Long-Term Operation – Final Environmental Impact Statement

Appendix H – Water Supply Technical Appendix

November 2024

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Acronyms and Abbreviations

Bay-Delta	San Joaquin River Delta
CVP	Central Valley Project
DWR	California Department of Water Resources
EIS	environmental impact statement
M&I	municipal and industrial
MAF	million acre-feet
SWP	State Water Project
TUCP	Temporary Urgency Change Petition
USACE	U.S. Army Corps of Engineers
VA	Voluntary Agreements

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Appendix H Water Supply Technical Appendix

This appendix documents the water supply technical analysis to support impact analysis in the environmental impact statement (EIS).

H.1 Background Information

This section describes surface water resources and water supplies that could be potentially affected by implementation of alternatives considered in this EIS, including:

- **Surface Water Hydrology:** Changes in surface water hydrology may occur in Trinity, Sacramento, Clear Creek, American, Stanislaus, and San Joaquin rivers, the San Francisco Bay and Sacramento and San Joaquin River Delta (Bay-Delta), and the Central Valley Project (CVP) and State Water Project (SWP) Service Area (south to Diamond Valley) due to changes in CVP and SWP operations. Full descriptions of CVP and SWP facilities and their operation are described in Appendix C, *Facility Descriptions and Operations*, and are not repeated in this section.
- **Overview of CVP and SWP Water Users:** Water users that may be affected by changes in CVP and SWP operations are located in Trinity, Sacramento, Clear Creek, American, Stanislaus, and San Joaquin rivers, Bay-Delta, and CVP and SWP Service Area (south to Diamond Valley) regions.

H.1.1 Overview of California Water Supply and Water Management Facilities

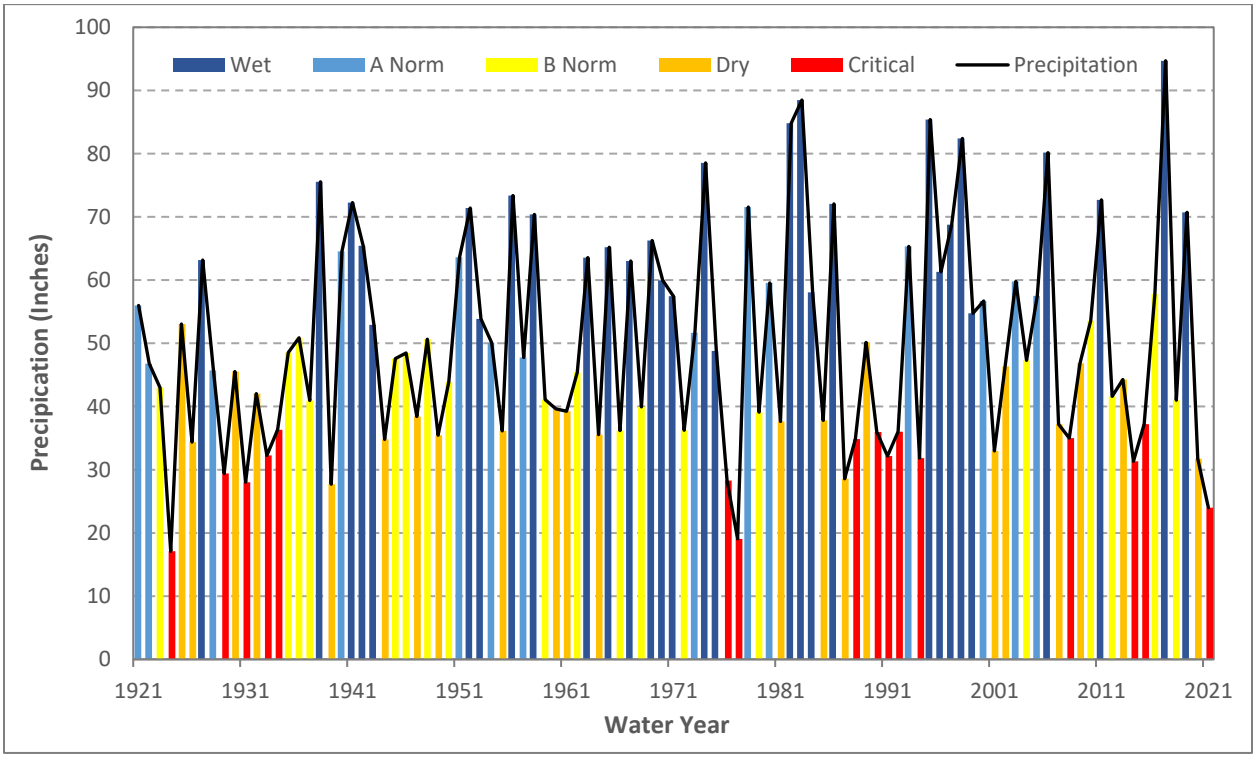
H.1.1.1 Sources of Water in California

Variability and uncertainty are dominant characteristics of California's water resources. Precipitation is the primary source of California's water supply (California Department of Water Resources 2018a). It varies greatly from year to year, as well as by season and location within the state. Unpredictability and geographic variation in precipitation that California receives make it challenging to manage available runoff to meet urban, agricultural, and environmental water needs. With climate change, precipitation patterns are expected to become even more unpredictable, as described in Appendix F, *Modeling*.

In an average water year, based on data from 2011–2015, California receives approximately 155 million acre-feet (MAF) of water from precipitation and imports from Colorado and Oregon, and Mexico (California Department of Water Resources 2018a). The total volume of water the state receives from precipitation can vary dramatically between dry and wet years. In 2011, a wet year, California received approximately 250 MAF of precipitation and in 2014, a critical year, California received approximately 100 MAF of precipitation (California Department of Water Resources 2018a).

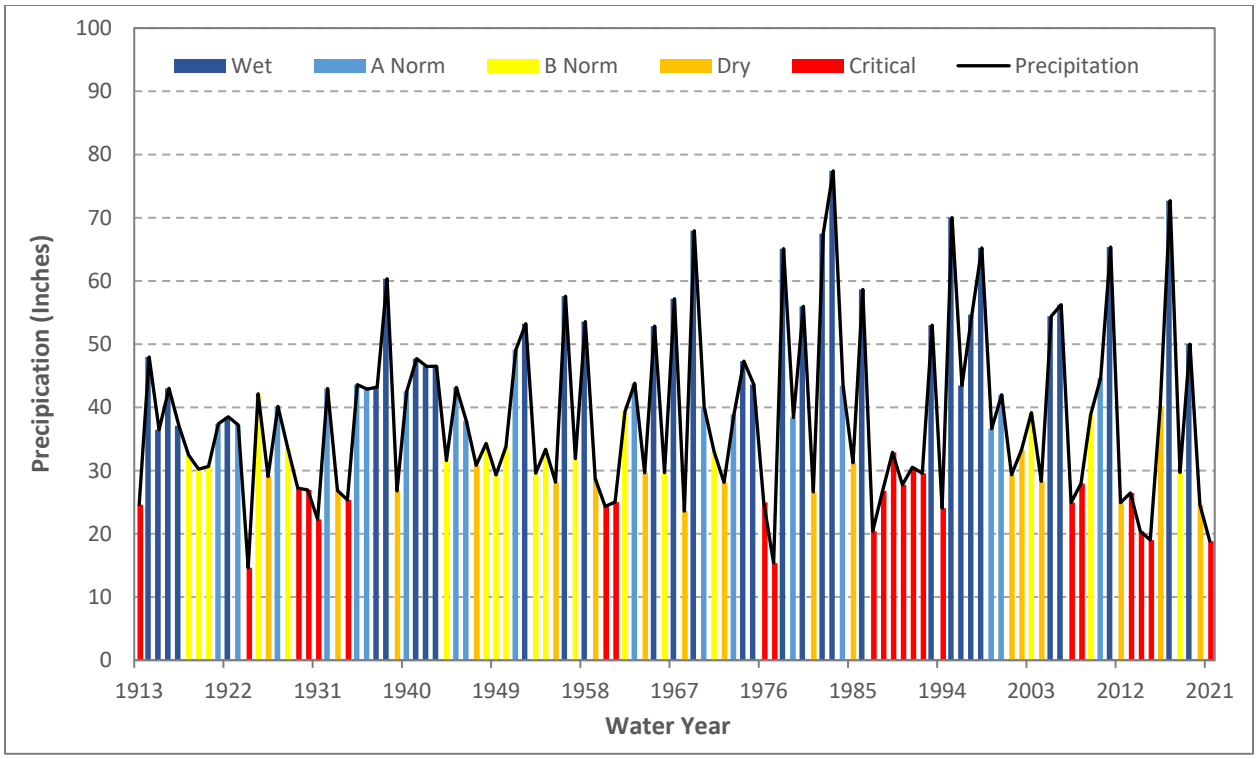
Seventy-five percent of California's annual precipitation falls between November and March (California Department of Water Resources 2023a). Most precipitation falls in the northern portion of the state and much of the demand comes from central and southern portions of the state where major agricultural and population centers are located (California Department of Water Resources 2018a).

Over time, annual precipitation trends have been changing and continue to change, as shown on Figure H-1, Sacramento River Hydrologic Region Precipitation Trends and Figure H-2, San Joaquin River Hydrologic Region Precipitation Trends. From 1906 to 1960, the California Department of Water Resources (DWR) classified 33% of water years in California as "dry" or "critically dry"; that percentage increased to 44% from 1961 to 2021 (California Department of Water Resources 2023b). From 1906 to 1960, DWR classified 45% of water years in California as "above normal" or "wet" and that percentage increased to 46% from 1961 to 2021. Additionally, the 1906 to 1960 period had 42% of water years classified as extreme ("critically dry" or "wet") and that percentage increased to 59% after 1960.



Source: California Department of Water Resources 2023b.

Figure H-1. Sacramento River Hydrologic Region Precipitation Trends



Source: California Department of Water Resources 2023c.

Figure H-2. San Joaquin River Hydrologic Region Precipitation Trends

Although there were more extreme water year classifications in the later period, overall precipitation averages in pre-1960 years and post-1960 years have little differences. Despite having similar precipitation averages, year to year variation and patterns of extreme condition occurrences are substantially different between time periods. Year to year statewide precipitation variation is larger and more frequent since 1961 when compared to the 1906 to 1960 period. Also, occurrence of a year-to-year change of more than 10 inches of precipitation is three times higher after 1960 as compared to before 1960. There are also more occurrences of sequential "critically dry" years and sequential "wet" years after 1960.

During an average year, approximately two thirds of the precipitation that California receives is lost through evapotranspiration by trees and other vegetation, evaporation into the atmosphere, runoff, storage as effective precipitation, or through other outflows (California Department of Water Resources 2018b). Therefore, approximately one third of the precipitation remains available for use by urban, agricultural, and other environmental uses. However, the variability of annual precipitation in California and the differences in volumes of precipitation and runoff between different regions of the state makes it difficult to standardize water management between years (California Department of Water Resources 2018b).

H.1.1.2 Development of Major California Water Management Facilities

Due to hydrologic variability that ranges from dry summers and fall months to floods in winter and spring, water from precipitation in winter and spring must be stored for use in summer and

fall. The amount of water stored as snowpack is highly variable from year to year. During dry periods, snowpack may comprise less than 5 MAF of water; however, snowpack during wet periods may comprise approximately 30 MAF (University of California, San Diego 2023). However, not all snowpack becomes available in a timely manner for uses throughout the state. Therefore, federal, state, and local agencies and private entities have constructed reservoirs, aqueducts, pipelines, and water diversion facilities to capture and use rainfall and subsequent snowmelt.

Water Facilities Development through Early 1900s

Spanish settlements were initially established in late 1700s in southern California, including conveyance systems to bring water to the pueblos. The first water storage and diversion project in California was constructed in 1772, including a 12-foot high dam on San Diego River and 6 miles of canals to deliver water to San Diego Mission (Bureau of Reclamation 1999). Over the next 80 years, other irrigation systems were constructed to provide water for communities and irrigated lands. The first major levee was constructed in Delta in 1840 along Grand Island to protect agricultural lands from floods.

After California became a state in 1850, the state legislature adopted English Common Law, which included the doctrine of riparian rights to provide water supplies to lands adjacent to rivers and streams (Bureau of Reclamation 1999). The California legislature at this time also recognized "pueblo water rights" granted under both Spanish and Mexican governments, including water rights on Los Angeles and San Diego rivers. Water rights also were influenced by the practice of miners of "posting notice" at their points of diversion to substantiate water rights as an "appropriative right" for areas not adjacent to rivers and streams. This set of appropriative rights was catalogued with respect to "first in time, first in right." Appropriative water rights were given statutory recognition in 1872.

Between the 1850s and early 1900s, miners, agricultural water users, and communities constructed numerous dams and canals (Bureau of Reclamation 1999). In the 1870s, the first wells were constructed with wood-burning engines. By the late 1890s, natural gas engines and electricity became available to power pumps. Between 1906 and 1910, over 4,000 natural gas or electric groundwater pumps were installed in San Joaquin Valley. Substantial use of groundwater caused extensive groundwater aquifer depletions and land subsidence in some areas of Central Valley. Availability of electricity to communities also resulted in more hydroelectric generation facilities and associated dams being constructed throughout the Sierra Nevada.

Conceptual Development of Central Valley Project and State Water Project

The need for coordinated water development was evaluated in the 1870s when Congress authorized the Alexander Commission to evaluate water supply concepts in Sacramento and San Joaquin rivers watersheds, including reservoirs and large-scale irrigation water supply projects (Bureau of Reclamation 1999).

1919 Marshall Plan

In 1919, Colonel Robert Marshall, chief geographer for the U.S. Geological Survey, proposed a major water storage and conveyance plan to irrigate lands in the Central Valley and San Francisco Bay Area and provide water to communities in San Francisco Bay Area and southern

California (Marshall 1919). The Marshall Plan recommended two major dams on the San Joaquin River (near Friant) and the Stanislaus River (between the present locations of Tulloch and Goodwin dams) to serve eastern San Joaquin Valley and reduce groundwater overdraft in Tulare and Kern counties. The plan identified four dams on Kern River to serve the Los Angeles area; and dams on Sacramento River near Red Bluff. On the Klamath River the plan identified a new dam downstream of Klamath Falls. The plan also identified dams along Sacramento River tributaries to provide stored water into two canals along the western and eastern sides of Central Valley to provide exchange water to San Joaquin River water rights holders affected by San Joaquin River dam, water to other San Joaquin Valley users, and water to communities in Contra Costa, Alameda, Santa Clara, and San Francisco counties.

