feasible locations, downstream of spawning areas in the Sacramento River. This action would not involve changes in flows or use of agricultural land. Therefore, no change in agricultural productivity compared to the No Action Alternative is anticipated, and no land would be converted from agricultural to nonagricultural use.

The Spawning and Rearing Habitat Named Projects program action, which is not part of the No Action Alternative, would increase woody material and gravel augmentation and floodplain work along the American River. While flow and reservoir levels would not change, the floodplain work, depending on location, could affect agricultural land. Therefore, agricultural land could be converted to nonagricultural uses.

The Drought Temperature Management program action, which is not part of the No Action Alternative, would evaluate and implement alternative shutter configurations at Folsom Dam to allow temperature flexibility as part of adaptive management. While flows could change, they would be increased in some conditions but not decreased. Sufficient water would be available for agricultural use. No conversion of agricultural land to nonagricultural use is anticipated.

San Joaquin River Region

The Lower San Joaquin River Habitat program action would implement the San Joaquin River Restoration Program, as described in the No Action Alternative. In addition, this action would implement rearing habitat restoration on the lower San Joaquin River not included in the No Action Alternative. This would involve a large-scale floodplain habitat restoration effort in the lower San Joaquin River. This action could remove agricultural land from agricultural use for restoration purposes, thus resulting in conversion of agricultural land to nonagricultural use. Mitigation Measure AG-2 could reduce effects by encouraging agencies with discretionary land approval powers to require land or conservation easements or in-lieu fees to mitigate for conversion of agricultural land.

The Spawning and Rearing Habitat Restoration program action, which is not part of the No Action Alternative, would place 4,500 tons of gravel annually in the Stanislaus River for spawning habitat. It would also construct an additional 50 acres of rearing habitat adjacent to the Stanislaus River by 2030. Further, it would study approaches to temperature management for listed species. Placement of gravel

would not change flow levels or affect agricultural land directly. Temperature management studies, while they would involve studies of flow regime, would not substantially affect flows and therefore would not affect agricultural land. However, construction of rearing habitat, depending on placement, could remove agricultural land from agricultural use. Therefore, there is a possibility that this program action could convert agricultural land to a nonagricultural use. Mitigation Measure AG-2 could reduce effects by encouraging agencies with discretionary land approval powers to require land or conservation easements or in-lieu fees to mitigate for conversion of agricultural land.

Bay-Delta Region

The Removing Predator Hot Spots program action, which is not part of the No Action Alternative, would not involve changes in flows or construction on agricultural land but rather would involve minimizing lighting at fish screens and bridges and possibly removing abandoned structures. No effects on agricultural productivity are anticipated and accordingly, no conversion of agricultural land would result.

The Small Screen Program action, which is not part of the No Action Alternative, could involve construction on agricultural land. However, any such construction would be evaluated under a separate environmental analysis. The screening action in itself would not result in conversion of agricultural land.

The Sacramento Deepwater Ship Channel program action, which is not part of the No Action Alternative, would involve repairing and/or replacing the West Sacramento lock system to hydraulically reconnect the ship channel with the mainstem of the Sacramento River. The action would not involve changes in flows or reservoir levels or construction on agricultural land. The action would not result in conversion of agricultural land.

The North Delta Food Subsidies/Colusa Basin Drain Study program action, which is not part of the No Action Alternative, would increase food entering the north Delta through flushing nutrients from the Colusa Basin into the Yolo Bypass and north Delta. DWR, Reclamation, and water users would work with partners to flush agricultural drainage (i.e., nutrients) from the Colusa Basin Drain through Knight's Landing Ridge Cut and Tule Canal to Cache Slough, improving the aquatic food web in the north Delta for fish species. Reclamation would work with DWR and partners to augment flow in the Yolo Bypass in July and/or September by closing Knights Landing Outfall Gates and routing water from Colusa Basin into Yolo Bypass to promote fish food production. This action would involve increasing flows into the Bay-Delta. Therefore, no reduction to agricultural productivity is anticipated, and no conversion of agricultural land to nonagricultural use would result.

The Tracy Fish Facility Improvements program action, which is not part of the No Action Alternative, would involve (1) incorporating additional fish exclusion barrier technology into the primary fish removal barriers, (2) incorporating additional debris removal systems at each trash removal barrier, screen, and fish barrier, (3) constructing additional channels to distribute the fish collection and debris removal among redundant paths through the facility, (4) constructing additional fish handling systems and holding tanks to improve system reliability, and (5) incorporating remote operation into the design and construction of the facility. Construction activities, depending on where they are located, could involve use of agricultural land. In this case, the action would result in conversion of agricultural land. Mitigation Measure AG-2 could reduce effects by encouraging agencies with discretionary land approval powers to require land or conservation easements or in-lieu fees to mitigate for conversion of agricultural land.

The Skinner Fish Facility Improvements program action, which is not part of the No Action Alternative, would involve (1) electroshocking and relocating predators, (2) controlling aquatic weeds, (3) developing

a fishing incentives or reward program for catching predators, and (4) operational changes when listed species are present. None of these activities would involve reduction of flow or use of agricultural land. Therefore, no reduction in agricultural productivity is anticipated, and no conversion of agricultural land to nonagricultural use would result.

The Delta Fish Species Conservation Hatchery program action, which is not part of the No Action Alternative, would involve construction and operation of a conservation hatchery for Delta Smelt. Depending on where this facility is sited, it could cause use of agricultural land. If this is the case, this action would result in conversion of agricultural land to nonagricultural purposes. Mitigation Measure AG-2 could reduce effects by encouraging agencies with discretionary land approval powers to require land or conservation easements or in-lieu fees to mitigate for conversion of agricultural land.

The Reintroduction Efforts from Fish Conservation and Culture Laboratory program action would supplement populations of Delta Smelt, focusing on capturing existing genetic diversity. The action would not affect flows or use agricultural land, so no change in agricultural productivity is anticipated. No conversion of agricultural land to nonagricultural use would result.

R.1.1.1.9 *Potential changes in land use related to cross-Delta transfers.*

While program actions could affect the amount of water available for beneficial purposes for water transfers, any effect on water transfers would be indirect, and assessment of the magnitude of any subsequent change would be speculative.

R.2.4 Alternative 2

Project-level action alternatives would change operations of the CVP and SWP, as described in Appendix F. The changes to CVP and SWP operations would change river flows and reservoir levels, which in turn could, if flows and levels are decreased, affect the ability of local jurisdictions to fulfill plans described in their general plans, affect productivity of agricultural land to the extent that land is converted from agricultural to nonagricultural use, and change water transfer patterns.

R.2.4.1 *Project-Level Effects*

R.1.1.1.10 *Potential changes in land use*

Effects Modeled by CWEST

As described in Appendix F and in Tables R.2-1 and R.2-2, CVP and SWP water deliveries to M&I water users would be greater overall under Alternative 1 than under the No Action Alternative. The increased CVP and SWP water supply availability would allow water users to reduce other water supplies overall, including groundwater. 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 under Alternative 1 and the No Action Alternative. Table R.2-13, Differences in Water Supply and Costs Between the No Action Alternative and Alternative 2, shows the modeled changes in average annual CVP/SWP deliveries, delivery costs, new supply, annualized new supply costs, surface and groundwater storage costs, lost water sales revenues, transfer costs, shortage costs, groundwater pumping savings, excess water savings, and average annual cost by region for Alternative 2 as compared to the No Action Alternative.

Table R.2-13. Differences in Water Supply and Costs Between the No Action Alternative and Alternative 2

	Trinity River	Sacramento River	San Francisco Bay Area	San Joaquin River	Bay-Delta	Central Coast	Southern California	Total
Average Annual CVP/SWP Deliveries (TAF)	0	2	54	50	10	12	518	647
Delivery Cost ($1,000)	$0	$43	$1,960	$4,706	$146	$2,258	$74,165	$83,278
New Supply (TAF)	0	0	-3	-1	0	0	-73	-76
Annualized New Supply Costs ($1,000)	$0	$0	-$526	-$286	$0	$0	-$25,145	-$25,957
Surface/ Groundwater Storage Costs ($1,000)	$0	$0	$252	$0	-$523	$0	-$3,483	-$3,755
Lost Water Sales Revenues ($1,000)	$0	$0	-$2,891	-$38	-$284	$0	-$22,967	-$26,180
Transfer Costs ($1,000)	$0	-$44	-$6,000	-$3,667	-$485	$0	-$13,813	-$24,010
Shortage Costs ($1,000)	$0	$0	-$965	-$14	-$95	$0	-$28,004	-$29,077
Groundwater Pumping Savings ($1,000)	$0	-$28	-$411	-$1,248	$50	-$884	-$39,856	-$42,376
Excess Water Savings ($1,000)	$0	-$31	-$449	-$3,465	-$147	-$1,791	-$5,951	-$11,833
Average Annual Cost ($1,000)	$0	-$60	-$9,029	-$4,012	-$1,338	-$417	-$65,054	-$79,909

TAF = thousand acre-feet

No municipal and industrial land uses in the Trinity River region are served by CVP and SWP water supplies. Therefore, the municipal and industrial land uses would be the same under Alternative 2 and the No Action Alternative in the Trinity River region.

