Chapter 5
Water Quality

This chapter presents the existing water quality within the area of analysis and discusses potential effects on water quality from the proposed alternatives.

5.1 Affected Environment

This section provides an overview of the regulatory setting associated with water quality standards and provides a description of the water bodies with the potential to be affected by the action alternatives.

5.1.1 Area of Analysis

Changes to the allocations of the Central Valley Project (CVP) municipal and industrial (M&I) and agricultural water service contractors during a Condition of Shortage ~~water shortage conditions~~ could affect water quality in portions of the Shasta and Trinity River, Sacramento River, American River, Delta, and West San Joaquin divisions. Figure 5-1 shows the regional area of analysis.

5.1.2 Regulatory Setting

The following section describes the applicable water quality laws, rules, regulations, and policies that influence the operation and comparative performance of the alternatives.

5.1.2.1 Federal

Federal Safe Drinking Water Act The Federal Safe Drinking Water Act (SDWA) was enacted in 1974 to protect the quality of drinking water in the United States (U.S.). This law focuses on all waters actually or potentially designated for drinking use, whether from above ground or underground sources. The SDWA authorized the U.S. Environmental Protection Agency (USEPA) to establish safe standards of purity for specified contaminants and required all owners or operators of public water systems to comply with primary (health-related) standards. State governments, which assume this power from the USEPA, also encourage attainment of secondary standards (nuisance-related). Contaminants of concern in a domestic water supply are those that either pose a health threat or in some way alter the aesthetic acceptability of the water. These types of contaminants are currently regulated by the USEPA through primary and secondary maximum contaminant levels (MCLs). As directed by the SDWA amendments of 1986, the USEPA has been expanding its list of primary MCLs. MCLs have been proposed or established for approximately 100 contaminants.

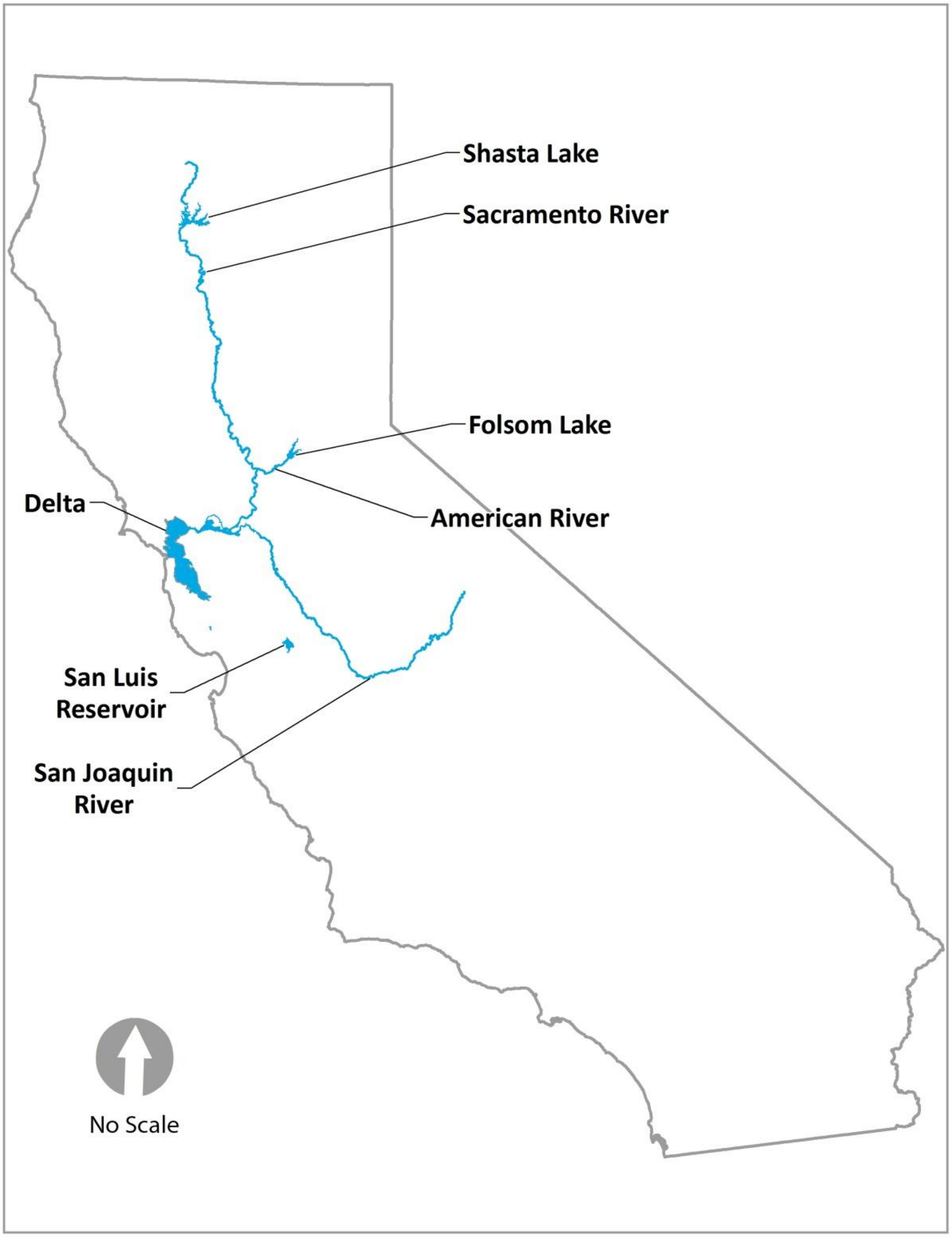


Figure 5-1. Water Quality Area of Analysis

Federal Clean Water Act Growing public awareness and concern for controlling water pollution led to enactment of the Federal Water Pollution Control Act Amendments of 1972. As amended in 1977, this law became commonly known as the Clean Water Act (CWA). The CWA established the basic structure for regulating discharges of pollutants into the waters of the U.S.

It gave the USEPA the authority to implement pollution control programs such as setting wastewater standards for industrial and municipal dischargers. The CWA also continued requirements to set water quality standards for all known contaminants in surface waters. The CWA made it unlawful for any person to discharge any pollutant from a point source into navigable waters, unless a permit was obtained under its provisions (USEPA 2002a).

Section 303(d) of the 1972 CWA requires states, territories and authorized tribes to develop a list of water quality-impaired segments of waterways. The 303(d) list includes water bodies that do not meet water quality standards for the specified beneficial uses of that waterway, even after point sources of pollution have installed the minimum required levels of pollution control technology. The law requires that these jurisdictions establish priority rankings for water bodies on their 303(d) lists and implement a process, called Total Maximum Daily Loads (TMDLs), to meet water quality standards (USEPA 2002b). Within California, TMDL implementation is through regional Basin Plans.

5.1.2.2 State

The California Porter-Cologne Water Quality Act   The California Porter-Cologne Water Quality Act (Porter-Cologne Act) was enacted in 1969 and established the State Water Resources Control Board (SWRCB). The Porter-Cologne Act defines water quality objectives as the limits or levels of water constituents that are established for reasonable protection of beneficial uses. Unlike the CWA, the Porter-Cologne Act applies to both surface and groundwater. The Porter-Cologne Act requires that each of nine semi-autonomous Regional Water Quality Control Boards (RWQCBs) establish water quality objectives, while acknowledging that water quality may be changed to some degree without unreasonably affecting beneficial uses. Beneficial uses, together with the corresponding water quality objectives, are defined as standards, per Federal CWA regulations. Therefore, the regional plans provide the regulatory framework for meeting State and Federal requirements for water quality control. Changes in water quality are only allowed if the change is consistent with the most restrictive beneficial use designation identified by the State, does not unreasonably affect the present or anticipated beneficial uses, and does not result in water quality less than that prescribed in the water quality control plans (Central Valley RWQCB 1998).

State Water Resources Control Board Decision 1641   SWRCB Decision-1641 presents the current water right requirements to implement the Sacramento-San Joaquin River Delta (Delta) flow-dependent objectives. In SWRCB Decision-1641, the SWRCB assigned responsibilities to the Bureau of Reclamation and California Department of Water Resources (DWR) for meeting these requirements. These responsibilities require that the CVP and the State Water Project (SWP) be operated to protect water quality, and that DWR and/or Reclamation will ensure that the flow dependent water quality objectives are met in the Delta (SWRCB 1999).

5.1.2.3 Regional/Local

Regional Water Quality Control Plans The California Water Code (Section 13240) requires the preparation and adoption of water quality control plans (Basin Plans), and the Federal CWA (Section 303) supports this requirement. According to Section 13050 of the California Water Code, Basin Plans consist of a designation or establishment for the waters within a specified area of beneficial uses to be protected, water quality objectives to protect those uses, and an implementation program needed for achieving the objectives. State law also requires that Basin Plans conform to the policies set forth in the Water Code, beginning with Section 13000, and any State policy for water quality control. The Basin Plans are regulatory references for meeting the state and federal requirements for water quality control (40 Code Federal Regulations 131.20). One significant difference between the State and Federal programs is that California's basin plans also establish standards for groundwater in addition to surface water (Central Valley RWQCB 1998).

Basin Plans are adopted and amended by nine RWQCBs under a structured process involving full public participation and state environmental review. Basin Plans and amendments thereto do not become effective until approved by the SWRCB. Regulatory provisions must be approved by the Office of Administrative Law. Adoption or revision of surface water standards is subject to the approval of the USEPA.

Basin Plans complement other water quality control plans adopted by the SWRCB, such as the Water Quality Control Plans (WQCP) for Temperature Control and Ocean Waters. The SWRCB and the RWQCBs maintain each Basin Plan in an updated and readily available edition that reflects the current water quality control programs.

Several different regional water quality control plans govern water bodies within the M&I Water Shortage Policy (WSP) area of analysis.

- The WQCP for the Central Valley Region RWQCB covers an area including the entire Sacramento and San Joaquin river basins, involving an area bound by the crests of the Sierra Nevada on the east and the Coast Range and Klamath Mountains on the west. The area covered in this WQCP extends some 400 miles, from the California-Oregon border to the headwaters of the San Joaquin River.

- The WQCP for the Tulare Lake Basin comprises the drainage area of the San Joaquin Valley south of the San Joaquin River.

- The WQCP for the San Francisco Bay Basin covers all or major portions of Alameda, Contra Costa, Marin, Napa, San Mateo, San Francisco, Santa Clara, Solano, and Sonoma counties.

- The WQCP for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary establishes water quality objectives for water bodies within the region in order to protect beneficial uses. The WQCP includes beneficial uses to be protected, water quality objectives, and a program to help achieve the water quality objectives. This plan supplements other water quality control plans, by the SWRCB and RWQCBs, relevant to the Bay-Delta Estuary watershed. These other plans and policies establish water quality standards and requirements for parameters such as toxic chemicals, bacterial contamination, and other factors which have the potential to adversely affect beneficial uses or cause nuisance conditions (SWRCB 1995).

5.1.3 Existing Conditions

The following section describes the existing water quality conditions within the study area.

5.1.3.1 Shasta and Trinity River Divisions

The Shasta and Trinity River divisions include a number of community service districts, water agencies, and cities in northern California that receive water from the major reservoirs. The Trinity River Division is located on the Trinity River, approximately 25 miles North of Redding and includes Whiskeytown Lake, the Clear Creek Tunnel, Lewiston Lake, Spring Creek Reservoir, and Trinity River and Reservoir. The Shasta Division is located on the Sacramento River approximately 10 miles north of Redding and includes the upper portion of the Sacramento River, Keswick Reservoir, and Shasta Lake. Both divisions catch the headwaters of the network of CVP waterways and channel the water southward (Reclamation 2012a).

Certain water bodies in the Shasta and Trinity River divisions are listed as water quality limited (impaired) for one or more of the constituents of concern. Table 5-1 presents the 303(d) listed water bodies within the area of analysis and information about the constituents of concern contributing to their impairment. Some water quality constituents are also of concern with respect to drinking water.