1930s State Water Plan

During the 1920s, California State Legislature commissioned a series of investigations to further evaluate the Marshall Plan (Bureau of Reclamation 1999). The 1930 Division of Water Resources Bulletin No. 25 outlined a statewide water plan, including the concept that became CVP and SWP. The plan included 37 water supply and flood management reservoirs, including a dam on San Joaquin River near Friant, and canals to distribute water along eastern San Joaquin Valley to reduce groundwater overdraft in Tulare and Kern counties; 14 dams along Trinity River, Sacramento River, and Sacramento River tributaries to provide water to San Joaquin River water rights contractors affected by the dam on San Joaquin River and water users on the west side of San Joaquin Valley and in Contra Costa County; and eight dams on San Joaquin Valley rivers to provide water to San Joaquin Valley. These dams included recommended facilities near present CVP, Trinity, Shasta, Folsom, New Melones, and Friant dams and present SWP Oroville Dam. Recommendations also included a Delta Cross Channel Canal to improve south Delta water quality; a canal from a south Delta pumping plant to a regulating reservoir and pumping plant near Mendota; canals from Mendota to San Joaquin Valley; a canal from Delta into Contra Costa County; and expansion of San Joaquin River and associated channels with five operable barriers along San Joaquin River. The study also addressed use of aquifer storage, improved navigation along Sacramento and San Joaquin rivers, flood management, saltwater barrier along the western Delta, recycled wastewater and stormwater in Southern California, and importation of Colorado River water to Southern California.

In 1933, the state authorized the Central Valley Project Act. However, during the 1930s depression, the state could not raise funds. The state appealed to the federal government for assistance. The state legislature approved the overall SWP in 1941.

As described above, six of 37 dams in SWP were included in CVP and SWP facilities (Bureau of Reclamation 1999). However, U.S. Army Corps of Engineers (USACE), local or regional water supply and/or flood management agencies, and hydropower entities constructed most of the recommended dams on Yuba, Bear, Feather, American, Mokelumne, Calaveras, Chowchilla, Fresno, Merced, Tuolumne, Stanislaus, Kings, Kaweah, Tule, and Kern rivers. USACE initially developed dams on Fresno and Chowchilla rivers; however, Hidden and Buchanan dams, respectively, were integrated into CVP to supply water to portions of the eastern side of San Joaquin Valley (Bureau of Reclamation 1999).

Overview of Central Valley Project

With passage of Rivers and Harbors Act of 1935, Congress appropriated funds and authorized construction of CVP by the U.S. Army Corps of Engineers (Bureau of Reclamation 1999). When the Rivers and Harbors Act was reauthorized in 1937, construction and operation of CVP was assigned to Reclamation, and CVP became subject to Reclamation Law (as defined in the Reclamation Act of 1902 and subsequent legislation). A full description of CVP facilities that were ultimately developed, and their operation today is presented in Appendix C.

Overview of State Water Project

As CVP facilities were being constructed after World War II, the state began investigations to meet additional water needs through development of the California Water Plan. In 1957, DWR published Bulletin Number 3 that identified new facilities to provide flood control in northern California and water supplies to San Francisco Bay Area, San Joaquin Valley, San Luis Obispo and Santa Barbara counties in the Central Coast Region, and southern California (California Department of Water Resources 1957). The study identified a seasonal deficiency of 2.675 MAF/year in 1950 that resulted in groundwater overdraft throughout many portions of California. The report described facilities to meet water demands and reduce groundwater overdraft, including facilities that would become part of SWP. In 1960, California voters authorized the Burns-Porter Act to construct initial SWP facilities. A full description of SWP facilities that were ultimately developed and their operation today is presented in Appendix C.

Other Major Water Supply and Flood Management Reservoirs

During the past 100 years, numerous water supply, flood management, and hydroelectric generation reservoirs were constructed throughout California. Many of these projects were constructed on tributaries to Sacramento and San Joaquin rivers and tributaries to Tulare Lake Basin. Operations of these non-CVP and non-SWP reservoirs affect flow patterns into Sacramento and San Joaquin rivers and Delta. However, implementation of alternatives evaluated in this EIS would not result in changes in operations in most of these reservoirs, except on lower Stanislaus River.

Major non-CVP and non-SWP reservoirs in Sacramento Valley and San Joaquin Valley watersheds, generally with storage capacities greater than 100,000 acre-feet, which could affect operations of CVP or SWP reservoirs or Delta facilities or could be affected by implementation of alternatives evaluated in this EIS, are detailed in Appendix C.

CVP and SWP Water Users

This section provides an overview of CVP and SWP water users potentially affected by changes in surface water hydrology with implementation of the alternatives. Appendix C describes in detail hydrologic conditions in Trinity, Sacramento, Clear Creek, American, Stanislaus, and San Joaquin rivers, Bay-Delta, and CVP and SWP Service Area (south to Diamond Valley) that could be changed by implementation of the alternatives. Figure H-3 displays CVP and SWP water users, rivers and reservoirs whose hydrologic conditions could change, and DWR hydrologic regions by which effects to CVP and SWP water users are organized.

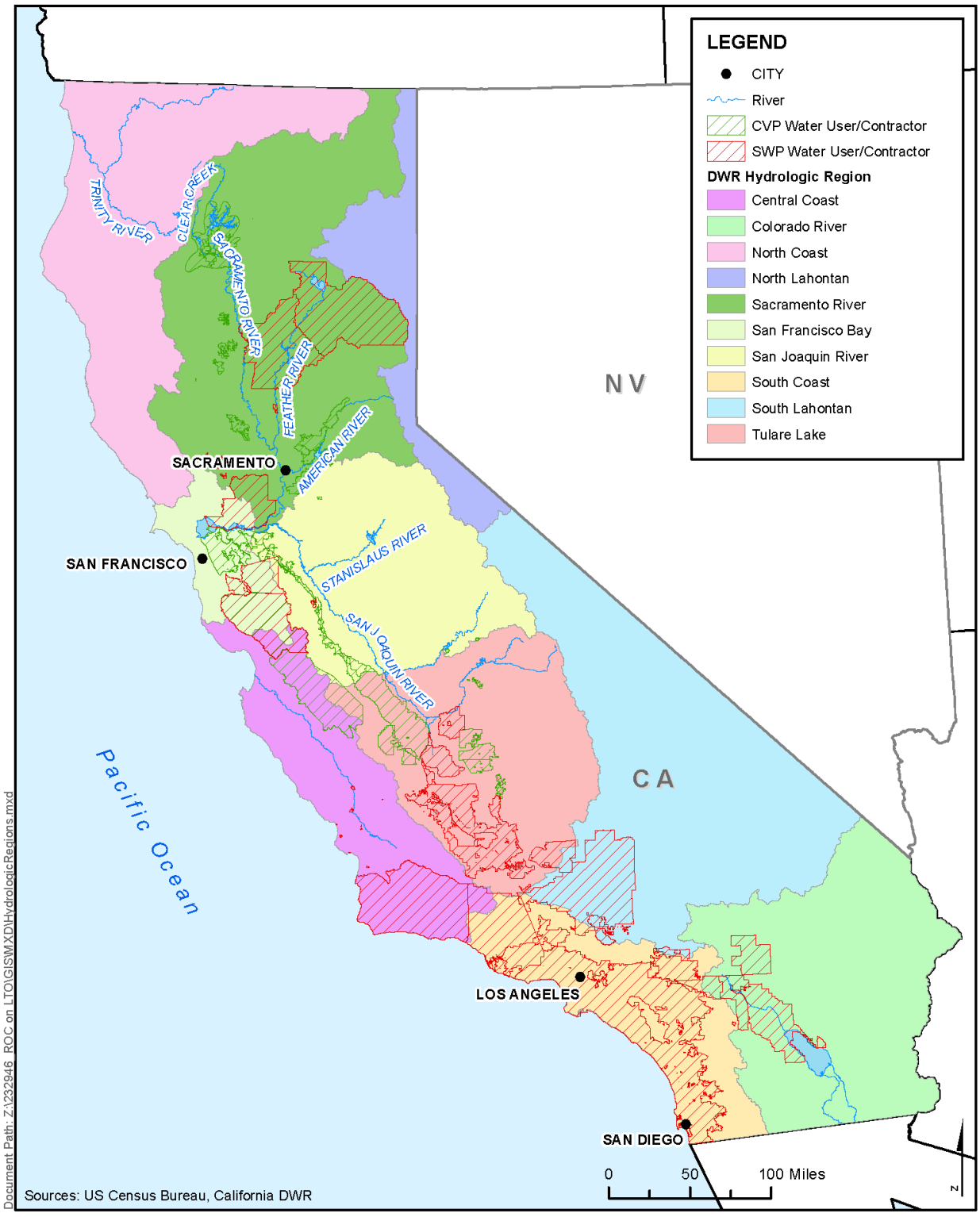


Figure H-3. CVP and SWP Water Users and DWR Hydrologic Regions

The CVP delivers water or makes water available for diversion to 245 agencies that hold water contracts; these contracts include Repayment Contracts, Exchange Contracts, Refuge Contracts, Settlement Contracts, and Water Service Contracts, as detailed in Table H-1. CVP water allocations for agricultural, environmental/refuges, and municipal and industrial (M&I) users vary based on factors such as hydrology, runoff forecast, prior water right commitments, reservoir storage, required water quality releases, required environmental releases, and operational limitations. Each year Reclamation determines the amount of water that can be allocated to each CVP contractor based on conditions for that year. In most cases, these allocations are expressed as a percentage of CVP contractors' contract total (for contracts that allow use of both agricultural and M&I water) or historical use (for M&I only contracts). North of the Delta, there are 42 Water Service or Repayment contractors across three CVP divisions that deliver water for agricultural, M&I, or both agricultural and M&I purposes. In the Delta and south of the Delta, there are 31 Water Service or Repayment contractors across three CVP divisions and one unit that deliver water for agricultural, M&I, or both agricultural and M&I purposes.

Table H-1. CVP Water Contractors

Contractor	M&I	AG	CVP Division	Hydrologic Region
WATER SERVICE CONTRACTS NORTH OF DELTA				
4-E Water District		X	Sacramento River Div	Sacramento River
Stony Creek Water District	X	X	Sacramento River Div	Sacramento River
U.S. Forest Service (Salt Creek)	X		Sacramento River Div	Sacramento River
Whitney Construction, Inc.	X		Sacramento River Div	Sacramento River
U.S. Forest Service	X		Sacramento River Div	Sacramento River
Colusa, County of (Stonyford)	X	X	Sacramento River Div	Sacramento River
Colusa Drain Mutual Water Company		X	Sacramento River Div	Sacramento River
Corning Water District	X	X	Sacramento River Div	Sacramento River
Proberta Water District	X	X	Sacramento River Div	Sacramento River
Thomes Creek Water District	X	X	Sacramento River Div	Sacramento River
Colusa County Water District	X	X	Sacramento River Div	Sacramento River
County of Colusa	X	X	Sacramento River Div	Sacramento River
4-M Water District	X	X	Sacramento River Div	Sacramento River
Colusa County Water District	X	X	Sacramento River Div	Sacramento River
Cortina Water District	X	X	Sacramento River Div	Sacramento River
Glenn Valley Water District	X	X	Sacramento River Div	Sacramento River
Holthouse Water District	X	X	Sacramento River Div	Sacramento River
La Grande Water District	X	X	Sacramento River Div	Sacramento River
Myers-Marsh Mutual Water Company	X	X	Sacramento River Div	Sacramento River
Davis Water District	X	X	Sacramento River Div	Sacramento River

Contractor	M&I	AG	CVP Division	Hydrologic Region
Dunnigan Wd	X	X	Sacramento River Div	Sacramento River
Glide Water District	X	X	Sacramento River Div	Sacramento River
Kanawha Water District	X	X	Sacramento River Div	Sacramento River
Kirkwood Water District	X	X	Sacramento River Div	Sacramento River
La Grande Water District	X	X	Sacramento River Div	Sacramento River
Orland-Artois Water District	X	X	Sacramento River Div	Sacramento River
Westside Water District	X	X	Sacramento River Div	Sacramento River
Feather Water District	X	X	Sacramento River Div	Sacramento River
Centerville Community Services District	X		Sacramento River Div	Sacramento River
Mountain Gate Community Services District	X		Sacramento River Div	Sacramento River
City of Redding	X		Sacramento River Div	Sacramento River
Shasta County Water Agency	X		Sacramento River Div	Sacramento River
City of Shasta Lake	X		Sacramento River Div	Sacramento River
Bella Vista Water District	X	X	Trinity River Div	Sacramento River
Clear Creek Community Services District	X	X	Trinity River Div	Sacramento River
Shasta Community Services District	X		Trinity River Div	Sacramento River
AMERICAN RIVER M&I CONTRACTS				
El Dorado Irrigation District	X		American River Div	Sacramento River
City of Roseville	X		American River Div	Sacramento River
City of Folsom	X		American River Div	Sacramento River
Sacramento County Water Agency	X		American River Div	Sacramento River
San Juan Water District	X		American River Div	Sacramento River
East Bay Municipal Utility District	X		American River Div	Sacramento River
Sacramento Municipal Utility District	X		American River Div	Sacramento River
Sacramento County (assignment from Sacramento Municipal Utilities District)	X		American River Div	Sacramento River
Placer County Water Agency	X	X	American River Div	Sacramento River
NORTH OF DELTA – SACRAMENTO RIVER SETTLEMENT CONTRACTS				
Alexander, Thomas & Karen		X	Sacramento River Div	Sacramento River
Anderson, Arthur L., et al.		X	Sacramento River Div	Sacramento River
Anderson, R. & J., Properties, L.P.		X	Sacramento River Div	Sacramento River
Anderson, R. & J., Properties, L.P.		X	Sacramento River Div	Sacramento River
Anderson-Cottonwood Irrigation District	X	X	Sacramento River Div	Sacramento River
Andreotti, Beverly F., et al.		X	Sacramento River Div	Sacramento River