Table R.2-13 shows that the average annual cost would be the same or less in all regions compared to the No Action Alternative. Therefore, it is expected that local jurisdictions would afford to have adequate water to implement their general plans, and that land use in 2030 would not change under Alternative 2 compared to the No Action Alternative in all regions.

In addition to project actions that were modeled, Alternative 1 includes project actions that were not modeled. These are described by region below and their effects are compared to those of the No Action Alternative.

R.1.1.1.11 Effects Not Modeled by CWEST

San Joaquin River Region

Alternative 2 would operate New Melones Reservoir in the same way as described in the No Action Alternative. No changes in use are anticipated

R.1.1.1.12 Potential changes in irrigated agricultural acreage and total production value

Effects Modeled by SWAP

Sacramento River and San Joaquin River Regions as Modeled under SWAP

As CalSim II modeling results show (Appendix F), flows and reservoir storage would increase in the Sacramento River, San Joaquin River, and Bay-Delta regions. In addition, deliveries for agricultural uses would increase (Tables R.2-1 and R.2-2). Note that counties in the Bay-Delta region are reported under the Sacramento River and San Joaquin River regions because the relevant SWAP regions span the Bay-Delta region and the Sacramento River and San Joaquin River regions.

Assumptions in the SWAP model do not account for any change in groundwater use under SGMA implementation, which requires that local public agencies and GSAs in high- and medium-priority basins develop and implement GSPs or Alternatives to GSPs in order to map how groundwater basins will reach long term sustainability. However, because in-stream flows are expected to increase with Alternative 2, no reduction in groundwater is anticipated. The additional surface water supply is expected to reduce the reliance of those areas on groundwater, no reduction in groundwater is anticipated.

Table R.2-14, Difference in Crops in the SWAP Regions (acres) in the Average Year Condition between the No Action Alternative and Alternative 2, shows the difference in acreage planted in the average year condition with respect to water availability between the No Action Alternative and Alternative 2, and Table R.2-15, Difference in Crop Productivity in the SWAP Regions (millions of dollars) in the Average Year Condition between the No Action Alternative and Alternative 2, shows the difference in productivity in the average year condition in millions of dollars. Table R.2-16, Difference in Crops in the SWAP Regions (acres) in the Dry and Critical Year Condition between the No Action Alternative and Alternative 2, shows the difference in acreage planted in the dry and critical year condition with respect to water availability between the No Action Alternative and Alternative 2, and Table R.2-17, Difference in Crop Productivity in the SWAP Regions (millions of dollars) in the Dry and Critical Year Condition between the No Action Alternative and Alternative 2, shows productivity in the dry and critical year condition in millions of dollars.

Table R.2-14. Difference in Crops in the SWAP Regions (acres) in the Average Year Condition between the No Action Alternative and Alternative 2

Crop Category	Grains	Field crops	Forage crops	Vegetable, truck, specialty	Orchards and vineyards	Total
Sacramento River	0	0	0	0	0	0
San Joaquin River	2,487	483	604	76	891	4,541
Total Irrigated Acreage (Acres)	2,487	483	604	76	891	4,541

Table R.2-15. Difference in Crop Productivity in the SWAP Regions (millions of dollars) in the Average Year Condition between the No Action Alternative and Alternative 2

Crop Category	Grains	Field crops	Forage crops	Vegetable, truck, specialty	Orchards and vineyards	Total
Sacramento River	0	0	0	0	0	0
San Joaquin River	4	1	2	1	7	14
Total Irrigated Acreage (Acres)	4	1	2	1	7	14

Table R.2-16. Difference in Crops in the SWAP Regions (acres) in the Dry and Critical Year Condition between the No Action Alternative and Alternative 2

Crop Category	Grains	Field crops	Forage crops	Vegetable, truck, specialty	Orchards and vineyards	Total
Sacramento River	0	0	0	0	0	0
San Joaquin River	36,158	5,392	7,275	752	6,570	56,147
Total Irrigated Acreage (Acres)	36,158	5,392	7,275	752	6,570	56,147

Table R.2-17. Difference in Crop Productivity in the SWAP Regions (millions of dollars) in the Dry and Critical Year Condition between the No Action Alternative and Alternative 2

Crop Category	Grains	Field crops	Forage crops	Vegetable, truck, specialty	Orchards and vineyards	Total
Sacramento River	0	0	0	0	0	0
San Joaquin River	50	9	13	4	46	121
Total Irrigated Acreage (Acres)	50	9	13	4	46	121

As shown in Table R.2-14, SWAP modeling shows that in the average year condition, there would be approximately 4,541 more acres of irrigated farmland in the San Joaquin River region under Alternative 2 compared to the No Action Alternative. Acreage of irrigated farmland in the Sacramento River region would be the same as under the No Action Alternative. As shown in Table R.2-15, the San Joaquin River region would have an increased productivity of approximately $14 million. Agricultural productivity in the Sacramento River region would be the same as under the No Action Alternative. Crop acreage and productivity in the Sacramento River region would remain the same because deliveries to this region in the average year condition would not change under Alternative 2 compared to the No Action Alternative.

As shown in Table R.2-16, in the dry and critical year condition, there would be approximately 56,147 more acres of irrigated farmland in the San Joaquin River region under Alternative 2 compared to the No Action Alternative. Acreage of irrigated farmland in the Sacramento River region would be the same as under the No Action Alternative. As shown in Table R.2-17, the San Joaquin River region would have an increased productivity of approximately $121 million. Agricultural productivity in the Sacramento River region would be the same as under the No Action Alternative. Crop acreage and productivity in the

Sacramento River region would remain the same because deliveries to this region in the average year condition would not change under Alternative 2 compared to the No Action Alternative.

In both the average and dry/critical year conditions, overall crop acreage and crop productivity in the San Joaquin River region would be greater under Alternative 2 compared to the No Action Alternative and would remain the same in the Sacramento River region. Therefore, no Therefore, no conversion of agricultural land to nonagricultural is expected to occur in these regions

In addition to project actions modeled under CalSim II and SWAP, Alternative 2 includes project actions that were not modeled. These are described in the following sections and their effects are compared to those of the No Action Alternative.

Effects Not Modeled by SWAP

Trinity River Region

This 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.

Sacramento River Region

As shown by CalSim II modeling (Tables R.2-1 and R.2-2), deliveries for agricultural uses would increase under the average and dry/critical conditions in this region, so no conversion of agricultural land to nonagricultural use is anticipated.

San Joaquin River Region

Alternative 2 would operate New Melones Reservoir in the same way as described in the No Action Alternative. No conversion of agricultural land to nonagricultural use is anticipated

Bay-Delta Region

The counties that constitute the Bay-Delta region do not correspond exactly to SWAP regions; rather, these counties span multiple SWAP regions. For this reason, the SWAP modeling analysis of the Bay-Delta region has been reported in the Sacramento River region and the San Joaquin River region in Tables R.2-14 through R.2-17 above. As shown by CalSim II modeling (Tables R.2-1 and R.2-2), deliveries for agricultural uses would increase under the average and dry/critical conditions in this region, so no conversion of agricultural land to nonagricultural use is anticipated.

San Francisco Bay Area Region

This region was not modeled under SWAP. As shown by CalSim II modeling (Tables R.2-1 and R.2-2), deliveries for agricultural uses would increase under the average and dry/critical conditions in this region, so no conversion of agricultural land to nonagricultural use is anticipated.

Central Coast Region

This region was not modeled under SWAP. Because there are no CVP/SWP agricultural water deliveries in this region (Tables R.2-1 and R.2-2), no conversion of agricultural land to nonagricultural use is anticipated.

Southern California Region

This region was not modeled under SWAP. As shown by CalSim II modeling (Tables R.2-1 and R.2-2), deliveries for agricultural uses would increase under the average and dry/critical conditions in this region, so no conversion of agricultural land to nonagricultural use is anticipated.

R.1.1.1.13 Potential changes in land use related to cross-Delta transfers.

Alternative 2 would allow the same volume of water transfer to take place during the same time period as the No Action Alternative. However, because the amount of water available in flows and reservoirs would change with respect to the No Action Alternative, modeling indicates that water transfers would also change. Table R.2-13 shows the projected changes in water transfer costs across the regions. Water transfer costs in all regions would either remain the same or decrease compared to the No Action Alternative. In addition, it is unlikely that changes in water transfers would result in changes in land use or conversion of agricultural land.

R.2.4.2 *Program-Level Effects*

No program actions are proposed for Alternative 2.

R.2.5 Alternative 3

Project-level action alternatives would change operations of the CVP and SWP, as described in Appendix F. The changes to CVP and SWP operations would change river flows and reservoir levels, which in turn could, if flows and levels are decreased, affect the ability of local jurisdictions to fulfill plans described in their general plans, affect productivity of agricultural land to the extent that land is converted from agricultural to nonagricultural use, and change water transfer patterns.