Table 5-1. 303(d) Listed Water Bodies within the Shasta and Trinity River Divisions and Associated Constituents of Concern

Name	Constituent	Potential Sources	Estimated Area Affected	Proposed TMDL Completion Year
Clear Creek (below Whiskeytown Lake)	Mercury	Resource Extraction	18 miles	2021
Cottonwood Creek	E.Coli Unknown Toxicity	Source Unknown Source Unknown	29 miles 29 miles	2021 2021
Keswick Reservoir	Cadmium Copper Zinc	Resource Extraction Resource Extraction Resource Extraction	135 acres 135 acres 135 acres	2020 2020 2020
Shasta Lake	Mercury Cadmium Copper Zinc	Resource Extraction Resource Extraction Resource Extraction Resource Extraction	27,335 acres 20 acres 20 acres 20 acres	2021 2020 2020 2020
Sacramento River (Keswick Dam to Cottonwood Creek)	Unknown toxicity	Source Unknown	15 miles	2019
Whiskeytown Lake	Mercury	Resource Extraction	98 Acres	2021
Trinity Lake	Mercury	Atmospheric Deposition Resource Extraction Natural Sources Source Unknown	15,985 acres	2019
Trinity River Hydrologic Unit, Upper Hydrologic Area	Sedimentation/ Siltation	Natural Sources Habitat Modification Hydromodification Resource Extraction	570 miles	2001

Source: SWRCB 2010.

There are only relatively small changes to Shasta and Trinity lakes and Lake Oroville as a result of the different agricultural and M&I water service contractor allocations in the alternatives. The changes in storage are a reasonable response of a complex system to different CVP allocation procedures and may not necessarily be specific responses to the different allocation schemes of one alternative versus another. Shasta and Trinity lakes never show a monthly change in storage for an alternative versus the No Action Alternative of more than +/- one percent of total storage. This is further discussed in Appendix B, Water Operations Model Documentation. Due to these minimal changes, water quality in Shasta and Trinity lakes is not discussed in further detail in this chapter.

In the Trinity Division, major concerns are sedimentation being carried into the waterways and Mercury contamination from abandoned mines. Based on Mercury, a fish consumption advisory exists for the east fork of the Trinity River (OEHHA 2014). Mercury is a lesser threat to drinking water quality because it generally does not appear in the water column, but tends to enter lake and river sediment where it eventually enters the food chain.

5.1.3.2 Sacramento River Division

This includes the Sacramento River and surrounding districts. Tehama, Glenn, and Colusa counties are the primary recipients of water from the unit, but the Tehama-Colusa Canal extends into Yolo County. The Sacramento Canals Unit consists of Red Bluff Diversion Dam, Funks Dam, Corning Pumping Plant, Tehama-Colusa Canal, and Corning Canal. Also included in the Sacramento River Division is the Black Butte Unit, consisting of Black Butte Dam and Lake (Reclamation 2012b).

Certain water bodies in the Sacramento River Division are listed as water quality limited (impaired) for one or more of the constituents of concern. Table 5-2 presents the 303(d) listed water bodies within the area of analysis and information about the constituents of concern contributing to their impairment. Some water quality constituents are also of concern with respect to drinking water.

The 303(d) list indicates that certain segments of the Sacramento River contain several constituents of concern, including dieldrin, mercury, polychlorinated biphenyls (PCBs), and unknown toxicity (see Table 5-2); however, the water quality in the Sacramento River is generally of high quality and concentrations of undesirable constituents are generally low.

Table 5-2. 303(d) Listed Water Bodies within the Sacramento River Division and Associated Constituents of Concern

Name	Constituent	Potential Sources	Estimated Area Affected	Proposed TMDL Completion Year
Sacramento River	Chlordane	Agriculture	16 miles	2021
	Dichlorodiphenyltrichloroethane (DDT)	Agriculture	98 miles	2021
	Dieldrin	Agriculture	98 miles	2021
	Mercury	Resource Extraction	114 miles	2021
	PCBs	Source Unknown	98 miles	2021
	Unknown Toxicity	Source Unknown	114 miles	2019
Black Butte Reservoir	Mercury	Resource Extraction	4,507 acres	2020

Source: SWRCB 2010.

Sacramento River above Bend Bridge near Red Bluff The Sacramento River sampling site above Bend Bridge near Red Bluff is approximately 52 miles downstream of Shasta Dam. Stream flow at this site is greatly influenced by managed releases from Shasta Lake and, during the rainy season, by storm water runoff. There are no artificial levees at this location; therefore, the stream channel and floodplain are in a natural, undisturbed state. The drainage basin area at this site is 9,100 square miles and includes much of northern California. Land cover in the area is mainly forestland; cropland, pasture, and rangeland cover most of the remaining land area. Mining operations take place or have taken place in the

Klamath Mountains and water quality effects from mining activities are likely to be detected at this location (United States Geological Survey [USGS] 2002). Table 5-3 presents data for the general water quality parameters.

Table 5-3. Water Quality Parameters Sampled on the Sacramento River Near Red Bluff

Water Quality Parameter	Minimum	Maximum	Average
pH (standard units)[2]	7.5	8.4	7.9
Turbidity (NTU)[1]	3	355	39
Dissolved Oxygen (mg/L)[1]	8.2	12	11
Total Organic Carbon (mg/L)[1]	0.9	3.2	1.6
Total Nitrogen (mg/L) [2]	0.02	0.59	0.09
Total Phosphorus (mg/L) [2]	0.02	0.4	0.04
Electrical Conductivity (µS/cm)[2]	103	148	122

Sources:

[1] USGS 2002: A total of 27 samples were collected over a three-year period 1996-1998).

[2] DWR 2014: sample period 2006-2009, samples taken slightly further downstream below Red Bluff Diversion Dam

Key: NTU = Nephelometric Turbidity Units, mg/L = milligrams per liter; µS/cm = micro siemens per centimeter

Sacramento River at Freeport The Sacramento River sampling site at Freeport is the furthest downstream monitoring site reported on the Sacramento River. Therefore, water quality samples at this site reflect the impacts of land use upstream. Agriculture is the predominant land use in the area. Table 5-4 presents the general water quality data for samples collected at Freeport.

Table 5-4. Water Quality Parameters Sampled[1] at Sacramento River at Freeport

Water Quality Parameter	Minimum	Maximum	Average
pH (standard units)	7	8.1	7.7
Turbidity (NTU)	12	368	54
Dissolved Oxygen (mg/L)	6.5	12.2	9.7
Total Organic Carbon (mg/L)	0.3	3.7	1.7
Total Nitrogen (mg/L)	0.058	0.26	0.13
Total Phosphorus (mg/L)	0.01	0.04	0.017
Electrical Conductivity (µS/cm)	51	166	124

Sources: USGS 2002

[1] A total of 31 samples were collected over a three-year period (1996-1998).

5.1.3.3 American River Division

The American River Division encompasses portions of Sacramento, San Joaquin, Placer, and El Dorado counties. The Folsom Unit consists of Folsom Lake and Lake Natoma on the American River. Folsom South Canal provides water for municipal and industrial use in Sacramento and San Joaquin Counties (Reclamation 2012c).

Certain water bodies in the American River Division are listed as water quality limited (impaired) for one or more of the constituents of concern. Table 5-5 presents the 303(d) listed water bodies within the area of analysis and information about the constituents of concern contributing to their impairment. Some water quality constituents are also of concern with respect to drinking water.

Table 5-5. 303(d) Listed Water Bodies within the American River Division and Associated Constituents of Concern

Name	Constituent	Potential Sources	Estimated Area Affected	Proposed TMDL Completion Year
American River, North Fork (North Fork Dam to Folsom Lake)	Mercury	Resource Extraction	71 Miles	2019
American River, South Fork (below Slab Creek Reservoir to Folsom Lake)	Mercury	Resource Extraction	37 Miles	2021
Folsom Lake	Mercury	Resource Extraction	11064 Acres	2019
Lake Natoma	Mercury	Resource Extraction	485 Acres	2019

Source: SWRCB 2010.

Table 5-6 presents general water quality data for Folsom Lake. Table 5-7 presents water quality data on the American River below Folsom Dam.

Table 5-6. Water Quality Parameters Sampled at Folsom Lake

Water Quality Parameter	Minimum	Maximum	Average
PH (standard units)	5.8	8.5	7.1
Turbidity (NTU)	1	68	1.2
Dissolved Oxygen (mg/L)	7.0	14	10.3
Total Organic Carbon (mg/L)	2	3.5	N/A
Total Nitrogen (mg/L)	N/A	N/A	N/A
Total Phosphorus (mg/L)	N/A	N/A	N/A
Electric Conductivity (µS/cm)	19	123	52

Source: Larry Walker Associates 1999

Table 5-7. Water Quality Parameters Sampled at the American River below Folsom Dam

Water Quality Parameter	Minimum[1]	Maximum[1]	Average[1]
Nitrate and Nitrite as N (mg/L)	<0.050	0.230	0.13
Total Phosphorus as P (mg/L)	<0.050	0.1	<0.05
Total Dissolved Solids (mg/L)	20	91	47.5
Mercury (dissolved) (µg/L)	<0.005	0.01	<0.005

Source: LSA Associates, Inc. 2003

[1] Sampling Dates: 2/16/1999, 5/18/1999, 8/24/1999, 11/8/1999, 3/6/2000, 5/15/2000, 8/16/2000, 11/7/2000

Water in the lower American River is generally considered to be of good quality. Table 5-8 presents general water quality data for the lower American River.

Table 5-8. Water Quality Parameters Sampled on the Lower Fork American River[1] (American River at WTP)

Water Quality Parameter	Minimum	Maximum	Average
pH (standard units)	5.9	9.3	7.4
Turbidity (NTU)	0.7	146	4.5
Dissolved Oxygen (mg/L)	5.2	12.95	9.5
Total Organic Carbon (mg/L)	0.7	3.0	1.7
Total Nitrogen (mg/L)	0.01	0.19	0.05
Total Phosphorus (mg/L)	0.01	0.1	0.02
Electrical Conductivity (µS/cm)	40	95	60

Sources: DWR 2013
[1] Samples collected 01/2006 – 12/2012

5.1.3.4 Delta Division

This includes the Delta region where the Sacramento and San Joaquin Rivers come together, including part of the Bay Area. The Delta Division provides for transport of water through the central portion of the Central Valley. The main features of the division are the Delta Cross Channel, Contra Costa Canal, and Delta-Mendota Canal (Reclamation 2012d).

Certain water bodies in the Delta Division are listed as water quality limited (impaired) for one or more of the constituents of concern. Table 5-9 presents the 303(d) listed water bodies within the area of analysis and information about the constituents of concern contributing to their impairment. Some water quality constituents are also of concern with respect to drinking water.

Table 5-9. 303(d) Listed Water Bodies within the Delta Division and Associated Constituents of Concern

Name	Constituent	Potential Sources	Estimated Area Affected	Proposed TMDL Completion Year
Sacramento-San Joaquin Delta[1]	Chlorpyrifos	Urban Runoff/Storm Sewers Agricultural Return Flows	42,011 Acres	2007 (completed)
	Chlordane	Agriculture	6,795 acres	2011
	DDT	Agriculture	42,011 acres	2011
	Diazinon	Agriculture Urban Runoff/Storm	42,011 acres	2007 (completed)
	Dieldrin	Agriculture	6,795 acres	2011
	Electrical Conductivity	Agriculture	20,819 acres	2019
	Group A Pesticides	Agriculture	42,011 acres	2011

Name	Constituent	Potential Sources	Estimated Area Affected	Proposed TMDL Completion Year
	Invasive Species	Source Unknown	42,011 acres	2019
	Mercury	Resource Extraction	42,011 acres	2008
	PCBs	Source Unknown	6,795 acres	2019
	Unknown Toxicity	Source Unknown	42,011 acres	2019

Source: SWRCB 2010.
Notes:
[1] Delta Waterways include the central portion, eastern portion, export area, northern portion, northwestern portion, southern portion, and western portion

Water quality in the Delta Region is governed in part by Delta hydrodynamics, which are highly complex. The following paragraphs provide a brief description of the hydrodynamic conditions in the Delta, to serve as a context for the descriptions of potential environmental consequences of the M&I WSP. Thereafter follows a discussion of general water quality in the Delta and water quality constituents of concern with respect to drinking water.