Contractor	M&I	AG	CVP Division	Hydrologic Region
Baber, Jack W., et al.		X	Sacramento River Div	Sacramento River
Cranmore Farms (Assigned to Pelger Road 1700)		X	Sacramento River Div	Sacramento River
Beckley, Ralph & Ophelia (Assigned to Mary Kristine Charter)		X	Sacramento River Div	Sacramento River
Butler, Dianne E., Revocable Intervivos Trust		X	Sacramento River Div	Sacramento River
Butte Creek Farms, Inc.		X	Sacramento River Div	Sacramento River
Butte Creek Farms, Inc.		X	Sacramento River Div	Sacramento River
Butte Creek Farms, Inc.		X	Sacramento River Div	Sacramento River
Butte Creek Farms, Inc.		X	Sacramento River Div	Sacramento River
Byrd, Anna C. & Osborne, Jane		X	Sacramento River Div	Sacramento River
Byrd, Anna C. & Osborne, Jane		X	Sacramento River Div	Sacramento River
Cachil Dehe Band of Wintun Indians		X	Sacramento River Div	Sacramento River
Carter Mutual Water Company		X	Sacramento River Div	Sacramento River
Chesney, Adona, Trustee		X	Sacramento River Div	Sacramento River
Churkin, Michael, Jr., et al.		X	Sacramento River Div	Sacramento River
Conaway Preservation Group, LLC (10,000 AF assigned to Woodland-Davis)		X	Sacramento River Div	Sacramento River
Cummings, William C.		X	Sacramento River Div	Sacramento River
Daniell, Harry W.		X	Sacramento River Div	Sacramento River
Davis, Ina M.		X	Sacramento River Div	Sacramento River
Driscoll Strawberry Associates, Inc.		X	Sacramento River Div	Sacramento River
Driver, Gary, et al.		X	Sacramento River Div	Sacramento River
Driver, Gregory E.		X	Sacramento River Div	Sacramento River
Driver, John A. & Clare M., Trustees		X	Sacramento River Div	Sacramento River
Driver, John A. & Clare M., Trustees		X	Sacramento River Div	Sacramento River
Driver, William A., et al.		X	Sacramento River Div	Sacramento River
Dyer, Jeffrey E. & Wing-Dyer, Jan		X	Sacramento River Div	Sacramento River
E.L.H. Sutter Properties		X	Sacramento River Div	Sacramento River
Eastside Mutual Water Company		X	Sacramento River Div	Sacramento River
Eggleston, Ronald H., et ux.		X	Sacramento River Div	Sacramento River
Ehrke, Allen A. & Bonnie E.		X	Sacramento River Div	Sacramento River
Exchange Bank (Nature Conservancy)		X	Sacramento River Div	Sacramento River
Fedora, Sibley G. & Margaret L., Trustees		X	Sacramento River Div	Sacramento River
Forry, Laurie & Adams, Lois		X	Sacramento River Div	Sacramento River

Contractor	M&I	AG	CVP Division	Hydrologic Region
Furlan, Emile & Simone, Family Trust		X	Sacramento River Div	Sacramento River
Gillaspy, William F., Trustee		X	Sacramento River Div	Sacramento River
Giovannetti, B. E.		X	Sacramento River Div	Sacramento River
Giusti, Richard J. & Sandra A., Trustees		X	Sacramento River Div	Sacramento River
Gjermann, Hal		X	Sacramento River Div	Sacramento River
Glenn-Colusa Irrigation District		X	Sacramento River Div	Sacramento River
Gomes, Judith A., Trustee		X	Sacramento River Div	Sacramento River
Green Valley Corporation		X	Sacramento River Div	Sacramento River
Green Valley Corporation		X	Sacramento River Div	Sacramento River
Griffin, Joseph & Prater, Sharon		X	Sacramento River Div	Sacramento River
Hale, Judith. A. & Marks, Alice K.		X	Sacramento River Div	Sacramento River
Hale, Judith. A. & Marks, Alice K.		X	Sacramento River Div	Sacramento River
Hatfield Robert and Bonnie		X	Sacramento River Div	Sacramento River
Heidrick, Joe Jr., Trustee		X	Sacramento River Div	Sacramento River
Heidrick, Mildred M, Trustee		X	Sacramento River Div	Sacramento River
Heidrick, Mildred M, Trustee		X	Sacramento River Div	Sacramento River
Henle, Thomas N., Trustee		X	Sacramento River Div	Sacramento River
Hiatt, Thomas & Illerich, Phillip, Trustees		X	Sacramento River Div	Sacramento River
Hiatt, Thomas, Trustee		X	Sacramento River Div	Sacramento River
Howald Farms, Inc.		X	Sacramento River Div	Sacramento River
Howard, Theodore W. & Linda M.		X	Sacramento River Div	Sacramento River
J.B. Unlimited, Inc.		X	Sacramento River Div	Sacramento River
Jaeger, William L. & Patricia A.		X	Sacramento River Div	Sacramento River
Jansen, Peter & Sandy		X	Sacramento River Div	Sacramento River
Kary, Carol, Trustee		X	Sacramento River Div	Sacramento River
Kary, Carol, Trustee		X	Sacramento River Div	Sacramento River
King, Benjamin & Laura		X	Sacramento River Div	Sacramento River
King, Laura		X	Sacramento River Div	Sacramento River
KLSY, LLC		X	Sacramento River Div	Sacramento River
Knaggs Walnut Ranches Company, L.P. (Assigned to Yolo Land Trust)		X	Sacramento River Div	Sacramento River
Knights Landing Investors, LLC		X	Sacramento River Div	Sacramento River
Lake California Property Owners Association, Inc.	X		Sacramento River Div	Sacramento River
Lauppe, Burton H. & Kathryn L.		X	Sacramento River Div	Sacramento River

Contractor	M&I	AG	CVP Division	Hydrologic Region
Lauppe, Burton H. & Kathryn L.		X	Sacramento River Div	Sacramento River
Leiser, Dorothy L.		X	Sacramento River Div	Sacramento River
Leviathan, Inc.		X	Sacramento River Div	Sacramento River
Lockett, William P. & Jean B.		X	Sacramento River Div	Sacramento River
Lomo Cold Storage & Micheli, Justin J.		X	Sacramento River Div	Sacramento River
Lonon, Michael E.		X	Sacramento River Div	Sacramento River
Maxwell Irrigation District		X	Sacramento River Div	Sacramento River
MCM Properties, Inc.		X	Sacramento River Div	Sacramento River
Mehrhof Montgomery, Susan & John McPherson Montgomery		X	Sacramento River Div	Sacramento River
Meridian Farms Water Company		X	Sacramento River Div	Sacramento River
Mesquite Investors, LLC (McClatchy/Riverby Limited)		X	Sacramento River Div	Sacramento River
Meyer Crest, Ltd.	X		Sacramento River Div	Sacramento River
Micke, Daniel H. & Nina J.		X	Sacramento River Div	Sacramento River
Morehead, Joseph A. & Brenda		X	Sacramento River Div	Sacramento River
Munson, James T. & Delmira		X	Sacramento River Div	Sacramento River
Natomas Basin Conservancy		X	Sacramento River Div	Sacramento River
Natomas Central Mutual Water Company	X	X	Sacramento River Div	Sacramento River
Nelson, Thomas L., Jr. & Hazel H.		X	Sacramento River Div	Sacramento River
Nene Ranch, LLC		X	Sacramento River Div	Sacramento River
O'Brien, Frank J. & Janice C.		X	Sacramento River Div	Sacramento River
Odysseus Farms Partnership		X	Sacramento River Div	Sacramento River
Oji Brothers Farms, Inc.		X	Sacramento River Div	Sacramento River
Oji, Mitsue, Family Partnership, et al.		X	Sacramento River Div	Sacramento River
Otterson, Mike, Trustee		X	Sacramento River Div	Sacramento River
Pacific Realty Associates. LP (dba M&T Chico Ranch, Inc.)		X	Sacramento River Div	Sacramento River
Pelger Mutual Water Company		X	Sacramento River Div	Sacramento River
Penner, Roger & Leona		X	Sacramento River Div	Sacramento River
Pleasant Grove Verona Mutual Water Company		X	Sacramento River Div	Sacramento River
Princeton-Codora-Glenn Irrigation District		X	Sacramento River Div	Sacramento River
Provident Irrigation District		X	Sacramento River Div	Sacramento River
Quad-H Ranches, Inc.		X	Sacramento River Div	Sacramento River

Contractor	M&I	AG	CVP Division	Hydrologic Region
Rauf, Abdul & Tahmina		X	Sacramento River Div	Sacramento River
Reclamation District Nos. 900 & 1000		X	Sacramento River Div	Sacramento River
Reclamation District No. 1004		X	Sacramento River Div	Sacramento River
Reclamation District No. 108		X	Sacramento River Div	Sacramento River
Redding Rancheria Tribe		X	Sacramento River Div	Sacramento River
Redding, City of	X		Sacramento River Div	Sacramento River
Reische, Eric L.		X	Sacramento River Div	Sacramento River
Reische, Laverne C., et al.		X	Sacramento River Div	Sacramento River
Richter, Henry D., et al.		X	Sacramento River Div	Sacramento River
River Garden Farms Company		X	Sacramento River Div	Sacramento River
Riverview Golf & Country Club	X		Sacramento River Div	Sacramento River
Roberts Ditch Irrigation Company, Inc.		X	Sacramento River Div	Sacramento River
Rubio, Exequiel P. & Elsa A.		X	Sacramento River Div	Sacramento River
Sacramento River Ranch, LLC		X	Sacramento River Div	Sacramento River
Sacramento, County of		X	Sacramento River Div	Sacramento River
Seaver, Charles W. & Barbara J., Trustees		X	Sacramento River Div	Sacramento River
Schreiner (Sioux Creek Property, LLC)		X	Sacramento River Div	Sacramento River
Sutter Mutual Water Company		X	Sacramento River Div	Sacramento River
Sycamore Family Trust		X	Sacramento River Div	Sacramento River
Tarke, Stephen E. & Debra F., Trustees		X	Sacramento River Div	Sacramento River
Tisdale Irrigation & Drainage Company		X	Sacramento River Div	Sacramento River
Tuttle, Charles, Jr. & Noack, Sue T., Trustees		X	Sacramento River Div	Sacramento River
Wakida, Haruye, Trustee		X	Sacramento River Div	Sacramento River
Wakida, Haruye, Trustee		X	Sacramento River Div	Sacramento River
Wallace, Kenneth L. Living Trust		X	Sacramento River Div	Sacramento River
West Sacramento, City of	X		Sacramento River Div	Sacramento River
Willey, Edwin A. & Marjorie E.		X	Sacramento River Div	Sacramento River
Wilson Ranch Partnership		X	Sacramento River Div	Sacramento River
Wilson, Dennis, Farms, Inc.(Assigned to Wallace, Joseph V. & Janice C.)		X	Sacramento River Div	Sacramento River
Windswept Land & Livestock Company		X	Sacramento River Div	Sacramento River
Wisler, John W., Jr.		X	Sacramento River Div	Sacramento River
Young, Russell L., et al.		X	Sacramento River Div	Sacramento River
Zelmar Ranch, Inc.		X	Sacramento River Div	Sacramento River

Contractor	M&I	AG	CVP Division	Hydrologic Region
Anderson-Cottonwood Irrigation District	X	X	Sacramento River Div	Sacramento River
WATER SERVICE CONTRACTS SOUTH OF DELTA				
Banta-Carbona Irrigation District	X	X	Delta Div	San Francisco Bay, San Joaquin River
Byron-Bethany Irrigation District 1	X	X	Delta Div	San Joaquin River
Del Puerto Water District	X	X	Delta Div	San Joaquin River
Eagle Field Water District	X	X	Delta Div	San Joaquin River
Mercy Springs Water District	X	X	Delta Div	San Joaquin River
Oro Loma Water District	X	X	Delta Div	San Joaquin River
Pajaro Valley Water Management Agency, Santa Clara Valley Water District	X	X	Delta Div	Central Coast
Pajaro Valley Water Management Agency, Westlands Water District	X	X	Delta Div	Central Coast, San Joaquin River
Patterson Irrigation District	X	X	Delta Div	San Joaquin River
The West Side Irrigation District	X	X	Delta Div	San Joaquin River
Tracy, City of	X	X	Delta Div	San Joaquin River
U.S. Department of Veteran Affairs	X		Delta Div	San Joaquin River
West Stanislaus Irrigation District		X	Delta Div	San Joaquin River
Westlands Water District Distribution District 1	X	X	Delta Div	San Joaquin River
Westlands Water District Distribution District 1	X	X	Delta Div	San Joaquin River
Westlands Water District Distribution District 1	X	X	Delta Div	San Joaquin River
Westlands Water District Distribution District 2	X	X	Delta Div	San Joaquin River
Coelho Family Trust	X	X	Delta Div	Tulare Lake
Fresno Slough Water District	X	X	Delta Div	Tulare Lake
James Irrigation District	X	X	Delta Div	Tulare Lake
Laguna Water District	X	X	Delta Div	Tulare Lake
Reclamation District No. 1606	X	X	Delta Div	Tulare Lake
Tranquillity Irrigation District	X	X	Delta Div	Tulare Lake
Tranquillity Public Utility District	X	X	Delta Div	Tulare Lake
Westlands Water District (Assigned from Oro Loma)		X	Delta Div	Tulare Lake
County of Fresno	X	X	Miscellaneous	Tulare Lake

Contractor	M&I	AG	CVP Division	Hydrologic Region
Hills Valley Irrigation District	X	X	Miscellaneous	Tulare Lake
Kern-Tulare Water District	X	X	Miscellaneous	Tulare Lake
Lower Tule River Irrigation District	X	X	Miscellaneous	Tulare Lake
Pixley Irrigation District	X	X	Miscellaneous	Tulare Lake
Kern-Tulare Water District	X	X	Miscellaneous	Tulare Lake
Tri-Valley Water District	X	X	Miscellaneous	Tulare Lake
Tulare, County of	X	X	Miscellaneous	Tulare Lake
San Benito County Water District	X	X	San Felipe Div	Central Coast
Santa Clara Valley Water District	X	X	San Felipe Div	San Francisco Bay, Central Coast
City of Avenal	X		West San Joaquin Div	Tulare Lake
State of California	X		West San Joaquin Div	San Joaquin River
State of California (Parks and Recreation)	X		West San Joaquin Div	San Joaquin River
City of Coalinga	X		West San Joaquin Div	Tulare Lake
City of Huron	X		West San Joaquin Div	Tulare Lake
Pacheco Water District	X	X	West San Joaquin Div	San Joaquin River
Panoche Water District	X	X	West San Joaquin Div	San Joaquin River
San Luis Water District	X	X	West San Joaquin Div	San Joaquin River, Tulare Lake
Westlands Water District	X	X	West San Joaquin Div	San Joaquin River, Tulare Lake
SOUTH OF DELTA – EXCHANGE CONTRACTS				
Central California Irrigation District		X	Delta Div	San Joaquin River
Columbia Canal Company		X	Delta Div	San Joaquin River
Firebaugh Canal Company		X	Delta Div	San Joaquin River
San Luis Canal Company		X	Delta Div	San Joaquin River
SOUTH OF DELTA – SETTLEMENT CONTRACTS				
Dudley & Indart/Coelho/Hansen			Delta Div	San Joaquin River
Coelho Family Trust			Delta Div	San Joaquin River
Fresno Slough Water District			Delta Div	San Joaquin River
James Irrigation District			Delta Div	San Joaquin River
Lempesis, Virginia L-Trustee			Delta Div	San Joaquin River
Meyers Farms Family Trust			Delta Div	San Joaquin River
Reclamation District No. 1606			Delta Div	San Joaquin River
Tranquillity Irrigation District			Delta Div	San Joaquin River

Contractor	M&I	AG	CVP Division	Hydrologic Region
Tranquillity Public Utility District			Delta Div	San Joaquin River
IN DELTA				
Contra Costa Water District	X		Delta Div	San Francisco Bay, Sacramento River, San Joaquin River
EASTSIDE CONTRACTS/AGREEMENT				
Central San Joaquin Water Conservation Dist.	X	X	East Side Div	San Joaquin River
Stockton-East Water District	X	X	East Side Div	San Joaquin River
Oakdale Irrigation District			East Side Div	San Joaquin River
South San Joaquin Irrigation District			East Side Div	San Joaquin River
REFUGES – CONTRACTS/AGREEMENTS				
North of Delta Refuges				Sacramento River
South of Delta Refuges				San Joaquin River

Source: Bureau of Reclamation 2016
Key: Ag = Agricultural
Div = Division
M&I = Municipal and Industrial

The SWP delivers water to 29 public water agencies in Northern, Central and Southern California that hold long-term contracts for surface water deliveries. Table H-2 list agencies with long-term SWP contracts. Agencies deliver water for both urban and agricultural use, representing over 27 million municipal water users and 750,000 acres of irrigated farmland. Five agencies use SWP water primarily for agricultural uses and the remaining 24 use SWP water primarily for municipal use. Alameda County Flood Control and Water Conservation District - Zone 7, Alameda County Water District, and Santa Clara Valley Water District all receive their SWP supplies through the South Bay Aqueduct.