R.2.5.1 *Project-Level Effects*

R.1.1.1.14 Potential changes in land use

Effects Modeled by CWEST

As described in Appendix F and in Tables R.2-1 and R.2-2, CVP and SWP water deliveries to M&I water users would be greater overall under Alternative 3 than under the No Action Alternative. The increased CVP and SWP water supply availability would allow water users to reduce other water supplies overall, including groundwater. 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 under Alternative 3 and the No Action Alternative. Table R.2-18, Differences in Water Supply and Costs Between the No Action Alternative and Alternative 3, shows the modeled changes in average annual CVP/SWP deliveries, delivery costs, new supply, annualized new supply costs, surface and groundwater storage costs, lost water sales revenues, transfer costs, shortage costs, groundwater pumping savings, excess water savings, and average annual cost by region for Alternative 3 as compared to the No Action Alternative.

Table R.2-18. Differences in Water Supply and Costs Between the No Action Alternative and Alternative 3

	Trinity River	Sacramento River	San Francisco Bay Area	San Joaquin River	Bay-Delta	Central Coast	Southern California	Total
Average Annual CVP/SWP Deliveries (TAF)	0	2	54	49	10	12	498	625
Delivery Cost ($1,000)	$0	$37	$1,971	$4,591	$140	$2,232	$71,746	$8
New Supply (TAF)	0	0	-3	-1	0	0	-66	-70
Annualized New Supply Costs ($1,000)	$0	$0	-$526	-$286	$0	$0	-$23,394	-$24,206
Surface/ Groundwater Storage Costs ($1,000)	$0	$0	$252	$0	-$523	$0	-$3,303	-$3,574
Lost Water Sales Revenues ($1,000)	$0	$0	-$2,891	-$41	-$284	$0	-$22,940	-$26,156
Transfer Costs ($1,000)	$0	-$35	-$6,000	-$3,491	-$510	$0	-$14,203	-$24,238
Shortage Costs ($1,000)	$0	$0	-$965	-$14	-$95	$0	-$28,016	-$29,090
Groundwater Pumping Savings ($1,000)	$0	-$26	-$411	-$1,286	$51	-$844	-$39,343	-$41,858
Excess Water Savings ($1,000)	$0	-$27	-$459	-$3,352	-$140	-$1,786	-$5,330	-$11,094
Average Annual Cost ($1,000)	$0	-$50	-$9,029	-$3,878	-$1,361	-$398	-$64,782	-$79,500

TAF = thousand acre-feet

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

Table R.2-18 shows that the average annual cost would be less in all regions compared to the No Action Alternative. Therefore, it is expected that local jurisdictions would afford to have adequate water to implement their general plans, and that land use through 2030 would not change under Alternative 3 compared to the No Action Alternative in all regions.

In addition to project actions that were modeled, Alternative 1 includes project actions that were not modeled. These are described by region below and their effects are compared to those of the No Action Alternative.

Effects Not Modeled by CWEST

Bay-Delta Region

The Clifton Court Aquatic Weed Removal project action under Alternative 1 would involve application of aquatic herbicides and algaecides and operation of the Clifton Court Forebay intake gates to control flow of the water in and out of the Clifton Court Forebay. Because this action does not include changes in flows, it is unlikely that this action would result in local jurisdictions being unable to implement general plans because of lack of water. Changes in land use as a result of this action are unlikely, as compared to the No Action Alternative.

As discussed under No Action Alternative, the Tracy Fish Collection Facility and the Skinner Fish Facility project actions involve fish screening and hauling salvaged fish by truck to release sites. None of these activities affect flow or reservoir levels. These actions, as under the No Action Alternative, would not result in land use changes, as compared to the No Action Alternative.

The San Joaquin Basin Steelhead Telemetry Study project action would continue a telemetry study for the migration and survival of San Joaquin Origin Central Valley Steelhead. This action is not part of the No Action Alternative. This action would not change flows or reservoir levels. Therefore, no reduction in M&I water is anticipated, and changes in land use as a result of this action are unlikely, as compared to the No Action Alternative.

R.1.1.1.15 Potential changes in irrigated agricultural acreage and total production value

Effects Modeled by SWAP

Sacramento River and San Joaquin River Regions as Modeled under SWAP

As CalSim II modeling results show (Appendix F), flows and reservoir storage would increase in the Sacramento River, San Joaquin River, and Bay-Delta regions. In addition, deliveries for agricultural uses would increase (Tables R.2-1 and R.2-2). Note that counties in the Bay-Delta Region are reported below under the Sacramento River and San Joaquin River regions because the relevant SWAP regions span the Bay-Delta region and the Sacramento and San Joaquin River regions.

Assumptions in the SWAP model do not account for any change in groundwater use under SGMA implementation, which requires that local public agencies and GSAs in high- and medium-priority basins develop and implement GSPs or Alternatives to GSPs in order to map how groundwater basins will reach long term sustainability. However, because in-stream flows are expected to increase with Alternative 3, no reduction in groundwater is anticipated. The additional surface water supply is expected to reduce the reliance of those areas on groundwater, no reduction in groundwater is anticipated.

Table R.2-19, Difference in Crops in the SWAP Regions (acres) in the Average Year Condition between the No Action Alternative and Alternative 3, 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.2-20, Difference in Crop Productivity in the SWAP Regions (millions of dollars) in the Average Year Condition between the No Action Alternative and Alternative 3, shows the difference in productivity in the average year condition in millions of dollars. Table R.2-21, Difference in Crops in the SWAP Regions (acres) in the Dry/Critical Year Condition between the No Action Alternative and Alternative 3, shows the difference in acreage planted in the dry/critical year condition with respect to water availability between the No Action Alternative and Alternative 2, and Table R.2-22, Difference in

Crop Productivity in the SWAP Regions (millions of dollars) in the Dry/Critical Year Condition between the No Action Alternative and Alternative 3, shows productivity in the dry/critical year condition in millions of dollars.

Table R.2-19. Difference in Crops in the SWAP Regions (acres) in the Average Year Condition between the No Action Alternative and Alternative 3

Crop Category	Grains	Field crops	Forage crops	Vegetable, truck, specialty	Orchards and vineyards	Total
Sacramento River	0	0	0	0	0	0
San Joaquin River	2,674	507	652	78	946	2,674
Total Irrigated Acreage (Acres)	2,674	507	652	78	946	2,674

Table R.2-20. Difference in Crop Productivity in the SWAP Regions (millions of dollars) in the Average Year Condition between the No Action Alternative and Alternative 3

Crop Category	Grains	Field crops	Forage crops	Vegetable, truck, specialty	Orchards and vineyards	Total
Sacramento River	0	0	0	0	0	0
San Joaquin River	4	1	2	1	8	15
Total Irrigated Acreage (Acres)	4	1	2	1	8	15

Table R.2-21. Difference in Crops in the SWAP Regions (acres) in the Dry/Critical Year Condition between the No Action Alternative and Alternative 3

Crop Category	Grains	Field crops	Forage crops	Vegetable, truck, specialty	Orchards and vineyards	Total
Sacramento River	0	0	0	0	0	0
San Joaquin River	36,112	5,373	7,246	752	6,556	56,039
Total Irrigated Acreage (Acres)	36,112	5,373	7,246	752	6,556	56,039

Table R.2-22. Difference in Crop Productivity in the SWAP Regions (millions of dollars) in the Dry/Critical Year Condition between the No Action Alternative and Alternative 3

Crop Category	Grains	Field crops	Forage crops	Vegetable, truck, specialty	Orchards and vineyards	Total
Sacramento River	0	0	0	0	0	0
San Joaquin River	50	8	13	4	45	121
Total Irrigated Acreage (Acres)	50	8	13	4	45	121

As shown in Table R.2-19, SWAP modeling shows that in the average year condition, there would be of approximately 2,674 more acres of irrigated farmland in the San Joaquin River region under Alternative 3

compared to the No Action Alternative. Acreage of irrigated farmland in the Sacramento River region would be the same as under the No Action Alternative. As shown in Table R.2-20, the San Joaquin River region would have an increased productivity of approximately $15 million. Agricultural productivity in the Sacramento River region would be the same as under the No Action Alternative. Crop acreage and productivity in the Sacramento River region would remain the same because deliveries to this region in the average year condition would not change under Alternative 3 compared to the No Action Alternative.

As shown in Table R.2-21, In the dry and critical year condition, there would be of approximately 56,039 more acres of irrigated farmland in the San Joaquin River region under Alternative 3 compared to the No Action Alternative. Acreage of irrigated farmland in the Sacramento River region would be the same as under the No Action Alternative. As shown in Table R.2-22, the San Joaquin River region would have an increased productivity of approximately $121 million. Agricultural productivity in the Sacramento River region would be the same as under the No Action Alternative. Crop acreage and productivity in the Sacramento River region would remain the same because deliveries to this region in the dry and critical year condition would not change under Alternative 3 compared to the No Action Alternative.

In both the average and dry/critical year conditions, overall crop acreage and crop productivity in the San Joaquin River region would be greater under Alternative 3 compared to the No Action Alternative and would remain the same in the Sacramento River region. Therefore, no conversion of agricultural land to nonagricultural is expected to occur in these regions.

In addition to project actions modeled under CalSim II and SWAP, Alternative 3 includes project actions that were not modeled. These are described in the following sections and their effects are compared to those of the No Action Alternative.

