Watershed Sanitary Survey

Final

Modesto Irrigation District and
Stanislaus Regional Water Authority

September 30, 2020

Contents

Tables

Figures

Appendices

List of Acronyms

AB	Assembly Bill
ACS	American Community Survey
ACU	Apparent Color units
AMWA	Association of Metropolitan Water Agencies
ASDWA	Association of Drinking Water Administrators
AWWA	American Water Works Association
BLM	Bureau of Land Management
BMP	Best Management Practice
BSSP	Bacteriological sample siting plan
BTEX	Benzene, Toluene, Ethylbenzene, and Xylene
$CaCO_3$	Calcium carbonate
CAF	Confined animal facility
CAL FIRE	California Department of Forestry and Fire Protection (formerly known as CDF)
CALOES	California Office of Emergency Services
CAP	*Cryptosporidium* Action Plan
CCL	Contaminant Candidate List
CCR	California Code of Regulations
CDFG	California Department of Fish and Game
CDFW	California Department of Fish and Wildlife (formerly known as CDFG)
CDPH	California Department of Public Health
CDPR	California Department of Parks and Recreation
CEDCSU	Center for Economic Development, Cal State Chico
CEQA	California Environmental Quality Act
CFU	Colony forming units
CHP	California Highway Patrol
CSAP	California Science Advisory Panel

CTR	California Toxics Rule
CVRWQCB	Central Valley Regional Water Quality Control Board
DBP	Disinfection By-Products
D/DBP	Disinfectants/Disinfection By-Products
DHS	Department of Health Services
District	Modesto Irrigation District
DDW	Division of Drinking Water (SWRCB)
DLR	Detection limit for reporting
DO	Dissolved oxygen
DOF-DRU	California Department of Finance, Demographic Research Unit
DPRA	Don Pedro Recreation Agency
DWR	California Department of Water Resources
E. coli	Escherichia coli
EPTDS	Entry points to the distribution system
GAC	Granular activated carbon
GCSD	Groveland Community Services District
gpd	Gallons per day
GPM	Gallons per minute
HAA	Haloacetic acid
HHWP	Hetch Hetchy Water and Power
HPC	Heterotrophic plate count
IESWTR	Interim Enhanced Surface Water Treatment Rule
ICR	Information Collection Rule
IDSE	Initial Distribution System Evaluation
JPA	Joint Powers Authority
L	Liter
LAMPS	Local agency management programs
LRAA	Locational running annual average
LT1ESWTR	Long Term 1 Enhanced Surface Water Treatment Rule
LT2ESWTR	Long Term 2 Enhanced Surface Water Treatment Rule

LTO	Licensed timber operator
LUST	Leaking underground storage tank
MCL	Maximum contaminant level
MCLG	Maximum contaminant level goal
MG	Million gallon
MGD	Million gallons per day
mg/L	Milligrams per liter
MID	Modesto Irrigation District
mL	Milliliter
MPN	Most probable number
MS4	Municipal Separate Storm Sewer System
MTBE	Methyl tert-Butyl Ether
MTF	Multiple tube fermentation
MRDL	Maximum residual disinfectant levels
MRWTP	Modesto Regional Water Treatment Plant
NAWC	National Association of Water Companies
NL	Notification level
NOM	Natural organic matter
NPDES	National Pollutant Discharge Elimination System
NPS	National Park Service
NRA	National Recreation Area
NRCS	Natural Resources Conservation Service
NTU	Nephelometric turbidity units
OHV	Off-Highway Vehicle
OWTS	On site wastewater treatment systems
PG&E	Pacific Gas and Electric
pMCL	Primary maximum contaminant level
PSC	Potential source of contamination
psi	Pounds per square inch
PWS	Public Water System

RAA	Running annual average
RPF	Registered professional forester
RV	Recreational vehicle
RWQCB	Regional Water Quality Control Board
SDWA	Safe Drinking Water Act
SFPUC	San Francisco Public Utilities Commission
SMARA	Surface Mining and Reclamation Act
sMCL	Secondary maximum contaminant level
SSO	Sanitary sewer overflow
SRWA	Stanislaus Regional Water Authority
SWRCB	State Water Resources Control Board
SWTR	Surface Water Treatment Rule
TCOC	Tuolumne County Ordinance Code
TDS	Total dissolved solids
THMs	Trihalomethanes
THP	Timber Harvest Plan/Permit
THMFP	Trihalomethane formation potential
TID	Turlock Irrigation District
TMDL	Total maximum daily load
TMF	Tailings Management Facility
TOC	Total organic carbon
TRPS	Terminal Reservoir Pump Station
TTHM	Total Trihalomethanes
TUD	Tuolumne Utilities District
UCMR	Unregulated Contaminant Monitoring Rule
µg/L	Micrograms per liter
USBR	United States Bureau of Reclamation
USDA	United States Department of Agriculture
USFS	United States Forest Service
USGS	United States Geological Survey

UST	Underground Storage Tank
USFWS	United States Department of the Interior Fish and Wildlife Service
US EPA	United States Environmental Protection Agency
UV	Ultraviolet
WDR	Waste Discharge Requirements
WRF	Water Research Foundation
WSS	Watershed Sanitary Survey
WTP	Water Treatment Plant
WWTP	Wastewater Treatment Plant
#	Number

Watershed Sanitary Survey Executive Summary

This Watershed Sanitary Survey (WSS) of the Modesto Reservoir Watershed and Lower Tuolumne River Watershed is prepared for the Modesto Irrigation District (MID) and Stanislaus Regional Water Authority (SRWA). MID is a publicly-owned utility district that provides drinking water to the City of Modesto as well as irrigation water and electricity to the Modesto area. SRWA is a joint powers authority (JPA) which includes the cities of Ceres and Turlock with participation from Turlock Irrigation District (TID), although TID is not a part of the JPA.

Background

The California Surface Water Treatment Rule (SWTR) requires that all domestic water suppliers using surface water conduct a WSS of their watersheds, and to update that survey every five years thereafter. The survey is required to evaluate potential contaminant sources within the watershed that may impact drinking water quality.

MID completed its initial WSS for the Modesto Reservoir Watershed in June 1996 and its most recent update in 2014. The primary water supply source is the Tuolumne River, upstream of the La Grange Diversion Dam, which diverts MID's supply to the Modesto Reservoir. Water in Modesto Reservoir flows by gravity to the southwest where the reservoir outlet/plant intake is located.

SRWA is preparing to construct a new surface water treatment plant (WTP) that will provide supplemental drinking water supply to the cities of Ceres and Turlock. The sources water for the new SRWA treatment plant is the Tuolumne River with an intake downstream of the La Grange Diversion Dam near the city of Hughson. Raw water will be withdrawn from an existing infiltration gallery located four to five feet below the river bottom and pumped to the new WTP. SWRA is currently in the process of permitting and building facilities and plan to begin operation in 2022.

The Don Pedro Reservoir is a tributary to both MID and SRWA source water intakes, while the Modesto Reservoir is only a tributary to the MID intake and the Lower Tuolumne River downstream of the La Grange Diversion Dam is only a tributary to the SRWA intake.

Water Supply Systems

In 1994, MID started treating surface water at the Modesto Regional Water Treatment Plant (MRWTP) and wholesaling it to the City of Modesto. Up until 2015, MID operated a conventional 36 MGD surface water treatment plant. Between 2010 and 2015, MID expanded capacity by adding a 36 MGD membrane water treatment plant that operates in parallel for a total of 81 MGD. The primary water supply source is the Tuolumne River, which is diverted at the La Grange Diversion Dam. The supply is diverted via MID's Upper Main Canal to Modesto Reservoir, which is a 27,000 acre-foot man-made reservoir used to store water for irrigation, domestic use and water used for hydroelectric power generation upstream. Upstream of La Grange Diversion Dam, the Don Pedro Dam forms the Don Pedro Reservoir, the District's primary water storage facility. MID jointly owns the Don Pedro Reservoir with Turlock Irrigation District (TID).

In January 2014, the MRWTP received the rarely achieved Phase IV Presidents Award recognition from the Partnership for Safe Water. The Partnership program is a national initiative developed by the US Environmental Protection Agency (US EPA), the American Water Works Association (AWWA), the Association of Drinking Water Administrators (ASDWA), Association of Metropolitan Water Agencies (AMWA), the National Association of Water Companies (NAWC),), and the Water Research Foundation (WRF). The Partnership program recognizes water suppliers who strive to provide drinking water quality that surpasses the federal standards, through treatment plant and distribution system optimization. Phase IV Excellence in Water Treatment award is the next goal for the MRWTP, which is the highest possible level of performance that can be achieved through the Partnership program.

The SRWA project is under design and is expected to start operation in 2022. The project area is located in Stanislaus County, extending from Fox Grove Regional Park. A raw water pump station will be located on the south bank of the Tuolumne River and convey raw water from the TID infiltration gallery to a new WTP west of Aldrich Road. Treated water from the WTP would then be conveyed via pipeline to the existing water systems for the City of Ceres and City of Turlock.

The WTP would be built in two or more phases. Phase 1 of the WTP would be built on half of a 48-acre site and provide 15 MGD capacity. Full build out of the WTP is anticipated to have a capacity of 45 MGD. Although the design is not finished, it is anticipated that the treatment process would use conventional coagulation, flocculation, and sedimentation for turbidity and disinfection by-product (DBP) precursor removal; intermediate ozone for primary disinfection; biologically active filtration with granular activated carbon (GAC) over sand as the media; free chlorine for final disinfection; and lime and carbon dioxide addition for finished water stabilization.

Upstream Watersheds

The primary water supply sources are a 1,000 square mile area, drained by the Tuolumne River upstream of the La Grange Diversion Dam, the MID Upper Main Canal, the Modesto Reservoir, and the Lower Tuolumne River Watershed, which extends from the La Grange Diversion Dam to the river's confluence with the San Joaquin River.

For the purposes of this watershed sanitary survey, the watershed is divided into three parts: (1) the Modesto Reservoir Subwatershed, which includes the lands that drain directly into Modesto Reservoir and the Upper Main Canal, (2) the Don Pedro Reservoir Subwatershed, which includes the lands that drain into the Tuolumne River upstream of Don Pedro Reservoir, and (3) the Lower Tuolumne River watershed, including lands that drain into the Tuolumne River downstream of the La Grange Diversion Dam (see Figure 2-1).

The Don Pedro Reservoir Subwatershed, however, does not include the subwatershed upstream of O'Shaughnessy Dam, which forms Hetch Hetchy Reservoir. A separate watershed sanitary survey is prepared for the Hetch Hetchy Reservoir Subwatershed by the San Francisco Public Utilities Commission (SFPUC). The Hetch Hetchy Reservoir subwatershed and its tributaries do not influence the Don Pedro Reservoir subwatershed except through water discharged from the O'Shaughnessy Dam. A brief summary of the Hetch Hetchy Watershed Sanitary Surveys is included in Section 2.2.

Cities make up a very small portion of land use area in the region, with 98 percent of the land unincorporated. Maintenance of native forests and preservation of rural and natural watershed characteristics are important in the 1.7 million acres of open land.

The Upper Tuolumne River Watersheds are generally regarded as producing surface water of excellent quality; the water is suitable for almost any use and contains low concentrations of contaminants. Runoff generated from the upper reaches of the watershed is suitable for human consumption except for the risk of pathogens, which is generally associated with livestock grazing, wildlife, and campers.

Significant Potential Contaminant Sources and Source Water Quality Recommendations

Significant potential contaminant sources (PSCs) and associated water quality recommendations for each sub-watershed are described in this section.

Don Pedro Reservoir

The Don Pedro Reservoir watershed study area lies entirely within Tuolumne County. Significant contaminant sources identified in this sanitary survey update include recreation, septic tank and leach field systems, sanitary sewer overflows (SSO), mine runoff, and unauthorized activities.

Recreational activities in Don Pedro Reservoir are managed by Don Pedro Recreation Agency (DPRA). Recreational activities around Don Pedro Reservoir include fishing, motored boating, sailing, water skiing, and camping, and the Suntex Marina and DPRA also operate an annual fireworks display. Altogether recreation activities attract 340,000 visitors per year to Don Pedro Reservoir.

Limited data suggests that bacteria concentrations are less than the objectives of the Central Valley Regional Water Quality Control Board (CVRWQCB) Basin Plan. MID and SRWA should maintain coordination with DPRA to receive any monitoring data performed within the Don Pedro Reservoir. Continued monitoring will help to better quantify the effects of potential contaminant sources such as recreational activities and wet weather runoff from active and abandoned mining locations. In addition to the Don Pedro Reservoir, DPRA reports seasonal data to RWQCB on bacterial count reports for the DPRA swimming lagoon, which is a separate water body from the reservoir.

Approximately two-thirds of Tuolumne County residents use septic tank and leach field systems. It is estimated that about 2 million gallons of sewage are discharged into the ground per day in the County from approximately 18,000 septic systems. The presence of shallow depths to bedrock, coarse-textured soils, and restrictive lot sizes and/or configurations in Tuolumne County may pose a potential threat to surface waters from septic tank systems. There is generally a lack of information on existing septic tanks and the extent of impacts from failing systems. Tuolumne County recognizes the need to identify the locations and severity of potential impacts through more extensive evaluations in order to effectively address these problems. The State Water Board adopted the Water Quality Control Policy for Siting, Design, Operation, and Maintenance of Onsite Wastewater Treatment Systems (OWTS Policy) in 2012 and put it into effect in 2013. The OWTS Policy establishes a statewide, risk-based, tiered approach for the regulation. Corrective measures for failing septic systems can be problematic in that each system in need of replacement may require expensive on-site improvements and/or specially engineered systems.

The long detention time in Don Pedro Reservoir likely allows for die-off of pathogens before they can make it to the MID and SRWA intakes. MID and SRWA can consider working with DPRA to maintain updated information on the location and number of problematic septic tank systems in the watershed in order to quantify the potential impacts of such systems on surface water quality. MID and SRWA should support Tuolumne County's efforts to enforce current septic system regulations, as well as OWTS Policy requirements.

Over 100 active and inactive mines are identified by CVRWCB within the Central Valley region with potential impacts on surface waters via wet weather runoff, three of which are in Tuolumne County. The Clean Water Action Section 303(d) lists for Don Pedro Reservoir a total maximum daily load (TMDL) for mercury associated with historic resource extraction (mining) activities. Mercury was detected at all reservoir sample locations in 2012, but at concentrations far less than both the maximum contaminant level (MCL) of 0.002 mg/L and the California Toxics Rule (CTR) benchmark of 50 ng/L. In a 2018 grab sample at Flemming Meadows area, mercury was not detected. The CVRWQCB has proposed policy for mercury discharge offsets for discharges to the San Francisco Bay and Sacramento-San Joaquin River Delta and tributaries. In addition to mercury, other heavy metals could be discharged in storm water runoff from old mine sites and lead to water quality degradation. Dissolved copper concentrations exceeded the CTR objective of 1.8 ug/L in two of eight samples collected in 2012, though concentrations for total copper were far below the action level of 1300 ug/L. The 2018 sample was non-detect for total copper and iron. One of eight Don Pedro Reservoir iron samples exceeded the secondary MCL (sMCL) for treated water.

