Appendix 6A Water Quality Constituents and Beneficial Uses

Appendix 6A Water Quality Constituents and Beneficial Uses

This appendix provides a general description of the surface water quality constituents that could be affected by construction and operation of the proposed Sites Reservoir, as identified in Chapter 6, *Surface Water Quality*, and identifies the designated beneficial uses for surface waterbodies in the study area. The study area includes drainages in the Sites Reservoir inundation area, Shasta Lake and the Sacramento River, Lake Oroville and the Feather River, Folsom Lake and the American River, Yolo Bypass, and the Delta (Figure 1-1). Conveyance and storage facilities for moving water to and from Sites Reservoir are also considered, including the CBD due to its multiple beneficial uses and discharge to the Yolo Bypass and the Sacramento River (Figure 1-2). In addition, San Luis Reservoir is considered due to potential changes in CVP and SWP export operations at the Jones and Banks Pumping Plants. In addition, this appendix identifies impaired surface waters (in accordance with the Clean Water Act [CWA] Section 303(d)) in the study area.

6A.1 Beneficial Uses of Surface Waters in the Study Area

The CWA requires states to establish water quality standards that specify both the beneficial uses of water bodies and the water quality that must be met and maintained in order to protect the designated beneficial uses. Designated beneficial uses of surface waters serve as a basis for establishing water quality objectives and discharge prohibitions to attain the objectives. In California, beneficial uses of water bodies and objectives necessary to protect the beneficial uses are prescribed in water quality control plans. The beneficial uses for surface waters in the study area are presented in Table 6A-1.

Table 6A-1. Beneficial Uses of Water Bodies in the Study Area

Surface Water Body	Municipal and Domestic Supply (MUN)	Agricultural Supply (AGR)	Industrial Service Supply (IND)	Industrial Process Supply (PRO)	Groundwater Recharge (GWR)	Fresh Water Replenishment (FRSH)	Navigation (NAV)	Hydropower Generation (POW)	Water Contact Recreation (REC-1)	Non-contact Water Recreation (REC-2)	Commercial and Sport Fishing (COMM)	Warm Fresh Water Habitat (WARM)	Cold Fresh Water Habitat (COLD)	Wildlife Habitat (WILD)	Rare, Threatened, or Endangered Species (RARE)	Migration of Aquatic Organisms (MIGR)	Spawning, Reproduction, and/or Early Development (SPWN)	Shellfish Harvesting (SHELL)	Estuarine Habitat (EST)
San Joaquin River Basin																			
San Luis Reservoir	E	E	E	–	–	–	–	E	E	E	–	E[b]	–	E	–	–	–	–	–
Sacramento River Basin																			
Shasta Lake	E	E	–	–	–	–	–	E	E	E	–	E[b]	E[b]	E	–	–	E[c,d]	–	–
Sacramento River: Shasta Dam to Colusa Basin Drain	E	E	E	–	–	–	E	E	E[a]	E	–	E[b]	E[b]	E	–	E[c,d]	E[c,d]	–	–
Colusa Basin Drain	–	E	–	–	–	–	–	–	E[a]	–	–	E[b]	E[b]	E	–	E[d]	E[d]	–	–
Sacramento River: Colusa Basin Drain to “I” Street Bridge	E	E	–	–	–	–	E	–	E[a]	E	–	E[b]	E[b]	E	–	E[c,d]	E[c,d]	–	–
Lake Oroville	E	E	–	–	–	–	–	E	E	E	–	E	E	E	–	–	E[d]	–	–
Feather River below Lake Oroville (Fish Barrier Dam to Sacramento River)	E	E	–	–	–	–	–	–	E[a]	E	–	E[b]	E[b]	E	–	E[c,d]	E[c,d]	–	–
Folsom Lake	E	E	P	–	–	–	–	E	E	E	–	E	E	E	–	–	E[d]	–	–
American River below Lake Natoma (Folsom Dam to Sacramento River)	E	E	E	–	–	–	–	E	E[a]	E	–	E[b]	E[b]	E	–	E[c,d]	E[c,d]	–	–
Yolo Bypass[e]	–	E	–	–	–	–	–	–	E	E	–	E[b]	E[b]	E	–	E[c,d]	E[d]	–	–
Sacramento-San Joaquin River Delta																			
Sacramento-San Joaquin River Delta[e,f,g]	E	E	E	E	E	–	E	–	E	E	E	E[b]	E[b]	E	E	E[c,d]	E[d]	E	E

Sources: Central Valley Regional Water Quality Control Board 2018a; State Water Resources Control Board 2018

[a] Canoeing and rafting included in REC-1 designation.