Effects Not Modeled by SWAP

Trinity River Region

This 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.

Sacramento River Region

As shown by CalSim II modeling (Tables R.2-1 and R.2-2), deliveries for agricultural uses would increase under the average and dry/critical conditions in this region, so no conversion of agricultural land to nonagricultural use is anticipated.

San Joaquin River Region

As shown by CalSim II modeling (Tables R.2-1 and R.2-2), deliveries for agricultural uses would increase under the average and dry/critical conditions in this region, so no conversion of agricultural land to nonagricultural use is anticipated.

Bay-Delta Region

The counties that constitute the Bay-Delta region do not correspond exactly to SWAP regions; rather, these counties span multiple SWAP regions. For this reason, the SWAP modeling analysis of the Bay-Delta region has been reported in the Sacramento River region and the San Joaquin River region in Tables R.2-19 through R.2-22 above.

As shown by CalSim II modeling (Tables R.2-1 and R.2-2), deliveries for agricultural uses would increase under the average and dry/critical conditions in this region, so no conversion of agricultural land to nonagricultural use is anticipated.

The Clifton Court Aquatic Weed Removal project action under Alternative 1 would involve application of aquatic herbicides and algaecides and operation of the Clifton Court Forebay intake gates to control flow of the water in and out of the Clifton Court Forebay. Because this action does not include changes in flows or reservoir levels or construction on agricultural land, this action is unlikely to result in conversion of agricultural land to nonagricultural purposes.

As discussed under No Action Alternative, the Tracy Fish Collection Facility and the Skinner Fish Facility project actions involve fish screening and hauling salvaged fish by truck to release sites. None of these activities affect flow or reservoir levels or surrounding land. These actions, as under the No Action Alternative, would not result in conversion of agricultural land to nonagricultural purposes, as compared to the No Action Alternative.

The San Joaquin Basin Steelhead Telemetry Study project action would continue a telemetry study for the migration and survival of San Joaquin Origin Central Valley Steelhead. This action is not part of the No Action Alternative. This action would not change flows or reservoir levels or involve construction. No conversion of agricultural land to nonagricultural uses is anticipated, as compared to the No Action Alternative.

San Francisco Bay Area Region

This region was not modeled under SWAP. As shown by CalSim II modeling (Tables R.2-1 and R.2-2), deliveries for agricultural uses would increase under the average and dry/critical conditions in this region, so no conversion of agricultural land to nonagricultural use is anticipated.

Central Coast Region

This region was not modeled under SWAP. As shown by CalSim II modeling (Tables R.2-1 and R.2-2), there would be no change in deliveries for agricultural uses under the average and dry/critical conditions in this region, so no conversion of agricultural land to nonagricultural use is anticipated.

Southern California Region

This region was not modeled under SWAP. As shown by CalSim II modeling (Tables R.2-1 and R.2-2), deliveries for agricultural uses would increase under the average and dry/critical conditions in this region, so no conversion of agricultural land to nonagricultural use is anticipated.

R.1.1.1.16 Potential changes in land use related to cross-Delta transfers.

Alternative 3 would allow the same volume of water transfer to take place during the same time period as the No Action Alternative. However, because the amount of water available in flows and reservoirs would change with respect to the No Action Alternative, modeling indicates that water transfers would also change. Table R.2-18 shows the projected changes in water transfer costs across the regions. Water transfer costs in all regions would either remain the same or decrease. In addition, it is unlikely that changes in water transfers would result in changes in land use or conversion of agricultural land.

R.2.5.2 *Program-Level Effects*

R.1.1.1.17 *Potential changes in land use*

Sacramento River Region

The Small Screen Program program action in the Sacramento River region would continue to work within existing authorities to screen small diversions throughout CVP and SWP streams and the Bay-Delta. This action would not change flows or reservoir levels. However, a small amount of land may be needed to construct these screens, and some of this land may be agricultural. Because this action would not change flows, local jurisdictions would have adequate water to implement their general plans. Therefore, no change in land use is anticipated.

The Adult Rescue program action, which is not part of the No Action Alternative, would trap and haul adult salmonids and sturgeon from Yolo and Sutter Bypasses during droughts and after periods of bypass flooding and move them up the Sacramento River to spawning grounds. The Adult Rescue program action would involve placement of temporary juvenile collection weirs at key feasible locations, downstream of spawning areas in the Sacramento River, and transport of collected fish to a safe release location(s) in the Bay-Delta upstream of Chipps Island. These actions would not affect flow or reservoir levels. Because this action would not change water deliveries, local jurisdictions would have adequate water to implement their general plans. Therefore, no change in land use is anticipated.

The Trap and Haul program action, which is not part of the No Action Alternative, would capture and transport juvenile Chinook Salmon and Steelhead in the Sacramento River watershed in drought years when low flows and resulting high water temperatures are unsuitable for volitional downstream migration and survival. Reclamation would place temporary juvenile collection weirs at key feasible locations, downstream of spawning areas in the Sacramento River. This action would not involve changes in flows. Because this action would not change water deliveries, local jurisdictions would have adequate water to implement their general plans. Therefore, no change in land use is anticipated.

San Joaquin River Region

The Lower San Joaquin River Habitat program action would implement the San Joaquin River Restoration Program, as described in the No Action Alternative. In addition, this action would implement rearing habitat restoration on the lower San Joaquin River not included in the No Action Alternative. This would involve a large-scale floodplain habitat restoration effort in the lower San Joaquin River. This action would not change flows, although it would involve connecting a floodplain to its river. Because the action would not change water deliveries, local jurisdictions would continue to have adequate water for implementing their general plans, and no change in land use is anticipated.

Bay-Delta Region

The Removing Predator Hot Spots program action, which is not part of the No Action Alternative, would not involve changes in flows or construction on agricultural land but rather would involve minimizing lighting at fish screens and bridges and possibly removing abandoned structures. Because the action would not change flows, local jurisdictions would continue to have adequate water for implementing their general plans, and no change in land use is anticipated

The Small Screen Program action, which is not part of the No Action Alternative, could involve construction on agricultural land. The action does not involve changes in flows. Because the action would

not change flows, local jurisdictions would continue to have adequate water for implementing their general plans, and no change in land use is anticipated.

The Sacramento Deepwater Ship Channel program action, which is not part of the No Action Alternative, would involve repairing and/or replacing the West Sacramento lock system to hydraulically reconnect the ship channel with the mainstem of the Sacramento River. The action would not involve changes in flows or reservoir levels. Because the action would not change flows, local jurisdictions would continue to have adequate water for implementing their general plans, and no change in land use is anticipated.

The North Delta Food Subsidies/Colusa Basin Drain Study program action would increase food entering the north Delta through flushing nutrients from the Colusa Basin into the Yolo Bypass and north Delta. DWR, Reclamation, and water users would work with partners to flush agricultural drainage (i.e., nutrients) from the Colusa Basin Drain through Knight's Landing Ridge Cut and Tule Canal to Cache Slough, improving the aquatic food web in the north Delta for fish species. Reclamation would work with DWR and partners to augment flow in the Yolo Bypass in July and/or September by closing Knights Landing Outfall Gates and routing water from Colusa Basin into Yolo Bypass to promote fish food production. This action would involve increasing flows into the Bay-Delta. Because the action would not reduce flows, local jurisdictions would continue to have adequate water for implementing their general plans, and no change in land use is anticipated.

The Additional Habitat Restoration (25,000 acres within the Bay-Delta) program action would restore an addition 25,000 acres of habitat within the Bay-Delta. Depending on where the restoration is located, it is possible that the action would use agricultural land. In this case, agricultural productivity would be affected and land could be converted from agricultural to nonagricultural use. This action would have a greater effect than the No Action Alternative.

The Tracy Fish Facility Improvements program action, which is not part of the No Action Alternative, would involve (1) incorporating additional fish exclusion barrier technology into the primary fish removal barriers, (2) incorporating additional debris removal systems at each trash removal barrier, screen, and fish barrier, (3) constructing additional channels to distribute the fish collection and debris removal among redundant paths through the facility, (4) constructing additional fish handling systems and holding tanks to improve system reliability, and (5) incorporating remote operation into the design and construction of the facility. Construction activities, depending on where they are located, could involve use of agricultural land. This action would not involve changes in flows, and therefore local jurisdictions would continue to have adequate water for implementing their general plans. No change in land use is anticipated.

The Skinner Fish Facility Improvements program action, which is not part of the No Action Alternative, would involve (1) electroshocking and relocating predators, (2) controlling aquatic weeds, (3) developing a fishing incentives or reward program for catching predators, and (4) operational changes when listed species are present. None of these activities would involve reduction of flow. Therefore, local jurisdictions would continue to have adequate water for implementing their general plans. No change in land use is anticipated.

The Delta Fish Species Conservation Hatchery program action, which is not part of the No Action Alternative, would involve construction and operation of a conservation hatchery for Delta Smelt. Depending on where this facility is sited, it could cause use of agricultural land. This action would not involve changes in flows, and therefore local jurisdictions would continue to have adequate water for implementing their general plans. No change in land use is anticipated.