Unauthorized activities in the watershed include illegal dumping, off-road vehicle use, illegal camping, marijuana cultivation, and illegal drug manufacture and disposal. The Public Works Department in Tuolumne County notifies MID when illegal dumping occurs and is responsible for developing and implementing an enforcement strategy.

Modesto Reservoir

The overall water quality at Modesto Reservoir is good, and MID has been diligent in maintaining water quality records from their sampling efforts. Significant contaminant sources identified in this sanitary survey update for the Modesto Reservoir include recreation, wildlife, wildfire, and grazing.

The Stanislaus County Parks and Recreation Department manages the Modesto Reservoir Regional Park, which comprises approximately half of the Modesto Reservoir Subwatershed. Both swimming and boating are allowed in Modesto Reservoir. The annual visitor count averaged 98,000 persons between 2014 and 2018 with up to 153,000 visitors recorded in a single year. In 1998, MID prepared a Modesto Reservoir Management Plan, which restricts and guides uses of the reservoir to reduce the possibility of contamination from recreational uses.

Daily analysis of MID's raw water total coliform and *E. coli* show the source water quality has remained stable over the past 5 years. However, total organic carbon (TOC) has increased about 10 percent during the last 5 years, potentially due to lasting impacts of the Rim Fire and heavy rainfall following periods of drought. Section 4 provides a detailed analysis of the source water quality. For bacteriological analysis, the Shady Point sample site has historically had the highest concentrations of total coliform and *E. coli* during holiday weekends. However, the results of an evaluation performed by MID on the past twenty years of reservoir data (raw water bacteriological quality) suggest that the water quality entering the treatment plant does not correlate to the holiday weekend / seasonal high bacteriological counts within the recreation areas.

Raw water *E. coli* counts during holiday summer weekends, when the majority of the visitors come to Modesto Reservoir, are less than one count higher than the year-round average. Results indicate that current recreational activities have very little effect on raw water bacteriological quality. MID ceased monthly monitoring for *Cryptosporidium* in 2017 with permission from DDW due to very little detection of *Cryptosporidium* and *Giardia* during this and the prior WSS periods

Only a small portion of cattle grazing rangeland on the southeast and northern shores drains into the Modesto Reservoir Subwatershed. Grazing leases with ranchers have eliminated problematic areas from grazing, restricted cattle access to the reservoir, and prohibited the presence of calves younger than four months during the wet season.

The resident population of Canadian geese at Modesto Reservoir directly impacts water quality due to submergence of droppings during reservoir water level fluctuations. Canadian geese numbers have grown so much in recent years that the California Department of Fish and Wildlife (CDFW) issued the Stanislaus County Parks & Recreation Department a permit that allows for the addling of goose eggs. MID should continue to work with Stanislaus County to continue monitoring the goose population at Modesto Reservoir to assure that Stanislaus County's current control efforts are continuing to be effective and representative of the need.

Lower Tuolumne River Watershed

The upper portion of the watershed is relatively undeveloped, and contributes minimal contamination to the water bodies. Most of the lower portion of the study area is under agricultural production, and runoff from agricultural lands occasionally drains into the Tuolumne River. Two dairies and one cattle feedlot operate within the watershed. The runoff control from these facilities is regulated. The Central Valley Waterboard (Region 5) regulates bovine feedlots through General Waste Discharge Requirements (2019). The order prohibits discharge from production areas to surface waters. (https://www.waterboards.ca.gov/centralvalley/water_issues/confined animal_ facilities/program_regs_requirements/dairy/)

The town of Waterford operates the Waterford wastewater treatment plant (WWTP) adjacent to the north shore of the river near Hickman Bridge and upstream of the infiltration gallery. The WWTP currently meets their CVRWQCB waste discharge permit requirements. SRWA should coordinate with the City of Waterford and ensure that SWRA is included in the City of Waterford WWTP notification plan to be notified of incidents that may impact source water quality.

SRWA completed a Source Water Quality Analysis at the infiltration gallery to characterize the water quality of the Tuolumne River at the proposed intake location and support permitting of the new surface water supply project. Phase 1 of this effort began in October 2016 and completed in October 2017. Phase 1 sampling included general water characterization parameters, Title 22 contaminants, microbial parameters, pesticides and other synthetic organic chemicals, and additional unregulated constituents. Phase 2 began in October 2017 and completed in October

2018. Phase 2 monitoring categories included general water characterization parameters with significant process design implications (e.g., pH, turbidity, iron, manganese, etc.), Title 22 contaminants with primary or secondary maximum contaminant levels, microbial parameters that may impact the required level of treatment, and parameters included on the United States Environmental Protection Agency (USEPA) fourth Unregulated Contaminant Monitoring Rule (UCMR). The data acquired was used to inform the design of the WTP, and the findings of both phases of analysis are summarized below. See Appendix J for excerpts from the reports.

In general, the source water quality was high with low total suspended solids (TSS), total dissolved solids (TDS), conductivity (specific conductance), sulfate, and chloride. All of the nitrogen species were substantially below their respective primary MCLs (pMCL). The total iron concentrations in Phase 1 ranged from 0.032 to 0.68 mg/L, with 6 of the 15 samples above the sMCL of 0.3 mg/L. Phase 2 results improved with 1 of 7 samples exceeding the sMCL. Iron is expected to be easily removed at the WTP through oxidation, clarification, and filtration.

Cryptosporidium and *Giardia* concentrations were consistent with historical monitoring values, and only 1 of 24 samples collected during Phase 1 and Phase 2 had detected oocyst for *Cryptosporidium*. The results of testing through both phases (24 months of monitoring) put the source water in Bin 1 of the Long-Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR). Bin 1 is the lowest Bin classification, meaning that no additional treatment beyond the 2-log removal required under the Interim Enhanced Surface Water Treatment Rule is necessary.

None of the high-use pesticides, defined as those applied at a rate of 5,000 lbs/year or greater or applied to an area of 10,000 acres or greater, were detected in any of the samples collected in either phase of monitoring. None of the organic contaminants with a pMCL were detected in the source water samples. None of the hormones, antibiotics, or algae indicators found in the EPA's UCMR and Candidate Contaminate List (CCL) were detected.

SRWA plans to continue with semiannual source water monitoring through the completion of the construction of the WTP.

Invasive Species

To date, no invasive mussel species have been found in Don Pedro Reservoir, Modesto Reservoir, or in the upper Tuolumne River. However, the potential for these species to become introduced remains a concern. MID, DPRA, and TID are proactively coordinating with other agencies including CDFW, SFPUC, and Stanislaus County Parks and Recreation through the North Central Valley Consortium (Consortium) to establish a Prevention Program Plan (Plan) to prevent the introduction and spread of aquatic invasive species, specifically quagga and zebra mussels. The Prevention Program seeks to prevent introduction through assessment of vulnerability of a water body, public education, monitoring, and management of recreational activities.

Asian clams are widespread in California, are present in Modesto Reservoir, and have been observed in the ozone contactor of the conventional half of the MRWTP, as well at the bottom of the membrane basin. According to the USGS fact sheet (https://nas.er.usgs.gov/queries/FactSheet.aspx?speciesID=92), Asian clams have the ability to impact treatment through their potential to clog pipes and disrupt water flow.

Conclusions and Recommendations

The primary potential contaminant sources in the Don Pedro Reservoir subwatershed include wastewater SSOs, recreational activities, septic tank and leach field systems, mine runoff, and unauthorized activity. Water quality issues include invasive species and *Cryptosporidium* and *Giardia*. The overall water quality in Modesto Reservoir is good. MID has been diligent in maintaining water quality records from their sampling efforts. Significant sources of contamination for Modesto Reservoir include recreational activities and the resident goose population. Water quality issues include algae, invasive species, and *Cryptosporidium* and *Giardia*.

The primary potential contaminant sources in the Lower Tuolumne River study area result from agricultural activities. Source water monitoring performed 2016 to 2018 near the intake for the proposed SRWA WTP indicate that water quality issues include moderate levels of total coliform and *E. coli*.

As described in this report, the SWRCB/RWQCB, Stanislaus County, and several other agencies have policies and controls in place to protect the natural resources of the watersheds. Based on the findings and conclusions of this watershed sanitary survey, the following additional controls are recommended:

1. MID should continue to work with DRPA to establish notification procedures from the CVRWQCB of any wastewater SSOs that occur in the watershed. In the past four years, MID did receive notification for SSO spills, which totaled 12,500 gallons discharged to waterways, much less than the last 4 years.
2. MID currently monitors the source water in the Modesto Reservoir according to the MRWTP permit requirements. In addition, sampling at the Don Pedro Reservoir should be performed at least once every 5 years. The latest data available is from sampling performed in August 2012 and limited analysis of samples taken by DPRA (2015-2018). MID should maintain communication with DPRA regarding any future water quality testing performed at the Don Pedro Reservoir. Available future water quality data should be compared to the 2012

and 2015-2018 sampling as a basis for water quality assessment in Don Pedro Reservoir.

3. MID should continue to work with the DPRA and Stanislaus County Parks and Recreation to maintain consistent invasive species monitoring and inspection practices for both the Don Pedro and Modesto Reservoirs. In addition, MID should encourage regular re-evaluation for maximum effectiveness of the self-inspection program. In addition, MID should encourage regular re-evaluation for maximum effectiveness of the self- inspection program. To minimize risk of introducing mussels through raft boats on the Tuolumne River just upstream of Don Pedro Reservoir, MID and DPRA should continue to work with the USFS to help them with an ongoing Mussel Prevention Program similar to the DPRA program.
4. Algae monitoring at Modesto Reservoir is currently being performed bi-weekly.
5. MID is currently performing bi-weekly algae monitoring at Modesto Reservoir and this should continue. Cyanotoxins monitoring should be performed if algae blooms are suspected.
6. MID should continue all sampling required by DDW and be prepared to add analysis for future constituents of concern and UCMR5 constituents as it relates to MID.
7. MID should begin monitoring for microplastics as soon as DDW issues requirements and approved methods are available.
8. Ten percent higher TOC levels observed in Modesto Reservoir in the last 5 years could lead to higher DBP levels in the distribution systems for MID. For now, MRWTP has been able to meet all water quality goals with the slightly higher TOC. MID should continue to monitor TOC and be prepared to develop strategies to remove additional TOC, if needed.
9. MID should confirm that new cropland or converted lands do not have the potential to drain contaminants directly into the water ways.
10. SRWA should continue the extended Phase 2 Extended Monitoring Sampling Program (semi-annual sampling) shown in Appendix L. In addition, the Tuolumne River supply should continue to be sampled for PFAS (as initiated March 2019), as well as add sampling for UCMR5 constituents,
11. SRWA should begin monitoring for microplastics as soon as DDW issues requirements and approved methods are available.
12. SRWA should start algae monitoring if algal blooms are detected in Don Pedro Reservoir, the Tuolumne River, or if any water treatment challenges arise as a potential result of raw water algae. Cyanotoxins monitoring should be performed if algae blooms are suspected of occurring.

13. The mean total coliform value from samples collected during Phase 2 sampling in the Lower Tuolumne River was 3,400 MPN/100 mL, with a maximum of up to 16,000 MPN/100 mL. The SRWA should continue to monitor coliform levels and evaluate any potential impacts on the design of SRWA's WTP. The proposed SRWA treatment plant that includes coagulation, flocculation, sedimentation, ozone, and biological filters is a robust treatment train that is expected to meet and exceed treated water quality standards.
14. SRWA should coordinate with MID in future watershed water quality sampling efforts following forest fires in shared watershed areas.
15. SRWA should, upon commissioning of the new SRWA WTP, engage with local authorities who have regular interactions with the watershed and Tuolumne River to inform them of the new SRWA plant and source water quality objectives. The goal is to establish proactive communication around the identification of unauthorized activities that could impact water supply. Local authorities may include County law enforcement and Fish and Wildlife.

1 Introduction

This Watershed Sanitary Survey (WSS) is prepared for the Modesto Irrigation District (MID) and Stanislaus Regional Water Authority (SRWA). The California Surface Water Treatment Rule (SWTR) requires that all domestic water suppliers using surface water supply sources conduct a watershed sanitary survey of their water supply watersheds, and to update that survey every five years thereafter. The survey is required to evaluate potential contaminant sources within the watershed that may impact drinking water quality. MID completed its initial Watershed Sanitary Survey for the Modesto Reservoir Watershed in June 1996, and its most recent update was for the period ending in September 2014. This Watershed Sanitary Survey update covers a five-year period since the last survey and is expanded to include the Lower Tuolumne River Watershed, which is tributary to the SRWA intake. This section discusses the history of source water protection in the watershed, project objectives, the conduct of the study, and report organization. Please note that for context some information from the previous WSS was left in this document.

1.1 Background

Source water protection is the first and foremost barrier required for inclusion in a well-developed, multiple-barrier protection and treatment plan for public drinking water supplies. A comprehensive source water protection program can prevent contaminants from entering the public water supply, reduce treatment costs, and increase public confidence in the quality, reliability, and safety of drinking water supplies. Developing and implementing source protection includes an assessment of potential sources of contamination in the watershed.

The 1986 Amendments to the Safe Drinking Water Act (SDWA) SWTR required watershed sanitary surveys and watershed management plans only for surface water supplies qualifying for filtration avoidance. The State of California Title 22, Code of Regulations (CCR), Article 7, Section 64665, requires all water suppliers to conduct a sanitary survey of their watersheds at least once every five years.

As a result of the additional SDWA Amendments of 1996, source water protection has become a national priority. The 1996 amendments required that a more comprehensive, watershed-based “prevention” approach be applied for the purpose of improving and preserving water quality of the public water supply source. The prevention approach has two key elements:

- Assignment of primary responsibility to the individual states, in recognition of each state’s unique characteristics, flexibility, expertise, and resources needed to achieve optimum results.

- A strong directive to include public information disclosure and involvement within the states' decision-making processes.

The preparation of this watershed sanitary survey fulfills the SWTR requirement, and the national and state goals of developing a comprehensive watershed-based prevention approach to water quality.

1.2 Objectives

The objectives of this watershed sanitary survey are to:

- Meet the SWTR requirements for a watershed sanitary survey;
- Analyze water quality data available at the intakes and evaluate with respect to applicable drinking water regulations in the watershed;
- Conduct an inventory of potential contaminant sources within the watershed study areas, updating changes in conditions and activities since 2014;
- Report on future development that might impact water quality;
- Evaluate existing controls and management practices intended to protect drinking water quality within the watershed; and
- Provide recommendations for implementation in order to protect water quality.