[b] Resident does not include anadromous. Segments with both COLD and WARM beneficial use designations will be considered cold-water bodies for the application of water quality objectives.
[c] Cold-water protection for salmon and steelhead.
[d] Warm-water protection for striped bass, sturgeon, and shad.
[e] Beneficial uses vary throughout the Delta and will be evaluated on a case-by-case basis. COMM is a designated beneficial use for the Sacramento-San Joaquin Delta and Yolo Bypass waterways listed in Appendix 43 of the Basin Plan for the Sacramento River and San Joaquin River Basins and not tributaries to the listed waterways or portions of the listed waterways outside of the legal Delta boundary unless specifically designated.
[f] Delta beneficial uses are shown as designated by the Water Quality Control Plan for the Sacramento River Basin and the San Joaquin River Basin and the Water Quality Control Plan for the San Francisco Bay/Sacramento San Joaquin Delta Estuary.
[g] Per State Water Board Resolution No. 90-28, Marsh Creek and Marsh Creek Reservoir in Contra Costa County are assigned the following beneficial uses: REC-1 and REC-2 (potential uses), WARM, WILD, and RARE. COMM is a designated beneficial use for Marsh Creek and its tributaries listed in Appendix 43 of the Basin Plan for the Sacramento River and San Joaquin River Basins within the legal Delta boundary.
Notes: E = Existing Beneficial Use; P = Potential Beneficial Use

6A.2 Water Quality Constituents

6A.2.1. Nutrients, Organic Carbon, and Dissolved Oxygen

Nutrients in surface water, primarily nitrogen and phosphorus, come from natural sources such as weathering of rocks, soil, and atmospheric deposition; anthropogenic sources including agricultural and urban runoff; and wastewater discharges (National Oceanic and Atmospheric Administration 2020; U.S. Environmental Protection Agency 1998:2). Ammonia is an important nutrient for plant growth as it can be converted to nitrite and nitrate by bacteria and then used by plants (State Water Board n.d.:1). Nitrate and ammonia are the most common forms of nitrogen in aquatic systems (State Water Board n.d.:1).

Although nutrients are necessary for a healthy ecosystem, nutrient over-enrichment, or eutrophication, in water bodies results in the excessive growth of macrophytes, phytoplankton, and potentially toxic algal blooms. Overgrowth of algae may obstruct water conveyance facilities and clog water-intake pipes, produce taste and odor problems in municipal water supplies due to decaying algae, and affect recreational use of surface waters (U.S. Geological Survey n.d.). Eutrophication may result in a reduction of dissolved oxygen (DO), due to microbial decomposition of macrophytes and phytoplankton (Chislock et al. 2013). Extreme cases of DO depletion may result in fish kills.

The beneficial uses of surface water most directly affected by nutrient concentrations include those relevant to drinking water supplies (municipal and domestic supply [MUN]), aquatic organisms (cold freshwater habitat [COLD], warm freshwater habitat [WARM], and estuarine habitat [EST]), and recreational activities (water contact recreation [REC-1], noncontact water recreation [REC-2]), which can be indirectly affected by the eutrophication effects of nutrients. The beneficial uses of surface waterbodies in the study area are identified in Table 6A-1.