The Reintroduction Efforts from Fish Conservation and Culture Laboratory program action would supplement populations of Delta Smelt, focusing on capturing existing genetic diversity. The action would not affect flows, and therefore local jurisdictions would continue to have adequate water for implementing their general plans. No change in land use is anticipated.

R.1.1.1.18 Potential changes in irrigated agricultural acreage and total production value

Sacramento River Region

The Small Screen Program program action in the Sacramento River region would continue to work within existing authorities to screen small diversions throughout CVP and SWP streams and the Bay-Delta. This action would not change flows or reservoir levels. However, a small amount of land may be needed to construct these screens, and some of this land may be agricultural. It is possible that a small amount of agricultural land could be converted to nonagricultural uses compared to the No Action Alternative. Mitigation Measure AG-2 could reduce effects by encouraging agencies with discretionary land approval powers to require land or conservation easements or in-lieu fees to mitigate for conversion of agricultural land.

The Adult Rescue program action, which is not part of the No Action Alternative, would trap and haul adult salmonids and sturgeon from Yolo and Sutter Bypasses during droughts and after periods of bypass flooding and move them up the Sacramento River to spawning grounds. The Trap and Haul program action would involve placement of temporary juvenile collection weirs at key feasible locations, downstream of spawning areas in the Sacramento River, and transport of collected fish to a safe release location(s) in the Bay-Delta upstream of Chipps Island. These actions would not affect flow or reservoir levels or agricultural land. Accordingly, no land would be converted from agricultural to nonagricultural uses.

The Trap and Haul program action, which is not part of the No Action Alternative, would capture and transport juvenile Chinook Salmon and Steelhead in the Sacramento River watershed in drought years when low flows and resulting high water temperatures are unsuitable for volitional downstream migration and survival. Reclamation would place temporary juvenile collection weirs at key feasible locations, downstream of spawning areas in the Sacramento River. This action would not involve changes in flows or use of agricultural land. Therefore, no change in agricultural productivity compared to the No Action Alternative is anticipated, and no land would be converted from agricultural to nonagricultural use.

San Joaquin River Region

The Lower San Joaquin River Habitat program action would implement the San Joaquin River Restoration Program, as described in the No Action Alternative. In addition, this action would implement rearing habitat restoration on the lower San Joaquin River not included in the No Action Alternative. This would involve a large-scale floodplain habitat restoration effort in the lower San Joaquin River. This action could remove agricultural land from agricultural use for restoration purposes, thus resulting in conversion of agricultural land to nonagricultural use. Mitigation Measure AG-2 could reduce effects by encouraging agencies with discretionary land approval powers to require land or conservation easements or in-lieu fees to mitigate for conversion of agricultural land.

Bay-Delta Region

The Removing Predator Hot Spots program action, which is not part of the No Action Alternative, would not involve changes in flows or construction on agricultural land but rather would involve minimizing lighting at fish screens and bridges and possibly removing abandoned structures. No effects on agricultural productivity are anticipated and accordingly, no conversion of agricultural land would result.

The Sacramento Deepwater Ship Channel program action, which is not part of the No Action Alternative, would involve repairing and/or replacing the West Sacramento lock system to hydraulically reconnect the ship channel with the mainstem of the Sacramento River. The action would not involve changes in flows or reservoir levels or construction on agricultural land. The action would not result in conversion of agricultural land.

The North Delta Food Subsidies/Colusa Basin Drain Study program action would increase food entering the north Delta through flushing nutrients from the Colusa Basin into the Yolo Bypass and north Delta. DWR, Reclamation, and water users would work with partners to flush agricultural drainage (i.e., nutrients) from the Colusa Basin Drain through Knight's Landing Ridge Cut and Tule Canal to Cache Slough, improving the aquatic food web in the north Delta for fish species. Reclamation would work with DWR and partners to augment flow in the Yolo Bypass in July and/or September by closing Knights Landing Outfall Gates and routing water from Colusa Basin into Yolo Bypass to promote fish food production. This action would involve increasing flows into the Bay-Delta. Therefore, no reduction to agricultural productivity is anticipated, and no conversion of agricultural land to nonagricultural use would result.

The Additional Habitat Restoration (25,000 acres within the Bay-Delta) program action would restore an addition 25,000 acres of habitat within the Bay-Delta. Depending on where the restoration is located, it is possible that the action would use agricultural land. In this case, agricultural productivity would be affected and land could be converted from agricultural to nonagricultural use. Mitigation Measure AG-2 could reduce effects by encouraging agencies with discretionary land approval powers to require land or conservation easements or in-lieu fees to mitigate for conversion of agricultural land.

The Tracy Fish Facility Improvements program action, which is not part of the No Action Alternative, would involve (1) incorporating additional fish exclusion barrier technology into the primary fish removal barriers, (2) incorporating additional debris removal systems at each trash removal barrier, screen, and fish barrier, (3) constructing additional channels to distribute the fish collection and debris removal among redundant paths through the facility, (4) constructing additional fish handling systems and holding tanks to improve system reliability, and (5) incorporating remote operation into the design and construction of the facility. Construction activities, depending on where they are located, could involve use of agricultural land. In this case, the action would result in conversion of agricultural land. Mitigation Measure AG-2 could reduce effects by encouraging agencies with discretionary land approval powers to require land or conservation easements or in-lieu fees to mitigate for conversion of agricultural land.

The Skinner Fish Facility Improvements program action, which is not part of the No Action Alternative, would involve (1) electroshocking and relocating predators, (2) controlling aquatic weeds, (3) developing a fishing incentives or reward program for catching predators, and (4) operational changes when listed species are present. None of these activities would involve reduction of flow or use of agricultural land. Therefore, no reduction in agricultural productivity is anticipated, and no conversion of agricultural land to nonagricultural use would result.

The Delta Fish Species Conservation Hatchery program action, which is not part of the No Action Alternative, would involve construction and operation of a conservation hatchery for Delta Smelt. Depending on where this facility is sited, it could cause use of agricultural land. If this is the case, this action would result in conversion of agricultural land to nonagricultural purposes.

The Reintroduction Efforts from Fish Conservation and Culture Laboratory program action would supplement populations of Delta Smelt, focusing on capturing existing genetic diversity. The action would not affect flows or use agricultural land, so no change in agricultural productivity is anticipated. No conversion of agricultural land to nonagricultural use would result.

R.1.1.1.19 Potential changes in land use related to cross-Delta transfers.

While program actions could affect the amount of water available for beneficial purposes for water transfers, any effect on water transfers would be indirect, and assessment of the magnitude of any subsequent change would be speculative.

R.2.6 Alternative 4

Project-level action alternatives would change operations of the CVP and SWP, as described in Appendix F. The changes to CVP and SWP operations would change river flows and reservoir levels, which in turn could, if flows and levels are decreased, affect the ability of local jurisdictions to fulfill plans described in their general plans, affect productivity of agricultural land to the extent that land is converted from agricultural to nonagricultural use, and change water transfer patterns.

R.2.6.1 *Project-Level Effects*

R.1.1.1.20 Potential changes in land use

Effects Modeled by CWEST

As described in Appendix F and in Tables R.2-1 and R.2-2, CVP and SWP water deliveries to M&I water users would be less overall under Alternative 4 than under the No Action Alternative. The decreased CVP and SWP water supply availability would require water users to seek other sources of water to make up the difference. These other water sources would come with an increased cost, as shown in the final row of Table R.2-22. It is anticipated that the additional water supplies would not result in changes in the general plan development plans without subsequent environmental documentation. Adequate water supplies from CVP/SWP and other sources would be available to support future municipal and industrial land uses projected in existing general plans under Alternative 4 and the No Action Alternative. Table R.2-23, Differences in Water Supply and Costs Between the No Action Alternative and Alternative 4, shows the modeled changes in average annual CVP/SWP deliveries, delivery costs, new supply, annualized new supply costs, surface and groundwater storage costs, lost water sales revenues, transfer costs, shortage costs, groundwater pumping savings, excess water savings, and average annual cost by region for Alternative 4.

Table R.2-23. Differences in Water Supply and Costs Between the No Action Alternative and Alternative 4

	Trinity River	Sacramento River	San Francisco Bay Area		San Joaquin River	Bay-Delta	Central Coast	Southern California	Total
Average Annual CVP/SWP Deliveries (TAF)	0	-2	-11		-10	-14	-2	-91	-130
Delivery Cost ($1,000)	$0	-$33	-$402		-$900	-$351	-$448	-$13,506	-$15,640
New Supply (TAF)	0	0	0		0	0	0	8	9
Annualized New Supply Costs ($1,000)	$0	$0	$0		$89	$0	$0	$3,870	$3,959
Surface/ Groundwater Storage Costs ($1,000)	$0	$0	-$65		$0	$321	$0	$859	$1,115
Lost Water Sales Revenues ($1,000)	$0	$8	$647		$0	$676	$0	$5,412	$6,743
Transfer Costs ($1,000)	$0	$121	$2,789		$1,115	$369	$0	$2,990	$7,384
Shortage Costs ($1,000)	$0	$2	$218		$0	$212	$0	$8,249	$8,681
Groundwater Pumping Savings ($1,000)	$0	$14	$70		$521	$54	$391	$8,564	$9,615
Excess Water Savings ($1,000)	$0	$23	-$15		$385	$228	$241	-$159	$704
Average Annual Cost ($1,000)	$0	$137	$3,242		$1,211	$1,509	$184	$16,278	$22,562

TAF = thousand acre-feet

No municipal and industrial land uses in the Trinity River region are served by CVP and SWP water supplies. Therefore, the municipal and industrial land uses would be the same under Alternative 4 and the No Action Alternative in this region.