1.3 Conduct of the Study

HDR prepared this watershed sanitary survey. The literature survey consisted of collecting and reviewing reports, maps, and public agency file documents, and other available information from government agencies and other stakeholders in the watershed. Additional information was gathered by contacting government agencies and other entities regarding specific facilities and programs in person and electronic communications.

Sampling results at the Modesto Reservoir intake and the lower Tuolumne River near the infiltration gallery are the primary data used in the water quality evaluation. HDR conducted a field survey in June and November 2019. The field surveys included visual inspection of potential impacts to water quality including erosion, runoff, unpermitted encroachments, and land uses. Representative photographs are provided in the photo appendix at the end of this document.

1.4 Report Content and Organization

The content and organization of this watershed sanitary survey is consistent with the format recommended in the American Water Works Association California-Nevada Section Watershed Sanitary Survey Guidance Manual (1993). The report is organized according to the following sections:

- Introduction
- Watershed Study Areas and Water Supply Systems - This section provides an overview of the physical, hydrologic, and land use characteristics of the watershed. The treatment plants are described, and a summary of upstream and adjacent watershed sanitary surveys is provided.
- Potential Contaminant Sources - This section describes the contaminant sources in the watershed, assesses the water quality implications of these sources, and describes existing watershed conditions management activities currently in place.
- Water Quality - This section contains a brief update of the regulations. An evaluation of the source water and finished water quality data that have been collected in the last five years, and recommended monitoring improvements.
- Conclusions and Recommendations - This section contains the key findings from this sanitary survey and recommendations.
- A complete list of references used in the preparation of this watershed sanitary survey is included at the end of this report.

This page intentionally left blank

2 Watershed Study Areas and Water Supply Systems

2.1 Watershed Sanitary Survey Study Area Descriptions

The Tuolumne River is a primary tributary to the San Joaquin River, extending from an extensive network of tributaries in the Sierra Nevada to its confluence with the San Joaquin River in the San Joaquin Valley west of Modesto (see Figure 2-1). Flows on the major tributaries, and the Tuolumne River itself, are controlled by operational releases from various dam facilities.

Upstream of Don Pedro Reservoir, the Upper Tuolumne River watershed covers approximately 1,000 square miles and lies entirely within Tuolumne County. The Don Pedro Reservoir Subwatershed, however, does not include the subwatershed upstream of O'Shaughnessy Dam, which forms Hetch Hetchy Reservoir, because a watershed sanitary survey is prepared for that subwatershed by the SFPUC. Downstream of Don Pedro Reservoir, the Lower Tuolumne River is primarily within Stanislaus County. Modesto Reservoir and the Upper Main Canal are located in Stanislaus County.

Water from Don Pedro Reservoir travels downstream to the La Grange Diversion Dam where water is diverted into the TID and MID upper main canals. The TID canal fills Turlock Lake and the MID canal fills Modesto Reservoir. Tuolumne River water not diverted at La Grange Diversion Dam travels downstream from La Grange Diversion Dam to the San Joaquin River.

For the purposes of this watershed sanitary survey, the watershed is divided into three parts: (1) the Don Pedro Reservoir Subwatershed, (2) the Modesto Reservoir Subwatershed, which includes the lands that drain directly into Modesto Reservoir and the Upper Main Canal, and (3) the Lower Tuolumne River Subwatershed, which includes lands that drain into the Tuolumne River downstream of the La Grange Diversion Dam (see Figure 2-1).

MID operates the MRWTP with intake located at the Modesto Reservoir. The primary water supply source to the MRWTP is the Tuolumne River, which is diverted to Modesto Reservoir, via MID’s Upper Main Canal at the La Grange Diversion Dam. The Don Pedro Reservoir Subwatershed and the Modesto Reservoir Subwatershed are tributaries to the MRWTP intake.

SRWA is in the process of design and construction of a water treatment plant that will have an intake through an existing infiltration gallery operated by TID on the Tuolumne River outside of the town of Hughson. The primary water source for the SWRA WTP is the section of the Tuolumne River west and downstream of the La

Grange Diversion Dam. The Lower Tuolumne River Subwatershed and Don Pedro Reservoir Subwatershed comprise the watershed upstream of the SWRA intake (excluding the Hetch Hetchy watershed).

2.1.1 Don Pedro Reservoir Subwatershed Study Area Description

The Don Pedro Reservoir Subwatershed is predominantly undeveloped. The lower one-third of the watershed is rural grassland, with small towns along the major highways (see Figure 2-2). The upper two-thirds lie within the Stanislaus National Forest or Yosemite National Park, where the United States Forest Service (U.S. Forest Service) maintains numerous campgrounds. Don Pedro Reservoir is located at the lower end (i.e., western end) of the subwatershed, and is a popular location for boating, swimming, and camping. Don Pedro Reservoir has a capacity of 2,030,000 acre-feet, covering a surface area of 12,960 acres with 159 miles of shoreline.

Tuolumne County lies entirely within the foothills and higher elevations of the Sierra Nevada Mountains, and is relatively unpopulated. The towns within Tuolumne County each have a population less than 5,000 (see Table 2.1.). The watershed boundaries, population, land use, and human activities did not significantly change in the Don Pedro Reservoir subwatershed between 2014 and 2019.

The towns within the watershed are primarily located either along Highway 108, which parallels the northern watershed boundary, or Highway 120, which lies just north of the southern watershed boundary. Sonora is the largest town in the watershed, is the only incorporated city, and is also the county seat. Sonora has one high school and one alternative high school.

Jamestown is southwest and adjacent to Sonora; both towns are at the intersection of Highway 108, and Highway 49, which travels in a north-south direction in the western foothills of the watershed. Jamestown has one main street with a number of restaurants and shops that attract tourists. Jamestown is also home to Railtown State Historic Park, a popular destination for train enthusiasts and other visitors. South of Highway 108, and 10 miles east of Sonora, lies Tuolumne City, which offers the second high school in the area.

Groveland, Big Oak Flat, and Pine Mountain Lake are the largest communities situated on Highway 120, and Groveland is home to a large community park, Groveland Wayside Park. The smaller communities along Highway 120 include Chinese Camp and Buck Meadows, which lies just outside of the Don Pedro Reservoir Watershed in Mariposa County.

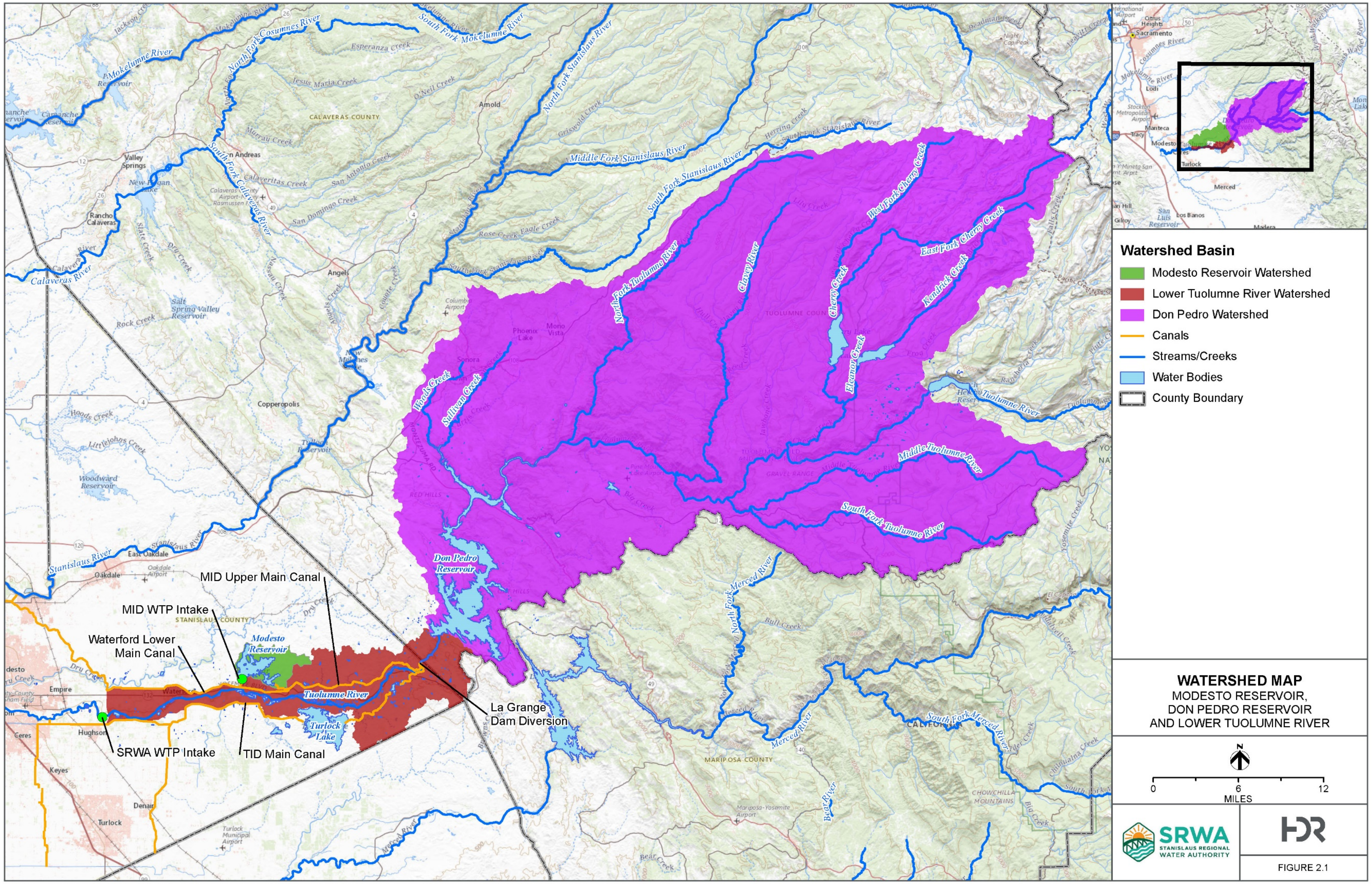


Figure 2-1. Modesto Reservoir, Don Pedro Reservoir, and Lower Tuolumne River Subwatersheds

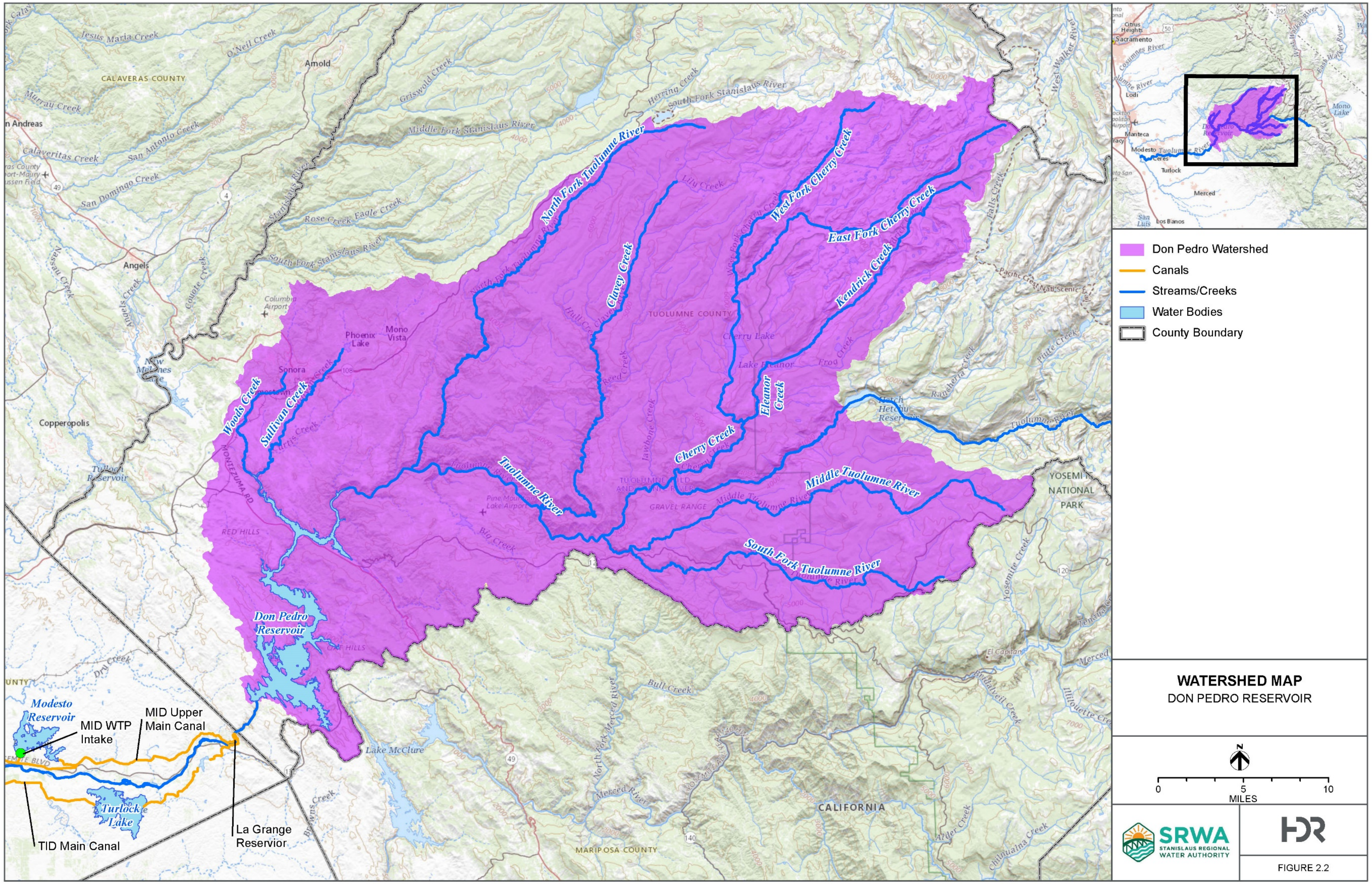


Figure 2-2. Don Pedro Reservoir Subwatershed

Table 2.1. Population of Towns within the Don Pedro Reservoir Watershed

Town	Population
Cedar Ridge CDP	1,003
Chinese Camp CDP	184
Cold Springs CDP (Tuolumne County)	125
East Sonora CDP	2,504
Groveland CDP	377
Jamestown CDP	2,621
Long Barn CDP	0
Mi-Wuk Village CDP	1,170
Mono Vista CDP	3,018
Phoenix Lake CDP	4,521
Pine Mountain Lake CDP	2,484
Sierra Village CDP	590
Sonora city	4,810
Soulsbyville CDP	2,167
Tuolumne City CDP (Tuolumne County)	1,628
Twain Harte CDP	2,275

Source: 2012-2016 American Community Survey (ACS), 5-year estimates
Incorporated City. All others are census designated places (CDPs)

Twain Harte, another town in the watershed, is situated along Highway 108. Twain Harte has a small, but busy, downtown and a large community park, Eproson Park, which features a golf course, tennis courts, stage, and skate park. The smaller communities along Highway 108 include Mi-Wuk Village, Sierra Village, and Long Barn. These communities can be characterized as clusters of residential developments.