The principal factors affecting Delta hydrodynamic conditions are: 1) river inflows from the San Joaquin and Sacramento River systems; 2) daily tidal inflows and outflows through the San Francisco Bay; and, 3) export pumping from the south Delta through the SWP Banks Pumping Plant and CVP Jones Pumping Plant. Because tidal inflows are approximately equivalent to tidal outflows during each daily tidal cycle, tributary inflows and export pumping are the principal variables that define the range of hydrodynamic conditions in the Delta. Freshwater flows into the Delta from three major sources: the Sacramento River, the San Joaquin River, and the eastside streams (CALFED 2000).

Water that enters the Delta via the Sacramento River flows by various routes to the export pumps in the southern Delta. Some of this flow is drawn to the SWP and CVP pumps through interior Delta channels, facilitated by the CVP's Delta Cross Channel. Water that does not travel into the Central Delta continues towards the San Francisco Bay. Under certain conditions, additional Sacramento River waters flow into the Central and South Delta. The Sacramento River waters flow through Threemile Slough, around the western end of Sherman Island and up the San Joaquin River towards the export pumps. When freshwater outflow is relatively low, water with a higher salt concentration enters the Central and South Delta as tidal inflow from the San Francisco Bay. When SWP and CVP exports cause flow from the Sacramento River to move toward the pumps, then "reverse flow" occurs in the lower San Joaquin River and water of a lower quality is drawn towards the export pumps. Prolonged reverse flow has the potential to adversely affect water quality in the Delta and at the export pumps by increasing salinity (SWRCB ~~1997~~1999, Entrix 1996, CALFED 2000).

Delta Water Quality The existing water quality constituents of concern in the Delta can be categorized broadly as metals, pesticides, nutrient enrichment and associated eutrophication, constituents associated with suspended sediments and turbidity, salinity, bromide, and organic carbon. The main source of constituents of concern, according to the 2010 303(d) listing is agriculture. Urban runoff and resource extraction also are potential sources of some constituents.

Table 5-10 presents water quality data at selected stations within the Delta. Salinity and Bromide concentrations are of specific concern because it can adversely affect municipal, industrial, agricultural, and recreational uses; therefore these constituents are further discussed below.

Table 5-10. Water Quality Data for Selected Stations within the Delta

Location	Mean Total Dissolved Solids (mg/L)	Mean Electrical Conductivity (µS/cm)	Mean Bromide, Dissolved (mg/L)	Mean Dissolved Organic Carbon (mg/L)	Mean Chloride, Dissolved (mg/L)
Sacramento River at Hood	92.4	155	0.015	2.1	6.1
North Bay Aqueduct at Barker Slough	188	323	0.042	6.0	24
SWP Clifton Court Intake	235	401	0.190	3.4	62
CVP Banks Pumping Plant	225	392	0.186	3.4	59
Contra Costa Intake at Rock Slough	255	553	0.240	3.8	77
San Joaquin River at Vernalis	324	531	0.210	3.1	68

Source: California DWR 2013
Sampling period varies, depending on location and constituent, but generally is between 2006-2012

Salinity Salinity is a measure of the mass fraction of salts (including chloride and bromide), measured in parts per thousand (ppt). Salinity is measured using a variety of methods. Total dissolved solids (TDS) is a measure of the concentration of salt, as measured in mg/L (DWR 2001). TDS is defined as those solids remaining after drying a sample to a constant weight at 180 degrees Celsius (°C). Electrical conductivity (EC) is a measure of the ability of a solution to carry a current and depends on the total concentration of ionized substances dissolved in the water. Because changes in EC of water are generally directly proportional to changes in dissolved salt concentrations, EC is a convenient surrogate measure for TDS.

Salinity is a concern in the Delta because it can adversely affect municipal, industrial, agricultural, and recreational uses. Table 5-11 illustrates that within the Delta, mean TDS concentrations are highest in the west Delta and the south Delta channels that are affected by the San Joaquin River (CALFED 2000). Salinity problems in the western Delta result primarily from the intrusion of saline water from the San Francisco Bay system (SWRCB ~~1997~~1999). The extent of seawater intrusion into the Delta is a function of daily tidal fluctuations, the freshwater inflow to the Delta from the Sacramento and San Joaquin rivers, the rate of export at the SWP and CVP intake pumps, and the operation of various control structures, such as the Delta Cross-Channel Gates and Suisun Marsh Salinity Control System (DWR 2001). In the southern Delta, salinity is largely associated with the high concentrations of salts carried by the San Joaquin River into the Delta (SWRCB ~~1997~~1999). The high mean concentration of TDS in the San Joaquin River at Vernalis reflects the accumulation of salts in agricultural soils and the effects of recirculation of salts via the Delta Mendota Canal (CALFED 2000). Locations in the north portion of the Delta at Barker Slough, which is not substantially affected by seawater intrusion, and in the Sacramento River at Greene's Landing have lower mean concentrations of TDS than other locations in the Delta. A similar pattern is seen using mean EC levels as a surrogate for TDS.

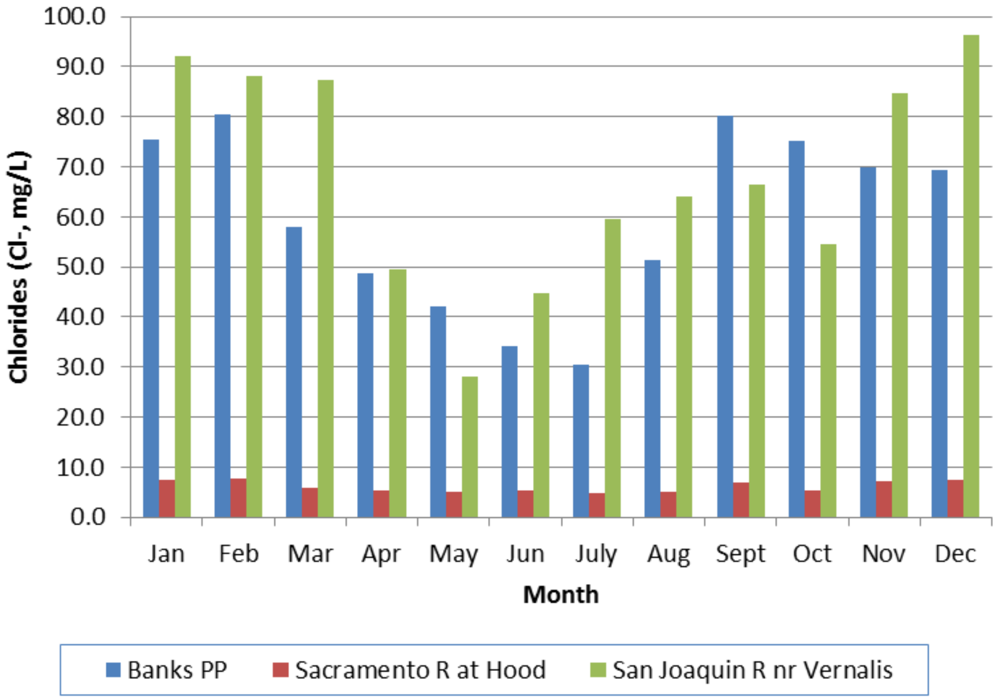
Table 5-11. Comparison of Total Dissolved Solids Concentrations at Selected Stations Within the Delta

TDS (mg/L)	Sacramento River at Hood	Banks Pumping Plant	San Joaquin River Near Vernalis
Mean	92	225	324
Median	91	233	330
Low	46	74	64
High	140	428	672

Source: California DWR 2013

Water quality data collected between 2006 and 2012 show that TDS levels at Banks Pumping Plant and in the Sacramento River at Hood never exceeded the secondary MCL for drinking water of 500 mg/L (Table 5-11) (DWR 2013). In the San Joaquin River near Vernalis, only 27 out of the 201 samples exceeded the secondary MCL for TDS. The secondary MCL for chloride is 250 mg/L, and the secondary MCL for electrical conductivity is 900 µS/cm. Because TDS is a measure of the total dissolved solids and does not measure the relative contribution of individual constituents such as chloride and bromide, it is possible to meet the secondary TDS MCL for (500 mg/L) but still exceed a standard for an individual salt constituent such as chloride (250 mg/L) (DWR 2001). For this reason, and because of their importance in formation of disinfection by-products (DBPs), chloride and bromide are addressed in detail in the following sections.

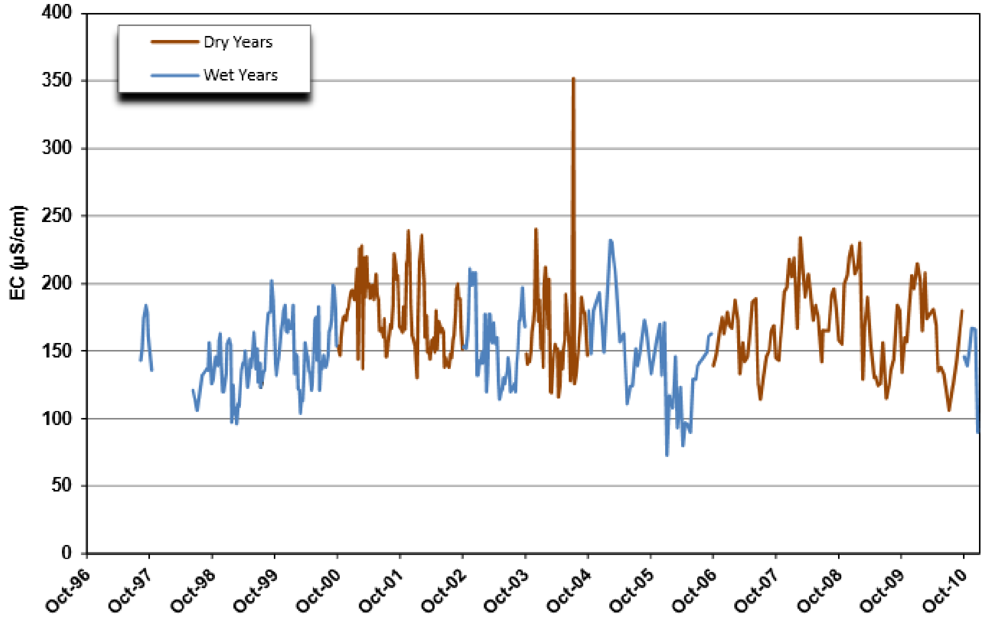
Figure 5-2 presents monthly median chloride concentrations at Banks Pumping Plant, Sacramento River at Hood, and the San Joaquin River near Vernalis. As Figure 5-2 shows, the lowest median concentrations of chloride typically occur in spring and early summer (April through July). The monthly median concentrations of chloride for the period of record (January 2006-December 2012) do not exceed the secondary MCL for chloride of 250 mg/L.



Source: California DWR 2013.
Note: Bars represent the average monthly value.