Table R.2-23 shows that the average annual CVP/SWP deliveries would be less than under the No Action Alternative and the average annual cost would be greater in all regions except the Trinity River region. In some regions, such as the Sacramento River region and the Central Coast region, the differences between Alternative 4 and the No Action Alternative would not be great. However, in the other regions, particularly in the Southern California region, the difference between Alternative 4 and the No Action Alternative is substantial. In this region, nearly 100,000 acre-feet less of CVP/SWP water would be delivered and the average annual cost would be over $16 million. 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 replacing the water not delivered

if they are unprepared. 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.

In addition to project actions that were modeled, Alternative 4 includes project actions that were not modeled. These are described by region below and their effects are compared to those of the No Action Alternative.

Effects Not Modeled by CWEST

Bay-Delta Region

As discussed under No Action Alternative, the Tracy Fish Collection Facility and the Skinner Fish Facility project actions involve fish screening and hauling salvaged fish by truck to release sites. None of these activities affect flow or reservoir levels or surrounding land. It is unlikely that this action would result in local jurisdictions being unable to implement general plans because of lack of water. Changes in land use as a result of this action are unlikely, as compared to the No Action Alternative.

R.1.1.1.21 Potential changes in irrigated agricultural acreage and total production value

Effects Modeled by SWAP

Sacramento River and San Joaquin River Regions as Modeled under SWAP

As CalSim II modeling results show (Appendix F), flows and reservoir storage would decrease in the Sacramento River, San Joaquin River, and Bay-Delta regions. In addition, deliveries for agricultural uses would decrease (Tables R.2-1 and R.2-2). Note that counties in the Bay-Delta region are reported under the Sacramento River and San Joaquin River regions because the relevant SWAP regions span the Bay-Delta region and the Sacramento River and San Joaquin River regions.

Assumptions in the SWAP model do not account for any change in groundwater use under SGMA implementation, which requires that local public agencies and GSAs in high- and medium-priority basins develop and implement GSPs or Alternatives to GSPs in order to map how groundwater basins will reach long term sustainability. Alternative 4 would reduce CVP and SWP deliveries, so demand on groundwater and other alternative water sources could increase. Because sufficient groundwater might not be available in the future to replace reduced CVP/SWP supplies, it is possible that SWAP acreage and production value decreases under Alternative 4 could be greater than modeled under SWAP.

Table R.2-24, Difference in Crops in the SWAP Regions (acres) in the Average Year Condition between the No Action Alternative and Alternative 4, below shows the difference in acreage planted in the average year condition with respect to water availability between the No Action Alternative and Alternative 4, and Table R.2-25, Difference in Crop Productivity in the SWAP Regions (millions of dollars) in the Average Year Condition between the No Action Alternative and Alternative 4, shows the difference in productivity in the average year condition in millions of dollars. Table R.2-26, Difference in Crops in the SWAP Regions (acres) in the Dry and Critical Year Condition between the No Action Alternative and Alternative 4, shows the difference in acreage planted in the dry and critical year condition with respect to water availability between the No Action Alternative and Alternative 4, and Table R.2-27, Difference in Crop Productivity in the SWAP Regions (millions of dollars) in the Dry and Critical Year Condition between the No Action Alternative and Alternative 4, shows productivity in the dry and critical year condition in millions of dollars.

Table R.2-24. Difference in Crops in the SWAP Regions (acres) in the Average Year Condition between the No Action Alternative and Alternative 4

Crop Category	Grains	Field crops	Forage crops	Vegetable, truck, specialty	Orchards and vineyards	Total
Sacramento River	-50	-3	-4	-3	-1	-60
San Joaquin River	-3,612	-649	-835	-52	-610	-5,758
Total Irrigated Acreage (Acres)	-3,662	-652	-840	-54	-611	-5,818

Table R.2-25. Difference in Crop Productivity in the SWAP Regions (millions of dollars) in the Average Year Condition between the No Action Alternative and Alternative 4

Crop Category	Grains	Field crops	Forage crops	Vegetable, truck, specialty	Orchards and vineyards	Total
Sacramento River	0	0	0	0	0	0
San Joaquin River	-6	-1	-2	0	-5	-14
Total Irrigated Acreage (Acres)	-6	-1	-2	0	-5	-14

Table R.2-26. Difference in Crops in the SWAP Regions (acres) in the Dry and Critical Year Condition between the No Action Alternative and Alternative 4

Crop Category	Grains	Field crops	Forage crops	Vegetable, truck, specialty	Orchards and vineyards	Total
Sacramento River	-177	1	-1,998	-13	-241	-2,427
San Joaquin River	-7,426	-937	-2,533	-53	-1,384	-12,333
Total Irrigated Acreage (Acres)	-7,603	-936	-4,530	-66	-1,625	-14,760

Table R.2-27. Difference in Crop Productivity in the SWAP Regions (millions of dollars) in the Dry and Critical Year Condition between the No Action Alternative and Alternative 4

Crop Category	Grains	Field crops	Forage crops	Vegetable, truck, specialty	Orchards and vineyards	Total
Sacramento River	0	0	-2	0	-1	-3
San Joaquin River	-12	-2	-6	0	-10	-29
Total Irrigated Acreage (Acres)	-12	-2	-8	0	-11	-33

As shown in Table R.2-24, SWAP modeling shows that in the average year condition, there would be approximately 5,758 fewer acres of irrigated farmland in the San Joaquin River region and approximately 60 fewer acres in the Sacramento River Region under Alternative 4 compared to the No Action Alternative. As shown in Table R.2-25, the San Joaquin River region would have a decreased productivity of approximately $14 million. Agricultural productivity in the Sacramento River region would be the

same as under the No Action Alternative because deliveries to this region in the average year condition would decrease minimally under Alternative 4 compared to the No Action Alternative.

As shown in Table R.2-26, in the dry and critical year condition, there would be approximately 12,333 fewer acres of irrigated farmland in the San Joaquin River region and approximately 2,427 acres of irrigated farmland in the Sacramento River Region under Alternative 4 compared to the No Action Alternative. As shown in Table R.2-27, the San Joaquin River region would have a decreased productivity of approximately $29 million and the Sacramento River region a decreased productivity of approximately $3 million.

In both the average and dry/critical year conditions, overall crop acreage would be less in the San Joaquin River and Sacramento River regions under Alternative 4 compared to the No Action Alternative. In addition, crop productivity would decrease for both regions under the dry/critical condition. Crop productivity would also be less for the San Joaquin River region in the average condition, but would remain the same for the Sacramento River region compared to the No Action Alternative. Therefore, some conversion of agricultural land to nonagricultural is expected to occur in both regions under both conditions.

In addition to project actions modeled under CalSim II and SWAP, Alternative 4 includes project actions that were not modeled. These are described by region in the following sections and their effects are compared to those of the No Action Alternative.

Effects Not Modeled by SWAP

Trinity River Region

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.

Sacramento River Region

As shown by CalSim II modeling (Tables R.2-1 and R.2-2), deliveries for agricultural uses would decrease slightly under the average and dry/critical conditions in this region. Accordingly, there could be some conversion of agricultural land to nonagricultural use under Alternative 4. Implementation of Mitigation Measure AG-1 would reduce this effect by encouraging water users to develop alternative sources of water.

San Joaquin River Region

As shown by CalSim II modeling (Tables R.2-1 and R.2-2), deliveries for agricultural uses would decrease slightly under the average and dry/critical conditions in this region. Accordingly, there could be some conversion of agricultural land to nonagricultural use under Alternative 4. Implementation of Mitigation Measure AG-1 would reduce this effect by encouraging water users to develop alternative sources of water.

Bay-Delta Region

The counties that constitute the Bay-Delta region do not correspond exactly to SWAP regions; rather, these counties span multiple SWAP regions. For this reason, the SWAP modeling analysis of the Bay-

Delta region has been reported in the Sacramento River region and the San Joaquin River region in Tables R.2-8, R.2-9, R.2-10, and R.2-11 above.

As shown by CalSim II modeling (Tables R.2-1 and R.2-2), deliveries for agricultural uses would decrease slightly under the average and dry/critical conditions in this region. Accordingly, there could be some conversion of agricultural land to nonagricultural use under Alternative 4. Implementation of Mitigation Measure AG-1 would reduce this effect by encouraging water users to develop alternative sources of water.

As discussed under No Action Alternative, the Tracy Fish Collection Facility and the Skinner Fish Facility project actions involve fish screening and hauling salvaged fish by truck to release sites.