U.S. Forest Service campgrounds can be found throughout the Stanislaus National Forest in the upper watershed, including at Cherry Lake, the largest lake in the Stanislaus National Forest. U.S. Forest Service campgrounds also can be found throughout Yosemite National Park farther east in the watershed.

The Tuolumne Band of Me-Wuk Indians' Black Oak Casino is located on an otherwise rural road north of Tuolumne City. The casino offers gambling (1,300 slot machines, 25 table games), a 148-room hotel, 4 restaurants, 3 bars, live entertainment, and a bowling alley and arcade. The casino opened an outdoor amphitheater in May

2018 with capacity for 6,000 people. The venue hosted 12 events in 2019 from May through October.

Wineries, white water rafting, cave spelunking, skiing, snowboarding, jet skiing, gold mine tours, Columbia State Park, Pinecrest Lake and Lake Don Pedro also attract tourists to Tuolumne County.

The SFPUC invests in a Watershed and Environmental Improvement Program (WEIP) in order to proactively manage, protect, and restore environmental resources that affect or are affected by the operation of the SFPUC water supply system. The SFPUC has committed $50 to WEIP objectives that focuses on five watersheds (Upper Tuolumne River, Lower Tuolumne River, Alameda Watershed and Peninsula Watershed, and San Francisco Lands). The Annual Report FY 2015-2016 (see Appendix A) summarizes the following priorities by watershed.

- Upper Tuolumne River (O'Shaughnessy Dam to Don Pedro Reservoir): Fund collaborative studies and monitoring partnerships as part of the Upper Tuolumne River Ecosystem Program
- Lower Tuolumne River (downstream of Don Pedro Reservoir): Protection of low-lying flood areas through permanent conservation easements and/or fee title purchase of the property from willing land owners.

The SFPUC and partner agencies meet regularly with the Upper Tuolumne River Stakeholders Group to provide updates and receive input from participants. As of the time of preparation of the Annual Report FY 2015-2016, approximately $7M in bond and operating funds had been invested to meet WEIP commitments in the Tuolumne River Watershed.

The Hetch Hetchy Reservoir watershed includes supply watersheds that directly contribute to the Tuolumne River and the areas immediately surrounding the Moccasin and Priest reservoirs, as well as watersheds that contribute supply under adverse conditions. In 2018, leaks form the Moccasin Diversion Dam caused concern that the dam could fail. The flow from Don Pedro Reservoir to Tuolumne River was increased to make room for potential water coming from Moccasin Diversion Dam in the event of a failure. The increased flow from the Don Pedro Reservoir to the Tuolumne River contributed to a temporary increase in organics coming into the Modesto Reservoir during that time.

2.1.2 Modesto Reservoir and Upper Main Canal Watershed Description

The Modesto Reservoir Subwatershed includes the lands that drain directly into Modesto Reservoir and the Upper Main Canal. Modesto Reservoir can store 28,000 acre-feet of water and receives water releases from the Tuolumne River from the La Grange Diversion Dam through the MID Upper Main Canal to meet lake level needs, as a byproduct of hydro generation and to meet downstream water demands (agricultural and domestic). The Modesto Reservoir Subwatershed is approximately 11,500 acres (18 square miles) and is characterized by rolling plains with elevation changes of only 100 feet from the highest edge of the watershed to the reservoir water surface.

The Modesto Reservoir watershed extends primarily to the east and north of the reservoir (see Figure 2-4). The land use is primarily range land to the east, and range land and almond orchards to the north. Several land owners in the watershed converted pastures to vineyards and orchards since the last WSS, totaling 8,585 acres converted from range land between 2014 and 2019. The range land converted in the past 5 years is identified in Figure 2-3.

Stanislaus County manages a recreational area at Modesto Reservoir, with facilities located primarily at the southern, eastern and western edges of the reservoir. The Modesto Reservoir recorded between 50,000 and 150,000 visitors each year 2014 to 2018 (Table 3.7). Recreation activities at the reservoir include swimming, boating, waterskiing, picnicking, archery, overnight camping, and music and wellness festivals.

The Upper Main Canal traverses agricultural grasslands and range lands from the La Grange Diversion Dam to Modesto Reservoir. Although the canal is largely bermed on both sides, some lands drain into the canal. MID graded the canal banks to minimize run off into the Upper Main Canal, as recommend in the 2009 WSS. However, observations during the field survey suggested that some orchards planted since the 2014 WSS appear to be graded such that runoff from orchards may enter the canal. Most of the land around the Upper Main Canal drains to the Tuolumne River (downstream of the watershed). There are no towns or communities in the area that drain directly into Modesto Reservoir or the Upper Main Canal. The only structures are the canal itself, a few farms, and recreational facilities at Modesto Reservoir, including developed campsites, restrooms, and a marina with boat ramps.

On November 25, 2019, HDR completed a physical survey of the Modesto Reservoir watershed that included the following primary elements:

- Modesto Reservoir and Facilities
- MID Main Canal from the Reservoir east to La Grange Road

A number of representative photos were taken during the survey representative of conditions and they are included in the photo appendix at the end of this document.

Modesto Reservoir Recreation Facilities

Overall the facilities were observed to be in very good condition with a number of Best Management Practices (BMPs) in place that protect water quality. Signage restricting the location of public camping is provide along the waterfront in areas in order to provide a water quality buffer.

Trash cans were spread out throughout the day use areas and campgrounds with both 4 cubic yard bins and 50 gallon trash cans throughout. The 50-gallon trash cans were tethered to trees or poles in order to protect from being blown over and spilling. Oil absorbent disposal cans are provided at the boat ramps. Dedicated hot coal disposal containment is also provided in high traffic areas.

Most of the restrooms at the recreation area are vault toilets and well maintained with no indications of spills or overflow observed at the time of the survey. The recreation area also has eight restrooms with flush toilets. The sewage from the flush restrooms is pumped to an onsite wastewater treatment plant at the campground with treated effluent pumped to a percolation pond approximately 300 feet from the reservoir. The treatment plant and ponds are graded to drain away from the reservoir if there is a spill. These restrooms were also observed to be well maintained and very clean.

No dogs are allowed on the property and signage is provided accordingly throughout. The invasive species control program is in full effect with a turnout for boat mussel inspection provided at the reservoir entrance for and an electronic sign clearly indicating the need for boat inspection with additional signage placed strategically at each of the boat ramps.

The only fueling area on the reservoir is for Sherriff's vessels and located at the Marina on the east side of the reservoir. An emergency shut off is provided nearby as well as a designated sampling station.

Cattle grazing is limited to the north and east sides of the reservoir and along the Main Canal directly upstream from the inlet to the Modesto Reservoir. MID staff report that the rancher with cattle along the northwest of the reservoir is required to provide annual reports to MID indicating the number of head, newborns, any animal fatalities, and any other changes in conditions that may impact water quality. Additionally, by agreement, the rancher is required to remove any carcasses immediately.

Potential water quality impacts directly around the Modesto Reservoir include the following and are described in detail in Section 3.

- California Department of Forestry and Fire Protection (CAL FIRE) has training or practice fires to the west of the reservoir. MID has worked closely with the department to coordinate timing of the burning around dry periods of the year and educated the department on the need to create berms on slopes facing the reservoir in order to provide additional water quality protection. MID will continue to work with CAL FIRE and this is expected to continue to be a low risk item.
- During the site survey it was observed that clearing activities were occurring on the north side of the reservoir and it appeared that the land would be converted to orchard. MID should inspect the area as work continues and

coordinate to educate the property owner in order to construct the necessary berms or grading to avoid direct drainage into the reservoir.

- Festivals bring significant crowds to the property. The Dirtybird festival was held for the second year in a row in the fall of 2019 and brought several thousand visitors to the reservoir. The event included both daytime attendance and overnight camping. The event coordinators worked with MID to bring in additional portable toilets and trash cans and located them away from the reservoir and drainage courses on the property. Additionally, the primary parking was located a mile from the reservoir and attendees that didn't have vehicle passes were shuttled from the parking lot to the overflow campgrounds, which were set back from the shoreline. MID monitored conditions throughout the event and immediately following the event and results of that sampling event are provided Section 4. Another event, the Sum of Us Festival, is planned to take place at the Modesto Reservoir in May 2020 and expects 500-1,000 attendees. It is unknown if this festival will recur at the same location annually after the first event.
- Cattle grazing is still occurring on the north and east sides of the reservoir and adjacent to the main canal. The rancher has an agreement with MID to provide an annual report and to manage the operation to minimize exposure. These potential contact points from cattle grazing are located on the opposite side of the reservoir from the intake. Cattle grazing areas that were previously located closer to the intake have since been taken out of operation.
- Geese have been known to be a potential water quality threat. MID has been actively working with Stanislaus County to manage populations on the reservoir for a number of years.

Main Canal from the La Grange Diversion Dam to Modesto Reservoir

The MID canal from the La Grange Diversion Dam to the Modesto Reservoir is approximately 12 miles long. An offshoot canal connects the Modesto Reservoir to the MID canal approximately 10 miles downstream of the La Grange Diversion Dam. The MID canal downstream of the connecting segment does not contribute to the Modesto Reservoir watershed and is outside of the scope of this WSS. The segment connecting the MID canal and the Modesto Reservoir is approximately 2 miles long and is primarily unlined with a natural profile and vegetated sides.

After the La Grange Diversion Dam, the canal passes through 1 mile of underground tunnel to La Grange Road. Field observation of this segment was not available.

Between La Grange Road and the Modesto Reservoir connection, the Main Canal is fully concrete lined. The canal passes underground through a second 0.2 mile segment approximately 4 miles downstream of the diversion dam. The remainder of the canal is open top.

Approximately 8 locations were observed along the MID Main Canal where culverts from grazing land appeared to drain into the canal. Survey observation could not determine if the culverts are emergency overflows for periods of high-intensity storm events only or if they divert runoff more frequently. MID should monitor these culverts for any changes and observe if runoff enters the canal at these location during high storm events. Several creeks and additional runoff to the north of the MID canal are directed under the canal and enter the Lower Tuolumne River watershed.

The canal segment directly upstream from Modesto Reservoir has a natural meandering alignment with a variable cross section and wooded/vegetated banks. The property south of this connecting canal segment is grazing land and the area to the north includes orchards. Both north and south embankments of the main canal along this segment have a vegetated buffer. During the site survey, no bank erosion or other indicators of overland runoff from the adjacent properties into the canal were observed along the canal connection to the Modesto Reservoir, with the exception of one orchard to the south of the connecting canal adjacent to the MID connection point where site grading indicated that runoff from the property would enter the canal.

Access to the Main Canal is secured and includes locked gates at both ends (Modesto Reservoir-west, and La Grange Road-east). Therefore, there is minimal potential exposure to the public along this reach. The O&M Road is graveled and appeared to be well maintained. This reach includes multiple security gates, bridges, check structures, turn outs, and inlets from storm drain culverts that drain adjacent properties.

Water quality through this reach appeared to be very clear with no indications of bank erosion, or other water quality issues observed at the time of the survey.

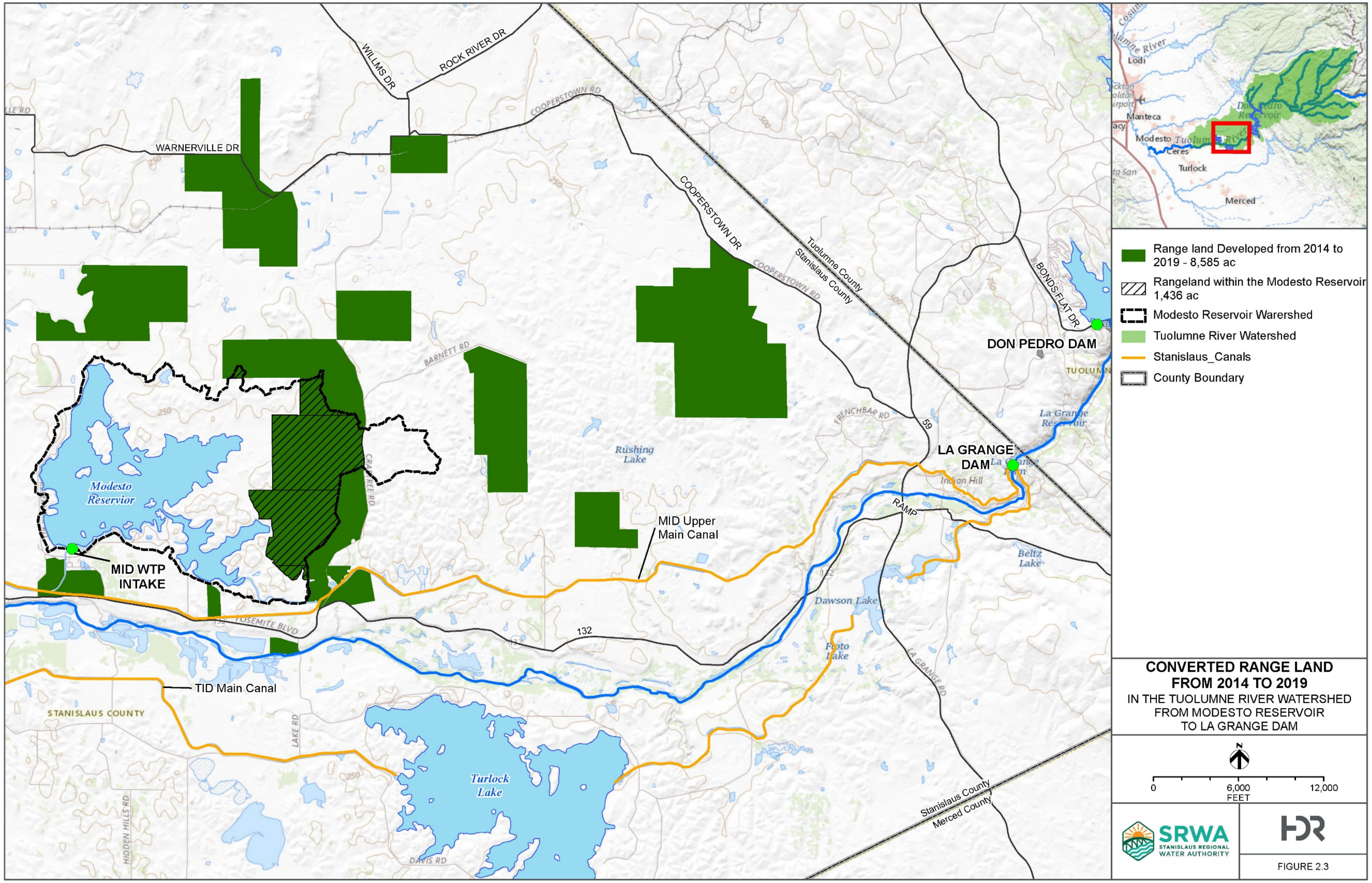


Figure 2-3. Modesto Reservoir - Upper Main Canal Land Uses (MID 2019)