California drinking water standards (maximum contaminant levels [MCLs]) have been set for nitrate at 45 milligrams per liter (mg/L) (or 10 mg/L as nitrogen) and nitrite at 1 mg/L (as nitrogen) because nitrate is converted to nitrite in the human body, and nitrite can compete with oxygen for receptor sites on hemoglobin in the bloodstream. This interferes with normal respiration and is of particular concern in infants and pregnant women (State Water Resources Control Board 2020). The MCL for nitrate plus nitrite (as nitrogen) is 10 mg/L. There are no state or federal drinking water standards for phosphorus. There is no California drinking water standard for ammonia. There are no numerical water quality criteria for nutrients in the Sacramento-San Joaquin River or Bay-Delta basin plans covering the study area. In addition, the Sacramento-San Joaquin River Basin Plan has an applicable narrative objective for biostimulatory substances, which restricts biostimulatory substances in waters in concentrations that promote aquatic growths in concentrations that cause nuisance or adversely affect beneficial uses (Central Valley Regional Water Quality Control Board 2018a:3.3). The U.S. Environmental Protection Agency (USEPA) is currently developing nutrient criteria recommendations for lakes and reservoirs of the conterminous United States.

6A.2.2. Organic Carbon

Organic carbon sources to surface water include natural sources, such as decomposing animal and plant matter, and anthropogenic sources like domestic wastewater, urban runoff and agricultural discharge. Organic carbon in water is of primary concern to municipal water supplies because, in addition to bromide (a naturally occurring salt), organic carbon contributes to the formation of disinfection byproducts (DBPs) in treated drinking water. Chlorine, commonly used as a disinfectant in drinking water treatment processes, reacts with organic carbon to form DBPs such as trihalomethanes (THMs), and haloacetic acids (HAAs) (Tak and Vellanki 2018:681-682). Bromate, another DBP, forms in the presence of bromide when ozone is used to disinfect drinking water (World Health Organization 2005:1).

DBPs can be harmful to humans when consumed at low concentrations over a lifetime. Accordingly, organic carbon concentrations are of primary concern for the municipal water supply beneficial use. Epidemiological studies have indicated that long-term exposure to THMs may increase the risk of bladder cancer (Villanueva et al. 2015:107). Laboratory studies with rodents have shown that HAAs are carcinogenic, but the data from human cancer studies have been “inadequate to evaluate the relationship between human cancer and exposure” (U.S. Department of Health and Human Services 2018:58).

There are no state or federal regulatory numerical water quality objectives or criteria for organic carbon or any USEPA-recommended criteria. However, Sacramento-San Joaquin River Basin Plan outlines a Drinking Water Policy detailing a narrative objective for chemical constituents that includes drinking water chemical constituents of concern, including organic carbon. This objective indicates that waters shall not contain chemical constituents in concentrations that adversely affect beneficial uses. The revised policy requires the Central Valley Water Board to consider the necessity for inclusion of monitoring of organic carbon, salinity, and nutrients when renewing waste discharge requirements (WDRs) based on the discharge loading, proximity to drinking water intakes, and trends in ambient conditions for these constituents. According to the Central Valley Water Board, source control evaluations from 2011 indicate that organic carbon and nutrient loads will not likely increase in the future as a result of current regulatory actions (Central Valley Regional Water Quality Control Board 2018a).

Under USEPA’s Stage 1 Disinfectants and Disinfection Byproducts Rule (63 FR 69390), municipal drinking water treatment facilities are required to remove specific percentages of total organic carbon in their source water through enhanced treatment methods unless the drinking water treatment system can meet alternative criteria. USEPA’s action thresholds begin at 2–4 mg/L total organic carbon (in source water) and, depending on source water alkalinity, may require a drinking water utility to employ treatment to achieve as much as a 35% reduction in total organic carbon. Where total organic carbon concentration in source water is between 4 and 8 mg/L, up to a 45% reduction in total organic carbon may be required. (U.S. Environmental Protection Agency 2010).

6A.2.3. Dissolved Oxygen

DO is a critical water quality constituent for all forms of aquatic life. Oxygen enters surface water primarily from the atmosphere, and to a lesser extent from photosynthetic aquatic plants, and from groundwater in areas where groundwater inflow contributes significantly to streamflow

(U.S. Geological Survey n.d.). DO concentrations vary with several factors, including season, time of day, water temperature, salinity, and organic matter. The season and time of day dictate photosynthesis processes, which require sunlight. Increases in water temperature and salinity reduce the solubility of oxygen (National Oceanic and Atmospheric Administration n.d.). High nutrient concentrations, from point and nonpoint sources, can cause increased algal and aquatic plant growth in waterbodies, which can increase DO concentrations when photosynthesizing during the day, but lower DO levels at night and when algal blooms, for example, undergo decomposition (U.S. Environmental Protection Agency 2016). Low DO levels due to excessive nutrient loadings can kill fish, cause an imbalance of prey and predator species, and result in a decline in aquatic resources (U.S. Environmental Protection Agency 1998:iii,1).