San Francisco Bay Area Region

This region was not modeled under SWAP. As shown by CalSim II modeling (Tables R.2-1 and R.2-2), deliveries for agricultural uses would decrease slightly under the average and dry/critical conditions in this region. Accordingly, there could be some conversion of agricultural land to nonagricultural use under Alternative 4. Implementation of Mitigation Measure AG-1 would reduce this effect by encouraging water users to develop alternative sources of water.

Central Coast Region

This region was not modeled under SWAP. Because there are no CVP/SWP agricultural water deliveries in this region (Tables R.2-1 and R.2-2), no conversion of agricultural land to nonagricultural use is anticipated.

Southern California Region

This region was not modeled under SWAP. As shown by CalSim II modeling (Tables R.2-1 and R.2-2), deliveries for agricultural uses would decrease slightly under the average and dry/critical conditions in this region. Accordingly, there could be some conversion of agricultural land to nonagricultural use under Alternative 4. Implementation of Mitigation Measure AG-1 would reduce this effect by encouraging water users to develop alternative sources of water.

R.1.1.1.22 Potential changes in land use related to cross-Delta transfers.

Alternative 4 would allow the same volume of water transfers as the No Action Alternative to take place over a longer period of time (from July to November rather than July to September) than under the No Action Alternative, providing for more flexibility in timing of water transfers. Environmental analysis for water supply for the increased period of water transfers would be analyzed separately, apart from this document. Because the amount of water available in flows and reservoirs would change with respect to the No Action Alternative, modeling indicates that water transfers would also change. Table R.2-23 shows the projected changes in water transfer costs across the regions. Water transfer costs in all regions would increase except for the Trinity River and Central Coast regions, where water transfer costs would remain the same as under the No Action Alternative. In the San Joaquin River, San Francisco Bay Area, and Southern California regions, water transfer costs would increase by between approximately $1 million and $3 million. Because water transfer costs would increase substantially in these regions over costs in the No Action Alternative, it is possible that changes in water transfers could result in changes in land use or conversion of agricultural land in the San Joaquin River, San Francisco Bay, and Southern California regions.

However, because Alternative 4 would allow for a longer period of time when transfers can take place than under the No Action Alternative, growers who want to participate in a water transfer contract would have more flexibility in their operations in the home region. Therefore, it is likely, because the same volume of water would be allowed for transfers under Alternative 4 as under the No Action Alternative, that growers would be able to participate in cross-Delta transfers without choosing cropland idling as the method of making water available for transfer. This is a countervailing factor in the effect of water transfers on agricultural lands, reducing the likelihood that Alternative 4 would result in conversion of agricultural land to nonagricultural uses in the Sacramento River region as a result of cross-Delta water transfers. Nevertheless, it is possible that changes in water transfers could result in changes in land use or conversion of agricultural land in the San Joaquin River, San Francisco Bay, and Southern California regions. Implementation of 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 in years with these actions.

R.2.6.2 *Program-Level Effects*

R.1.1.1.23 *Potential changes in land use*

Alternative 4 proposes water use efficiency measures which would increase irrigation efficiency and urban water use efficiency. These measures are primarily focused on upgrades to existing systems and installation of small-scale devices to capture water and increase efficiency in an agricultural or urban setting. A potential method of water use efficiency is the alteration of land use for lands with high water use or whose irrigation contributes to significant problems, including problem drainage.

Through implementation of this measure it is possible that high water use land could be converted to another purpose and effects to land use could occur. The exact nature of the water use efficiency measures to be implemented has not been defined and the magnitude of this effect is speculative at this time; however, implementation of conversion of land use could have an effect on land uses in the study area under Alternative 4. Mitigation Measure AG-2 could reduce effects by encouraging agencies with discretionary land approval powers to require land or conservation easements or in-lieu fees to mitigate for conversion of agricultural land. These effects will be determined and analyzed at a later date.

R.1.1.1.24 *Potential changes in irrigated agricultural acreage and total production value*

Alternative 4 proposes water use efficiency measures which would increase irrigation efficiency and urban water use efficiency. These measures are primarily focused on upgrades to existing systems and installation of small-scale devices to capture water and increase efficiency in an agricultural or urban setting. A potential method of water use efficiency is the alteration of land use for lands with high water use or whose irrigation contributes to significant problems, including problem drainage.

Implementation of this measure has the potential to convert agricultural land to nonagricultural uses or to convert existing crops to more water efficient crops, changing the total production value. The exact nature of the water use efficiency measures to be implemented has not been defined and the magnitude of this effect is speculative at this time; however, implementation of conversion of land use could have a large-scale effect on agricultural land in the study area under Alternative 4. Mitigation Measure AG-2 could reduce effects by encouraging agencies with discretionary land approval powers to require land or conservation easements or in-lieu fees to mitigate for conversion of agricultural land. These effects will be determined and analyzed at a later date.

R.1.1.1.25 Potential changes in land use related to cross-Delta transfers.

While program actions could affect the amount of water available for beneficial purposes for water transfers, any effect on water transfers would be indirect, and assessment of the magnitude of any subsequent change would be speculative.

R.2.7 Mitigation Measures

Both of the mitigation measures below rely on entities other than Reclamation to implement the measures. Because Reclamation does not have authority to implement these measures, Reclamation cannot ensure that they will be implemented. If they are implemented, they 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.

Mitigation Measure AG-2: Impose Conditions on Discretionary Land Use Approvals

Agencies that approve changes in land use that involve conversion of agricultural land to nonagricultural use should impose conditions on such approvals. Conditions should provide for the protection of an equal area of agricultural land to the agricultural land that would be converted and could include the following methods.

- Provide for a new conservation easement through grant or purchase to protect agricultural land that is not protected at the time of approval.
- Pay in-lieu fees sufficient to purchase easement or land into a fund specified for such purposes.

R.2.8 Summary of Impacts

Table R.2-28, Impact Summary, includes a summary of impacts, the magnitude and direction of those impacts, and potential mitigation measures for consideration.

Table R.2-28. Impact Summary

Impact	Alternative	Magnitude and Direction of Impacts	Potential Mitigation Measures[a]
Potential changes in land use (Project-Level)	No Action	No Impact	–
	1–3	Land uses would not change under this alternative	–
	4	In the Southern California region, reduced CVP/SWP deliveries could result in local jurisdictions being unable to implement their general plans. In other regions, although deliveries would be less than under the No Action alternative, local jurisdictions would be able to	MM-AG-1

Impact	Alternative	Magnitude and Direction of Impacts	Potential Mitigation Measures[a]
		replace water not delivered with water from other sources	
Potential changes in land use (Program-Level)	No Action	No Impact	–
	1-3	Land uses would not change under program actions for these alternatives	–
	4	There is a potential for water use efficiency measures to cause changes in land use as a result of alteration of land use for those with exceptionally high water use or significant irrigation problems. Magnitude of these effects is undetermined; however, there is a potential for large scale changes	MM-AG-1
Potential changes in irrigated agricultural acreage and total production value (Project-Level)	No Action	No Impact	–
	1	During years with a fall action to maintain the X2 position or operations of the Suisun Marsh Salinity Control Gates for the Summer-Fall Delta Smelt Habitat Action, agricultural crop acreage and productivity could decrease slightly in areas affected by these actions Otherwise, irrigated farmland acreage and crop productivity would increase in the San Joaquin River region and would remain the same in other regions	MM AG-1 MM AG-2
	2	Irrigated farmland acreage and crop productivity would increase in the San Joaquin River region and would remain the same in other regions	–
	3	Irrigated farmland acreage and crop productivity would increase in the San Joaquin River region and would remain the same in other regions	–
	4	Irrigated farmland acreage and crop productivity would decrease in the Sacramento River and San Joaquin River regions. In addition, agricultural water deliveries to the San Francisco Bay Area would decrease, so some conversion of agricultural farmland could result	MM-AG-1 MM-AG-2

Impact	Alternative	Magnitude and Direction of Impacts	Potential Mitigation Measures[a]
Potential changes in irrigated agricultural acreage and total production value (Program-Level)	No Action	No Impact	–
	1	Construction and restoration on agricultural land could result in conversion	MM AG-2
	2	n/a	n/a
	3	Construction and restoration on agricultural land could result in conversion	MM AG-2
	4	There is a potential for changes in agricultural land use to nonagricultural land use or changes in production value as a result of water use efficiency measures leading to alteration of land use for those with exceptionally high water use or significant irrigation problems. Magnitude of these effects is undetermined; however, there is a potential for large scale changes	MM AG-2
Potential changes in land use related to cross-Delta transfers (Project-Level)	No Action	No Impact	–
	1	Extended time period for transfers would allow participants in water transfer contracts more flexibility; water transfer costs would either remain the same or decrease in all regions	–
	2, 3	Water transfer costs would either remain the same or decrease in all regions	–
	4	Reduced deliveries would increase water transfer costs and potentially result in changes in land use or conversion of agricultural land to nonagricultural use in the San Joaquin River, San Francisco Bay, and Southern California regions	MM AG-1
Potential changes in land use related to cross-Delta transfers (Program-Level)	No Action	No Impact	–
	1, 3, 4	No Impact	–
	2	n/a	–

Notes:
[a] Proposed mitigation measures MM AG-1 and MM AG-2, if implemented, would be implemented by an entity other than Reclamation. Therefore, it is not possible to ensure that these measures would be implemented. However, if they are implemented, they will reduce impacts on agricultural land.
n/a = not applicable

R.2.9 Cumulative Effects

R.1.1.2 Changes in Land Use

The No Action Alternative would not result in any changes to water operations. Therefore, the No Action Alternative would not contribute to changes in land use. Accordingly, the No Action Alternative is not evaluated further in this section.