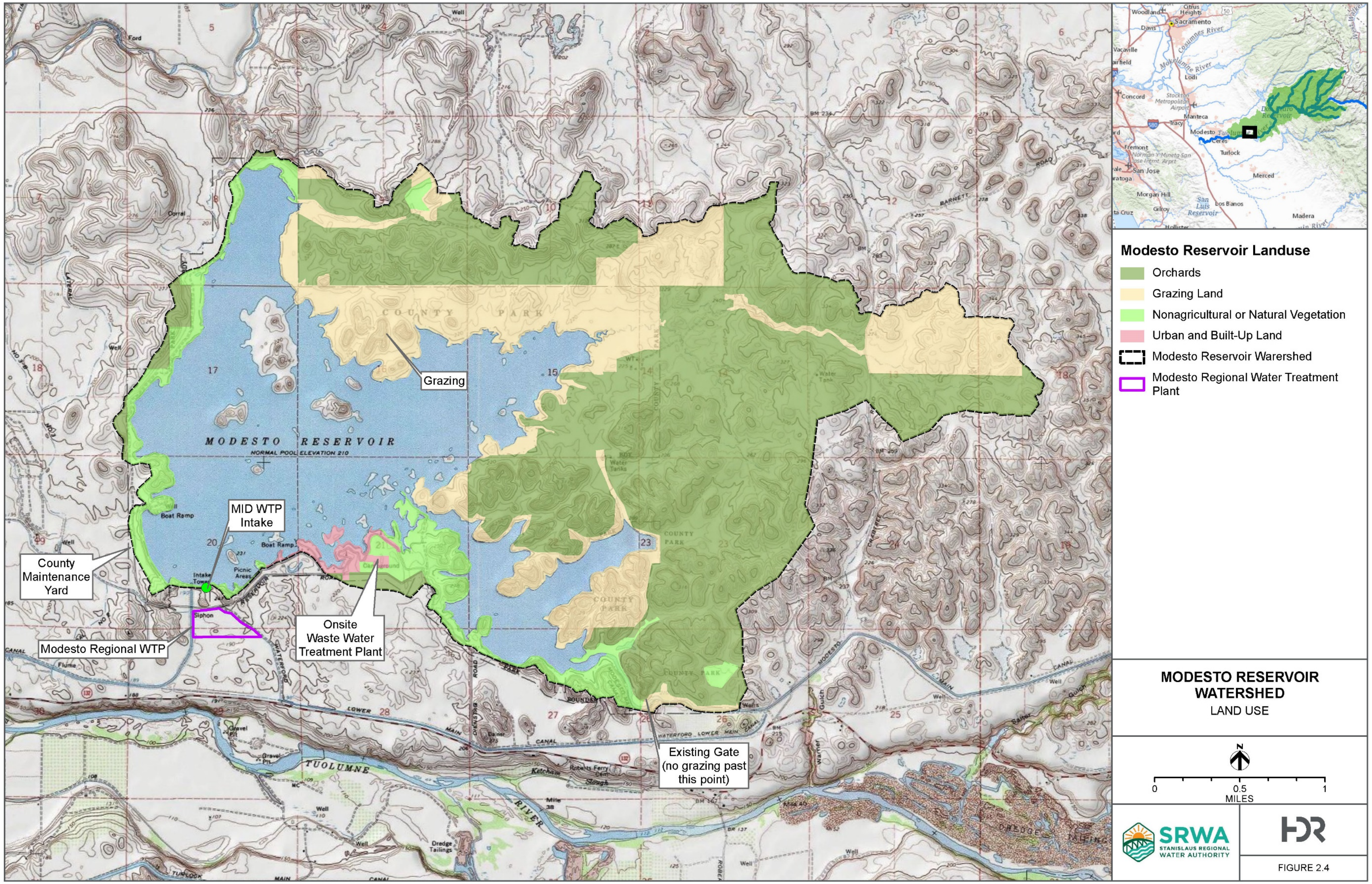


Figure 2-4. Modesto Reservoir Land Uses (2019)

2.1.3 Lower Tuolumne River Subwatershed Description

The Lower Tuolumne River Subwatershed includes approximately 29 miles of Tuolumne River drainage from downstream of the Don Pedro Diversion Dam to the TID infiltration gallery west of Geer Road (see Figure 2-5). This watershed includes 2.5 miles of Tuolumne River between the Don Pedro Diversion Dam and the La Grange Diversion Dam and does not include the Turlock Lake watershed, the TID Upper Main Canal that delivers water from La Grange Diversion Dam to Turlock Lake, or the TID Main Canal that delivers water from Turlock Lake to west of Geer Road. Turlock Lake and the TID canal previously contributed to the Lower Tuolumne Subwatershed through occasional diversions from the TID canal to the Tuolumne River over the Hickman Spill at the eastern edge of Waterford; however the Hickman Spill is no longer operational and the Lower Tuolumne Subwatershed no longer receives discharge from the TID canal.

The northern and southern boundaries of the watershed are formed by the surrounding natural topography for the easternmost 12 miles of the watershed. West of Turlock Lake, the northern boundary of the Lower Tuolumne River Watershed is mostly formed by the south bank of the MID Upper Main Canal to the Modesto Reservoir and by the MID Lower Main Canal from Modesto Reservoir westward. Lower Dominici Creek and Salter Gulch are piped under the MID Canal and flow directly to the Lower Tuolumne River. The Lower Dominici Creek culvert under the MID canal is approximately 220 ft long. The pipe terminates into open, vegetated channel that meanders approximately 2,400 ft before discharging into the Tuolumne River. The Salter Gulch culvert under the canal is approximately 250 ft long and discharges into an open vegetated channel that meanders approximately 8,000 ft prior to discharge into the Tuolumne River. There are no dairies located in proximity of either creek. Water from additional areas east of the Modesto Reservoir, and north of the MID canal, flow into the Lower Tuolumne River through groundwater seepage under the canal West of Turlock Lake, and the south bank of the watershed is mostly formed by the north bank of the TID Main Canal. The Lower Tuolumne River subwatershed ends at the TID infiltration gallery and includes only the tributaries to the Tuolumne River upstream from the infiltration gallery intake.

The MID Canal Subwatershed occasionally contributes to the Lower Tuolumne River watershed. Surplus irrigation water deliveries from MID cannot be returned to the main MID Canal and are drained to river systems or groundwater. Under these circumstances, water from the MID Canal system enters the Lower Tuolumne River primarily through surface drainage. The natural setting, land use, and existing hydrology of the Lower Tuolumne River watershed are described in the following subsections. The watershed boundaries, main watercourses, and the water source locations are shown on Figure 2-5.

In the vicinity of Waterford, the MID system includes structures to allow the return of flows back into the Tuolumne River. These structures are the Waterford Lower Main (WLM) and Lateral-1 Santa Fe in Empire. Over the last 10 years, the WLM has a mean average spill of 1,642 acre-feet per year, with a high of 3,550 acre-feet in 2011 and a low of 168 acre-feet in 2015. These flows all occurred during the irrigation season. The spill occurs directly to the river from the canal through a steep flume adjacent South Reinway Park. Lateral-1 in Santa Fe has a similar volume of return flowing to the river immediately upstream of the Santa Fe Bridge.

Other than the Modesto Reservoir, there is no groundwater percolation infrastructure under MID’s ownership in the watershed." (Source: Email communication with John Mauterer, MID Irrigation Department. 8/28/20.)

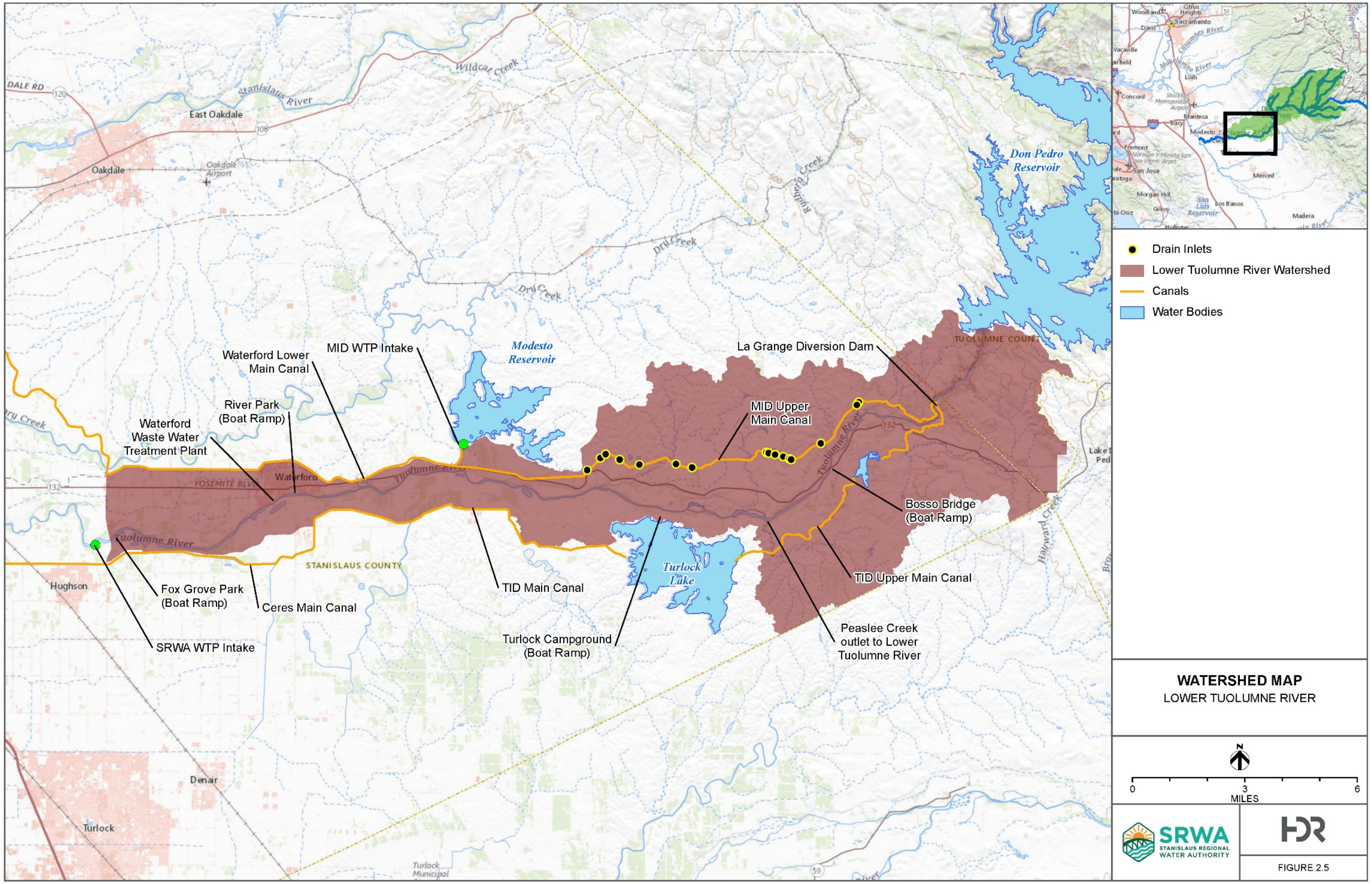


Figure 2-5. Lower Tuolumne River Watershed

This page intentionally left blank

Natural Setting and Land Use

The topography of the lower Tuolumne River Subwatershed is varied, with steep mountainous on the eastern side of the study area as the foothills of the Sierra Nevada Mountains, and rolling hills, and then flatter plains as the river flows toward the Central Valley to the west. Vegetation in the Sierra Nevada foothills of Stanislaus County is generally grassland or woodland. Non-native annual grasses make up the majority of grassland areas in the subwatershed. The woodlands in the subwatershed are predominantly California Grey Pine, Blue Oak, Interior Live Oak, and Valley Oak. Wooded areas commonly include an understory of shrubs which support a wide variety of species. Mammals common to the woodland area include bats, gray foxes, coyotes, deer, raccoons, bobcats, possums, rabbits, and rodents.

The creeks and rivers support riparian vegetation along their banks, including Willows and Fremont cottonwoods, valley oak, California sycamore, box elder, and Oregon ash with a thick shrubbery undergrowth buttonbush, honeysuckle, elderberry, and gooseberry. Smaller plants such as poison oak, nettle, mule fat, wild grape, and long-stemmed shade tolerant grasses also grow in riparian areas.

Within the study area, native land uses (including native vegetation, riparian vegetation, surface water, and/or barren lands) comprise approximately 68 percent of the land. Agriculture accounts for 29 percent of the land use, while urban areas comprise 3 percent. A more detailed summary of land uses within the Lower Tuolumne Subwatershed is provided in Table 2.2.

Soils within the Tuolumne River basin range from gravelly, cobbly debris from dredge and mine tailings in upstream portions of the subwatershed to deep, well-drained soils (Grangeville-Tujunga association, which includes soils of the recent alluvial flood plains) in the downstream portion of the subwatershed. Soils in the upstream area draining into the river are dominated by deep, slowly permeable soils on high terraces, and shallow to moderately deep soils on rolling, eroded terraces (Montepellier-Whitney association, which includes soils of the high alluvial terraces, partially eroded to rolling hills).

No earthquake faults are known to exist within the valley portion of Stanislaus County.

Table 2.2. Summary of Land Uses

Land Use	Area (acres)	Percent of Total Study Area
Agricultural		
Alfalfa	127	0.2
Almond and Walnuts	10,432	19
Corn	443	1

Table 2.2. Summary of Land Uses

Land Use	Area (acres)	Percent of Total Study Area
Grain	227	0.4
Fallow and idle	1,177	2
Grapes	564	1
Other Deciduous	1,478	3
Other Truck	9	0.02
Pasture	1,116	2
Flowers, Nursery and Christmas Tree Farms	590	1
Subtotal	16,163	29
Urban		
Urban	1,909	3
Subtotal	1,909	3
Native Classes		
Native classes	35,423	63
Water	2,570	5
Subtotal	37,993	68
TOTAL	56,064	100

Source: California Department of Conservation, Division of Land Resource Protection, Farmland Mapping and Monitoring Program. *Stanislaus County Important Farmland.* (2018).