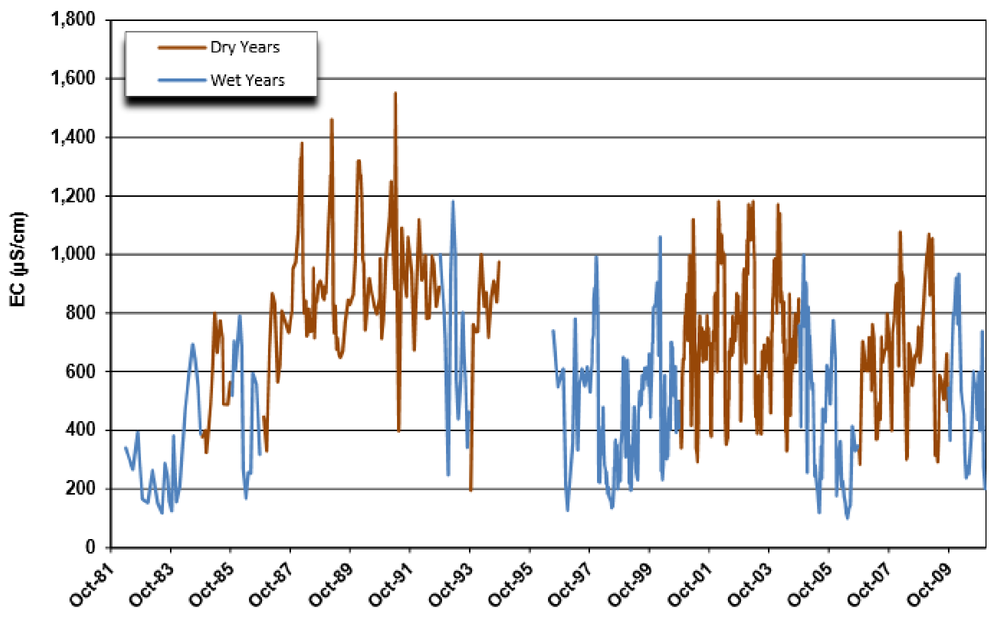
Figure 5-2. Monthly Average Chloride Concentrations at Banks Pumping Plant, Sacramento River at Hood, and San Joaquin River near Vernalis

Salinity patterns in the Delta also vary with water year type (Reclamation 2013). As shown in Figures 5-3 through 5-5, salinity, as measured by EC, is higher in dry water years (WYs) than in wet WYs (DWR 2013). In addition, a DWR project report (DWR 2013) found that EC levels generally rise during the late summer and fall months when river flows are low.



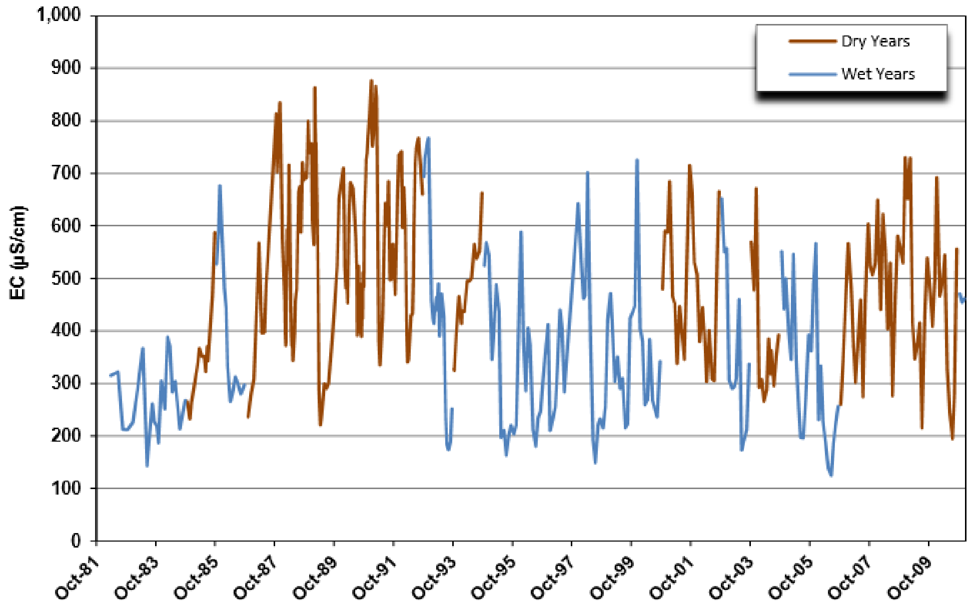
Source: DWR 2013.

Figure 5-3. Average Electrical Conductivity (µS/cm) by Year Type at the Sacramento River at Hood in the Sacramento-San Joaquin Delta



Source: DWR 2013.

Figure 5-4. Average Electrical Conductivity (µS/cm) by Year Type at the San Joaquin River at Vernalis in the Sacramento-San Joaquin Delta



Source: DWR 2013.

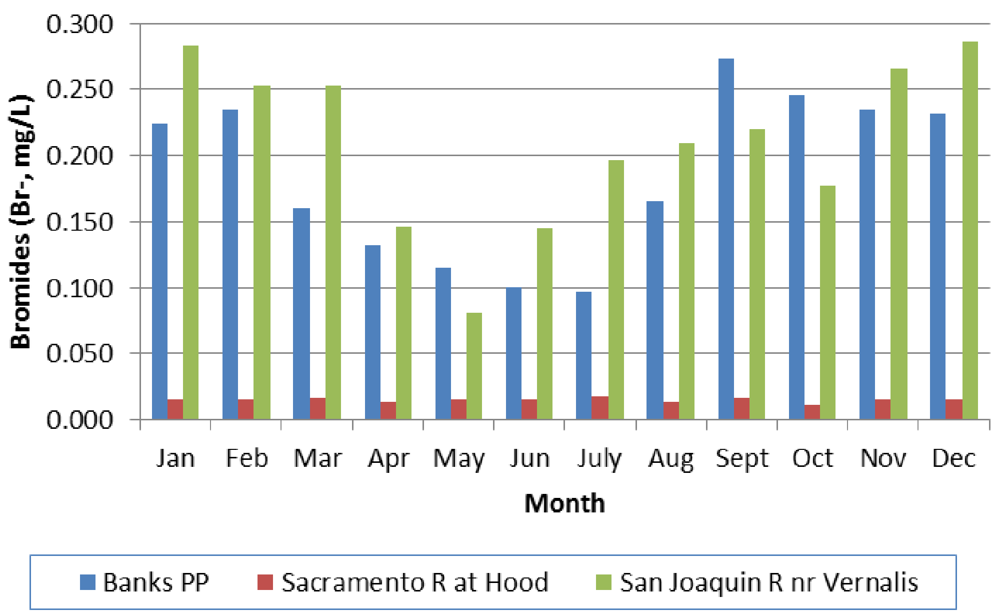
Figure 5-5. Average Electrical Conductivity (µS/cm) by Year Type at Banks Pumping Plant in the Sacramento-San Joaquin Delta

Bromide Bromide is important from a drinking water perspective because during chlorination of drinking water for disinfection, bromide reacts with natural organic compounds in the water to form trihalomethanes (THMs). Four species of THMs are regulated in drinking water including chloroform, bromodichloromethane, dibromochloromethane, and bromoform.

Stage 1 Disinfectants and Disinfection Byproducts Rule requires lower levels of bromate, a disinfection by-product of bromide, in drinking water (0.010 mg/L) than previously required. The Long Term 1 Enhanced Surface Water treatment Rule requires additional disinfection, primarily for pathogens such as *Cryptosporidium* and *Giardia*, and the requirement for increased disinfection has the potential to increase the quantity of disinfection by-products formed. In order to meet stringent USEPA drinking water standards, CALFED has proposed that the concentration of bromide levels at export pumps not exceed 0.05 mg/L (DWR 2001). However, this recommendation is a non-enforceable target level, and it has been found that this target level is often exceeded (CALFED 2008).

The primary source of bromide in Delta waters is sea-water intrusion (CALFED 2000). Other sources of bromide include drainage returns in the San Joaquin River and within the Delta, connate water beneath some Delta Islands, and possibly agricultural applications of the pesticide methyl bromide (CALFED 2000). The San Joaquin River and agricultural irrigation sources are primarily a "recirculation" of bromide that originated from historical sea-water intrusions (CALFED 2000). The bromide and chloride data shown in Table 5-11 indicates that seawater intrusion is highest in the western and southern portions of the Delta, where the direct effects of seawater intrusion and the effects of recirculated bromide from the San Joaquin River exist (DWR 2001).

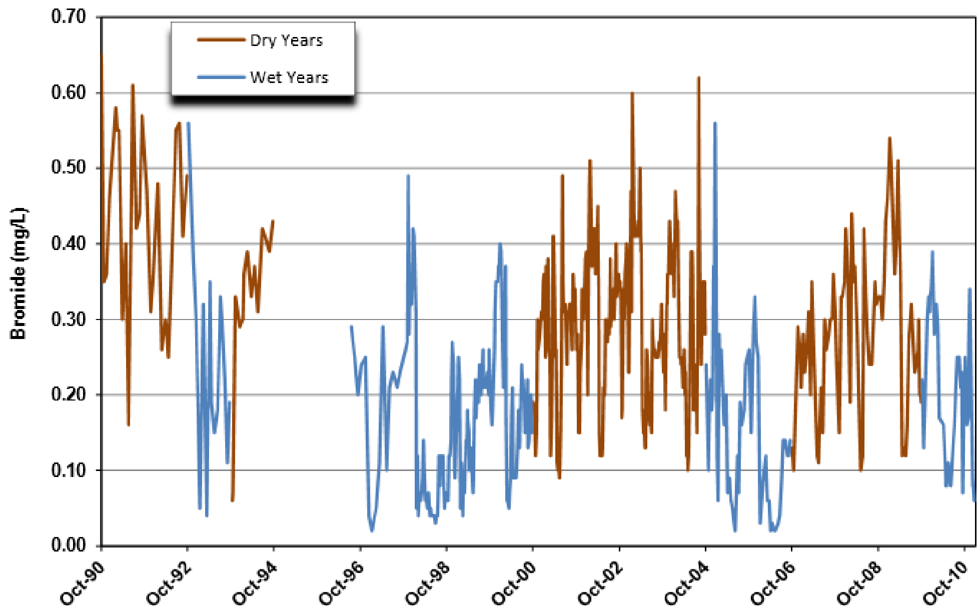
In addition to varying geographically within the Delta, bromide varies seasonally, in a pattern similar to that exhibited by salinity. Figure 5-6 presents median monthly bromide concentrations at Banks Pumping Plant, Sacramento River at Hood, and the Jan Joaquin River near Vernalis for each month of the year over the period of record (January 2006 - December 2012). The lowest median monthly concentrations of bromide typically occur in spring and early summer (April through July) when the high river flows and high Delta outflows reduce seawater intrusion.



Source: California DWR 2013.
Note: Bars represent the Average.

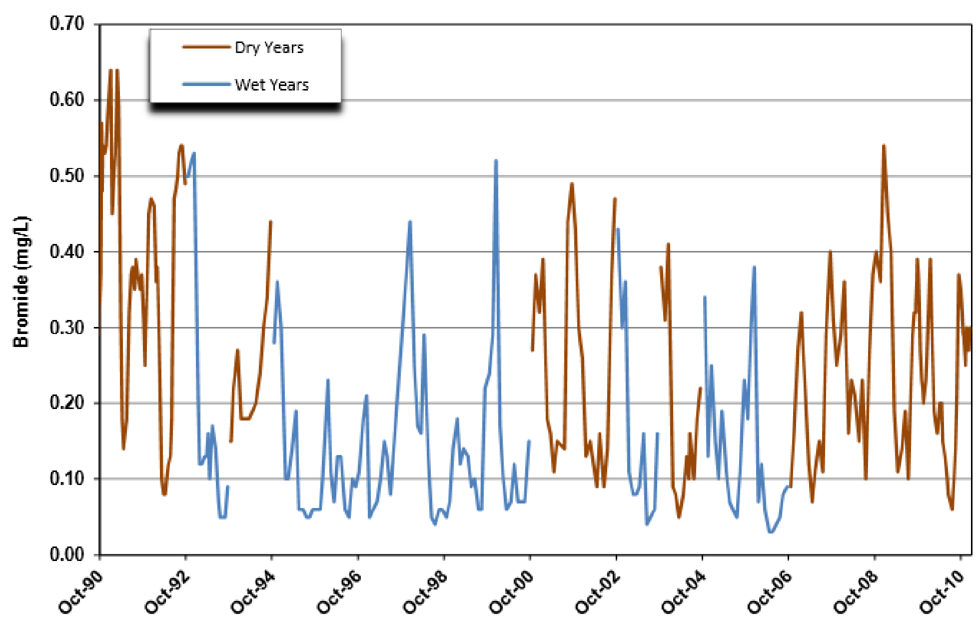
Figure 5-6. Monthly Average Bromide Concentrations at Banks Pumping Plant, Sacramento River at Hood, and San Joaquin River near Vernalis

In the Delta, the type of water year (e.g., wet, dry, normal) has a strong influence on bromide concentration (DWR 2012). Figures 5-7 through 5-8 illustrate that average bromide concentrations at three locations were higher in dry WYs than in wet WYs (DWR 2012).