Water supplies for agencies include imported SWP water, groundwater, local surface water, and for some agencies other imported supplies. The agencies collectively have received deliveries ranging from approximately 200,000 acre-feet in critical water years to approximately 4.0 MAF in wet years (California Department of Water Resources 2023d).

Table H-2. SWP Long-term Water Supply Contracting Agencies

Contractor	Hydrologic Region
CENTRAL COASTAL AREA	
San Luis Obispo County Flood Control and Water Conservation District	Central Coast

Contractor	Hydrologic Region
Santa Barbara County Flood Control and Water Conservation District	Central Coast, South Coast
NORTH BAY AREA	
Napa County Flood Control and Water Conservation District	Sacramento River
Solano County Water Agency	Sacramento River, San Francisco Bay
SAN JOAQUIN VALLEY AREA	
County of Kings	Tulare Lake
Castaic Lake Water Agency	
Dudley Ridge Water District	Tulare Lake
Empire West Side Irrigation District	Tulare Lake
Kern County Water Agency	South Coast, South Lahontan, Tulare Lake
Oak Flat Water District	Tulare Lake
Tulare Lake Basin Water Storage District	Tulare Lake
SOUTH BAY AREA	
Alameda County Flood Control and Water Conservation District –Zone 7	San Francisco Bay
Alameda County Water District	San Francisco Bay
Santa Clara Valley Water District	Central Coast, San Francisco Bay, San Joaquin River
SOUTHERN CALIFORNIA AREA	
Antelope Valley-East Kern Water Agency	South Coast, South Lahontan, Tulare Lake
Castaic Lake Water Agency	South Coast
Coachella Valley Water District	Colorado River
Crestline-Lake Arrowhead Water Agency	South Coast, South Lahontan
Desert Water Agency	Colorado River, South Coast
Littlerock Creek Irrigation District	South Lahontan
The Metropolitan WD of Southern California	South Coast
Mojave Water Agency	Colorado River
Palmdale Water District	South Coast, South Lahontan
San Bernardino Valley Municipal Water District	South Coast, South Lahontan
San Gabriel Valley Municipal Water District	South Coast
San Gorgonio Pass Water Agency	South Coast, Colorado River
Santa Clarita Valley Water Agency	South Coast
Ventura County Watershed Protection District	Central Coast, South Coast, Tulare Lake

Contractor	Hydrologic Region
UPPER FEATHER RIVER AREA	
City of Yuba City	Sacramento River
County of Butte	Sacramento River
Plumas County Flood Control and Water Conservation District	North Lahontan, Sacramento River

Source: California Department of Water Resources 2023e.

H.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.

H.2.1 Methods and Tools

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

H.2.2 Changes in CVP and SWP Deliveries

Changes in CVP and SWP operations under the action alternatives as compared to the No Action Alternative would result in changes to water supply deliveries to CVP and SWP contractors. Numerical models are available to quantitatively analyze changes in CVP and SWP systems proposed under the alternatives to determine potential impacts to delivery of CVP and SWP water. Except for the changes to reservoir conditions in the CVP Trinity River Division, changes in reservoirs that store CVP and SWP water outside of the Central Valley are not included in CVP and SWP numerical models and are evaluated qualitatively.

Surface water supply analysis was conducted using the CalSim 3 model, as described in Appendix F, to simulate operational assumptions of each alternative that was described in Chapter 3, *Alternatives*.

H.2.2.1 Use of CalSim 3 Model

DWR and Reclamation developed the CalSim 3 reservoir-river basin planning model to simulate operation of CVP and SWP over a range of different hydrologic conditions. Inputs to CalSim 3 include water demands (including water rights), stream accretions and depletions, reservoir inflows, irrigation efficiencies, and parameters to calculate return flows, nonrecoverable losses and groundwater operations. Sacramento Valley and tributary rim basin hydrology uses an adjusted historical sequence of monthly stream flows over a 100-year period (1921 to 2021) to represent a sequence of flows at a future level of development and accounting for climate change. Adjustments to historic water supplies are imposed based on future land use conditions.

The resulting hydrology represents water supply available from Central Valley streams to CVP and SWP at a future level of development. Water rights deliveries to non-CVP and non-SWP water rights holders are not modified in CalSim 3 simulations of alternatives. CalSim 3 produces outputs for river flows and diversions, reservoir storage, Delta flows and exports, Delta inflow and outflow, deliveries to project and non-project users, and controls on project operations.

The CalSim 3 model monthly simulation of an actual daily (or even hourly) operation of CVP and SWP results in several limitations in use of model results. Monthly CalSim 3 model results must be used in a comparative manner to reduce effects of use of monthly and other assumptions that are indicative of real-time operations, but do not specifically match real-time observations. CalSim 3 model output is based upon a monthly time step. CalSim 3 model output includes minor fluctuations of up to 5% due to model assumptions and approaches. Therefore, if quantitative changes between a specific alternative and the No Action Alternative are 5% or less, conditions under the specific alternative would be considered to be "similar" to conditions under the No Action Alternative.

Under extreme hydrologic and operational conditions where there is not enough water supply to meet all demands, CalSim 3 utilizes a series of operating rules to reach a solution to allow for continuation of the simulation. It is recognized that these operating rules are a simplified version of very complex decision processes that CVP and SWP operators would use in actual extreme conditions. Therefore, model results and potential changes under these extreme conditions should be evaluated on a comparative basis between alternatives and are an approximation of extreme operational conditions.

H.2.2.2 Analysis of Changes in Water Supply Deliveries

CalSim 3 outputs for the alternatives are compared to CalSim 3 outputs for the No Action Alternative to evaluate changes in water supply deliveries to CVP and SWP water users by hydrologic region: Sacramento River, San Joaquin River, San Francisco Bay, Central Coast, Tulare Lake (not including Friant-Kern Canal and Madera Canal water users), South Lahontan, and South Coast.

H.2.3 No Action Alternative

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

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

The No Action Alternative is based on 2040 conditions. Changes that would occur over that time frame without implementation of the action alternatives are not analyzed in this technical

appendix. However, the changes to water supply that are assumed to occur by 2040 under the No Action Alternative are summarized in this section.

Conditions in 2040 would be different than existing conditions because of the following factors:

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

By the end of September, the surface water elevations at CVP reservoirs generally decline. It is anticipated that climate change would result in more short-duration high-rainfall events and less snowpack in the winter and early spring months. The reservoirs would be full more frequently by the end of April or May by 2040 than in recent historical conditions, potentially resulting in increased CVP and SWP water supply deliveries in the spring if water is released. However, as the water is released in the spring, there would be less snowpack to refill the reservoirs. This condition would reduce reservoir storage, thereby decreasing CVP and SWP water supply deliveries.

Under the No Action Alternative, land uses in 2040 would occur in accordance with adopted general plans. Development under the general plans could affect water supply, depending on the type and location of development. Infill projects where areas are already developed could increase density but would be done in compliance with applicable zoning and general plan policies. Development in non-urbanized areas could convert natural or rural areas to developed areas, resulting in increased water supply demand.

Consistent with the 2020 Record of Decision, the No Action Alternative is expected to result in potential changes in water supply deliveries, with improved water supply deliveries to some CVP and SWP contractors and for other water users, deliveries would remain similar to existing conditions. These changes were described and considered in the 2020 Record of Decision.

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

H.2.4 Alternative 1

H.2.4.1 Potential changes in water supply deliveries

Trinity River, Sacramento River, Clear Creek, and American River

CVP and SWP deliveries to contractors and water made available for diversion in Trinity, Sacramento, Clear Creek, and American Rivers watersheds under Alternative 1 are detailed in Table H-3. CVP Refuge Level 2 would see reductions of less than 5% in their total deliveries in both average water years as well as dry and critical water years. As discussed in *Section H.2.2 Changes in CVP and SWP Deliveries,* CalSim 3 model output includes minor fluctuations of up to 5% due to model assumptions; approaches and changes 5% or less are considered "similar" to conditions under the No Action Alternative. In addition, minor deviations in CVP Refuge Level 2 deliveries are the result of modeling but do not reflect an intention by Reclamation to deviate

from the Central Valley Project Improvement Act. All contract delivery types, except for deliveries to CVP Refuge Level 2 would remain the same or increase slightly relative to the No Action Alternative. The contract type with the largest increase on a percentage basis would be SWP M&I water users in dry and critical water year types with those increases averaging approximately 13%.

Table H-3 Alternative 1 - Trinity River, Sacramento River, Clear Creek, and American River Contract Deliveries[a] (thousand acre-feet)

	Alternative 1	No Action Alternative	Difference from No Action Alternative
ANNUAL AVERAGE			
CVP Settlement Contractors	1,831	1,830	0
CVP Refuge Level 2	182	183	-1
CVP M&I	103	102	1
CVP Ag	316	311	6
SWP M&I	43	40	2
DRY AND CRITICAL WATER YEARS			
CVP Settlement Contractors	1,779	1,779	0
CVP Refuge Level 2	173	176	-3
CVP M&I	86	84	2
CVP Ag	208	194	13
SWP M&I	33	30	4

[a] Sacramento River DWR Hydrologic Region
Ag = Agricultural
CVP = Central Valley Project
SWP = State Water Project
M&I = Municipal and Industrial

Stanislaus River and San Joaquin River

CVP and SWP deliveries to contractors in Stanislaus River and San Joaquin River watersheds under Alternative 1 are detailed below in Table H-4. As is indicated in Table H-4, Alternative 1 would increase water supply deliveries for all contract types. The largest increase on a percentage basis would be for SWP agricultural water users in dry and critical water years with those increases averaging approximately 61%.

Table H-4. Alternative 1 – Stanislaus River and San Joaquin River Contract Deliveries[a] (thousand acre-feet)

	Alternative 1	No Action Alternative	Difference from No Action Alternative
ANNUAL AVERAGE			
CVP Exchange Contractors	808	806	2
CVP Refuge Level 2	257	256	1
CVP M&I	14	13	1
CVP Ag	534	477	57
SWP Ag	3	3	1
DRY AND CRITICAL WATER YEARS			
CVP Exchange Contractors	756	750	6
CVP Refuge Level 2	238	236	2
CVP M&I	11	10	1
CVP Ag	275	210	65
SWP Ag	2	2	1

a San Joaquin River DWR Hydrologic Region
Ag = Agricultural
CVP = Central Valley Project
SWP = State Water Project
M&I = Municipal and Industrial

Bay-Delta

CVP and SWP contract deliveries in Bay-Delta under Alternative 1 are detailed below in Table H-5. As is indicated in Table H-5, Alternative 1 would increase water supply deliveries for all contract types. The largest increase on a percentage basis would be for CVP agricultural water users in dry and critical water years with those increases averaging approximately 41%.

Table H-5. Alternative 1 - Bay-Delta Contract Deliveries[a] (thousand acre-feet)

	Alternative 1	No Action Alternative	Difference from No Action Alternative
ANNUAL AVERAGE			
CVP M&I	273	265	8
CVP Ag	48	43	5

	Alternative 1	No Action Alternative	Difference from No Action Alternative
SWP M&I	216	180	36
DRY AND CRITICAL WATER YEARS			
CVP M&I	266	254	12
CVP Ag	24	17	7
SWP M&I	136	111	25

[a] San Francisco DWR Hydrologic Region
Ag = Agricultural
CVP = Central Valley Project
SWP = State Water Project
M&I = Municipal and Industrial

CVP and SWP Service Areas

This section details changes in contract deliveries under Alternative 1 to CVP and SWP Service Areas in central coast, Tulare Lake, South Lahontan, and south coast regions. In addition to the modeled estimates of changes to water supply, water transfers could increase water supplies in drier year types (but they are not included in the CalSim 3 modeling results). Water transfers are the same under all the alternatives, as described in Chapter 3, Section 3.1.4.5, *Water Transfers*.

Central Coast Region

SWP contract deliveries in the central coast region under Alternative 1 are detailed below in Table H-6. As is indicated in Table H-6, SWP M&I deliveries would increase on average approximately 27%.

Table H-6. Alternative 1 - Central Coast Region Contract Deliveries[a] (thousand acre-feet)

	Alternative 1	No Action Alternative	Difference from No Action Alternative
ANNUAL AVERAGE			
SWP M&I	46	36	10
DRY AND CRITICAL WATER YEARS			
SWP M&I	29	20	9

[a] Central Coast DWR Hydrologic Region
SWP = State Water Project
M&I = Municipal and Industrial

Tulare Lake Region

CVP and SWP contract deliveries in Tulare Lake region under Alternative 1 are detailed below in Table H-7. As is indicated in Table H-7, there would be an increase or no measurable change to water supply deliveries for all contract types. The largest increase on a percentage basis would be for SWP agricultural water users in dry and critical water years with those increases averaging approximately 56%.

Table H-7. Alternative 1 - Tulare Lake[a] Region Contract Deliveries[b] (thousand acre-feet)

	Alternative 1	No Action Alternative	Difference from No Action Alternative
ANNUAL AVERAGE			
CVP Refuge Level 2	14	14	0
CVP Ag	671	583	88
SWP M&I	96	71	25
SWP Ag	823	555	267
DRY AND CRITICAL WATER YEARS			
CVP Refuge Level 2	13	12	0
CVP Ag	329	237	92
SWP M&I	51	35	16
SWP Ag	425	272	153

[a] Does not include Friant-Kern Canal or Madera Canal water users
[b] Tulare Lake DWR Hydrologic Region
Ag = Agricultural
CVP = Central Valley Project
SWP = State Water Project
M&I = Municipal and Industrial

South Lahontan Region

SWP contract deliveries in south Lahontan region under Alternative 1 are detailed below in Table H-8. As is indicated in Table H-8, SWP M&I deliveries would increase on average approximately 22%.