The only incorporated area within the Lower Tuolumne River Subwatershed is the City of Waterford. Waterford has an estimated 8,957 residents as of 2018 census population and lies primarily on the northern bank of the Tuolumne River. Several residences in Waterford are within 100 feet of the River. These residences are included in the area served by the City of Waterford sewer system and WWTP. The City is serviced by a central municipal sewer collection with treatment at the City of Waterford Wastewater Treatment Plant located adjacent to the northern bank of the Tuolumne River near Hickman Bridge. The unincorporated communities of Hickman and La Grange lie within the study area. Although Hickman is supplied with drinking water service by the City of Waterford, both Hickman and LaGrange have septic, rather than sewer connections. (Source: http://www.stancounty.com/planning/bp/sewer-and-water.shtm).

Land ownership in the watershed is mostly private, with farming as the overwhelming private use of the land. Publicly-owned areas are mostly park lands, including Stanislaus County's La Grange Regional Park and Fox Grove Park (owned by California Department of Fish & Wildlife [CDFW] and operated by the County) adjacent to the infiltration gallery. Public access to the river is available at several boat launch locations along the Lower Tuolumne River.

MID owns the land north of the Tuolumne River for approximately 1.5 river miles downstream of La Grange Diversion Dam. TID owns the land south of the Tuolumne River between the TID Upper Main Canal and the Tuolumne River from La Grange Diversion Dam to upstream of the Highway 132 crossing.

Existing Hydrology

The Tuolumne River originates at the Mount Lyell glacier in Yosemite National Park and flows west 150 miles through the San Joaquin Valley until it meets the San Joaquin River (Figure 2-1). The river passes through Hetch Hetchy Reservoir and Don Pedro Reservoir before reaching the La Grange Reservoir where TID and MID divert water for irrigation purposes and drinking water supply. Flow in the lower Tuolumne River is supplied by releases from La Grange Reservoir which is owned and operated by TID and MID. Water from La Grange Reservoir: (1) supplies the TID system through the TID Upper Main Canal, (2) supplies the MID system through the MID Main Canal, and (3) is released to the Lower Tuolumne River for reservoir operating purposes and to satisfy minimum in-stream flow requirements established by the Federal Energy Regulatory Commission (FERC).

Flow in the Lower Tuolumne River varies greatly both annually and monthly depending on precipitation, upstream diversions, releases from New Don Pedro Reservoir, water year type, and associated flood control operations. During winter and spring months, flow in the river is usually at its highest due to storm runoff and flood control releases from New Don Pedro Reservoir. Winter and spring total seasonal flow through the Lower Tuolumne River at La Grange Diversion Dam averaged nearly 100,000 acre-ft during 2015 to 2019. Flow is usually at the lowest from July through December, averaging a total seasonal flow of 190,700 acre-ft during the summer and fall season. Groundwater inflow during these months may consist largely of applied irrigation water that has leached down through the soil and accounts for a large proportion of the river flow during very dry years when required instream flow releases are low.

The TID infiltration gallery is located approximately 25 river miles downstream from the La Grange Diversion Dam. From La Grange Diversion Dam to the infiltration gallery, the Tuolumne River Watershed is limited in topography and range, and there are only a few seasonal tributaries to the river within this area. TID maintains a consistent 300 cubic feet per second (cfs) flow in the river downstream of La Grange Diversion Dam for salmon spawning.

2.2 Watershed Sanitary Survey Summaries

Watershed sanitary surveys prepared by other water agencies for upstream, overlapping, or adjacent sections of the Tuolumne River and Modesto Reservoir are summarized in this section. Additional watersheds adjacent to the Lower Tuolumne River and Modesto Reservoir Watershed are shown in Figure 2-6.

2.2.1 SFPUC Hetch Hetchy Reservoir Watershed Sanitary Survey

The SFPUC prepares a Watershed Sanitary Survey for the Hetch Hetchy Reservoir annually and local water sources and upper non-Hetch Hetchy sources every five years. The 2009-2012 Hetch Hetchy WSS Annual Reports were summarized in the MID 2014 Modesto Reservoir WSS. The executive summaries of the 2013-2018 Hetch Hetchy WSS Annual Reports were made available for review by SFPUC for this report.

The Hetch Hetchy watershed is located in Yosemite National Park and is managed by the National Park Service (NPS) who provides the protection activities that are deemed necessary by the SFPUC and outlined in a memorandum of agreement (MOA) between SFPUC and NPS. Program components specified in the MOA include Park Ranger duties, including contacts with the public, good erosion control along trails, and signage and public education regarding public protection requirements.

Hetch Hetchy Reservoir water regularly meets all Federal and State filtration avoidance criteria, including watershed protection, bacteriological quality, and operational standards. One of the criteria for continued filtration avoidances is to maintain a watershed control program that is designed to effectively limit or minimize potential contamination by *Giardia lamblia* cysts, viruses, and *Cryptosporidium* oocysts. The SFPUC effectively maintains a watershed control program that includes the identification, monitoring, and control of watershed characteristics and activities which may have an adverse effect on the source water quality.

Recommended improvements for reducing potential contaminating activities in the Hetch Hetchy reservoir watershed included more consistent interpretive information and signage, human waste management (particularly replace the Tuolumne Meadows Wastewater Treatment Plant which is outdated), animal waste management (maintain corral mitigations at Tuolumne Meadows), and trail maintenance (mitigate trail erosion to Elizabeth Lake). Recommended mitigations for potential contaminating activities in the Priest and Moccasin Supply reservoirs and areas adjacent to these watersheds include continued wildlife control for waterfowl and swallows, fuelbreak and vegetation management to reduce potential wildfire impacts, and road maintenance improvements to minimize soil erosion. These recommendations were consistent in all annual update reports 2013 through 2018.

In June 2014, NPS approved the "Record of Decision" for the Tuolumne River Plan that allows for permanent improvements to be made in the watershed. Initial projects undertaken included removal of the Tuolumne Meadows gas station building and paving of the road system in the Tuolumne Meadows Campground in 2017, trail rehab work on the Soda Springs trail in 2017 and 2018, trail rehabilitation work on a segment of the Great Sierra Wagon Road between Lambert Dome and Tuolumne Lodge in 2018, and the Restore Tuolumne Riverbanks project in 2018. NPS is responsible for planning and implementation of Tuolumne River Plan projects.

A significant storm event in March 2018 caused significant flooding impacts in the Priest and Moccasin watersheds. Multiple facilities sustained damage from the flooding and unapproved water entered both balancing reservoirs. Priest reservoir had been substantially lowered prior to the event for maintenance and Moccasin reservoir was taken out of service the day of the event and remained out of service through the end of the year. Unapproved water also entered the Foothill Tunnel and traveled to Red Mountain Bar where it was discharged into the Don Pedro Reservoir. Flood damage repairs were initiated immediately after the storm event and continued through the end of the year.

The following significant potential contaminant sources have been identified for the Hetch Hetchy Reservoir:

- Recreation usage: swimming is not allowed in the Hetch Hetchy Reservoir and within one mile upstream of any tributary.
- Unauthorized activities: camping too close to lakes or streams, improperly disposing of human waste, and overflowing of Tuolumne Meadows wastewater detention ponds.
- Wildfires: the 2013 Rim Fire reached the shores of the reservoir, although less than 2 percent of the fire occurred within the Hetch Hetchy watershed. SFPUC is actively involved in wildfire incident management to ensure water quality concerns are addressed during fire suppression activities.

The following significant potential contaminant sources have been identified for the Moccasin Creek watershed:

- Wildlife: wildlife control programs for waterfowl and swallows have been implemented to maintain low fecal coliform bacteria levels.
- Soil erosion: gopher burrows appear to be causing shoreline erosion and elevated turbidities in Priest Reservoir.
- Wildfire: Fuel breaks and vegetative management have been effective in minimizing wildfire impacts.
- Grazing: grazing occurs on private land in the watershed.

- Mining: there are 107 mining claims in the Moccasin Creek Natural Watershed.
- Waste disposal facilities: Groveland Community Services District lift station, the Moccasin Wastewater System, and Big Oak Flat Waste Transfer station are all potential contamination sources.
- Flooding: flooding from a significant storm event in March 2018 caused damage to multiple facilities and unapproved water entered both balancing reservoirs.

Water quality monitoring conducted in 2013 through 2018 found that:

- All turbidity monitoring and fecal coliform samples collected at Tesla Portal, the Filtration Avoidance (FA) compliance point for the San Francisco Regional Water System, complied with FA requirements in all annual sampling events
- Results of all turbidity monitoring and fecal coliform measurements for the three Upcountry small water systems also complied with FA requirements in all annual water quality sampling events
- Annual source water quality sampling at the Hetch Hetchy and Moccasin reservoirs found no primary chemical contaminants at levels above the detection limits for reporting (DLRs). Aluminum (a secondary contaminant) was detected at levels above DLR in 2016, 2017, and 2018 and iron (also a secondary contaminant) was detected at levels above the DLR in 2018.

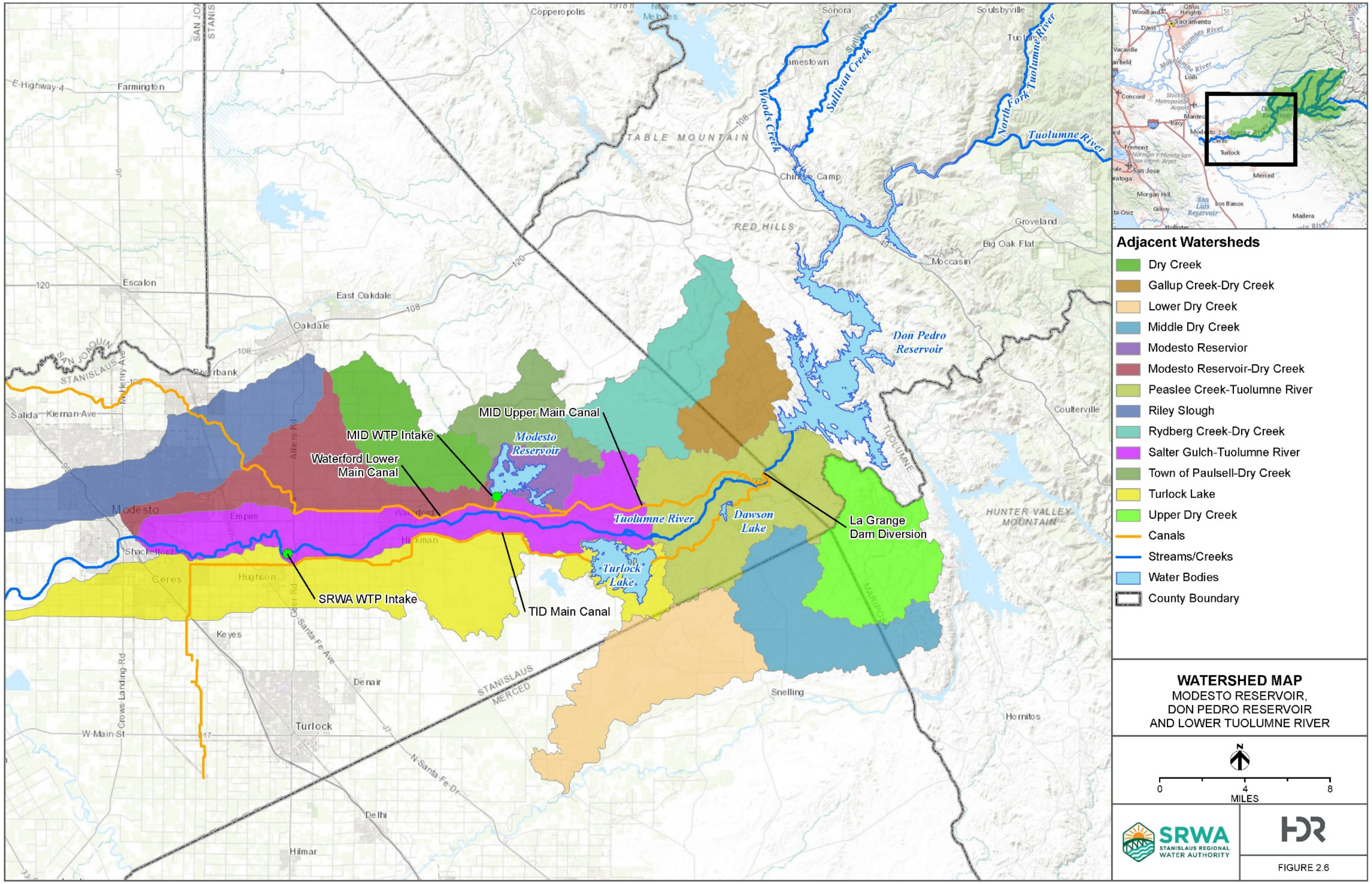


Figure 2-6. Adjacent Watershed Sanitary Survey Boundaries

This page intentionally left blank

2.2.2 Don Pedro Recreation Agency Don Pedro Reservoir Watershed Sanitary Survey

DPRA is not required to prepare a separate WSS because the Don Pedro Reservoir watershed is captured in this WSS prepared for MID and SWRA. Previously identified contaminating activities of significant impact include non-body contact recreation and naturally-occurring activities such as fires. Wastewater discharges and overflows have not been significant.

2.2.3 TID Lower Tuolumne River and Turlock Lake Watershed Sanitary Survey

Turlock Irrigation District (TID) prepared their most recent watershed sanitary survey in 2008 for the Lower Tuolumne River, downstream of La Grange Dam, including Turlock Reservoir. The Lower Tuolumne River watershed is included in the study area of this WSS; the Turlock Lake Watershed is outside the watershed study area.

Turlock Lake receives inflow from the TID Upper Main Canal, which diverts water at La Grange Dam far upstream from the infiltration gallery. The Turlock Lake Watershed was included in the TID WSS study area because water from the TID Main Canal section, that transports water from Turlock Lake, was occasionally diverted to the Tuolumne River at Hickman Spill, 6.7 miles upstream of the infiltration gallery, during wet years. The Hickman spill is no longer in operation, therefore Turlock Lake is no longer considered a tributary to the SRWA intake at the TID infiltration gallery.

The following significant potential contaminant sources were identified:

- Wastewater treatment facilities: The City of Waterford WWTP is located along the Tuolumne River upstream of the TID infiltration gallery.
- Pesticide/herbicide use in agriculture: The Tuolumne River is identified as an impaired water body for diazinon, a common pesticide applied primarily to almond orchards. Almonds are the primary crop grown in the Lower Tuolumne River watershed.
- Grazing animals which have access to creeks: Grazing occurs primarily on private lands. Several hundred acres of grazing land adjacent to Peaslee Creek had been converted to orchards.
- Dairies, dairy waste land application, and a cattle feedlot: two dairy operations and one feedlot are located in the watershed. The closest dairy is Sawyer Dairy, located at Roberts Ferry Bridge, approximately 14 miles upstream from the SRWA Intake. These facilities are regulated by the WDR and surface water discharges are prohibited. No indication or reports of surface discharge were identified for the study period.