Source: DWR 2012.

Figure 5-7. Average Bromide Concentrations (mg/L) by Year Type at the San Joaquin River at Vernalis in the Sacramento-San Joaquin Delta



Source: DWR 2012.

Figure 5-8. Average Bromide Concentrations (mg/L) by Year Type at Banks Pumping Plant in the Sacramento-San Joaquin Delta

5.1.3.5 West San Joaquin Division

The West San Joaquin Division consists of the Westlands Water District as well as the Delta Division in Alameda, Contra Costa, and San Joaquin counties. The Division includes the San Joaquin River, connected to the Delta Mendota Canal and the San Luis Reservoir, connected to the San Luis Canal and California Aqueduct. Flows in the San Joaquin River play a major role in the water quality of the region. Flows in the river are controlled mostly by dams on east-side tributaries and on the upstream portions of the main stem (Reclamation n.d.).

The West San Joaquin Division includes the San Luis Unit, which is operated by both the CVP and SWP. This unit includes the San Luis Reservoir and Canal, O'Neill Dam and Forebay, B.F. Sisk Reservoir, and Los Banos and Little Panoche Detention Reservoirs. San Luis Reservoir serves as the major storage reservoir and O'Neill Forebay acts as an equalizing basin for the upper stage dual-purpose pumping-generating plant. Los Banos and Little Panoche Reservoirs control cross drainage along the San Luis Canal (Reclamation 2012e). San Luis Reservoir allocations are conveyed through the Pacheco Tunnel to San Felipe Division users in Santa Clara and San Benito counties.

Certain water bodies in the West San Joaquin Division are listed as water quality limited (impaired) for one or more of the constituents of concern. Table 5-12 presents the 303(d) listed water bodies within the area of analysis and information about the constituents of concern contributing to their impairment. Some water quality constituents are also of concern with respect to drinking water.

Table 5-12. 303(d) Listed Water Bodies within the West San Joaquin Division and Associated Constituents of Concern

Name	Constituent	Potential Sources	Estimated Area Affected	Proposed TMDL Completion Year
O'Neill Forebay	Mercury	Source Unknown	2,254 Acres	2012
San Joaquin River[1]	Alpha.-Benzenehexachloride	Source Unknown	29 miles	2022
	Arsenic	Source Unknown	14 Miles	2021
	Boron	Agriculture	134 miles	2019
	Chlorpyrifos	Agriculture	145 miles	2007
	Dichlorodiphenyldichloroethylene (DDE)	Agriculture	32 miles	2011
	DDT	Agriculture	145 miles	2011
	Diazinon	Agriculture	99 miles	2007
	Diuron	Agriculture	3 miles	2021
	EC	Agriculture	57 miles	2019
	E coli	Source Unknown	20 miles	2021
	Group A Pesticides	Agriculture	145 miles	2011

Name	Constituent	Potential Sources	Estimated Area Affected	Proposed TMDL Completion Year
	Invasive Species	Source Unknown	70 miles	2019
	Mercury	Resource Extraction	57 miles	2012
	Selenium	Agriculture	3 miles	2002
	Temperature	Source Unknown	40 miles	2021
	Toxaphene	Source Unknown	3 miles	2019
	Unknown Toxicity	Agriculture and Source Unknown	145 miles	2019
San Luis Reservoir	Mercury	Source Unknown	13,007 Acres	2021

Source: SWRCB 2010.

Notes:

[1] San Joaquin River includes the following stretches: Mendota Pool to Bear Creek, Bear Creek to Mud Slough, Mud Slough to Merced River, Merced River to Tuolumne River, Tuolumne River to Stanislaus River, Friant Dam to Mendota Pool, and Stanislaus River to Delta Boundary

5.1.3.6 Beneficial Uses

Application of water quality objectives (i.e., standards) to protect designated beneficial uses is critical to water quality management in California. State law defines beneficial uses to include (but not be limited to) "...domestic; municipal; agricultural and industrial supply; power generation; recreation; aesthetic enjoyment; navigation; and preservation and enhancement of fish, wildlife, and other aquatic resources or preserves" (Water Code Section 13050(f)). Protection and enhancement of existing and potential beneficial uses are primary goals of water quality planning. Significant points concerning the concept of beneficial uses are:

1. All water quality problems can generally be stated in terms of whether there is water of sufficient quantity or quality to protect or enhance beneficial uses (Central Valley RWQCB 1998).

2. Beneficial uses do not include all of the reasonable uses of water. For example, disposal of wastewaters is not included as a beneficial use. This is not to say that disposal of wastewaters is a prohibited use; it is merely a use that cannot be satisfied to the detriment of beneficial uses. Similarly, the use of water for the dilution of salts is not a beneficial use although it may, in some cases, be a reasonable and desirable use of water (Central Valley RWQCB 1998).

3. The protection and enhancement of beneficial uses require that certain quality and quantity objectives be met for surface and ground waters (Central Valley RWQCB 1998).

4. Fish, plants, and other wildlife, as well as humans, use water beneficially.

The beneficial uses designated for waters within the area of analysis are presented in Table 5-13. In some cases, a beneficial use may not be applicable to the entire body of water. In these cases, RWQCB judgment is applied. Water bodies within the basins that do not have beneficial uses designated are assigned municipal and domestic supply designations in accordance with the provisions of SWRCB Resolution No. 88-63. These municipal and domestic supply designations in no way affect the presence or absence of other beneficial uses in these water bodies.

The Porter-Cologne Act defines water quality objectives as "… the limits or levels of water quality constituents or characteristics which are established for the reasonable protections of the beneficial uses of water or the preventions of nuisance within a specified area" [Water Code 13050(H)]. The Basin Plans present water quality objectives in numerical or narrative format for specified water bodies or for protection of specified beneficial uses throughout a specific basin or region.

Table 5-13. Beneficial Uses of Water Bodies in the Area of Analysis

Beneficial Use Designation	Shasta Lake	Sacramento River	Delta	Delta-Mendota Canal	San Luis Reservoir	O'Neill Reservoir	California Aqueduct	North Fork American River	Middle Fork American River	Folsom Lake	Lower American River	Whiskey Town Reservoir	Clear Creek	San Joaquin River	Cottonwood Creek	Black Butte Reservoir
Municipal and Domestic Supply	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Irrigation Watering	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Stock Watering		✓	✓	✓	✓	✓	✓		✓			✓	✓	✓	✓	✓
Industrial Process Supply			✓				✓							✓		
Industrial Service Supply		✓	✓		✓		✓				✓					
Hydropower Generation	✓	✓			✓		✓		✓	✓	✓	✓		✓		
Water Contact Recreation	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Canoeing and Rafting[1]		✓						✓	✓		✓		✓	✓	✓	
Non-contact Water Recreation	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Warm Freshwater Habitat[2]	✓	✓	✓	✓	✓	✓				✓	✓	✓	✓	✓	✓	✓
Cold Freshwater Habitat[2]	✓	✓	✓					✓	✓	✓	✓	✓	✓	✓	✓	
Warm[3] Water Migration Areas		✓	✓											✓		
Cold[4] Water Migration Areas		✓	✓										✓	✓	✓	
Warm Water Spawning Habitat[3]	✓	✓	✓							✓		✓	✓	✓	✓	✓
Cold Water Spawning Habitat[4]	✓	✓						✓	✓		✓		✓		✓	
Navigation		✓	✓													
Wildlife Habitat	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Source: Central Valley RWQCB 1998

[1] Shown for streams and rivers only with the implication that certain flows are required for this beneficial use.

[2] Resident does not include anadromous. Any segments with both COLD and WARM beneficial use designations will be considered COLD water bodies for the application of water quality objectives.

[3] Striped bass, sturgeon, and shad.

[4] Salmon and steelhead.

5.2 Environmental Consequences

These sections describe the environmental consequences associated with each alternative.

5.2.1 Assessment Methods

This section describes the assessment methods used to analyze potential water quality effects of the alternatives, including the No Action Alternative. The analysis for reservoirs and waterways uses both quantitative and qualitative methods to assess changes in water quality. The quantitative analysis relies on hydrologic modeling results that estimate changes in river flow rates and reservoir storage under each of the action alternatives. If the change in storage is equal to or less than 1,000 acre-feet (AF), or if the change in flow is less than 10 cubic feet per second (cfs), it is assumed that there would be no water quality impacts as this is within the error margins of the model. If the changes are small and within the normal range of fluctuations (similar to the No Action Alternative) for that time period, it is generally assumed that any water quality impacts would be negligible and are not further discussed within the chapter. Appendix B, Water Operations Model Documentation, describes the modeling efforts to quantify changes in reservoir surface water elevation and river flow rates.

Reservoir storage data is not available for all reservoirs included in the area of analysis. Where this data is not available, effects are evaluated based on transfer quantities, anticipated changes in water storage (increases or decreases), and the timing of the changes.

The analysis for the Delta uses both quantitative and qualitative methods to assess changes in water quality. The quantitative analysis relies on water quality modeling output that estimates changes in various water quality parameters under each of the action alternatives. Hydrodynamic and water quality modeling of the Delta was performed using the Delta Simulation Model-2 (DSM2). Appendix C, Delta Water Quality Model Documentation, presents details on the model set up and results to quantify changes in water quality in the Delta. Where modeling is not available, effects are evaluated based on changes in CVP deliveries, anticipated changes in flow through the Delta (increases or decreases), and the timing of the changes.

As mentioned in Chapter 5.1.3.1, changes in Shasta and Trinity lakes and Lake Oroville reservoir storage are minimal, and are likely to be the result of modeling small changes to allocations. These minimal changes may or may not occur and amount to a less than one percent change in reservoir storage levels. This is further discussed in Appendix B; therefore, storage changes in these reservoirs will not be further analyzed within Chapter 5.2. Additionally, changes in Sacramento River flows are minimal and are further discussed in detail in Appendix B.

All other water quality effects are analyzed at a qualitative level using the best available information and taking into consideration the magnitude and timing of the change, as well as any location specific water quality issues.

5.2.2 Alternative 1: No Action

The No Action Alternative includes the most likely future conditions in the absence of the action alternatives.

Under the No Action Alternative, CVP allocations and changes in reservoir storage could affect water quality. Under the No Action Alternative, reductions in storage could occur. Any reductions in storage would be a result of future population growth and increases in water demand on these water supply sources. However, it is expected that any reductions in storage would continue on the same pattern as currently observed. Therefore, the potential for reductions in monthly median storage in these reservoirs would be the same as existing conditions and would not affect water quality.

Reservoir constituents of concern within the area of analysis are primarily listed with resource extraction as a potential source of contamination. Contamination resulting from resource extraction is generally the result of legacy pollution from historic mining activities in the region and would not be affected by CVP water allocation methodology; therefore, water quality under the No Action Alternative would most likely exhibit the same range of constituent levels. Reservoirs would be subject to the same environmental influences and variations including wind patterns and climatic variations. Implementation of TMDLs may improve water quality in some cases, but these measures would be implemented regardless of CVP water allocation methodology. There would be no substantial changes in water quality associated with the No Action Alternative.

Under the No Action Alternative, CVP allocations and changes to long-term average flow rates in rivers and streams could affect water quality. Under the No Action Alternative, future long-term average flow rates in the rivers could generally be lower throughout most of the year because of general population growth and a corresponding increase in demand on water supply resources. However, there are many flow requirements in place for fish and wildlife that would help to maintain minimum flow rates. Additionally, these changes would not be attributed to the project; they would occur without the project. Any changes in flow rates would not be expected to substantially change water quality.