DO concentrations are generally adequate in flowing streams but may be substantially lower in areas of slow-moving water with high biological oxygen demand (a measure of the amount of oxygen consumed by bacteria when decomposing organic matter). In reservoirs, DO concentrations decrease with increasing water depth, particularly in thermally stratified waterbodies where the hypolimnion is isolated from reaeration due to lack of mixing and potentially a high sediment oxygen demand (Fafard 2018; Beutel 2003:208) In some reservoirs, DO may be depleted in the hypolimnion when sediment oxygen demand is high.

DO depletion affects primarily aquatic life beneficial uses, which include WARM; COLD; rare, threatened, or endangered species (RARE); migration of aquatic organisms; spawning, reproduction, and/or early development (SPWN); and estuarine habitat (EST).

The Sacramento-San Joaquin River Basin Plan contains numerical DO objectives for locations in the study area, as identified in Table 6A-2. For Delta waters not identified in Table 6A-2, and except for those bodies of water which are constructed for special purposes and from which fish have been excluded or where the fishery is not important as a beneficial use, the minimum DO concentration is 5.0 mg/L (Central Valley Regional Water Quality Control Board 2018a). In addition, for surface water bodies outside the legal boundaries of the Delta, the Sacramento-San Joaquin River Basin Plan requires that water bodies meet certain saturation levels and may not be reduced below the following levels at any time.

- Waters designated WARM: 5.0 mg/L
- Waters designated COLD: 7.0 mg/L
- Waters designated SPWN: 7.0 mg/L

There is no state drinking water MCL for DO.

Table 6A-2. Basin Plan Objectives for Dissolved Oxygen Applicable to the Study Area

Location	Minimum Dissolved Oxygen (mg/L)	Time Period
Sacramento River from Keswick Dam to Hamilton City	9.0[a]	June 1 to August 31
Feather River from Fish Barrier Dam at Oroville to Honcut Creek	8.0	September 1 to May 31
Sacramento River (below the I Street Bridge) and in all Delta waters west of the Antioch Bridge	7.0	year-round

Source: Central Valley Regional Water Quality Control Board 2018a

[a] When natural conditions lower dissolved oxygen below this level, the concentrations shall be maintained at or above 95% of saturation.

Note: mg/L = milligrams per liter

6A.2.4. Mercury and Methylmercury

Mercury is a naturally occurring element in air, soil, and water. Mercury exists in three forms, elemental, inorganic, and organic, each with different chemical properties and toxicity (World Health Organization 2017). While mercury that occurs in or is released into the environment is typically in an inorganic form, concerns about human and wildlife exposure are mostly related to organic mercury compounds—specifically methylmercury. Mercury, in all forms, is a constituent of concern throughout California. Methylmercury is the form of mercury that enters the food web in aquatic environments and bioaccumulates or builds up in fish and shellfish tissue through prey consumption and absorption from water. Methylmercury that diffuses into the water column can enter the bottom of the food web via phytoplankton and zooplankton or be exported downstream.

Consumption of contaminated fish is the major pathway for human exposure to mercury (via methylmercury from fish tissue) (U.S. Environmental Protection Agency 2019). Mercury is a neurotoxin that causes a range of effects in people from tingling sensations and the loss of muscle control to birth defects and death (State Water Resources Control Board 2017:1-4). The environmental concentrations of mercury in the water column and methylmercury are typically below concentrations causing direct acute and chronic effects to aquatic organisms.