- Wild animals: Wildlife along the riverbanks and surrounding riparian habitat are a potential source of *Giardia*, *Cryptosporidium*, viruses, and bacteria.
- Spills from traffic accidents on bridges or adjacent roads: Traffic accidents are projected to increase due to projected population growth.
- Septic systems: Turlock Lake State Recreation Area campground includes restroom facilities with septic system adjacent to Turlock Lake.
- Fuel additives: tert-butyl alcohol (TBA) was detected with a concentration above the Notification Level (12 µg/L) in one sample collected at the infiltration gallery. The likely source of fuel additives is recreational boating activity in the river, primarily in summer months.

2.2.4 MID 2014 Modesto Reservoir Watershed Sanitary Survey

MID previously prepared a watershed sanitary survey for the Modesto Reservoir and Don Pedro Reservoir in 2014. The following is a summary of the significant potential contaminant sources that were identified in the 2014 WSS:

Don Pedro Reservoir

- Sanitary sewer overflows: the total volume of wastewater SSOs and total volume reaching waterways increased significantly from 2009 to 2014.
- Recreation: A nearby swimming lagoon without a discharge permit had potential to release significant quantities of untreated water to a nearby creek
- Septic tank and leach field systems: Approximately two thirds of Tuolumne County residents used septic tank and leach field systems that discharged about 2 million gallons of sewage into the ground per day.
- Mine runoff: Storm water runoff from over 100 mines in the watershed may contain heavy metals, such as mercury, copper, and iron, which could degrade water quality
- Unauthorized activities: Illegal activities such as dumping, camping, off-road use, marijuana cultivation, or drug manufacture and disposal were potential contamination sources.

Modesto Reservoir

- Recreation: Swimming and boating are allowed in the reservoir and contaminant concentrations are highest on peak holiday weekends, increasing the potential to impact water quality.
- Wildlife: Canadian goose populations at the reservoir directly impacts water quality due to the submergence of droppings during reservoir level fluctuations.
- Grazing: Grazing in the watershed was identified as a potential contamination source. Implementation of cattle grazing BMPs and conversion of grazing sites

adjacent to the Modesto Reservoir to orchards by 2014 had mitigated some impacts from grazing.

2.3 MID Water System

MID is a publicly-owned utility that provides potable water service to the City of Modesto, in addition to irrigation water and electricity. MID was originally formed as an irrigation district in 1887. MID and TID built La Grange Diversion Dam on the Tuolumne River in 1893, to divert Tuolumne River water for agricultural use. MID diverts water to the north of the Tuolumne River and TID to the south. MID and TID constructed the original Don Pedro Reservoir in 1923. It was replaced by the completion of New Don Pedro Dam and reservoir in 1971, which is now referred to as the Don Pedro Diversion Dam.

2.3.1 System Facilities

In 1994, MID began operating the MRWTP to treat surface water for potable use by the City of Modesto. MRWTP began operating as a conventional 45 million gallon per day (MGD) surface water treatment plant. Between 2010 and 2015, MID expanded capacity by adding a 36 MGD membrane water treatment plant that operates in parallel with the conventional plant for a total maximum capacity of 81 MGD. The conventional plant includes primary disinfection by pre-ozonation followed by coagulation, optional pre-chlorination, flocculation, sedimentation, gravity filtration, post-chlorination and stabilization. The membrane plant includes six membrane filtration basins followed by an ozone contactor and membrane stabilization basin. Primary disinfection at the membrane plant is provided by chlorine and post-ozonation. Figure 2-7 shows a treatment schematic of the 45 million gallons per day (MGD) conventional plant with pre-ozonation and the 36 MGD membrane plant with post-ozonation.

Finished water is stored in a 5 million gallon (MG) underground treated water reservoir. From the underground reservoir, it is pumped 14.3 miles to the Terminal Reservoir Pump Station (TRPS) on the east side of Modesto. Finished water is wholesaled to the City of Modesto to meet base water demands.

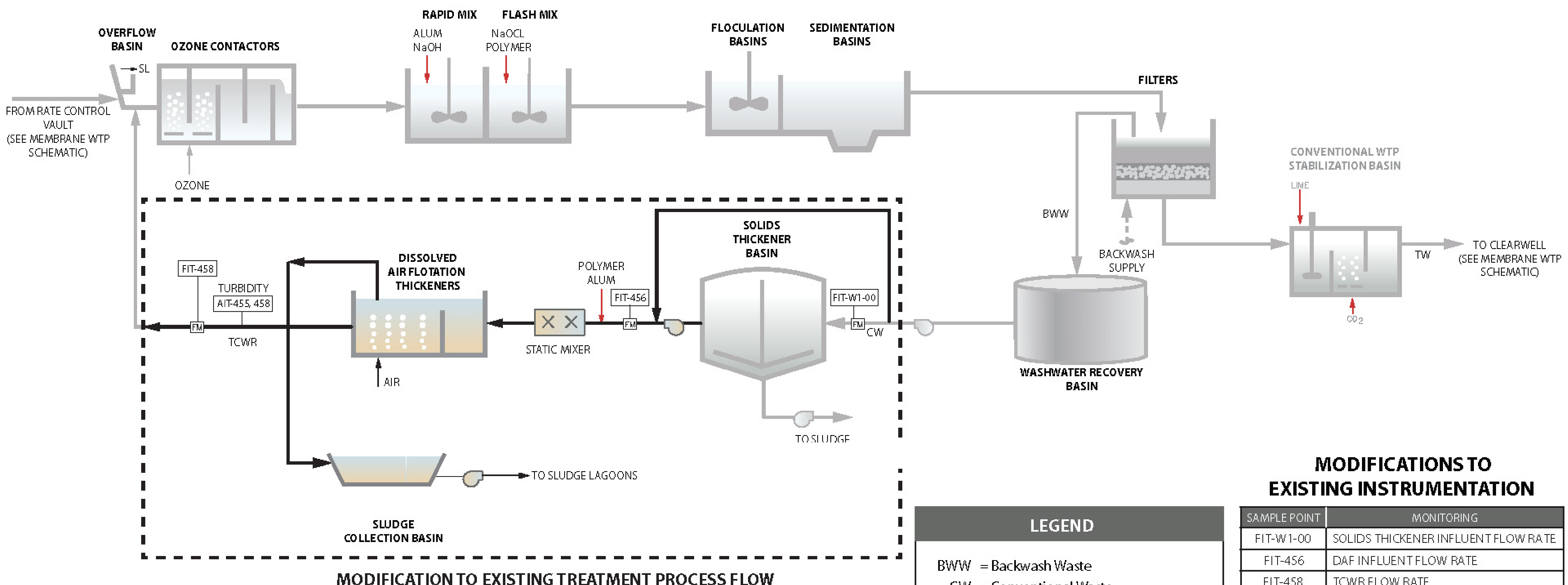
Diversion Emergency Plans

MID has a water quality emergency notification plan for the water treatment plant and pump station. The plan, which is updated at least annually, outlines the procedures for notifying the State Water Resources Control Board (SWRCB) Division of Drinking Water (DDW) and the City of Modesto in the event that the water supply fails to meet water quality standards and represents an imminent danger to the health of water users. Contact information includes work, home and cell phone numbers, as well as the City of Modesto on-call operator cell phone.

MID has developed an emergency disinfection standard operating procedure (SOP) that delineates actions to be taken in the event of disinfection failure or contamination problem that would require emergency disinfection at MRWTP. The SOP includes procedures for several scenarios including loss of ozonation, loss of pre- or post-filter chlorination, complete loss of chlorination feed, low chlorine residuals in the clear well, pipeline contamination, and chlorine monitoring at TRPS. There are three ozone generators at MRWTP supplying ozone for disinfection at the conventional plant and the membrane plant. The treatment plant is designed so that one generator supplies ozone to the conventional plant and a second generator supplies ozone to the membrane plant, with the third generator available as either a back up to the two online generators or to run concurrently to provide additional ozone to either the membrane or conventional plant. Ozone residual is continuously monitored in the process stream at five sampling locations in each ozone contact basin of the conventional and membrane plants. The treatment plant is manned continuously, and audible alarms alert the shift operator to loss of an ozone generator or decreases in ozone residual below target goals. If loss of ozone occurs, the plant may continue to operate and serve water to the City of Modesto and on-site staff by utilizing the disinfect concentration – contact time (CT) credit available from free chlorine residual in the treated water clearwells.

The plant has six pumps that can feed sodium hypochlorite at various application points in the treatment trains for both conventional and membrane filtration WTPs. In 2015, MID received permission from the SWRCB to allow for chlorine CT credits from the two on-site clearwells. Chlorine residual is continuously monitored downstream of filtration, downstream of the stabilization basins, at the finished water effluent vault, and at the TRPS. Audible alarms immediately alert the operator if the chlorine residual falls below target levels. Should the chlorine residual leaving the plant fall below target levels, operations staff can feed sodium hypochlorite solution directly into the 60-inch treated water effluent pipeline via a one-inch supply line from the chemical feed building to the treated water pump station. Chlorine residual can be maintained with two hypochlorite pumps in service for each treatment train; so there is redundancy built into the design. Enough sodium hypochlorite is available on-site to restore chlorine residual in the clearwell or at the TRPS storage tanks if needed. In the unlikely event that all sodium hypochlorite pumps fail simultaneously, the treatment plant will be shut down until repairs can be made. In the event of MRWTP shutdown, the City of Modesto is able to increase the volume of well water pumped into their distribution system to meet demand. The Emergency Disinfection SOP identifies the Plant Manager, Operations Supervisor, and Water Quality Supervisor to be notified in the event of a disinfection failure. Further notifications to water users and regulatory agencies will be in accordance with MID's water quality emergency notification plan.

CONVENTIONAL WATER TREATMENT PLANT SCHEMATIC



LEGEND

BWW = Backwash Waste
CW = Conventional Waste
NaOCL = Sodium Hypochlorite
SL = Storm Drain Lagoon
TW = Treated Water
TCWR = Treated Conventional Waste Return
= Pump
FM = Flow Meter
AIT = Analytical Instrument

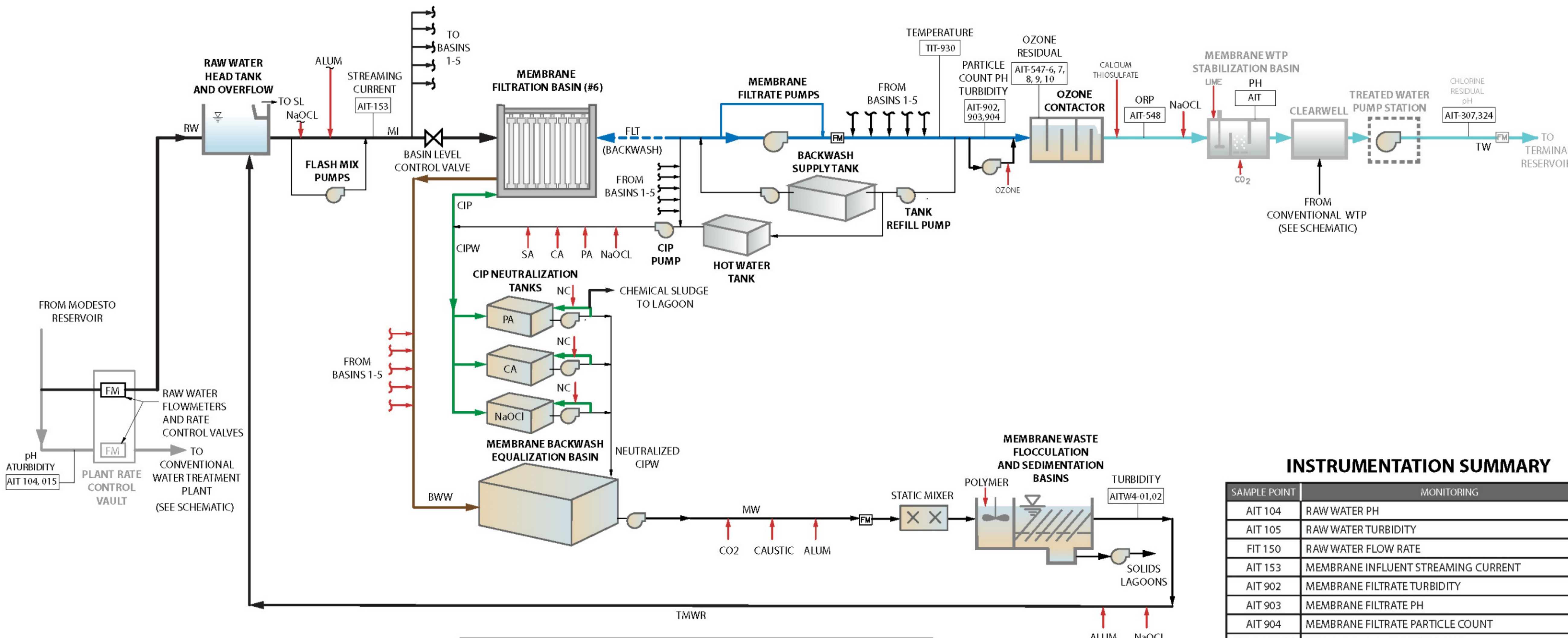
Existing Facilities are Screened

MODIFICATIONS TO EXISTING INSTRUMENTATION

SAMPLE POINT	MONITORING
FIT-W1-00	SOLIDS THICKENER INFLUENT FLOW RATE
FIT-456	DAF INFLUENT FLOW RATE
FIT-458	TCWR FLOW RATE
AIT-455	TCWR TURBIDITY-DAF#1
AIT-458	TCWR TURBIDITY-DAF#2

Figure 2-7. MRWTP Conventional and Membrane WTP Process Schematic

MEMBRANE WATER TREATMENT PLANT SCHEMATIC



LEGEND

BWW	= Backwash Waste	NC	= Neutralization Chemical
CA	= Citric Acid	ORP	= Oxidation Reduction Potential
CIP	= Clean-In-Place	OZW	= Ozonate Water
CIPW	= Clean in Place Waste	PA	= Phosphoric Acid
FLT	= Membrane Filtrate	RW	= Raw Water
MI	= Membrane Influent	SA	= Sulfuric Acid
MW	= Membrane Waste	SL	= Storm Drain Lagoon
NaOCL	= Sodium Hypochlorite	TMWR	= Treated Membrane Waste Return
(pump symbol)	= Pump	TW	= Treated Water
FM	= Flow Meter		
AIT	= Analytical Instrument		Existing Facilities are Screened

INSTRUMENTATION SUMMARY

SAMPLE POINT	MONITORING
AIT 104	RAW WATER PH
AIT 105	RAW WATER TURBIDITY
FIT 150	RAW WATER FLOW RATE
AIT 153	MEMBRANE INFLUENT STREAMING CURRENT
AIT 902	MEMBRANE FILTRATE TURBIDITY
AIT 903	MEMBRANE FILTRATE PH
AIT 904	MEMBRANE FILTRATE PARTICLE COUNT
FIT-MEX 930	MEMBRANE FILTRATE FLOW RATE
AIT 547-6	CONTACTOR SAMPLE POINT 1 - OZONE RESIDUAL
AIT 547-7	CONTACTOR SAMPLE POINT 2- OZONE RESIDUAL
AIT 547-8	CONTACTOR SAMPLE POINT 3 - OZONE RESIDUAL
AIT 547-9	CONTACTOR SAMPLE POINT 4 - OZONE RESIDUAL
AIT 547-10	CONTACTOR SAMPLE POINT 5 - OZONE RESIDUAL
AIT 548	OZONATED WATER OXIDATION REDUCTION POTENTIAL
AIT	STABILIZED WATER PH (MEMBRANE WTP)
AIT 324	TREATED WATER CHLORINE RESIDUAL
AIT 307	TREATED WATER PH
FIT 308	TREATED WATER FLOW RATE
FIT W4-00	MEMBRANE WASTE FLOW RATE
AIT W4-01	TREATED MEMBRANE WASTE TURBIDITY - FLOC/SED UNIT #1
AIT W4-02	TREATED MEMBRANE WASTE TURBIDITY - FLOC/SED UNIT #2
TIT 930	MEMBRANE FILTRATE TEMPERATURE

Figure 2-7 (continued). MRWTP Conventional and Membrane WTP Process Schematic

The SWRCB DDW is notified of SSOs or any incident that could pose a threat to public health by the Regional Water Quality Control Board (RWQCB) or other State Agency. The Tuolumne County Environmental Health Division and the Stanislaus County Environmental Resources coordinate various agencies that respond to a spill of hazardous materials in the watershed. CDFGMID may be notified of hazardous materials spills or other events that may affect source water quality by the SWRCB, Tuolumne County Environmental Division, Stanislaus County Environmental Resources, DPRA, the Stanislaus County Sheriff, or by the Parks and Recreation Department. Each agency has the MRWTP shift operator's telephone number. The shift operator will notify the Plant Manager, Operations Supervisor, Water Quality Supervisor, and/or Maintenance Supervisor, who will respond as needed.