Many of the constituents of concern in water bodies within the area of analysis have agriculture, resource extraction, or urban runoff listed as a potential source. Under the No Action Alternative, water allocation priority is given to M&I customers in years where CVP water supplies are not adequate to provide water to all water service contractors. This could lead to a reduction in agriculture, and a subsequent reduction in agricultural return flows which could introduce constituents of concern to area water bodies. However, water allocation under this alternative would continue on the same pattern as currently enforced;

therefore constituent levels are not likely to change as a result of water allocation methodology. Implementation of TMDLs may improve water quality in some cases, but these measures would be implemented regardless of CVP water allocation methodology. Water quality in these rivers under the No Action Alternative would exhibit the same range of constituent levels and be subject to the same environmental and riverine influences and variations, including wind patterns, climatic variation, water supply variations, and inland flow regime, that are already present. Therefore, the No Action Alternative would result in no water quality change on these rivers.

5.2.3 Alternative 2: Equal Agricultural and M&I Allocation

5.2.3.1 Shasta and Trinity River Divisions

Providing equal allocations to agricultural and M&I water service contractors in Dry and Critical WYs could cause changes in river flows resulting in water quality impacts in the Shasta and Trinity River divisions. As noted in the assessment methods above, reservoir storage amounts would not be affected by changes in CVP water allocations. Similarly, river flows in the Sacramento River downstream of these reservoirs would not be affected. Changes in flows are provided in Table 5-14. These changes in flow would account for a change in flow of a maximum of three percent. Changes are likely attributable to changes in CVP allocations throughout the year and not to changes in allocations from Alternative 2.

Table 5-14. Changes in Sacramento River flows below Keswick between Alternative 2 and the No Action Alternative (in cfs)

Sac Yr Type	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
W	60	-102	-70	-72	13	1	2	1	6	-14	1	-44
AN	-106	-50	19	10	34	10	2	62	3	6	-6	15
BN	-15	22	35	-22	44	40	49	88	1	-113	-8	-16
D	-11	-45	30	26	31	1	83	117	48	-54	332	-91
C	-5	-52	-9	49	-39	3	162	50	-154	-49	-97	-105

Key: Sac Yr Type = year type, W = wet, AN = above normal, BN = below normal, D = dry, C = critical

The large flow increase in August of dry years is a reasonable response of a complex system to different CVP allocation procedures. There are only two simulated years in the hydrologic modeling that are driving this average (August of 1949 and 1989). In these months, the model is responding to several small changes and moving more CVP water through the Delta. It is unlikely that the higher Sacramento River flows in August of dry years are an effect of CVP allocations under Alternative 2. For additional information on changes in Sacramento River flows, please see Appendix B.

5.2.3.2 Sacramento River Region

Providing equal allocations to agricultural and M&I water service contractors in Dry and Critical WYs could cause changes in river flows in the Sacramento River Region resulting in water quality impacts. Flows in the Sacramento River Region change only minimally under Alternative 2. Tables 5-15 and 5-16 provide changes in Sacramento River flows between the No Action Alternative and Alternative 2 at Wilkins Slough and Hood, respectively.

Table 5-15. Changes in Sacramento River flows at Wilkins Slough between Alternative 2 and the No Action Alternative (in cfs)

Sac Yr Type	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
W	55	-45	-6	-4	-4	-7	-6	-5	-2	-21	-4	-49
AN	-112	-50	-15	-3	-3	-3	-4	53	-11	-3	-15	10
BN	-7	20	22	-19	2	21	35	78	-13	-101	-11	-8
D	-13	-50	25	-20	25	-7	77	98	13	-80	318	-73
C	10	-52	-8	46	-46	-6	142	13	-180	-84	-114	-71

Key: Sac Yr Type = year type, W = wet, AN = above normal, BN = below normal, D = dry, C = critical

Table 5-16. Changes in Sacramento River flows at Hood between Alternative 2 and the No Action Alternative (in cfs)

Sac Yr Type	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
W	93	-92	-31	14	5	-5	-12	-2	4	-16	-11	-17
AN	-26	-30	43	97	40	-41	-1	61	0	-3	-18	6
BN	11	-6	17	-5	104	35	198	154	-23	-26	-49	-10
D	-14	-20	32	2	81	56	106	105	-26	45	735	197
C	34	-22	159	88	-59	-6	146	61	-187	391	62	84

Key: Sac Yr Type = year type, W = wet, AN = above normal, BN = below normal, D = dry, C = critical

The greatest change in flows occurs in August of dry WYs when there is a six percent increase in flows between the No Action Alternative and Alternative 2 at both Wilkins Slough and Hood. This is not likely to be an effect of changes in CVP allocations to M&I and agricultural water service contractors under Alternative 2, but rather reasonable response of a complex system to different CVP allocation procedures.

Although there are small changes in river flows in the Sacramento River region, these changes are likely attributable to additional CVP allocations and minimum flow requirements; therefore, water quality is not affected in the Sacramento Region under Alternative 2.

5.2.3.3 American River Region

Providing equal allocations to agricultural and M&I water service contractors in Dry and Critical WYs could cause changes in reservoir storage in the American River Region resulting in water quality impacts. Under Alternative 2, M&I water service contractors would receive the same level of ~~shortage~~ allocation~~s~~, as a percent of Contract Total, as agricultural water service contractors. This equal distribution would result in lower M&I deliveries during dry WYs directly out of Folsom Lake compared to the No Action Alternative. As a result, total storage in Folsom Lake increases by approximately three percent during the summer months of critical WYs. Changes in total storage are shown in Table 5-17.

Table 5-17. Changes in Folsom Lake Storage between Alternative 2 and the No Action Alternative (in thousand AF [TAF])

Sac Yr Type	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
W	2	2	1	0	0	0	0	1	1	1	2	1
AN	7	6	5	0	0	0	0	0	0	0	1	1
BN	9	10	10	11	9	9	1	1	2	4	10	6
D	7	7	7	8	6	3	5	8	10	9	0	5
C	12	12	10	10	12	15	20	25	33	31	24	25

Key: Sac Yr Type = year type, W = wet, AN = above normal, BN = below normal, D = dry, C = critical

Although there are changes in storage especially during dry and critical WYs as a result of changes in M&I and agricultural deliveries, these changes account for three percent or less of the total storage of the reservoir. The only current constituent of concern in Folsom Lake is mercury, with a potential source of resource extraction. Slight changes in reservoir levels as a result of Alternative 2 would not be enough to change the concentration of constituents within the reservoir, especially due to mercury's properties which cause it to settle within the sediment rather than throughout the water column. Additionally, resource extraction would not be affected by water allocations; therefore, the inflow of mercury into the reservoir would not be affected. Minimal changes in reservoir storage in Folsom Lake are not likely to affect water quality.

Providing equal allocations to agricultural and M&I water service contractors in Dry and Critical WYs could cause changes in river flows in the American River Region resulting in water quality impacts to M&I contractors. Under Alternative 2, M&I water service contractors would receive the same level of ~~shortage~~ allocation~~s~~, as a percent of Contract Total, as agricultural water service contractors. This equal distribution would result in lower M&I deliveries during dry WYs directly out of the American River Region compared to the No Action Alternative, but higher deliveries from Folsom Lake to agricultural water service contractors south of the Delta. As a result, flows in the American River are expected to increase by up to approximately 18 percent during August of critical WYs. Agricultural water deliveries would likely be highest during the month of

August, reducing the amount of water available for M&I deliveries under Alternative 2 compared to the No Action Alternative. Changes in flows on the American River below Nimbus and at H Street can be viewed in Table 5-18 and 5-19, respectively.

Tables 5-18 and 5-19 show a small number of months over all year types with minor decreases in flow under Alternative 2. Similar to flows on the Sacramento River, the hydrologic model is responding to several small changes within the complex system. It is unlikely that the few lower monthly American River flows are an effect of CVP allocations under Alternative 2.

Table 5-18. Changes in American River flows below Nimbus between Alternative 2 and the No Action Alternative (in cfs)

Sac Yr Type	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
W	17	20	30	31	16	3	2	8	9	4	-1	32
AN	86	11	47	94	25	3	9	13	18	16	2	15
BN	32	2	15	19	53	14	181	55	64	34	-28	108
D	-7	21	18	10	65	70	49	22	51	118	225	-16
C	15	34	60	41	1	2	3	5	-25	149	203	51

Key: Sac Yr Type = year type, W = wet, AN = above normal, BN = below normal, D = dry, C = critical

Table 5-19. Changes in American River flows at H Street between Alternative 2 and the No Action Alternative (in cfs)

Sac Yr Type	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
W	16	20	30	31	16	3	2	8	9	4	-1	32
AN	86	10	40	94	23	3	9	13	17	16	2	15
BN	32	2	15	18	53	13	181	53	62	34	-28	108
D	-7	21	17	10	65	70	48	22	50	97	207	-18
C	15	34	60	40	0	-1	1	5	-25	149	201	49

Key: Sac Yr Type = year type, W = wet, AN = above normal, BN = below normal, D = dry, C = critical

As discussed in Chapter 5.1.3.3, water in the American River is generally of good quality. The river is, however, 303(d) listed for mercury impairment. Mercury impairment is not likely to be affected by changes in CVP water allocations because contamination is generally the result of legacy pollution from historic mining activities and will not change in the area of analysis under Alternative 2. Releases from Folsom Lake may affect levels of mercury in the American River. However, changes in releases from Folsom Lake under Alternative 2 are minor, and increased American River flows would not be substantial enough to negatively impact water quality in the region.

5.2.3.4 Delta Division

Providing equal allocations to agricultural and M&I water service contractors in Dry and Critical WYs could change Delta salinity and bromide concentrations, resulting in water quality impacts. X2 calculations were completed to determine the movement of salinity throughout the Delta. The "X2" water quality parameter represents the distance from the Golden Gate to the location of 2 ppt salinity concentration in the Delta. Larger values indicate higher salinity concentrations in the Delta, and smaller values indicate lower salinity concentrations.

Under Alternative 2, X2 generally moves westward, likely due to the subtle increase in Sacramento River inflow in comparison with the No Action Alternative. These changes are minimal, however, as shown in Table 5-20. X2 is regulated from February through June; therefore, fluctuations in X2 resulting from changes in allocations are more likely to be present during the summer, fall, and early winter months. Although export patterns change under Alternative 2, Reclamation will continue to operate in a way to meet these strict standards, and therefore water quality within the Delta is expected to exhibit only minor changes in movement of salinity concentrations.

Table 5-20. Percent changes in Delta X2 between Alternative 2 and the No Action Alternative

Sac Yr Type	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
W	-0.07	0.07	-0.01	0.00	0.00	0.00	0.00	-0.01	-0.02	0.00	0.01	0.02
AN	-0.01	-0.05	-0.08	-0.03	0.00	0.04	0.01	-0.05	-0.05	-0.05	-0.02	0.00
BN	0.02	0.07	0.34	0.24	-0.01	-0.07	-0.14	-0.29	-0.20	-0.16	0.04	0.03
D	0.01	0.09	0.06	-0.05	-0.06	-0.07	-0.16	-0.26	-0.24	-0.09	-0.35	-0.23
C	-0.11	-0.01	0.00	-0.08	-0.06	-0.06	-0.28	-0.38	-0.11	-0.25	0.02	0.01

Key: Sac Yr Type = year type, W = wet, AN = above normal, BN = below normal, D = dry, C = critical

DSM2 modeling results and analysis for the Delta Division indicate that the largest percent change in CVP and SWP export EC under Alternative 2 would occur in April through June in Critical WYs. These increases in EC are expected to range from 2.3 to 4.8 percent for SWP exports and 1.5 to 2.5 percent for CVP exports. This increased EC is likely to be the result of an increase in river flows during dry and critical years, as well as a slight increase in agricultural return flows. Agricultural return flows are expected to be higher due to the greater acreage of irrigated crops under Alternative 2. Table 5-21 displays changes in EC at CVP export locations between the No Action Alternative and Alternative 2. Table 5-22 provides the same information at SWP export locations.