In freshwater environments, sulfate-reducing bacteria convert inorganic mercury to methylmercury primarily under anoxic (lacking oxygen) conditions, such as in sediments, flooded shoreline soils and, to a lesser degree, in the water column (State Water Resources Control Board 2017:4-3; Alpers et al. 2008). This process is affected by multiple environmental variables in water and sediment, including temperature, pH, and the presence of sulfate and organic carbon (U.S. Geological Survey 2014:39,41). Iron-reducing bacteria have also been implicated in mercury methylation, but to a lesser degree than sulfate-reducing bacteria (Yu et al. 2012:2684). Mercury methylation is also affected by hydrodynamic factors including wetting/drying cycles or reservoir level fluctuations, stratification, turbulence affecting sediment resuspension, water residence time, and depth. Demethylation can also occur as part of biotic or abiotic processes. Microbes can demethylate mercury, and in some cases this mercury is once again available to be methylated. The primary abiotic process is photodemethylation, in which exposure to light causes the mercury to demethylate. Mercury can also volatilize from the water column into the air.

Applicable water quality criteria and objectives for mercury and methylmercury are provided in Table 6A-3. The lowest applicable water column criterion for mercury is the 50 nanograms per liter (ng/L) total recoverable mercury CTR criterion. This criterion is intended for the protection of aquatic life but may not be sufficiently protective of human health and wildlife consuming large (trophic level 3 and trophic level 4) fish (Central Valley Regional Water Quality Control Board 2010a). Human health fish consumption advisories are often associated with mercury contamination. Applicable federal recommended criteria are identified in Table 1 of Appendix 6F, *Mercury and Methylmercury*. State criteria are more conservative than federal criteria for mercury/methylmercury.

Table 6A-3. Water Quality Criteria and Objectives for Mercury and Methylmercury Applicable to the Study Area

Applicable Criterion/Objective	Purpose	Medium (water or fish tissue)	Numerical Criterion or Objective
Sacramento–San Joaquin River Delta Estuary TMDL for Methylmercury[a]	To protect human health and wildlife To protect wildlife	Trophic level 4 fish Trophic level 3 fish Whole fish <50 mm in length	0.24 mg/kg[b] 0.08 mg/ kg[b] 0.03 mg/ kg[b]
California Toxics Rule	To protect human health (as total mercury)	Consumption of water + organism Consumption of organism only	0.050 µg/L 0.051 µg/L
Water Quality Control Plan for Inland Surface Waters, Enclosed Bays, and Estuaries of California—Tribal and Subsistence Fishing Beneficial Uses and Mercury Provisions	To protect human health and wildlife To protect wildlife	Sport fish Prey fish	0.2 mg/ kg[b,c] 0.05 mg/kg[d]

Sources: Central Valley Regional Water Quality Control Board 2010b; State Water Resources Control Board 2017; U.S. Environmental Protection Agency 2000

[a] This TMDL addresses fish mercury impairment in all waterways within the legal Delta except the westernmost portion of the Delta near Chipps Island.

[b] Methylmercury in edible muscle tissue of fish (wet weight).

[c] 12-month average concentration measured in trophic level 3 (150-500 millimeters total length) or trophic level 4 (200-500 millimeters total length) fish and is applicable to the highest trophic level in the waterbody.

[d] Methylmercury in whole fish (wet weight) of any species 50-150 millimeters total length (applicable if there are no trophic level 4 fish to evaluate the sport fish objective).

Notes: mm = millimeters; mg/kg = milligrams per kilogram; µg/L = micrograms per liter; TMDL = total maximum daily load

6A.2.5. Harmful Algal Blooms

Cyanobacteria are aquatic, photosynthetic bacteria that occur in fresh, marine, and brackish surface waterbodies (National Oceanic and Atmospheric Administration n.d.). When toxic cyanobacteria grow out of control, these masses of overgrowth are referred to as “harmful algal blooms” (HABs). Most toxin-producing cyanobacteria are freshwater species; however, studies have shown that freshwater cyanobacteria have a relatively broad range of salinity tolerance (Berg and Sutula 2015:p.21). Some of the most commonly occurring toxin-producing genera of cyanobacteria are *Microcystis*, *Dolichospermum*, and *Planktothrix*, which all produce the cyanotoxin, microcystin (U.S. Environmental Protection Agency 2020a; Central Valley Regional Water Quality Control Board 2019:15). The most commonly occurring cyanotoxins in the U.S. are microcystins, cylindrospermopsin, anatoxins, and saxitoxins (U.S. Environmental Protection Agency 2020a).