Table H-8. Alternative 1 - South Lahontan Region Contract Deliveries[a] (thousand acre-feet)

	Alternative 1	No Action Alternative	Difference from No Action Alternative
ANNUAL AVERAGE			
SWP M&I	280	228	52
DRY AND CRITICAL WATER YEARS			
SWP M&I	192	131	60

[a] South Lahontan DWR Hydrologic Region
SWP = State Water Project
M&I = Municipal and Industrial

South Coast Region

SWP contract deliveries in south coast region under Alternative 1 are detailed below in Table H-9. As is indicated in Table H-9, Alternative 1 would increase water supply deliveries for both contract types. The largest increase on a percentage basis would be for SWP agricultural water users in dry and critical water years with those increases averaging approximately 72%.

Table H-9. Alternative 1 - South Coast Region Contract Deliveries[a] (thousand acre-feet)

	Alternative 1	No Action Alternative	Difference from No Action Alternative
ANNUAL AVERAGE			
SWP M&I	1,567	1,151	416
SWP Ag	10	7	3
DRY AND CRITICAL WATER YEARS			
SWP M&I	857	586	270
SWP Ag	5	3	2

[a] South Coast DWR Hydrologic Region
Ag = Agricultural
SWP = State Water Project
M&I = Municipal and Industrial

H.2.5 Alternative 2

As discussed in Section H.2.1, Methods and Tools, Alternative 2 consists of four phases that are considered in the assessment of Alternative 2 to bracket the range of potential impacts.

Alternative 2, Multi-Agency Consensus, provides for governance decisions that would be made at certain junctures over time, which are described as four different "phases." Implementation of Alternative 2 may include the Alternative 2 Without Temporary Urgency Change Petition (TUCP) Delta Voluntary Agreements (VA) phase, Alternative 2 Without TUCP Without VA phase, Alternative 2 Without TUCP Systemwide VA phase, or Alternative 2 With TUCP Without VA phase. The effect on water supply deliveries for each phase would differ. The four phases were evaluated to present the possible effects (adverse and beneficial) resulting from operations under any singular phase. This section presents tables with the potential water supply deliveries under each phase of Alternative 2.

H.2.5.1 Potential changes in water supply deliveries

Trinity River, Sacramento River, Clear Creek, and American River

The CVP and SWP deliveries to contractors and water made available for diversion in Trinity, Sacramento, Clear Creek, and American rivers watersheds under Alternative 2 are detailed in Table H-10 through Table H-13. Under all phases of Alternative 2, all contract delivery types would increase, remain the same or decrease. The reductions in average annual deliveries under all phases of Alternative 2 would average less than 5% and are considered similar to conditions under the No Action Alternative, except for CVP Settlement Contractors water made available for diversion which would have a reduction of over 6% under Alternative 2 Without TUCP Systemwide VA and CVP agricultural deliveries which would have a reduction of 5% under Alternative 2 Without TUCP Without VA. In dry and critical water year types, some of the largest reductions in average deliveries would exceed this 5% level with CVP agricultural deliveries reduced by 13% to 15% across all phases. In dry and critical water year types, CVP Settlement Contractors water made available for diversion would be reduced by 5% under Alternative 2 With TUCP Without VA and Alternative 2 Without TUCP Without VA, and 9% under Alternative 2 Without TUCP Systemwide VA

Table H-10. Alternative 2 With TUCP Without VA - Trinity River, Sacramento River, Clear Creek, and American River Contract Deliveries[a] (thousand acre-feet)

	Alt2wTUCPwoVA	No Action Alternative	Difference from No Action Alternative
ANNUAL AVERAGE			
CVP Settlement Contractors	1,794	1,830	-37
CVP Refuge Level 2	183	183	-1
CVP M&I	102	102	-1
CVP Ag	298	311	-13
SWP M&I	41	40	1
DRY AND CRITICAL WATER YEARS			
CVP Settlement Contractors	1,688	1,779	-91

	Alt2wTUCPwoVA	No Action Alternative	Difference from No Action Alternative
CVP Refuge Level 2	175	176	-2
CVP M&I	82	84	-2
CVP Ag	167	194	-27
SWP M&I	30	30	0

[a] Sacramento River DWR Hydrologic Region
Ag = Agricultural
CVP = Central Valley Project
SWP = State Water Project
M&I = Municipal and Industrial

Table H-11. Alternative 2 Without TUCP Without VA - Trinity River, Sacramento River, Clear Creek, and American River Contract Deliveries[a] (thousand acre-feet)

	Alt2woTUCPwoVA	No Action Alternative	Difference from No Action Alternative
ANNUAL AVERAGE			
CVP Settlement Contractors	1,793	1,830	-37
CVP Refuge Level 2	181	183	-2
CVP M&I	102	102	0
CVP Ag	295	311	-16
SWP M&I	40	40	0
DRY AND CRITICAL WATER YEARS			
CVP Settlement Contractors	1,686	1,779	-93
CVP Refuge Level 2	172	176	-4
CVP M&I	84	84	0
CVP Ag	164	194	-30
SWP M&I	29	30	-1

[a] Sacramento River DWR Hydrologic Region
Ag = Agricultural
CVP = Central Valley Project
SWP = State Water Project
M&I = Municipal and Industrial

Table H-12. Alternative 2 Without TUCP Delta VA - Trinity River, Sacramento River, Clear Creek, and American River Contract Deliveries[a] (thousand acre-feet)

	Alt2woTUCPDeltaVA	No Action Alternative	Difference from No Action Alternative
ANNUAL AVERAGE			
CVP Settlement Contractors	1,799	1,830	-31
CVP Refuge Level 2	181	183	-2
CVP M&I	112	102	10
CVP Ag	296	311	-15
SWP M&I	40	40	0
DRY AND CRITICAL WATER YEARS			
CVP Settlement Contractors	1,691	1,779	-88
CVP Refuge Level 2	171	176	-5
CVP M&I	93	84	9
CVP Ag	169	194	-26
SWP M&I	29	30	-1

[a] Sacramento River DWR Hydrologic Region
Ag = Agricultural
CVP = Central Valley Project
SWP = State Water Project
M&I = Municipal and Industrial

Table H-13. Alternative 2 Without TUCP Systemwide VA - Trinity River, Sacramento River, Clear Creek, and American River Contract Deliveries[a] (thousand acre-feet)

	Alt2woTUCPAllVA	No Action Alternative	Difference from No Action Alternative
ANNUAL AVERAGE			
CVP Settlement Contractors	1,718	1,830	-113
CVP Refuge Level 2	181	183	-2
CVP M&I	111	102	9
CVP Ag	296	311	-15
SWP M&I	45	40	5

	Alt2woTUCPAllVA	No Action Alternative	Difference from No Action Alternative
DRY AND CRITICAL WATER YEARS			
CVP Settlement Contractors	1,611	1,779	-167
CVP Refuge Level 2	171	176	-5
CVP M&I	90	84	6
CVP Ag	167	194	-27
SWP M&I	33	30	3

[a] Sacramento River DWR Hydrologic Region
Ag = Agricultural
CVP = Central Valley Project
SWP = State Water Project
M&I = Municipal and Industrial

Stanislaus River and San Joaquin River

The CVP and SWP deliveries to contractors in Stanislaus River and San Joaquin River watersheds under Alternative 2 are detailed in Table H-14, Table H-15, Table H-16, and Table H-17. Under all phases of Alternative 2, all contract delivery types with exception of deliveries to CVP agricultural water users, would remain the same or increase. The reductions in average annual deliveries to CVP agricultural water users under Alternative 2 With TUCP Without VA and Alternative 2 Without TUCP Without VA would average less than 5% and are considered similar to conditions under the No Action Alternative. Under both Alternative 2 Without TUCP Delta VA and Alternative 2 Without TUCP Systemwide VA, average annual deliveries to CVP agricultural water users would be reduced by 7%. In dry and critical water year types, deliveries to CVP agricultural water users would be reduced by 11% under Alternative 2 With TUCP Without VA, 6% under Alternative 2 Without TUCP Without VA, and 15% under both Alternative 2 Without TUCP Delta VA and Alternative 2 Without TUCP Systemwide VA.

Table H-14. Alternative 2 With TUCP Without VA – Stanislaus River and San Joaquin River Contract Deliveries[a] (thousand acre-feet)

	Alt2wTUCPwoVA	No Action Alternative	Difference from No Action Alternative
ANNUAL AVERAGE			
CVP Exchange Contractors	807	806	1
CVP Refuge Level 2	256	256	0
CVP M&I	13	13	0
CVP Ag	473	477	-4

	Alt2wTUCPwoVA	No Action Alternative	Difference from No Action Alternative
SWP Ag	3	3	0
DRY AND CRITICAL WATER YEARS			
CVP Exchange Contractors	752	750	3
CVP Refuge Level 2	237	236	1
CVP M&I	9	10	0
CVP Ag	186	210	-24
SWP Ag	2	2	0

a San Joaquin River DWR Hydrologic Region
Ag = Agricultural
CVP = Central Valley Project
SWP = State Water Project
M&I = Municipal and Industrial

Table H-15. Alternative 2 Without TUCP Without VA – Stanislaus River and San Joaquin River Contract Deliveries[a] (thousand acre-feet)

	Alt2woTUCPwoVA	No Action Alternative	Difference from No Action Alternative
ANNUAL AVERAGE			
CVP Exchange Contractors	808	806	2
CVP Refuge Level 2	257	256	1
CVP M&I	13	13	0
CVP Ag	473	477	-4
SWP Ag	3	3	0
DRY AND CRITICAL WATER YEARS			
CVP Exchange Contractors	756	750	6
CVP Refuge Level 2	238	236	2
CVP M&I	10	10	0
CVP Ag	196	210	-13
SWP Ag	2	2	0

a San Joaquin River DWR Hydrologic Region
Ag = Agricultural

CVP = Central Valley Project
SWP = State Water Project
M&I = Municipal and Industrial

Table H-16. Alternative 2 Without TUCP Delta VA – Stanislaus River and San Joaquin River Contract Deliveries[a] (thousand acre-feet)

	Alt2woTUCPDeltaVA	No Action Alternative	Difference from No Action Alternative
ANNUAL AVERAGE			
CVP Exchange Contractors	808	806	2
CVP Refuge Level 2	257	256	1
CVP M&I	13	13	0
CVP Ag	440	477	-37
SWP Ag	3	3	0
DRY AND CRITICAL WATER YEARS			
CVP Exchange Contractors	755	750	6
CVP Refuge Level 2	238	236	2
CVP M&I	10	10	1
CVP Ag	178	210	-32
SWP Ag	2	2	0

a San Joaquin River DWR Hydrologic Region
Ag = Agricultural
CVP = Central Valley Project
SWP = State Water Project
M&I = Municipal and Industrial

Table H-17. Alternative 2 Without TUCP Systemwide VA – Stanislaus River and San Joaquin River Contract Deliveries[a] (thousand acre-feet)

	Alt2woTUCPAllVA	No Action Alternative	Difference from No Action Alternative
ANNUAL AVERAGE			
CVP Exchange Contractors	808	806	2
CVP Refuge Level 2	257	256	1
CVP M&I	13	13	0

	Alt2woTUCPAllVA	No Action Alternative	Difference from No Action Alternative
CVP Ag	441	477	-36
SWP Ag	3	3	0
DRY AND CRITICAL WATER YEARS			
CVP Exchange Contractors	756	750	6
CVP Refuge Level 2	238	277	2
CVP M&I	10	10	0
CVP Ag	177	609	-33
SWP Ag	2	2	0

a San Joaquin River DWR Hydrologic Region
Ag = Agricultural
CVP = Central Valley Project
SWP = State Water Project
M&I = Municipal and Industrial

Bay-Delta

The CVP and SWP contract deliveries in Bay-Delta under Alternative 2 are detailed below in Table H-18, Table H-19, Table H-20, and Table H-21. Under all phases of Alternative 2, deliveries to CVP M&I water users would increase or decrease slightly, deliveries to CVP agricultural water users would remain the same or decrease, and deliveries to SWP M&I water users would increase. The reductions in average annual deliveries under all phases of Alternative 2 would average less than 5% and are considered similar to conditions under the No Action Alternative. In dry and critical water year types, reductions in CVP agricultural average deliveries would exceed this 5% level with deliveries reduced by 11% under Alternative 2 With TUCP Without VA and 5% under Alternative 2 Without TUCP Without VA, Alternative 2 Without TUCP Delta VA, and Alternative 2 Without TUCP Systemwide VA.

Table H-18. Alternative 2 With TUCP Without VA - Bay-Delta Contract Deliveries[a] (thousand acre-feet)

	Alt2wTUCPwoVA	No Action Alternative	Difference from No Action Alternative
ANNUAL AVERAGE			
CVP M&I	264	265	-1
CVP Ag	42	43	-1
SWP M&I	186	180	6

	Alt2wTUCPwoVA	No Action Alternative	Difference from No Action Alternative
DRY AND CRITICAL WATER YEARS			
CVP M&I	251	254	-3
CVP Ag	15	17	-2
SWP M&I	114	111	3

[a] San Francisco DWR Hydrologic Region
Ag = Agricultural
CVP = Central Valley Project
SWP = State Water Project
M&I = Municipal and Industrial

Table H-19. Alternative 2 Without TUCP Without VA - Bay-Delta Contract Deliveries[a] (thousand acre-feet)

	Alt2woTUCPwoVA	No Action Alternative	Difference from No Action Alternative
ANNUAL AVERAGE			
CVP M&I	267	265	1
CVP Ag	42	43	0
SWP M&I	185	180	5
DRY AND CRITICAL WATER YEARS			
CVP M&I	257	254	3
CVP Ag	16	17	-1
SWP M&I	112	111	1

[a] San Francisco DWR Hydrologic Region
Ag = Agricultural
CVP = Central Valley Project
SWP = State Water Project
M&I = Municipal and Industrial

Table H-20. Alternative 2 Without TUCP Delta VA - Bay-Delta Contract Deliveries[a] (thousand acre-feet)

	Alt2woTUCPDeltaVA	No Action Alternative	Difference from No Action Alternative
ANNUAL AVERAGE			
CVP M&I	267	265	2
CVP Ag	41	43	-1
SWP M&I	185	180	5
DRY AND CRITICAL WATER YEARS			
CVP M&I	260	254	6
CVP Ag	16	17	-1
SWP M&I	113	111	2

[a] San Francisco DWR Hydrologic Region
Ag = Agricultural
CVP = Central Valley Project
SWP = State Water Project
M&I = Municipal and Industrial

Table H-21. Alternative 2 Without TUCP Systemwide VA - Bay-Delta Contract Deliveries[a] (thousand acre-feet)

	Alt2woTUCPAllVA	No Action Alternative	Difference from No Action Alternative
ANNUAL AVERAGE			
CVP M&I	268	265	3
CVP Ag	41	43	-1
SWP M&I	184	180	4
DRY AND CRITICAL WATER YEARS			
CVP M&I	261	254	7
CVP Ag	16	17	-1
SWP M&I	112	111	1

[a] San Francisco DWR Hydrologic Region
Ag = Agricultural
CVP = Central Valley Project

SWP = State Water Project
M&I = Municipal and Industrial

CVP and SWP Service Areas

This section details changes in contract deliveries under Alternative 2 to CVP and SWP Service Areas in central coast, Tulare Lake, South Lahontan, and south coast regions.