Table 5-21. Percent changes in EC between Alternative 2 and the No Action Alternative at CVP export locations

Sac Yr Type	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
W	0.2	0.1	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	-0.3	0.1	0.1	-0.2	0.0	0.1	0.0	0.1	0.0	-0.1	-0.1
BN	-0.1	0.1	0.0	0.1	0.0	-0.2	0.2	0.0	0.2	-0.2	-0.7	0.7
D	0.3	0.3	0.3	-0.1	-0.4	0.0	0.1	0.4	0.5	-0.3	-0.8	0.1
C	0.5	0.0	0.4	0.8	0.3	0.6	1.6	1.5	2.5	1.5	-0.6	1.0

Key: Sac Yr Type = year type, W = wet, AN = above normal, BN = below normal, D = dry, C = critical

Table 5-22. Percent changes in EC between Alternative 2 and the No Action Alternative at SWP export locations

Sac Yr Type	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
W	0.3	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	-0.2	-0.4	0.2	0.2	0.2	0.1	0.0	0.0	0.0	-0.1	-0.2	-0.1
BN	-0.2	0.2	0.2	1.0	-0.3	0.1	0.2	0.0	-0.1	-0.4	-0.6	0.9
D	0.3	0.4	0.6	-0.1	-0.3	-0.1	-0.1	0.3	0.8	-0.2	0.4	0.3
C	0.5	0.2	0.7	1.2	0.8	1.0	2.3	3.0	4.8	0.8	-0.5	0.7

Key: Sac Yr Type = year type, W = wet, AN = above normal, BN = below normal, D = dry, C = critical

DSM2 modeling results for bromide indicate an overall average increase in bromide concentrations for all year types of 1.2 percent for SWP and 1.3 percent for CVP. This increase is especially apparent in dry and critical years. Table 5-23 displays the bromide percent increase for SWP and CVP for all year types. Bromide concentrations are likely higher under Alternative 2 due to increased agricultural return flows, especially in the South of Delta region including the San Joaquin River.

Table 5-23. Annual percent change in bromide load for SWP and CVP between Alternative 2 and the No Action Alternative

Sac Yr Type	SWP % Diff	CVP % Diff
W	0.7	0.2
AN	-0.7	0.1
BN	1.9	0.6
D	1.4	2.2
C	3.3	4.2

Key: Sac Yr Type = year type, W = wet, AN = above normal, BN = below normal, D = dry, C = critical

Water quality in the Delta region would be reduced under the implementation of Alternative 2. These changes are most likely to negatively impact all SWP and CVP South of Delta users. Changes in salinity and bromide concentrations are small, and based on significant restrictions and monitoring of Delta water quality, any changes would be minor.

5.2.3.5 West San Joaquin Division

Providing equal CVP allocations to agricultural and M&I water service contractors in Dry and Critical WYs could change South of Delta reservoir storage resulting in water quality impacts. Under Alternative 2, CVP deliveries to agricultural water service contractors would increase compared to the No Action Alternative. This change in deliveries would have the greatest impact of South of Delta reservoirs and waterways. Table 5-24 provides total changes in CVP and SWP combined storage for San Luis Reservoir.

Table 5-24. Changes in total San Luis Reservoir storage between Alternative 2 and the No Action Alternative (in TAF)

Sac Yr Type	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
W	18	21	22	18	15	0	-1	0	-1	-1	2	3
AN	3	5	9	3	2	-6	-5	-3	-4	-4	-4	1
BN	3	7	30	27	6	-7	-8	-5	-5	-5	3	8
D	11	21	25	21	20	4	-1	-7	-20	-26	1	15
C	39	46	59	53	46	39	35	28	11	14	27	31

Key: Sac Yr Type = year type, W = wet, AN = above normal, BN = below normal, D = dry, C = critical

For CVP storage, reservoir storage is lowest in Dry and Critical WYs during the months of May through September when agricultural deliveries are highest. These decreases in reservoir storage account for a maximum decrease of 13 percent during July of Dry WYs and 10 percent during July of Critical WYs compared to the No Action Alternative. SWP storage in San Luis Reservoir increases significantly under Alternative 2. As a result, CVP decreases in storage are counterbalanced. Overall, total San Luis Reservoir storage is expected to decrease by up to five percent during the summer months of dry years.

Any decreases in San Luis Reservoir storage are a concern due to high levels of algae in the reservoir. San Luis Reservoir is shallow and experiences high algal growth during warm summer months. This algal growth affects M&I users because intakes are not low enough to avoid intake of contaminated waters. Any decreases in storage in the reservoir would accelerate this process. During Dry WYs SWP storage does not increase enough to balance CVP decreases, and water quality deterioration may be a concern.

5.2.4 Alternative 3: Full M&I Allocation Preference

5.2.4.1 Shasta and Trinity River Divisions

Use of the full M&I allocation preference under Alternative 3 could cause changes in river flows resulting in water quality impacts in the Shasta and Trinity

River Divisions. As noted above, reservoir storage amounts would not be affected by Alternative 3. Similarly, river flows in the Sacramento River downstream of these reservoirs would not be affected. Changes in flows are provided in Table 5-25. These changes in flow would account for a maximum change in flow of a maximum of three percent. Changes are likely attributable to changes in CVP allocations throughout the year and not to changes in allocations from Alternative 3.

Table 5-25. Changes in Sacramento River flows below Keswick between Alternative 3 and the No Action Alternative (in cfs)

Sac Yr Type	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
W	10	-50	8	-42	-15	20	-20	-22	-23	-4	-20	30
AN	118	85	7	-14	39	-11	-1	-10	3	-1	16	89
BN	-31	25	3	4	3	-14	-39	-19	-9	88	-11	6
D	-55	113	-31	-7	-1	1	-25	-67	1	137	-65	-47
C	-120	-30	-55	38	-51	36	-10	18	21	-4	237	-77

Key: Sac Yr Type = year type, W = wet, AN = above normal, BN = below normal, D = dry, C = critical

5.2.4.2 Sacramento River Region

Use of the full M&I allocation preference under Alternative 3 could cause changes in river flows in the Sacramento River Region resulting in water quality impacts. Flows in the Sacramento River Region change only minimally under Alternative 3. Tables 5-26 and 5-27 provide changes in Sacramento River flows between the No Action Alternative and Alternative 3 at Wilkins Slough and Hood, respectively.

Although there are small changes in river flows in the Sacramento River region, these changes are likely attributable to additional CVP allocations and minimum flow requirements; therefore, water quality is not affected in the Sacramento Region under Alternative 3.

Table 5-26. Changes in Sacramento River flows at Wilkins Slough between Alternative 3 and the No Action Alternative (in cfs)

Sac Yr Type	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
W	11	5	8	3	3	8	-17	-17	-18	0	-16	35
AN	123	93	11	0	6	3	5	-5	10	6	23	92
BN	-28	31	11	8	4	0	-37	-17	-7	78	-16	-9
D	-55	120	-25	-1	4	2	-28	-62	21	128	-68	-50
C	-115	-23	-55	41	-54	46	-2	28	38	10	258	-93

Key: Sac Yr Type = year type, W = wet, AN = above normal, BN = below normal, D = dry, C = critical

Table 5-27. Changes in Sacramento River flows at Hood between Alternative 3 and the No Action Alternative (in cfs)

Sac Yr Type	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
W	14	-45	21	-14	-14	11	-17	-14	-17	-9	1	12
AN	64	82	-34	-27	18	-60	11	5	1	3	16	108
BN	-77	19	-34	54	-62	-24	-94	-77	26	58	2	-32
D	31	143	-30	-3	-28	-46	-54	-83	24	188	-219	-329
C	-77	3	33	49	-82	-24	-50	-35	2	-48	24	-99

Key: Sac Yr Type = year type, W = wet, AN = above normal, BN = below normal, D = dry, C = critical

5.2.4.3 American River Region

Use of the full M&I allocation preference under Alternative 3 could cause changes in reservoir storage in the American River Region resulting in water quality impacts. Under Alternative 3, M&I water service contractors would receive 100 percent allocations during ~~water shortage conditions~~a Condition of Shortage. Since Folsom Lake is utilized primarily for M&I demands, Alternative 3 would result in decreases in total reservoir storage during dry years compared to the No Action Alternative. Changes in total storage can be viewed in Table 5-28.

Table 5-28. Changes in Folsom Lake storage between Alternative 3 and the No Action Alternative (in TAF)

Sac Yr Type	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
W	-1	-1	0	0	0	0	0	0	0	0	-1	0
AN	-2	-2	0	0	0	0	0	0	0	0	0	-2
BN	1	0	0	-4	-3	-3	-1	0	0	-2	-4	-1
D	1	0	0	-1	0	1	0	-1	0	-6	3	3
C	-7	-10	-11	-13	-12	-8	-8	-6	-6	-9	-7	-9

Key: Sac Yr Type = year type, W = wet, AN = above normal, BN = below normal, D = dry, C = critical

These changes in reservoir storage would account for a maximum decrease of one percent of total reservoir storage. This one percent decrease would occur only during critical WYs. The only constituent of concern in Folsom Lake is mercury. Contamination is the result of legacy pollutants from historic mining; therefore, changes in water allocations under Alternative 3 would not change the amount of mercury within the reservoir. Slight decreases in storage would not be enough to affect the water quality of the reservoir.

Use of the full M&I allocation preference under Alternative 3 could cause changes in river flows in the American River Region resulting in water quality impacts. Increased M&I deliveries during dry years would cause decreases in American River flows, especially during the month of August of dry and critical WYs when agricultural demands are highest and both M&I and agricultural demands must be met. Changes in flows on the American River below Nimbus and at H Street can be viewed in Table 5-29 and 5-30, respectively.

Table 5-29. Changes in American River flows below Nimbus between Alternative 3 and the No Action Alternative (in cfs)

Sac Yr Type	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
W	3	-4	-18	-8	-7	-2	-5	-1	-2	-1	13	-28
AN	-54	3	-43	-13	-17	-12	-4	-2	-11	-1	-6	15
BN	-46	0	-5	43	-39	-19	-66	-54	-44	-10	-4	-74
D	-2	13	-3	0	-33	-56	-30	-32	-75	23	-199	-64
C	30	31	2	4	-31	-78	-59	-74	-51	3	-75	19

Key: Sac Yr Type = year type, W = wet, AN = above normal, BN = below normal, D = dry, C = critical

Table 5-30. Changes in American River flows at H Street between Alternative 3 and the No Action Alternative (in cfs)

Sac Yr Type	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
W	3	-4	-18	-8	-7	-2	-4	0	-2	-1	13	-28
AN	-53	4	-43	-12	-15	-8	2	3	-10	-1	-6	15
BN	-46	1	-5	43	-39	-19	-65	-53	-43	-10	-4	-74
D	-2	13	-3	0	-33	-56	-29	-31	-75	24	-199	-61
C	31	31	2	4	-29	-75	-55	-73	-49	4	-75	28

Key: Sac Yr Type = year type, W = wet, AN = above normal, BN = below normal, D = dry, C = critical

Decreases in American River flows would be highest at H Street in dry WYs during August. This decrease in flow of approximately 199 cfs accounts for a 14 percent decrease in flow rate from the No Action Alternative. Decreases throughout the remainder of the year and in other WYs would be significantly less. Mercury is the only constituent of concern in the American River. The source of this contamination is listed as resource extraction, and it is likely affected by contaminated inputs from Folsom Lake. Contamination is the result of historic mining activities and would not be affected by Alternative 3. Changes in outflows from Folsom Lake into the American River are minor. Therefore, changes in water quality of the American River are not expected.

5.2.4.4 Delta Division

Use of the full M&I allocation preference under Alternative 3 could change Delta salinity and bromide concentrations resulting in water quality impacts. X2 calculations were completed to determine the movement of salinity throughout the Delta. Under this analysis, X2 generally moves eastward under Alternative 3, likely due to the subtle decrease in Sacramento River inflow in comparison with the No Action Alternative due to increased M&I allocations. These changes are minimal, however, as shown in Table 5-31.