Cyanotoxins typically remain within cyanobacteria until the cyanobacteria die or rupture, at which point the toxins are released; however, toxins can be actively released from living cyanobacteria as well (Graham et al. 2008:15), although this may vary by species. For example, microcystin variants and anatoxin-a are found intracellularly approximately 95% of the time during the HAB growth stage, whereas the distribution of cylindrospermopsin is approximately 50% intracellular and 50% extracellular (U.S. Environmental Protection Agency 2014:2). Extracellular cyanotoxins are more difficult to remove than intracellular cyanotoxins during water treatment (U.S. Environmental Protection Agency 2018). Once released, cyanotoxins eventually undergo biodegradation and, to some degree, photodegradation (Gagala and Mankiewicz-Boczek 2012: 1128-1129). Microcystins, for example, can be relatively rapidly degraded (days) by certain microbes in sediment (Berg and Sutula 2015:30; Gagala and Mankiewicz-Boczek 2012: 1132; Kormas and Lymperopoulou 2013:1). However, in the absence of bacteria that degrade microcystin, this cyanotoxin is fairly stable and will degrade slowly (Berg and Sutula 2015:30).

There are multiple environmental factors that contribute to the formation and maintenance (i.e., persistence) of HABs. Generally, HABs are dependent on water temperature of at least approximately 66°F or approximately 19°C, water column sunlight (known as irradiance), low turbidity, a calm, stratified water column coupled with long water residence times, and the availability of dissolved nutrients (specifically nitrogen and phosphorus) in non-limiting concentrations (U.S. Environmental Protection Agency 2016:17; Lehman et al. 2013:152; Berg and Sutula 2015:ii). Whereas water temperature exceeding approximately 66°F and irradiance are generally considered the primary drivers of bloom initiation, low flow and long water residence time may be the primary factors in maintaining HABs (Berg and Sutula 2015:iii; Lehman et al. 2013:154).

Stratified conditions in lakes and reservoirs indirectly promote HABs through increased temperatures, irradiance, and reduced loss of cyanobacteria. The magnitude of vertical stratification and stability of the water column increases with increased temperature. Increased temperatures in the top of the water column can increase HABs growth rates. In addition, in stable, stratified waterbodies, cyanobacteria can stay in the top layer of the water column where light is more abundant (rather than be mixed into lower layers), which supports higher growth rates. Further, increased stratification may be the result, in part, of increased water residence time, which minimizes flushing of HABs from a lake or reservoir and facilitates the use of available nutrients. (Berg and Sutula 2015: 33; Central Valley Regional Water Quality Board 2019:8-9). Increased residence, as determined by reduced flushing, contributes to HABs by reducing the rate of loss of cyanobacteria (Berg and Sutula 2015:33; U.S. Environmental Protection Agency 2020b).

The development of HABs in waterbodies is closely correlated with nutrient loading from the watershed via urban, agricultural, and industrial sources (Central Valley Regional Water Quality Board 2019:8). Nitrogen and phosphorus are the two nutrients that control cyanobacteria production (Berg and Sutula 2015:22-23). However, initiation of HABs does not appear to be associated with changes in nutrient concentrations or the ratio of nitrogen to phosphorus, but once blooms develop, an ample supply of nutrients is necessary to maintain the bloom (Berg and Sutula 2015:46-47). Provided that optimal temperature and light conditions are present, cyanobacterial biomass accumulation is directly proportional to the concentration of nitrogen and phosphorus available in the water column (Berg and Sutula 2015:22). Where nutrients concentrations are sufficient (i.e., non-limiting), the initiation of a bloom is likely not associated with changes in nutrient concentrations (Berg and Sutula 2015:iii).

In addition to driving bloom formation, elevated water temperature is also a key factor in controlling the duration and magnitude of *Microcystis* blooms (Lehman et al. 2017:106). Growth rates of cyanobacteria increase with increasing water temperature to a point; in temperate climates, cyanobacterial growth is typically optimal between approximately 77°F and 95°F (25°C and 35°C) (Berg and Sutula 2015:31). Elevated surface water temperatures can intensify stratification of the water column and thereby increase *Microcystis* biomass by maintaining the cyanobacteria colonies in the water's surface layer where light stimulates photosynthesis (Berg and Sutula 2015:33). Drought conditions typically result in increased reservoir drawdowns in summer. Reservoir drawdowns in summer can result in increased water residence time; increased nutrient concentrations through the reduction of water volume as well as increased nutrient loading from the sediment; and increased water temperatures (Bakker and Hilt 2016: 487). In deep reservoirs, drawdown can disturb the thermal stability of the water and thereby reduce or eliminate thermal stratification in summer (Bakker and Hilt 2016: 487).