Alternative 4, because of reduced M&I water deliveries and increased water use efficiency measures, could potentially result in local jurisdictions being unable to implement their general plans, particularly in the Southern California region.

The past, present, and reasonably foreseeable future projects, described in Appendix Y, *Cumulative Methodology*, may have effects on the ability of local jurisdictions to implement their general plans due to M&I water availability. The cumulative projects include actions across California to develop new water storage capacity, new water conveyance infrastructure, new water recycling capacity, and the reoperation of existing water supply infrastructure, including surface water reservoirs and conveyance infrastructure. The cumulative projects also include ecosystem improvement and habitat restoration actions to improve conditions for special status species whose special status in many cases constrains water supply delivery operations.

Implementation of Alternative 4 resource management plans and water efficiency measures could have cumulative operations impacts on local jurisdictions' ability to implement their general plans. Mitigation Measure AG-1[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 mitigation, the contribution of Alternative 4 to conditions resulting in an inability of local jurisdictions to implement their general plans would be substantial.

Collectively, the cumulative projects and Alternative 4 could potentially adversely affect land use by decreasing M&I water deliveries and increasing water use efficiency measures, resulting in a cumulative impact. The alternative's contribution to this cumulative impact would be substantial.

R.1.1.3 Changes in Irrigated Agriculture

The No Action Alternative would not result in any changes to water operations or proposed restoration activities. Therefore, the No Action Alternative would not contribute to changes in irrigated agriculture Accordingly, the No Action Alternative is not evaluated further in this section.

Alternatives 1 and 4 could cause a conversion of a small area of agricultural land to nonagricultural use in years with a fall action to maintain the X2 position for the Summer-Fall Delta Smelt Habitat Action as a result of changed agricultural water deliveries. Alternative 4 would potentially cause conversion of agricultural land to nonagricultural use as a result of reduced agricultural water deliveries and increased water use efficiency measures, which could in turn result in a reduction in crop productivity. In addition,

[1] As noted above in Section R.2.7, Reclamation does not have authority to implement the proposed mitigation measures MM AG-1 and MM AG-2. However, both proposed measures represent common agency actions. If the mitigation measures are implemented, they will reduce impacts on agricultural land as a result of the proposed alternatives.

Alternatives 1 and 3 would cause conversion of agricultural land to nonagricultural use as a result of habitat restoration activities.

The past, present, and reasonably foreseeable projects, described in Appendix Y, may have effects on irrigated agriculture. The cumulative projects include actions across California to develop new water storage capacity, new water conveyance infrastructure, new water recycling capacity, and the reoperation of existing water supply infrastructure—including surface water reservoirs and conveyance infrastructure. The cumulative projects also include ecosystem improvement and habitat restoration actions to improve conditions for special status species whose special status in many cases constrains water supply delivery operations. Collectively these cumulative 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 cumulative projects would potentially adversely affect 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 (DOC 2015). For example, approximately 67,500 acres (105 square miles) of Important Farmland and grazing land were converted to urban uses in Kern County between 1988 and 2014.
- Projected climate change is anticipated to affect agricultural productivity (Pathak et al. 2018, California Natural Resources Agency [CNRA] 2009) 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 have led to 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 is anticipated to 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 2010 and 2012, California's irrigated farmlands decreased by 91 square miles (DOC 2015), or approximately 58,600 acres. Prime farmland constituted 81 percent of the decrease, or approximately 47,600 acres. The primary cause was long-term idling or land retirement in the southern San Joaquin Valley and the counties surrounding the San Joaquin-Sacramento Delta. At the same time, urban land increased by approximately 29,000 acres. This was the lowest urbanization rate in the Farmland Mapping and Monitoring Program's history, reflecting the impact of the economic recession of the period. Nonetheless, in general the southern San Joaquin Valley and most of the counties surrounding the San Joaquin-Sacramento Delta have been areas of rapid urban and suburban growth. As discussed above in *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, CNRA 2009). CalSim II modeling, which provides input to SWAP modeling for

surface water availability, takes into account some water supply effects of climate change. An increase in average 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. This will lead to shallower snowpack, earlier snowmelt with associated increase in winter floods, and loss of snowpack as a reservoir to store water. This will decrease water availability during the growing season and lead to an associated reduction in crop productivity. Flood and unseasonal rains (discussed below) will 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 to 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.

Soil, groundwater, and drainage conditions within the WWD have combined to result in the retirement of substantial amounts of previously irrigated farmland. Approximately 90,000 acres of irrigated farmland with inadequate drainage has been removed from irrigation in the WWD (WWD 2013a) and its water transferred to other lands within the District. In all, the Westside Regional Drainage Plan (San Joaquin River Exchange Contractors Water Authority et al. 2003) provides for retirement of 200,000 acres of irrigated farmland in the southern San Joaquin Valley in order to address agricultural drainage problems. Local soil is 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). Local conditions also include a layer of hardpan clay near ground surface that is impermeable to water, leading to a perched or shallow groundwater table in addition to the deep groundwater table (San Joaquin River Exchange Contractors Water Authority et al. 2003). Agricultural runoff containing selenium and other materials from agricultural activities, specifically fertilizer and pesticides, has accumulated in this perched groundwater, resulting in both water quality issues and a saturated root zone. Both of these factors limit agricultural productivity. Accordingly, the federal government and local water agencies agreed to retire land in order to minimize the accumulation of agricultural drainage in the shallow groundwater.

The San Joaquin Valley's groundwater basins are chronically overdrafted. SGMA was enacted in 2014 to require water users to manage and use "groundwater in a manner that can be maintained during the planning and implementation horizon without causing undesirable results (DWR 2019b). SGMA mandates the establishment of GSAs made up of local agencies to prepare GSPs that will meet this goal.

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. In order to achieve this result, implementation of the GSPs 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 1 and 4 resource management plans could have cumulative operation impacts related to changes in agricultural water deliveries associated with the X2 position for the Summer-Fall Delta Smelt Habitat Action. 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. Mitigation Measure AG-2[2] would encourage agencies with discretionary land use approval powers to require land or conservation easement grants or payment of in-lieu fees to mitigate conversion of agricultural land to nonagricultural use, thus increasing protection on remaining agricultural land with the intention of minimizing future conversion. The contribution of Alternative 1 to conditions resulting in conversion of irrigated agricultural farmland would not be substantial with respect to water deliveries. In the case of cumulative projects anticipated to potentially generate temporary reductions in water supply deliveries or reduce surplus water supply availability to neighboring water users, the Alternative 1 improvement to water supply deliveries for many water users would help to reduce the severity of any potential cumulative effect. For those users who would not see improvements in water supply deliveries under this alternative, the potential changes in water supply deliveries under this alternative would not contribute to any cumulative water supply impacts because of Alternative 1's similarity to the No Action Alternative. Implementation of Alternative 4 resource manage plans and water efficiency measures could have cumulative operation impacts related to reduced agricultural water deliveries and increased water use efficiency measures. 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. Measure AG-2 would encourage agencies with discretionary land use approval powers to require land or conservation easement grants or payment of in-lieu fees to mitigate conversion of agricultural land to nonagricultural use, thus increasing protection on remaining agricultural land with the intention of minimizing future conversion. However, despite mitigation, the contribution of Alternative 4 to conditions resulting in conversion of irrigated agricultural farmland would be substantial.

In addition, several thousand acres are proposed for restoration under Alternatives 1 and 3 restoration measures. These proposed restoration actions, in combination with restoration actions proposed under the cumulative projects and other existing pressures on agricultural farmland, would result in a substantial adverse effect on irrigated agricultural land as a result of construction. Mitigation Measure AG-2 would encourage agencies with discretionary land use approval powers to require land or conservation easement grants or payment of in-lieu fees to mitigate conversion of agricultural land to nonagricultural use, thus increasing protection on remaining agricultural land with the intention of minimizing future conversion.

[2] As noted above in Section R.2.7, Reclamation does not have authority to implement the proposed mitigation measures MM AG-1 and MM AG-2. However, both proposed measures represent common agency actions. If the mitigation measures are implemented, they will reduce impacts on agricultural land as a result of the proposed alternatives.

However, despite mitigation, the contribution of Alternatives 1 and 3 to conditions resulting in conversion of irrigated agricultural farmland would be substantial.

Collectively, the cumulative projects and Alternatives 1, 3, and 4 could potentially adversely affect agriculture by increasing water flows for fish or acquiring agricultural land for habitat restoration, simultaneously decreasing water availability for agriculture, resulting in a cumulative impact. The alternatives' contribution to this cumulative impact would be substantial.

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