Table 5-31. Percent changes in Delta X2 between Alternative 3 and the No Action Alternative

Sac Yr Type	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
W	0.00	0.05	0.00	0.00	0.00	-0.01	0.02	0.03	0.04	0.01	0.00	0.00
AN	-0.03	-0.07	-0.05	0.00	0.00	0.04	0.01	0.00	0.02	0.02	-0.01	-0.03
BN	0.02	0.04	0.05	-0.03	0.00	0.01	0.07	0.14	-0.05	-0.03	-0.07	-0.04
D	-0.02	0.00	-0.19	-0.18	0.02	0.07	0.10	0.20	0.18	-0.15	0.05	0.21
C	0.00	-0.01	-0.02	-0.02	0.09	-0.01	0.08	0.20	0.21	0.02	0.06	0.05

Key: Sac Yr Type = year type, W = wet, AN = above normal, BN = below normal, D = dry, C = critical

DSM2 modeling results and analysis for the Delta Division indicate that the largest percent change in SWP and CVP export EC under Alternative 3 would occur in July through September in Critical WYs. These increases in EC are expected to range from 1.7 to 2.6 percent for SWP exports, and 0.5 to 1.1 percent for CVP exports. The slightly increased EC is likely to be the result of an increase in river flows during dry and critical years. Table 5-32 displays changes in EC at CVP export locations between the No Action Alternative and Alternative 3. Table 5-33 gives the same information at SWP export locations.

Table 5-32. Percent changes in EC between Alternative 3 and the No Action Alternative at CVP export locations

Sac Yr Type	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
W	-0.2	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.3	0.2	-0.1	-0.4	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BN	-0.1	-0.2	0.1	0.0	-0.4	-0.1	-0.1	-1.0	0.3	-0.1	0.2	-0.8
D	0.2	-0.2	0.6	-0.4	0.2	-0.1	-0.1	0.0	-0.1	0.1	0.6	-0.2
C	0.3	-0.1	-0.2	0.1	0.5	0.6	-0.2	-0.2	-0.6	0.5	0.4	1.1

Key: Sac Yr Type = year type, W = wet, AN = above normal, BN = below normal, D = dry, C = critical

Table 5-33. Percent changes in EC between Alternative 3 and the No Action Alternative at SWP export locations

Sac Yr Type	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
W	-0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.3	0.5	-0.1	-0.1	-0.2	0.0	0.0	0.0	0.0	0.0	0.1	0.0
BN	-0.3	-0.1	0.1	0.0	-0.1	-0.3	-0.2	-0.7	-0.5	0.1	0.0	-1.0
D	0.3	-0.2	0.7	-0.7	-0.4	-0.2	0.0	0.1	-0.1	0.2	-0.7	-0.4
C	0.4	0.2	-0.3	0.3	0.3	0.7	1.1	0.4	0.0	2.3	2.6	1.7

Key: Sac Yr Type = year type, W = wet, AN = above normal, BN = below normal, D = dry, C = critical

DSM2 modeling results for bromide indicate an overall average decrease in bromide concentrations for all year types of 0.4 percent for SWP and 0.5 percent for CVP with the largest percentage decreases occurring in Dry and Critical WYs. Table 5-34 displays the bromide percent increase for SWP and CVP for all year types. Bromide concentrations are likely lower under Alternative 3 due to a decrease in agricultural return flows due to the decrease in agricultural allocations, especially in the South of Delta region including the San Joaquin River.

Table 5-34. Average annual change in bromide load for SWP and CVP between Alternative 3 and the No Action Alternative

Sac Yr Type	SWP % Diff	CVP % Diff
W	0.1	0.1
AN	0.9	0.1
BN	-1.0	0.5
D	-1.0	-2.2
C	-0.9	-0.5

Key: Sac Yr Type = year type, W = wet, AN = above normal, BN = below normal, D = dry, C = critical

5.2.4.5 West San Joaquin Division

Use of the full M&I allocation preference under Alternative 3 could change South of Delta reservoir storage resulting in water quality impacts. Under Alternative 3, CVP deliveries to agricultural water service contractors would be reduced as much as necessary to maintain 100 percent M&I water service contractor allocations as long as possible. Since M&I deliveries do not show the extreme peaks in seasonality that are apparent in agricultural deliveries, Alternative 3 would lead to a general decrease in CVP San Luis Reservoir storage throughout the year during Wet, Above Normal, and Below Normal WYs. During Dry and Critical WYs, agricultural deliveries would be significantly cut, while M&I deliveries would continue at 100 percent of their allocation. This cut in agricultural deliveries would cause a decline in irrigable lands, and thus an increase in available CVP storage especially during summer months. SWP storage would be minimally affected. Table 5-35 provides total changes in storage for San Luis Reservoir.

Table 5-35. Total Changes in San Luis Reservoir storage between Alternative 3 and the No Action Alternative (in TAF)

Sac Yr Type	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
W	-1	-1	-2	-1	1	0	0	0	0	-1	-1	-2
AN	-1	-3	-5	6	10	9	7	4	-2	-2	-2	2
BN	-20	-20	-24	-21	-9	-5	-7	-8	-13	-9	-14	-18
D	-4	4	-17	-16	-16	-12	-10	-7	2	15	8	-9
C	2	-1	-4	2	7	6	10	15	19	21	32	23

Key: Sac Yr Type = year type, W = wet, AN = above normal, BN = below normal, D = dry, C = critical

San Luis Reservoir storage is lowest in Below Normal WYs when M&I deliveries are highest. These decreases in storage would be year round and could result in up to a four percent decrease in total storage during some months. Since San Luis Reservoir is shallow and has significant issues with algal blooms during the hot summer months, the summer would be especially crucial in the degradation of water quality in the reservoir.

5.2.5 Alternative 4: Updated M&I WSP

Implementation of the Updated M&I WSP would not change water quality. CVP deliveries under Alternative 4 are similar to those under the No Action Alternative. Allocation methodology for both agricultural and M&I water service contractors would be the same as under the No Action Alternative; therefore, water quality effects generated by Alternative 4 would be identical to the water quality effects of the No Action Alternative.

5.2.6 Alternative 5: M&I Contractor Suggested WSP

Implementation of the M&I Contractor Suggested WSP under Alternative 5 would not change water quality. CVP deliveries under Alternative 5 are similar to those under the No Action Alternative, with the exception that M&I contractors would receive ~~a~~ higher ~~level~~ deliveries during water shortages. This alternative would result in less than 0.2 percent changes in reservoir storage and river flows; therefore, water quality effects generated by Alternative 5 would be very close to the water quality effects of the No Action Alternative.

5.3 Mitigation Measures

Mitigation Measures are not identified for water quality.

5.4 Unavoidable Adverse Impacts

Under Alternative 2, water quality in the Delta region would be slightly degraded. Salinity and Bromide concentrations would increase slightly, especially during dry and critical WYs. Additionally, storage in San Luis Reservoir during summer months of Dry WYs would decrease by up to five percent which could degrade water quality and impact water users due to increased algae contamination. Under Alternative 3, water quality in San Luis Reservoir may experience minor degradation year round during Below Normal WYs due to decreases in storage of up to four percent.

5.5 Cumulative Effects

The timeline for the water quality cumulative effects analysis extends from 2010 through 2030, a 20-year period. The relevant geographic study area for the cumulative effects analysis is the same area of analysis as shown in Figure 5-1. The following section analyzes the cumulative effects using both the project and the projection methods, which are further described in Chapter 20, Cumulative Effects. Chapter 20 describes the projects included in the cumulative condition and growth and development trends in the area of analysis.

The cumulative analysis for water quality considers projects and conditions that could affect water quality in surface water bodies within the area of analysis.

5.5.1 Alternative 2: Equal Agricultural and M&I Allocation

Changes in CVP water allocations under the Equal Agricultural and M&I Allocation alternative, in combination with other cumulative projects, could degrade existing water quality.

Under Alternative 2, CVP deliveries to agricultural water service contractors would increase and CVP deliveries to M&I water service contractors would decrease. As a result, the most significant North of Delta impacts are increase in reservoir storage and river flows due to the reduction in M&I allocations. South of Delta, where agricultural demands are greatest, reservoir storage would decrease significantly. Alternative 2 also leads to a reduction in Delta outflows and degradation of Delta water quality in the form of increased salinity. Proposed modifications to CVP water allocations for agricultural and M&I water service contractors in combination with other cumulative projects could affect surface water quality through additional changes in reservoir storage and/or river flows.

Existing and foreseeable water acquisition programs with potential to affect reservoir storage and river flows, in addition to the impacts of Alternative 2, are described in Chapter 20. These projects include the Bay Delta Conservation Plan, the Shasta Lake Water Resources Investigation, Upper San Joaquin Storage Investigation, South Delta Improvements Program, San Luis Reservoir Low Point Improvement Project (SLLPIP), In-Delta Storage Program, North-of-the-Delta Offstream Storage Investigation, Long Term Water Transfers, the San Joaquin River Restoration Program, and the Franks Tract Project have the potential to impact water quality based on reservoir storage and river flows.

~~The BDCP alternatives 1-5 would result in reductions in Delta outflows, but alternatives 6-9 could potentially result in increased Delta outflows. Decreased~~

~~delta outflows may result in increased seawater intrusion into the west Delta leading to water quality degradation due to increased salinity and EC.~~ The Los Vaqueros Reservoir Expansion Project and the Shasta Lake Water Resources Investigation both focus on increased reservoir water supply, and are not expected to negatively impact water quality in the region. The South Delta Improvements Program, In-Delta Storage Program, North of Delta Offstream Storage Program, and Frank Tract Project are all aimed at enhancing Delta water quality, with the Franks Tract Program specifically aimed at reducing seawater intrusion into the west Delta. The Upper San Joaquin Storage Investigation and San Joaquin River Restoration Program are aimed at enhancing water quality on the San Joaquin River, which in turn may lead to Delta water quality enhancements including decreased salinity. The SLLPIP is aimed at maintenance of water quality in San Luis Reservoir, which could reduce the water quality impacts associated with a decrease in reservoir storage associated with Alternatives 2 and 3. Long-Term Water Transfers could negatively affect water quality South of Delta due to increased late-summer exports from the Delta.

The cumulative projects described above, with the exception of ~~BDCP Alternatives 1-5 and~~ Long Term Water Transfers, are likely to enhance water quality within the area of analysis. Therefore, implementation of Alternative 2 in combination with these cumulative projects would not generate an adverse cumulative effect on water supply. Implementation of Alternative 2 in combination with the ~~five BDCP Alternatives described above (1-5) and the~~ Long-Term Water Transfers would generate an adverse cumulative effect on water quality ~~for~~ by potentially increasing Delta salinity concentrations and increasing the likelihood of seawater intrusion west of Delta.

5.5.2 Alternative 3: Full M&I Allocation Preference

Changes in CVP water allocations under the Full M&I Allocation Preference alternative, in combination with other cumulative projects, could degrade existing water quality.

Alternative 3 would generate a decrease in storage and flows in most reservoirs and water bodies within the area of analysis. This decrease in flows would lead to a decrease in Delta outflows and an increase of Delta salinity concentrations when compared to the No Action Alternative. Although changes in Delta water quality would not be as pronounced as those expected under Alternative 2, there would still be negative impacts associated with the implementation of Alternative 3.

Based on the similarities in impacts of Alternative 2 and Alternative 3, cumulative impacts would be similar to those listed above under Alternative 2.

5.5.3 Alternative 4: Updated M&I WSP

Changes in CVP water allocations under the Updated M&I WSP alternative, in combination with other cumulative projects, could degrade existing water quality.

CVP deliveries under Alternative 4 are similar to those under the No Action Alternative. There are no anticipated changes to water quality based on increases in reservoir storage or river flows; therefore, there would be no cumulative impacts under Alternative 4.

5.5.4 Alternative 5: M&I Contractor Suggested WSP

Changes in CVP water allocations under the M&I Contractor Suggested WSP alternative, in combination with other cumulative projects, could degrade existing water quality.

CVP deliveries under Alternative 5 are expected to change only slightly from the No Action Alternative. Changes in reservoir storage and river flows under Alternative 5 are minimal and are not anticipated to impact water quality within the area of analysis. Therefore, there are no cumulative impacts under Alternative 5.

5.6 References

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