Central Coast Region

The SWP contract deliveries in the central coast region under Alternative 2 are detailed below in Table H-22, Table H-23, Table H-24, and Table H-25. Under all phases of Alternative 2, SWP M&I deliveries would increase on average up to approximately 5%.

Table H-22. Alternative 2 With TUCP Without VA - Central Coast Region Contract Deliveries[a] (thousand acre-feet)

	Alt2wTUCPwoVA	No Action Alternative	Difference from No Action Alternative
ANNUAL AVERAGE			
SWP M&I	38	36	2
DRY AND CRITICAL WATER YEARS			
SWP M&I	21	20	1

[a] Central Coast DWR Hydrologic Region
SWP = State Water Project
M&I = Municipal and Industrial

Table H-23. Alternative 2 Without TUCP Without VA - Central Coast Region Contract Deliveries[a] (thousand acre-feet)

	Alt2woTUCPwoVA	No Action Alternative	Difference from No Action Alternative
ANNUAL AVERAGE			
SWP M&I	37	36	1
DRY AND CRITICAL WATER YEARS			
SWP M&I	20	20	0

[a] Central Coast DWR Hydrologic Region
SWP = State Water Project
M&I = Municipal and Industrial

Table H-24. Alternative 2 Without TUCP Delta VA - Central Coast Region Contract Deliveries[a] (thousand acre-feet)

	Alt2woTUCPDeltaVA	No Action Alternative	Difference from No Action Alternative
ANNUAL AVERAGE			
SWP M&I	37	36	2
DRY AND CRITICAL WATER YEARS			
SWP M&I	21	20	1

[a] Central Coast DWR Hydrologic Region
SWP = State Water Project
M&I = Municipal and Industrial

Table H-25. Alternative 2 Without TUCP Systemwide VA - Central Coast Region Contract Deliveries[a] (thousand acre-feet)

	Alt2woTUCPAllVA	No Action Alternative	Difference from No Action Alternative
ANNUAL AVERAGE			
SWP M&I	37	36	1
DRY AND CRITICAL WATER YEARS			
SWP M&I	21	20	1

[a] Central Coast DWR Hydrologic Region
SWP = State Water Project
M&I = Municipal and Industrial

Tulare Lake Region

The CVP and SWP contract deliveries in Tulare Lake region under Alternative 2 are detailed below in Table H-26, Table H-27, Table H-28, and Table H-29. Under all phases of Alternative 2, all average annual contract delivery types with exception of deliveries to CVP agricultural water users, would remain the same or increase. The reductions in average annual deliveries to CVP agricultural water users under Alternative 2 With TUCP Without VA and Alternative 2 Without TUCP Without VA would average less than 5% and are considered similar to conditions under the No Action Alternative. Average annual deliveries to CVP agricultural water users under Alternative 2 Without TUCP Delta VA would be reduced by 7% and would be reduced by 6% under Alternative 2 Without TUCP Systemwide VA. In dry and critical water year types, deliveries to CVP agricultural water users would be reduced by 13% under Alternative 2 With

TUCP Without VA and Alternative 2 Without TUCP Systemwide VA, 7% under Alternative 2 Without TUCP Without VA, and 12% under Alternative 2 Without TUCP Delta VA.

Table H-26. Alternative 2 With TUCP Without VA - Tulare Lake[a] Region Contract Deliveries[b] (thousand acre-feet)

	Alt2wTUCPwoVA	No Action Alternative	Difference from No Action Alternative
ANNUAL AVERAGE			
CVP Refuge Level 2	14	14	0
CVP Ag	579	583	-4
SWP M&I	74	71	3
SWP Ag	583	555	28
DRY AND CRITICAL WATER YEARS			
CVP Refuge Level 2	13	12	0
CVP Ag	204	237	-33
SWP M&I	36	35	0
SWP Ag	277	272	5

[a] Does not include Friant-Kern Canal or Madera Canal water users
[b] Tulare Lake DWR Hydrologic Region
Ag = Agricultural
CVP = Central Valley Project
SWP = State Water Project
M&I = Municipal and Industrial

Table H-27. Alternative 2 Without TUCP Without VA - Tulare Lake[a] Region Contract Deliveries[b] (thousand acre-feet)

	Alt2woTUCPwoVA	No Action Alternative	Difference from No Action Alternative
ANNUAL AVERAGE			
CVP Refuge Level 2	14	14	0
CVP Ag	580	583	-3
SWP M&I	73	71	2
SWP Ag	578	555	22

	Alt2woTUCPwoVA	No Action Alternative	Difference from No Action Alternative
DRY AND CRITICAL WATER YEARS			
CVP Refuge Level 2	13	12	0
CVP Ag	219	237	-18
SWP M&I	35	35	0
SWP Ag	271	272	-1

[a] Does not include Friant-Kern Canal or Madera Canal water users
[b] Tulare Lake DWR Hydrologic Region
Ag = Agricultural
CVP = Central Valley Project
SWP = State Water Project
M&I = Municipal and Industrial

Table H-28. Alternative 2 Without TUCP Delta VA - Tulare Lake[a] Region Contract Deliveries[b] (thousand acre-feet)

	Alt2woTUCPDeltaVA	No Action Alternative	Difference from No Action Alternative
ANNUAL AVERAGE			
CVP Refuge Level 2	14	14	0
CVP Ag	541	583	-41
SWP M&I	72	71	1
SWP Ag	575	555	20
DRY AND CRITICAL WATER YEARS			
CVP Refuge Level 2	13	12	0
CVP Ag	207	237	-30
SWP M&I	34	35	-1
SWP Ag	275	272	2

[a] Does not include Friant-Kern Canal or Madera Canal water users
[b] Tulare Lake DWR Hydrologic Region
Ag = Agricultural
CVP = Central Valley Project
SWP = State Water Project
M&I = Municipal and Industrial

Table H-29. Alternative 2 Without TUCP Systemwide VA - Tulare Lake[a] Region Contract Deliveries[b] (thousand acre-feet)

	Alt2woTUCPAllVA	No Action Alternative	Difference from No Action Alternative
ANNUAL AVERAGE			
CVP Refuge Level 2	14	14	0
CVP Ag	544	583	-39
SWP M&I	72	71	1
SWP Ag	572	555	17
DRY AND CRITICAL WATER YEARS			
CVP Refuge Level 2	13	12	0
CVP Ag	206	237	-31
SWP M&I	34	35	-1
SWP Ag	270	272	-2

[a] Does not include Friant-Kern Canal or Madera Canal water users
[b] Tulare Lake DWR Hydrologic Region
Ag = Agricultural
CVP = Central Valley Project
SWP = State Water Project
M&I = Municipal and Industrial

South Lahontan Region

The SWP contract deliveries in south Lahontan region under Alternative 2 are detailed below in Table H-30, Table H-31, Table H-32, and Table H-33. Under all phases of Alternative 2, SWP M&I deliveries would increase on average up to approximately 5%.

Table H-30. Alternative 2 With TUCP Without VA - South Lahontan Region Contract Deliveries[a] (thousand acre-feet)

	Alt2wTUCPwoVA	No Action Alternative	Difference from No Action Alternative
ANNUAL AVERAGE			
SWP M&I	240	228	12
DRY AND CRITICAL WATER YEARS			
SWP M&I	141	131	9

[a] South Lahontan DWR Hydrologic Region
SWP = State Water Project
M&I = Municipal and Industrial

Table H-31. Alternative 2 Without TUCP Without VA - South Lahontan Region Contract Deliveries[a] (thousand acre-feet)

	Alt2woTUCPwoVA	No Action Alternative	Difference from No Action Alternative
ANNUAL AVERAGE			
SWP M&I	238	228	10
DRY AND CRITICAL WATER YEARS			
SWP M&I	137	131	6

[a] South Lahontan DWR Hydrologic Region
SWP = State Water Project
M&I = Municipal and Industrial

Table H-32. Alternative 2 Without TUCP Delta VA - South Lahontan Region Contract Deliveries[a] (thousand acre-feet)

	Alt2woTUCPDeltaVA	No Action Alternative	Difference from No Action Alternative
ANNUAL AVERAGE			
SWP M&I	241	228	13
DRY AND CRITICAL WATER YEARS			
SWP M&I	143	131	12

[a] South Lahontan DWR Hydrologic Region
SWP = State Water Project
M&I = Municipal and Industrial

Table H-33. Alternative 2 Without TUCP Systemwide VA - South Lahontan Region Contract Deliveries[a] (thousand acre-feet)

	Alt2woTUCPAllVA	No Action Alternative	Difference from No Action Alternative
ANNUAL AVERAGE			
SWP M&I	240	228	12
DRY AND CRITICAL WATER YEARS			
SWP M&I	143	131	12

[a] South Lahontan DWR Hydrologic Region
SWP = State Water Project
M&I = Municipal and Industrial

South Coast Region

The SWP contract deliveries in south coast region under Alternative 2 are detailed below in Table H-34, Table H-35, Table H-36, and Table H-37. Under all phases of Alternative 2, SWP agricultural deliveries would remain the same and SWP M&I deliveries would increase on average up to approximately 4% relative to the No Action Alternative. In dry and critical years, under all phases of Alternative 2, SWP agricultural deliveries would remain the same and deliveries to SWP M&I water users would increase or decrease slightly. The reductions under Alternative 2 Without TUCP Systemwide VA would average less than 5% and are considered similar to conditions under the No Action Alternative

Table H-34. Alternative 2 With TUCP Without VA - South Coast Region Contract Deliveries[a] (thousand acre-feet)

	Alt2wTUCPwoVA	No Action Alternative	Difference from No Action Alternative
ANNUAL AVERAGE			
SWP M&I	1,205	1,151	54
SWP Ag	7	7	0
DRY AND CRITICAL WATER YEARS			
SWP M&I	603	586	16
SWP Ag	3	3	0

[a] South Coast DWR Hydrologic Region
Ag = Agricultural
SWP = State Water Project

M&I = Municipal and Industrial

Table H-35. Alternative 2 Without TUCP Without VA - South Coast Region Contract Deliveries[a] (thousand acre-feet)

	Alt2woTUCPwoVA	No Action Alternative	Difference from No Action Alternative
ANNUAL AVERAGE			
SWP M&I	1,193	1,151	42
SWP Ag	7	7	0
DRY AND CRITICAL WATER YEARS			
SWP M&I	590	586	4
SWP Ag	3	3	0

[a] South Coast DWR Hydrologic Region
Ag = Agricultural
SWP = State Water Project
M&I = Municipal and Industrial

Table H-36. Alternative 2 Without TUCP Delta VA - South Coast Region Contract Deliveries[a] (thousand acre-feet)

	Alt2woTUCPDeltaVA	No Action Alternative	Difference from No Action Alternative
ANNUAL AVERAGE			
SWP M&I	1,186	1,151	36
SWP Ag	7	7	0
DRY AND CRITICAL WATER YEARS			
SWP M&I	590	586	4
SWP Ag	3	3	0

[a] South Coast DWR Hydrologic Region
Ag = Agricultural
SWP = State Water Project
M&I = Municipal and Industrial

Table H-37. Alternative 2 - South Coast Region Contract Deliveries[a] (thousand acre-feet)

	Alternative 2	No Action Alternative	Difference from No Action Alternative
ANNUAL AVERAGE			
SWP M&I	1,181	1,151	30
SWP Ag	7	7	0
DRY AND CRITICAL WATER YEARS			
SWP M&I	585	586	-1
SWP Ag	3	3	0

[a] South Coast DWR Hydrologic Region
Ag = Agricultural
SWP = State Water Project
M&I = Municipal and Industrial

H.2.6 Alternative 3

H.2.6.1 Potential changes in water supply deliveries

Trinity River, Sacramento River, Clear Creek, and American River

CVP and SWP deliveries to contractors and water made available for diversion in Trinity, Sacramento, Clear Creek, and American Rivers watersheds under Alternative 3 are detailed in Table H-38. As indicated in Table H-38, all contract delivery types would remain the same or decrease. The reduction in average annual deliveries would be less than 5% for CVP Settlement Contractors and CVP Refuge Level 2 and are considered similar to conditions under the No Action Alternative. As discussed in Section H.2.2, CalSim 3 model output includes minor fluctuations of up to 5% due to model assumptions and approaches and changes 5% or less are considered "similar" to conditions under the No Action Alternative. In addition, minor deviations in CVP Refuge Level 2 deliveries are the result of modeling but do not reflect an intention by Reclamation to deviate from the Central Valley Project Improvement Act. In dry and critical water year types, some reductions in average deliveries would exceed this 5% level with CVP Settlement Contractors water made available for diversion reduced by 10% in dry and critical water years and CVP M&I deliveries reduced by 10% in average water years and 16% in dry and critical water years. CVP agricultural water users would see reductions of 12% in their total deliveries in average water years as well as reductions of 32% in dry and critical water years. Deliveries to SWP M&I water users would see reductions of 32% in average water years and 13% in dry and critical water years.

Table H-38. Alternative 3 - Trinity River, Sacramento River, Clear Creek, and American River Contract Deliveries[a] (thousand acre-feet)

	Alternative 3	No Action Alternative	Difference from No Action Alternative
ANNUAL AVERAGE			
CVP Settlement Contractors	1,750	1,830	-81
CVP Refuge Level 2	181	183	-3
CVP M&I	91	102	-11
CVP Ag	272	311	-81
SWP M&I	27	40	-13
DRY AND CRITICAL WATER YEARS			
CVP Settlement Contractors	1,588	1,779	-191
CVP Refuge Level 2	176	176	0
CVP M&I	70	84	-14
CVP Ag	130	194	-64
SWP M&I	26	30	-4

[a] Sacramento River DWR Hydrologic Region
Ag = Agricultural
CVP = Central Valley Project
SWP = State Water Project
M&I = Municipal and Industrial

Stanislaus River and San Joaquin River

CVP and SWP deliveries to contractors in Stanislaus River and San Joaquin River watersheds under Alternative 3 are detailed below in Table H-39. All contract delivery types would decrease relative to the No Action Alternative. These reductions in average annual deliveries would be less than 5% for CVP Exchange Contractors and CVP Refuge Level 2 and are considered similar to conditions under the No Action Alternative. In dry and critical water year types, some reductions in average deliveries would exceed this 5% level with CVP Exchange Contractors deliveries reduced by more than 7%. CVP M&I water users would see reductions of 38% in their total deliveries in average water years, as well as reductions of 42% in dry and critical water years. CVP agricultural water users would see reductions of 64% in their total deliveries in average water years, as well as reductions of 71% in dry and critical water years. SWP agricultural water users would see reductions of 36% in their total deliveries in average water years as well, as reductions of 61% in dry and critical water years.