6A.3 California State Water Resources Control Board Constituents of Concern for Waterbodies in the Study Area

The Regional Water Quality Control Boards (RWQCBs) have adopted, and the California State Water Resources Control Board (SWRCB) has approved, water quality control plans (basin plans) for each watershed basin in the State. The basin plans designate the beneficial uses of waters within each watershed basin and water quality objectives designed to protect those uses pursuant to CWA Section 303. The beneficial uses together with the water quality objectives that are contained in the basin plans constitute State water quality standards.

Under the CWA section 303(d), the USEPA identifies and ranks water bodies for which existing pollution controls are insufficient to attain or maintain water quality standards based upon information prepared by all states, territories, and authorized Indian tribes (referred to collectively as "states" in the CWA). This list of impaired waters for each state comprises the state's 303(d) list. Each state must establish priority rankings and develop Total Maximum Daily Load (TMDL) values for all impaired waters. TMDLs calculate the greatest pollutant load that a water body can receive and still meet water quality standards and designated beneficial uses.

Section 305(b) of the CWA requires every state to submit a biennial water quality assessment of all state waters. These state-wide reports serve as the basis for USEPA's national Water Quality Inventory Report to Congress. Each water body is assessed regarding its ability to support the most common beneficial uses: aquatic life, drinking water supply, fish consumption, non-contact recreation, shell fishing, and swimming (all of which are also known as core beneficial uses). The USEPA requires states to integrate the 303(d) and 305(b) reports. For California, this report is called the California 303(d)/305(b) Integrated Report and is prepared by the SWRCB using Integrated Reports submitted by each RWQCB.

The SWRCB and RWQCBs have identified numerous water bodies within the project area that do not comply with applicable water quality standards and either adopted or are developing TMDLs as summarized in Table 6A-4.

Table 6A-4. Clean Water Act Section 303(d) Impaired Water Bodies in the Study Area

Waterbody	Constituent of Concern	TMDL Status
Sacramento River Basin		
Shasta Lake	Mercury	Under Development
Keswick Reservoir (portion downstream from Spring Creek	Zinc Cadmium Copper	Under Development (all listed constituents)
Sacramento River (Keswick Dam to Cottonwood Creek)	Cadmium Copper Zinc Toxicity	Approved 2002 Approved 2002 Approved 2002 Under Development
Sacramento River (Cottonwood Creek to Red Bluff)	Toxicity Mercury	Under Development (all listed constituents)
Sacramento River (Red Bluff to Knights Landing)	Mercury PCBs Toxicity DDT Dieldrin	Under Development (all listed constituents)
Sacramento River (Knights Landing to the Delta)	Mercury Dieldrin	Under Development (all listed constituents)

Waterbody	Constituent of Concern	TMDL Status
	DDT Chlordane PCBs Toxicity	
Lake Oroville	PCBs Mercury	Under Development (all listed constituents)
Feather River, Lower (Lake Oroville Dam to Confluence with Sacramento River)	Chlorpyrifos PCBs Mercury Chlorpyrifos Group A Pesticides Toxicity	Approved 2016 Under Development Under Development Under Development Under Development Under Development
Sacramento and Feather Rivers	Diazinon Chlorpyrifos	Approved 2008 Approved 2008
Stone Corral Creek	Dissolved Oxygen	Under Development
Folsom Lake	Mercury	Under Development
Lake Natoma	Mercury	Under Development
American River, Lower (Nimbus Dam to confluence with Sacramento River)	Mercury Toxicity PCBs Bifenthrin Pyrethroids Indicator Bacteria	Under Development (all listed constituents)
Colusa Basin Drain	Diazinon Azinphos-methyl (Guthion) Carbofuran Toxicity Group A Pesticides Malathion Low Dissolved Oxygen Mercury Indicator Bacteria DDT Dieldrin	Under Development (all listed constituents)
Knights Landing Ridge Cut	Dissolved Oxygen Salinity	Under Development (all listed constituents)
Yolo Bypass – Tule Canal (Yolo County)	Boron Fecal Indicator Bacteria, Salinity	Under Development (all listed constituents)
Central Valley	Diazinon Chlorpyrifos	Approved 2017 Approved 2017