Table H-39. Alternative 3 – Stanislaus River and San Joaquin River Contract Deliveries[a] (thousand acre-feet)

	Alternative 3	No Action Alternative	Difference from No Action Alternative
ANNUAL AVERAGE			
CVP Exchange Contractors	775	806	-31
CVP Refuge Level 2	253	256	-3
CVP M&I	8	13	-5
CVP Ag	168	477	-309
SWP Ag	1	3	-1
DRY AND CRITICAL WATER YEARS			
CVP Exchange Contractors	695	750	-55
CVP Refuge Level 2	229	236	-7
CVP M&I	5	10	-4
CVP Ag	61	210	-149
SWP Ag	1	2	-1

[a] San Joaquin River DWR Hydrologic Region
Ag = Agricultural
CVP = Central Valley Project
SWP = State Water Project
M&I = Municipal and Industrial

Bay-Delta

CVP and SWP contract deliveries in Bay-Delta under Alternative 3 are detailed below in Table H-40. All contract delivery types would decrease relative to the No Action Alternative. CVP M&I water users would see reductions of 16% in their total deliveries in average water years, as well as reductions of 13% in dry and critical water years. CVP agricultural water users would see reductions of 70% in their total deliveries in average water years, as well as reductions of 83% in dry and critical water years. SWP M&I water users would see reductions of 37% in their total deliveries in average water years, as well as reductions of 35% in dry and critical water years.

Table H-40. Alternative 3 - Bay-Delta Contract Deliveries[a] (thousand acre-feet)

	Alternative 3	No Action Alternative	Difference from No Action Alternative
ANNUAL AVERAGE			
CVP M&I	222	265	-44
CVP Ag	12	43	-30
SWP M&I	112	180	-68
DRY AND CRITICAL WATER YEARS			
CVP M&I	219	254	-35
CVP Ag	3	17	-14
SWP M&I	72	111	-39

[a] San Francisco DWR Hydrologic Region
Ag = Agricultural
CVP = Central Valley Project
SWP = State Water Project
M&I = Municipal and Industrial

CVP and SWP Service Areas

This section details changes in contract deliveries under Alternative 3 to CVP and SWP Service Areas in central coast, Tulare Lake, South Lahontan, and south coast regions.

Central Coast Region

SWP contract deliveries in the central coast region under Alternative 3 are detailed below in Table H-41. SWP M&I water users would see reductions of 52% in their total deliveries in average water years, as well as reductions of 54% in dry and critical water years.

Table H-41. Alternative 3 - Central Coast Region Contract Deliveries[a] (thousand acre-feet)

	Alternative 1	No Action Alternative	Difference from No Action Alternative
ANNUAL AVERAGE			
SWP M&I	17	36	-19
DRY AND CRITICAL WATER YEARS			
SWP M&I	9	20	-11

[a] Central Coast DWR Hydrologic Region
SWP = State Water Project
M&I = Municipal and Industrial

Tulare Lake Region

CVP and SWP contract deliveries in Tulare Lake region under Alternative 3 are detailed below in Table H-42. All contract delivery types would decrease. CVP Refuge Level 2 would see reductions of 7% in their total deliveries in average water years, as well as reductions of 8% in dry and critical water years. CVP agricultural water users would see reductions of 73% in their total deliveries in average water years, as well as reductions of 85% in dry and critical water years. SWP M&I water users would see reductions of 52% in their total deliveries in average water years, as well as reductions of 53% in dry and critical water years. SWP agricultural water users would see reductions of 55% in their total deliveries in both average water years, as well as dry and critical water years.

Table H-42. Alternative 3 - Tulare Lake[a] Region Contract Deliveries[b] (thousand acre-feet)

	Alternative 3	No Action Alternative	Difference from No Action Alternative
ANNUAL AVERAGE			
CVP Refuge Level 2	13	14	-1
CVP Ag	152	583	-431
SWP M&I	34	71	-37
SWP Ag	247	555	-308
DRY AND CRITICAL WATER YEARS			
CVP Refuge Level 2	11	12	-1
CVP Ag	34	237	-203
SWP M&I	17	35	-19
SWP Ag	122	272	-151

[a] Does not include Friant-Kern Canal or Madera Canal water users
[b] Tulare Lake DWR Hydrologic Region
Ag = Agricultural
CVP = Central Valley Project
SWP = State Water Project
M&I = Municipal and Industrial

South Lahontan Region

SWP contract deliveries in south Lahontan region under Alternative 3 are detailed below in Table H-43. SWP M&I water users would see reductions of 51% in their total deliveries in average

water years, as well as reductions of 57% in dry and critical water years, relative to the No Action Alternative.

Table H-43. Alternative 3 - South Lahontan Region Contract Deliveries[a] (thousand acre-feet)

	Alternative 3	No Action Alternative	Difference from No Action Alternative
ANNUAL AVERAGE			
SWP M&I	110	228	-117
DRY AND CRITICAL WATER YEARS			
SWP M&I	56	131	-75

[a] South Lahontan DWR Hydrologic Region
SWP = State Water Project
M&I = Municipal and Industrial

South Coast Region

SWP contract deliveries in south coast region under Alternative 3 are detailed below in Table H-44. All contract delivery types would decrease relative to the No Action Alternative. SWP M&I water users would see reductions of 53% in their total deliveries in average water years, and 55% in dry and critical water years. SWP agricultural water users would see reductions of 59% in their total deliveries in average water years, as well as reductions of 36% in dry and critical water years.

Table H-44. Alternative 3 - South Coast Region Contract Deliveries[a] (thousand acre-feet)

	Alternative 3	No Action Alternative	Difference from No Action Alternative
ANNUAL AVERAGE			
SWP M&I	531	1,151	-619
SWP Ag	3	7	-4
DRY AND CRITICAL WATER YEARS			
SWP M&I	262	586	-324
SWP Ag	2	3	-1

[a] South Coast DWR Hydrologic Region
Ag = Agricultural
SWP = State Water Project
M&I = Municipal and Industrial

H.2.7 Alternative 4

H.2.7.1 Potential changes in water supply deliveries

Trinity River, Sacramento River, Clear Creek, and American River

CVP and SWP deliveries to contractors and water made available for diversion in Trinity, Sacramento, Clear Creek, and American rivers watersheds under Alternative 4 are detailed in Table H-45. As indicated in Table H-45, average annual deliveries to CVP Settlement Contractors would slightly decrease, and average annual deliveries to CVP Refuge Level 2, CVP M&I, CVP agricultural, and SWP M&I deliveries would slightly increase or generate no measurable change relative to the No Action Alternative. Reductions in average annual deliveries to CVP Settlement Contractors and reductions in dry and critical water year types deliveries to CVP Settlement Contractors and CVP agricultural water users would be less than 5% and are considered similar to conditions under the No Action Alternative.

Table H-45. Alternative 4 - Trinity River, Sacramento River, Clear Creek, and American River Contract Deliveries[a] (thousand acre-feet)

	Alternative 4	No Action Alternative	Difference from No Action Alternative
ANNUAL AVERAGE			
CVP Settlement Contractors	1,804	1,830	-26
CVP Refuge Level 2	183	183	0
CVP M&I	103	102	0
CVP Ag	313	311	2
SWP M&I	42	40	2
DRY AND CRITICAL WATER YEARS			
CVP Settlement Contractors	1,714	1,779	-65
CVP Refuge Level 2	176	176	0
CVP M&I	84	84	1
CVP Ag	192	194	-2
SWP M&I	31	30	2

[a] Sacramento River DWR Hydrologic Region
Ag = Agricultural
CVP = Central Valley Project
SWP = State Water Project
M&I = Municipal and Industrial

Stanislaus River and San Joaquin River

CVP and SWP deliveries to contractors in Stanislaus River and San Joaquin River watersheds under Alternative 4 are detailed below in Table H-46. All contract delivery types, except for CVP agricultural water users, would remain the same relative to the No Action Alternative. The reduction in average annual deliveries for CVP agricultural water users would be less than 5% and are considered similar to conditions under the No Action Alternative. In dry and critical water year types, reductions in average deliveries for CVP agricultural water users would exceed this 5% level with deliveries reduced by 5%.

Table H-46. Alternative 4 – Stanislaus River and San Joaquin River Contract Deliveries[a] (thousand acre-feet)

	Alternative 4	No Action Alternative	Difference from No Action Alternative
ANNUAL AVERAGE			
CVP Exchange Contractors	807	806	1
CVP Refuge Level 2	256	256	0
CVP M&I	13	13	0
CVP Ag	490	477	13
SWP Ag	3	3	0
DRY AND CRITICAL WATER YEARS			
CVP Exchange Contractors	753	750	3
CVP Refuge Level 2	237	236	1
CVP M&I	9	10	0
CVP Ag	198	210	-11
SWP Ag	2	2	0

[a] San Joaquin River DWR Hydrologic Region
Ag = Agricultural
CVP = Central Valley Project
SWP = State Water Project
M&I = Municipal and Industrial

Bay-Delta

CVP and SWP contract deliveries in Bay-Delta under Alternative 4 are detailed below in Table H-47. All average annual contract delivery types would increase slightly but be less than 5% and therefore considered similar to conditions under the No Action Alternative. In dry and critical water year types, there would be reductions in average deliveries for CVP agricultural water users which would exceed the 5% level considered similar to conditions under the No Action

Alternative with deliveries reduced by 5% In dry and critical water years, there would be increases in average deliveries for SWP M&I water users of 7%.

Table H-47. Alternative 4 - Bay-Delta Contract Deliveries[a] (thousand acre-feet)

	Alternative 4	No Action Alternative	Difference from No Action Alternative
ANNUAL AVERAGE			
CVP M&I	266	265	1
CVP Ag	44	43	1
SWP M&I	188	180	8
DRY AND CRITICAL WATER YEARS			
CVP M&I	254	254	-1
CVP Ag	16	17	-1
SWP M&I	119	111	8

[a] San Francisco DWR Hydrologic Region
Ag = Agricultural
CVP = Central Valley Project
SWP = State Water Project
M&I = Municipal and Industrial

CVP and SWP Service Areas

This section details changes in contract deliveries under Alternative 4 to CVP and SWP Service Areas in central coast, Tulare Lake, South Lahontan and south coast regions.

Central Coast Region

SWP contract deliveries in the central coast region under Alternative 4 are detailed below in Table H-48. SWP M&I deliveries would increase on average approximately 8% relative to the No Action Alternative

Table H-48. Alternative 4 - Central Coast Region Contract Deliveries[a] (thousand acre-feet)

	Alternative 1	No Action Alternative	Difference from No Action Alternative
ANNUAL AVERAGE			
SWP M&I	39	36	3

	Alternative 1	No Action Alternative	Difference from No Action Alternative
DRY AND CRITICAL WATER YEARS			
SWP M&I	23	20	3

[a] Central Coast DWR Hydrologic Region
SWP = State Water Project
M&I = Municipal and Industrial

Tulare Lake Region

CVP and SWP contract deliveries in Tulare Lake region under Alternative 4 are detailed below in Table H-49. All average annual contract delivery types would remain the same or increase slightly relative to the No Action Alternative. In dry and critical water year types, there would be reductions in average deliveries for CVP agricultural water users that would exceed the 5% level considered similar to conditions under the No Action Alternative with deliveries reduced by 6%.

Table H-49. Alternative 4 - Tulare Lake[a] Region Contract Deliveries[b] (thousand acre-feet)

	Alternative 4	No Action Alternative	Difference from No Action Alternative
ANNUAL AVERAGE			
CVP Refuge Level 2	14	14	0
CVP Ag	600	583	17
SWP M&I	75	71	5
SWP Ag	596	555	41
DRY AND CRITICAL WATER YEARS			
CVP Refuge Level 2	13	12	0
CVP Ag	221	237	-16
SWP M&I	39	35	4
SWP Ag	304	272	32

[a] Does not include Friant-Kern Canal or Madera Canal water users
[b] Tulare Lake DWR Hydrologic Region
Ag = Agricultural
CVP = Central Valley Project
SWP = State Water Project
M&I = Municipal and Industrial

South Lahontan Region

SWP contract deliveries in south Lahontan region under Alternative 4 are detailed below in Table H-50. SWP M&I deliveries would increase on average approximately 8% relative to the No Action Alternative.

Table H-50. Alternative 4 - South Lahontan Region Contract Deliveries[a] (thousand acre-feet)

	Alternative 4	No Action Alternative	Difference from No Action Alternative
ANNUAL AVERAGE			
SWP M&I	247	228	20
DRY AND CRITICAL WATER YEARS			
SWP M&I	150	131	19

[a] South Lahontan DWR Hydrologic Region
SWP = State Water Project
M&I = Municipal and Industrial

South Coast Region

SWP contract deliveries in south coast region under Alternative 4 are detailed below in Table H-51. SWP M&I deliveries would increase on average approximately 6% and SWP agricultural deliveries would remain similar to the No Action Alternative.

Table H-51. Alternative 4 - South Coast Region Contract Deliveries[a] (thousand acre-feet)

	Alternative 4	No Action Alternative	Difference from No Action Alternative
ANNUAL AVERAGE			
SWP M&I	1,230	1,151	79
SWP Ag	7	7	0
DRY AND CRITICAL WATER YEARS			
SWP M&I	656	586	70
SWP Ag	3	3	0

[a] South Coast DWR Hydrologic Region
Ag = Agricultural
SWP = State Water Project
M&I = Municipal and Industrial

H.2.8 Mitigation Measures

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

H.2.8.1 Avoidance and Minimization Measures

Alternative 2

- *Fall and Winter Base flows for Shasta Refill and Redd Maintenance* - Relevant to water supply because it will result in more predicable management of storage in Shasta Reservoir. Alternative 2 updates the table for December through February releases to require more storage in Shasta Reservoir for higher release as shown below.

Table H-52. Keswick Dam December through February Default Release Schedule determined by EOS Storage.

Keswick Release (cfs)	Shasta EOS Storage (MAF)
3,250	≤2.4
4,000	≤2.8
4,500	≤3.2
5,000	>3.2

EOS = end-of-September; cfs = cubic feet per second; MAF = million acre-feet. These may be refined through future modeling and/or analysis efforts as part of the seasonal operations planning.

- *Minimum Instream Flows* - Relevant to water supply because it will allow more water to be placed in Shasta Reservoir storage when certain minimum flow conditions are met. In response to major storm events, Reclamation, after coordination through the SRG and SHOT, and also through adaptive management, may determine that lower flows achieve the same biological effects as the minimum flow of 3,250 cfs at Keswick Dam. If these flows are determined to meet the same biological intent, Reclamation may temporarily reduce below 3,250 cfs to preserve storage.
- *Water Temperature and Storage Management* – Relevant to water supply because it provides for a better balance between flood control releases and maintaining water storage in Shasta Reservoir. Reclamation is proposing to change the balance between risks of flood control releases for Shasta Reservoir and place a higher priority on maintaining storage for drought protection. The strategy is framed around a framework adapted from the multi-year drought sequence experienced in Victoria, Australia (Mount et al. 2016, “Victorian Objectives”) that establishes different objectives depending on hydrologic conditions and identifies actions that can be taken for fishery management and drought protection.

- *Storm-Flex* - The Storm-Flex AMM is relevant to water supply because it allows for a capture of high flows during storm-events which would enhance water supplies. During the OMR management season, Reclamation and DWR, through WOMT, may prepare an assessment to evaluate operating to an OMR index no more negative than -6,250 cfs between the start of OMR management season and the larval and juvenile delta smelt Protection Action onramp or the last day of February, whichever occurs first, to capture peak flows during storm-related events.

  If conditions indicate an entrainment protection condition is likely to trigger, Reclamation and DWR will reduce south Delta exports to achieve a 14-day average OMR index no more negative than -5,000 cfs, unless a further reduction in exports is required. If an entrainment protection condition is triggered, Reclamation and DWR will cease storm-flex and implement the entrainment protection condition.

Alternative 4

- *The Fall and Winter instream flows for Shasta Refill and Redd Maintenance* - Relevant to water supply because it will result in more predicable management of storage in Shasta Reservoir. Alternative 4 updates the table for December through February releases to require storage in Shasta Reservoir for higher release as shown in below.

Table H-53 Keswick Dam December through February Default Release Schedule determined by EOS Storage.

Keswick Release (cfs)	Shasta EOS Storage (MAF)
3,250	<2.4
4,000	≥2.4
4,500	≥2.8
5,000	≥3.2

EOS = end-of-September; cfs = cubic feet per second; MAF = million acre-feet.

- *Sacramento Water Temperature and Storage Management* - Relevant to water supply because it maintains water storage in Shasta Reservoir during drought conditions. Alternative 4 includes drought toolkit actions such as Wilkins Slough Relief and relaxation of D-1641 water quality requirements that may improve the volume of coldwater pool and level of drought protection in Shasta Reservoir.

  Reclamation would coordinate through governance to implement a water temperature management strategy that considers:

  - EOS Coldwater Pool
  - Minimization of modeled Temperature Dependent Mortality.

- *Storm Flex*

The Storm-Flex AMM is relevant to water supply because it allows for a capture of high flows during storm-events which would enhance water supplies. Reclamation and DWR may operate to an OMR no more negative than -6,250 cfs to capture peak flows during storm-related events when no backstop conditions are triggered and following conditions are met:

- The Delta is in excess conditions as defined in 2018 amendment to the COA, and
- QWEST is greater than 0.

DWR and Reclamation, through Governance, will use estimates of the real-time distribution of winter-run Chinook salmon, Particle Track Model, and prediction tool output to assess potential winter-run Chinook salmon entrainment risk differences using OMR inputs of -5000, and -6250 cfs. If the assessment indicates that additional entrainment protections are unlikely to be triggered, Reclamation and DWR may operate to OMR no more negative than -6,250 cfs and will update the assessment no less than weekly. If conditions indicate a backstop condition is likely to trigger, Reclamation and DWR will resume OMR no more negative than -5,000 cfs. If a backstop condition is triggered, Reclamation and DWR will cease storm-flex and implement the backstop.

H.2.8.2 Additional Mitigation Measures

MM-WS-1: Coordination with Byron Bethany Irrigation District (Alternatives 1-4)
DWR will coordinate with Byron Bethany Irrigation District prior to herbicide treatments.

MM-WS-2: Coordination with Contra Costa Water District (Alternatives 1-4)
Reclamation will coordinate with Contra Costa Water District (CCWD) to avoid creating new or additional restrictions on CCWD's ability to fill Los Vaqueros Reservoir, beyond the restrictions that are imposed under the then current CCWD Biological Opinions and Incidental Take Permits, so that with implementation of the selected alternative, CCWD will have opportunities to fill Los Vaqueros Reservoir that are at least comparable to the current opportunities.

Additional Mitigation Measures

Of the reductions in average annual water supply deliveries identified for Alternatives 1 and 4 evaluated above, all adverse changes were 5% or less of total supply delivered. As was noted in Section H.2.2, changes forecast in water supply deliveries are considered "similar" to conditions anticipated under the No Action Alternative given the evaluation approaches and assumptions relied on in the CalSim 3 model to estimate changes across CVP and SWP. Alternatives 2 and 3 would generate reductions in average annual deliveries to some contractor types that would exceed 5% and would represent a measurable reduction in water supply when compared to the No Action Alternative. These reductions in water supply deliveries and water made available for diversion would not be able to be replaced reliably from other sources, such as water transfers or groundwater pumping. Water transfers are included in the No Action Alternative and would not be available to further offset the reduced water supply deliveries generated by Alternatives 2 and 3. Reliance on groundwater pumping to offset these reductions would not be feasible given the potential for numerous environmental effects generated by additional groundwater pumping in an

area with declining groundwater levels and the limits on the availability of groundwater supplies with the implementation of the Sustainable Groundwater Management Act (see Appendix I, *Groundwater Technical Appendix*, for more information). Given the environmental and technological limits on the implementation of other potential options to offset this impact, no feasible mitigation has been identified to reduce the severity of these reductions.

H.2.9 Summary of Impacts

Table H-54 includes a summary of impacts, magnitude and direction of those impacts, and potential mitigation measures for consideration.

Table H-54. Impact Summary

Impact	Alternative	Magnitude and Direction of Impacts 1	Potential Mitigation Measures
Potential changes in water supply deliveries and water made available for diversion	No Action	Continuation of existing water supply deliveries to CVP and SWP contractors. [2]	Mitigation Measure WS-1
	Alternative 1	**Trinity River, Sacramento River, Clear Creek, and American River Watersheds –** No measurable change in CVP Settlement Contractors water made available for diversion, CVP M&I, and SWP M&I deliveries <5% reductions in water supply deliveries to CVP Refuge Level 2 Increases in water deliveries for CVP agricultural water users **Stanislaus River and San Joaquin River Watersheds –** Improvements in water deliveries for all contractor types **Bay-Delta –** Improvements in water deliveries for all contractor types **CVP Service Areas** ***Tulare Lake[3] –*** No measurable change in CVP Refuge Level 2 deliveries Improvements in water deliveries for all other contractor types ***Central Coast, South Lahontan Region, South Coast –***	Mitigation Measure WS-1 Mitigation Measure WS-2

Impact	Alternative	Magnitude and Direction of Impacts 1	Potential Mitigation Measures
		Improvements in water deliveries for all contractor types	
	Alternative 2	**Trinity River, Sacramento River, Clear Creek, and American River Watersheds –** No measurable change in water deliveries for SWP M&I water users <5% reductions in average water supply deliveries to CVP Refuge Level 2 and CVP M&I water users 5% reduction in average water supply deliveries to CVP agricultural water users 6% reduction in average water made available for diversion to CVP Settlement Contractors **Stanislaus River and San Joaquin River Watersheds –** No measurable change in water deliveries for CVP Refuge Level 2, CVP M&I, and SWP agricultural water users 7% reduction in average deliveries to CVP agricultural water users Improvements in average water made available for diversion to CVP Settlement Contractors **Bay-Delta –** <5% reductions in average deliveries to CVP M&I and CVP agricultural water users Improvements in average water deliveries for SWP M&I water users **CVP Service Areas** ***Tulare Lake[3] –*** No measurable change in water deliveries for CVP Refuge Level 2 7% reduction in average deliveries to CVP agricultural water users Improvements in average water deliveries for all other contractor types ***South Coast –*** No measurable change in water deliveries for SWP agricultural water users Improvements in average water deliveries for SWP M&I water users ***Central Coast, South Lahontan –*** Improvements in average water deliveries for all contractor types	Mitigation Measure WS-1 Mitigation Measure WS-2

Impact	Alternative	Magnitude and Direction of Impacts 1	Potential Mitigation Measures
	Alternative 3	**Trinity River, Sacramento River, Clear Creek, and American River Watersheds –** No measurable change in average CVP Refuge Level 2 and CVP Settlement Contractors deliveries. 10% reduction in average deliveries to CVP M&I water users. 12% reduction in average deliveries to CVP agricultural water users 32% reduction in average deliveries to SWP M&I water users **Stanislaus River and San Joaquin River Watersheds –** <5% reductions in CVP Exchange Contractor and CVP Refuge Level 2 deliveries 38% reduction in average deliveries to CVP M&I water users 64% reduction in average deliveries to CVP agricultural water users 36% reduction in average deliveries to SWP agricultural water users **Bay-Delta –** 16% reduction in average deliveries to CVP M&I water users 70% reduction in average deliveries to CVP agricultural water users 37% reduction in average deliveries to SWP M&I water users **CVP Service Areas** ***Central Coast–*** 52% reduction in average deliveries to SWP M&I water users ***Tulare Lake[3] –*** 7% reduction in average deliveries to CVP Refuge Level 2 73% reduction in average deliveries to CVP agricultural water users 52% reduction in average deliveries to SWP M&I water users 55% reduction in average deliveries to SWP agricultural water users ***South Lahontan –***	Mitigation Measure WS-1 Mitigation Measure WS-2

Impact	Alternative	Magnitude and Direction of Impacts 1	Potential Mitigation Measures
		51% reduction in average deliveries to SWP M&I water users ***South Coast –*** 53% reduction in average deliveries to SWP M&I water users 59% reduction in average deliveries to SWP agricultural water users	
	Alternative 4	**Trinity River, Sacramento River, Clear Creek, and American River Watersheds –** No measurable change in CVP Refuge Level 2 and CVP M&I, and CVP agricultural deliveries 5% increase in average deliveries to SWP M&I water users <5% reductions in average water supply made available for diversion to CVP Settlement Contractors **Stanislaus River and San Joaquin River Watersheds –** No measurable change in CVP and SWP average deliveries. **Bay-Delta–** No change in average water deliveries for CVP M&I water users <5% increases in average deliveries for CVP agricultural water users and SWP M&I water users. **CVP & SWP Service Areas** ***Tulare Lake[3] –*** No measurable change in CVP Level 2 Refuge deliveries. <5% increases in average deliveries for CVP agricultural water users 7% improvements in average water deliveries for SWP M%I and agricultural water users ***South Coast –*** No measurable change in SWP agricultural deliveries 6% improvements in average water deliveries for SWP M&I water users ***Central Coast, South Lahontan–*** 8% improvements in average water deliveries for all contractor types	Mitigation Measure WS-1 Mitigation Measure WS-2

[1] For the evaluation of alternatives, operation of the action alternatives is compared to the No Action Alternative.
[2] Under the No Action Alternative, Reclamation would operate the CVP consistent with the 2020 Record of Decision implementing the Proposed Action consulted upon for the 2019 Biological Opinions and the reasonable and prudent measures in the incidental take statements. DWR would operate the SWP consistent with the 2020 Record of Decision and the 2020 Incidental Take Permit for the SWP. Reclamation and DWR would operate consistent with authorizing legislation, water rights, contracts, and agreements as described by common components. The evaluation under the No Action Alternative is compared to existing conditions.
[3] Does not include Friant-Kern Canal or Madera Canal water users.
Ag = Agricultural
CVP = Central Valley Project
SWP = State Water Project
M&I = Municipal and Industrial

H.2.10 Cumulative Impacts

Past, present, and reasonably foreseeable projects, described in Appendix Y, *Cumulative Impact Technical Appendix* may have cumulative effects on water supply, to the extent that they could affect reservoirs that store CVP water, tributaries, and agricultural land.

- Past and present actions contribute to the existing condition of the affected environment in the project area while reasonably foreseeable actions are those that are likely to occur in the future that are not speculative. Past, present, and reasonably foreseeable projects include actions to develop water storage capacity, water conveyance infrastructure, water recycling capacity, the reoperation of existing water supply infrastructure, including surface water reservoirs and conveyance infrastructure, and habitat restoration actions. The projects identified in Appendix Y that have the most potential to contribute to cumulative impact on water supply are: Pacheco Reservoir/San Luis Low Point Improvement Project
- Contra Costa Canal Replacement Project
- Alternative Intake Project
- Davis-Woodland Water Supply Project
- Eastern San Joaquin Integrated Conjunctive Use Program
- Suisun Marsh Habitat Management, Preservation, and Restoration Plan
- South Delta Temporary Barriers Project
- San Francisco Bay Delta Action Plan
- Prospect Island Tidal Habitat Restoration Project
- Bradmoor Island Habitat Restoration
- Lookout Slough Habitat Restoration
- Chipps Island Habitat Restoration
- Klamath River Renewal Project

- Sites Reservoir
- Delta Conveyance Project
- Bay-Delta Water Quality Control Plan Update
- Los Vaqueros Reservoir Expansion Project

The No Action Alternative would continue with current operations of the CVP and may result in changes to water supply of reservoir that store CVP water, tributaries, and agricultural lands. These changes may potentially contribute to the cumulative impact and were described and considered in the 2020 Record of Decision.

Alternative 1 would improve water supply deliveries to some CVP and SWP contractors and for other water users result in reductions below 5% which, as was detailed in Section H.2.2, would be similar to conditions anticipated under the No Action Alternative given evaluation approaches and assumptions relied on in CalSim 3 model to estimate changes across CVP and SWP. Alternatives 2 and 4 would have similar impacts to Alternative 1 and would not generate substantial contributions to cumulative water supply conditions. Alternative 3 would be similar to Alternatives 1, 2, and 4, resulting in reductions in average water supply deliveries to some CVP and SWP contractors. The reductions in surface water deliveries for many water users under Alternative 3 would be larger than the reductions anticipated under other alternatives. As is detailed above in Section H.2.6, *Alternative 3*, these reductions in average deliveries in dry and critical water year types could, for some contractor delivery types, approach 85% when compared to the No Action Alternative.

Alternative 1, 2, and 4's contribution to these conditions would be expected to be minimal. In the case of projects identified in Appendix Y that are anticipated to potentially generate temporary reductions in water supply deliveries or reduce surplus water supply availability to neighboring water users, Alternative 1, 2, and 4's improvement to water supply deliveries for many water users would help to reduce the severity of any potential cumulative impact. In the case of water users to whom Alternatives 1, 2, and 4 are not forecasted to improve deliveries, potential changes in water supply deliveries would not contribute to any cumulative water supply impacts given, as was noted above, these alternatives' similarity to the No Action Alternative.

Given Alternative 3's larger reductions in CVP and SWP deliveries, this alternative could contribute to the potential cumulative conditions described above in the event of a dry or critical water year type occurrence during a period when a project identified in Appendix Y was generating temporary reductions in water supply deliveries or reductions of surplus water supply availability to neighboring water users. Alternative 3 could in that situation amplify its contribution to the cumulative condition.

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