Waterbody	Constituent of Concern	TMDL Status
	Pyrethroids	Approved 2019
Primary Storage Reservoir for Delta Exports		
San Luis Reservoir	Mercury Total DDT (sum of 4,4'- and 2,4'-isomers of DDT, DDE, and DDD) PCBs Chlordane, PCBs	Under Development (all listed constituents)
O'Neil Forebay	Mercury PCBs	Under Development (all listed constituents)
Sacramento-San Joaquin River Delta		
Delta Waterways (northern)	PCBs Diazinon DDT Group A Pesticides Toxicity Chlorpyrifos Dieldrin Chlordane Mercury	Under Development Approved 2007 Under Development Under Development Under Development Approved 2007 Under Development Under Development Approved 2011
Delta Waterways (northwestern portion)	Diazinon DDT Group A Pesticides Invasive Species Chlorpyrifos Mercury Toxicity Electrical Conductivity	Approved 2007 Under Development Under Development Under Development Approved 2007 Approved 2011 Under Development Under Development
Delta Waterways (central and eastern portions)	Diazinon DDT Group A Pesticides Toxicity Chlorpyrifos Mercury Invasive Species	Approved 2007 Under Development Under Development Under Development Approved 2007 Approved 2011 Under Development
Delta Waterways (southern portion)	DDT Group A Pesticides Chlorpyrifos Toxicity Electrical Conductivity Mercury Invasive Species	Under Development Under Development Approved 2007 Under Development Under Development Approved 2011 Under Development

Waterbody	Constituent of Concern	TMDL Status
Delta Waterways (Stockton Ship Channel)	Toxicity Diazinon PCBs[a] Furan Compounds Group A Pesticides Chlorpyrifos DDT Organic Enrichment/Low Dissolved Oxygen Mercury Dioxin[a] Invasive Species Temperature, water	Under Development Approved 2007 Under Development Under Development Under Development Approved 2007 Under Development Approved 2007 Approved 2011 Under Development Under Development Under Development Under Development
Delta Waterways (western portion)	DDT Toxicity Group A Pesticides Electrical Conductivity Chlorpyrifos Mercury Diazinon Invasive Species PCBs Chlordane Dieldrin PAHs Arsenic Total DDT (sum of 4,4'- and 2,4'-isomers of DDT, DDE, and DDD)	Under Development Under Development Under Development Under Development Approved 2007 Approved 2011 Approved 2007 Under Development Under Development Under Development Under Development Under Development Under Development Under Development
Middle River (Delta Waterways, southern portion)	Low Dissolved Oxygen	Under Development
Sacramento-San Joaquin Delta (San Francisco Bay Regional Water Quality Control Board)	Chlordane DDT Dieldrin Mercury PCBs Selenium Dioxin compounds Furan Compounds Invasive Species PCBs (dioxin-like)	Under Development Under Development Under Development Approved 2008 Approved 2010 Approved 2016 Under Development Under Development Under Development Approved 2010

Source: Central Valley Regional Water Quality Control Board 2018b

[a] The areas of Stockton Ship Channel impacted by PCB contamination in sportfish encompass Old Mormon Slough, New Mormon Slough, McLeod Lake, Turning Basin, Morrelli Boat Ramp, and Louis Park Boat Ramp (California Department of Health Services 1998 warning). This listing was made by USEPA in 1998 and was under the Stockton Turning Basin, upper (Port Turning Basin) on previous lists. In order to consolidate listings for same areas, all listings for Stockton Turning Basin are now under the Delta Waterways (Stockton Ship Channel).

Notes: DDD = dichlorodiphenyl dichloroethane; DDE = dichlorodiphenyldichloroethylene; DDT = dichlorodiphenyltrichloroethane; PAHs = polyaromatic hydrocarbons; PCBs = polychlorinated biphenyls

6A.4 References

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