The City of Modesto also has an emergency notification plan and an emergency response plan for the municipal water system serving the City of Modesto and the surrounding area water users. These plans can be used in the unlikely event of an imminent danger to the health of the water users. Immediate and secondary actions that must be taken are described for both a system-wide problem and localized or isolable emergency. The plan includes notices to be issued in the event of bacteriological and chemical water quality emergencies.

2.4 SRWA Water System

The proposed SRWA WTP will be constructed in two or more phases and have an initial capacity of 15 MGD with potential to expand capacity up to 30 MGD. The WTP will be located on a 48-acre site, and the initial construction is anticipated to occupy half of that property.

2.4.1 System Facilities

SRWA is in the process of designing and constructing a Regional Surface Water Supply Project (RSWSP) that will draw and treat water from the Tuolumne River, and distribute treated water to Turlock and Ceres. Major components of this project include a water treatment plant and finished water transmission pipeline system. A new raw water pump station and pipeline will also be constructed to supply the RSWSP and provide supplemental fish flows in the river during the irrigation season.

The raw water pump station will consist of a building and small yard area west of Geer Road along the south bank of the Tuolumne River. The building will house six large pumps that draw water from the existing infiltration gallery, which consists of screened collection pipes under the river bed, and send it through a pipeline to both the water treatment plant and the nearby Ceres Main Canal. In addition to the pumps, the building and yard will house equipment needed to maintain, operate, and control the pump station's mechanical, electrical, and instrumentation systems. Stormwater from the site will be percolated into riverbank soils.

TID constructed the infiltration gallery with the intention of providing a diversion point to supply the Ceres Main Canal and to supply a future raw drinking water supply. The infiltration gallery is located adjacent to Fox Grove County Park, on the south side of the river, and between the towns of Waterford and Hughson, California. Water will be pumped from the infiltration gallery to the planned water treatment plant. Water pumped from the infiltration gallery will also replace a portion of the irrigation demands for the TID Ceres Main Canal to provide increased instream flows during summer months.

Although the design is not finished, it is anticipated that the treatment process will use conventional coagulation, flocculation, and sedimentation for turbidity and disinfection by-product (DBP) precursor removal; intermediate ozone for primary disinfection; biologically active filtration with GAC and sand as the media; free chlorine for final disinfection; and lime and carbon dioxide addition for finished water stabilization. A process schematic for the proposed plant is shown in Figure 2-8 and Figure 2-9.

The water treatment plant will be located on a parcel of land east of Geer Road. It will include several buildings and concrete process structures and open basins. There will also be outdoor pump stations. Several process structures will be partly or mostly buried. Buildings will provide spaces for plant operation, offices, maintenance rooms, parts storage, and equipment housing. Paved roadways will allow vehicle traffic to all structures. The plant will have a complete infrastructure system of electrical, water, storm drain, sewer, fire protection, chemical, process residuals, security, and communication systems. All stormwater runoff will be collected in an on-site retention basin for percolation into the existing soils or redirection to the Ceres Main Canal. The plant structures and facilities will be surrounded by a re-planted orchard and screening landscaping when completed.

2.4.2 Emergency Plans

Because the RSWSP facilities will not be completed for several years (projected 2022 operation), there has been no work conducted to date associated with emergency planning. A water quality emergency response plan, including customer notification, will be developed prior to plant start-up.

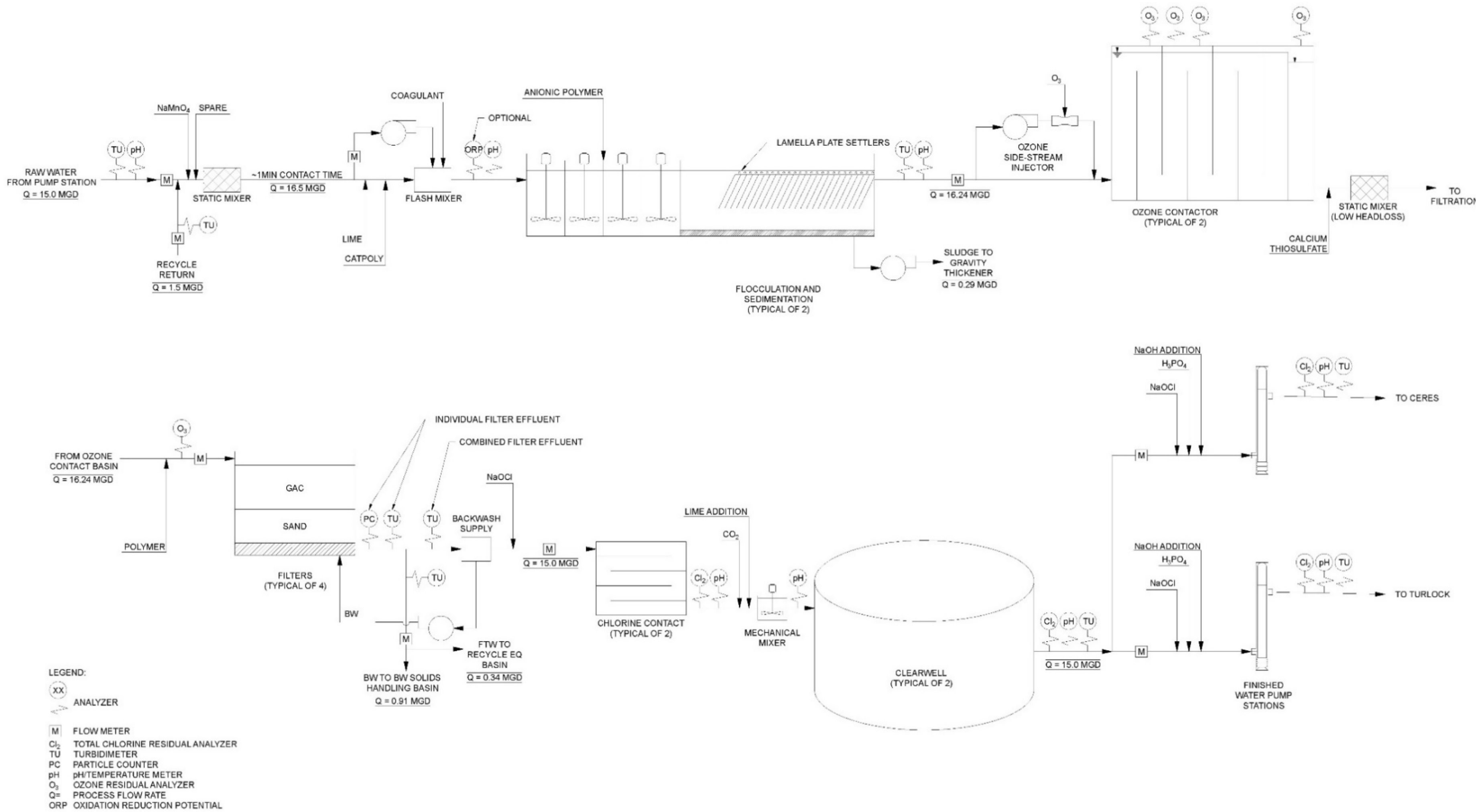


Figure 2-8. SRWA Proposed Plant Process Schematic (1 of 2)

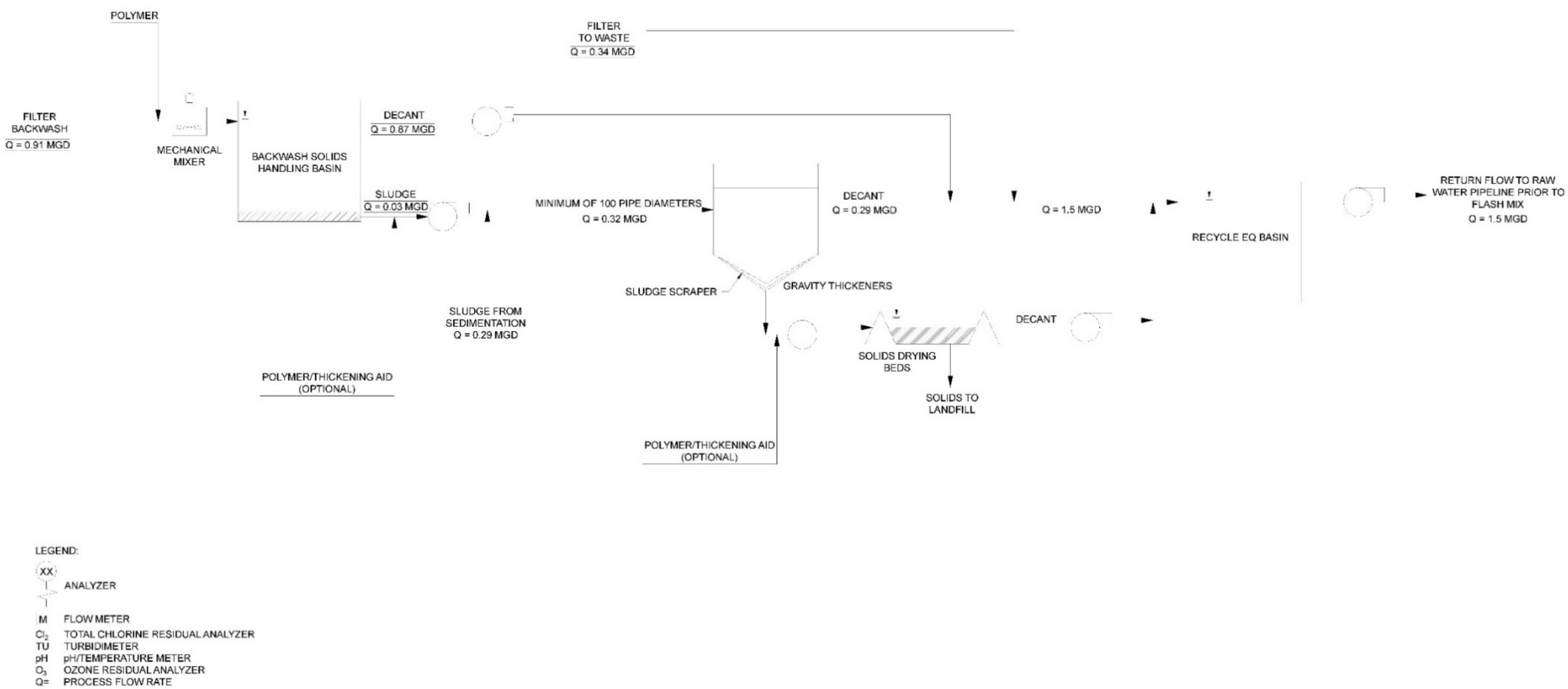


Figure 2-9: SRWA Proposed Plant Process Schematic (2 of 2)

3 Potential Contaminant Sources

For each potential contaminant, the anticipated watershed source is identified, the related water quality concerns are identified, and the regulation and management of the potentially contaminating activity is described. The watershed management recommendations regarding these potential contaminant sources are summarized in Section 5.

The Don Pedro Reservoir watershed study area lies entirely within Tuolumne County. Information for many types of potential contaminating activities within the watershed is often presented for the entire county. Where information is available to limit the data to the Don Pedro Reservoir watershed study area, this qualifying information is noted.

The Modesto Reservoir and Upper Main Canal watersheds and the Lower Tuolumne River watershed lie within Stanislaus County. Because of the small size of the watersheds and the limited range of activities in the watersheds, data specific to the watershed were gathered. The federal and state laws protecting water quality from point and nonpoint sources are described in detail in Section 3.17.

3.1 Wastewater

Wastewater discharges are a primary concern to downstream drinking water intakes because of the types of contaminants in the effluent. Wastewater discharges are considered a “point source” discharge and are managed accordingly by the Central Valley Regional Water Quality Control Board (CVRWQCB) through their issuance of National Pollutant Discharge Elimination System (NPDES) permits and Waste Discharge Requirements (WDR). Following receipt of a report of waste discharge, the CVRWQCB issues waste discharge requirements that prescribe how the discharge is to be managed. This process is described in Section 3.17. Under NPDES regulations, permitted municipalities can discharge treated wastewater effluent into source waters.

3.1.1 Potential Contaminant Sources

Don Pedro Reservoir

This section summarizes information on various wastewater treatment plants within the watershed and also the entire county. NPDES and WDR permit information is summarized, if available.

Blue Oaks, Fleming Meadows and Moccasin Point Wastewater Treatment Plants

The Blue Oak, Fleming Meadows and Moccasin Point WWTPs are located on the southeastern border of Don Pedro Reservoir, where the majority of recreation associated with the reservoir occurs. Treatment at the three plants is similar. Wastewater is pumped to an aeration/sedimentation pond for treatment. When in operation, the sedimentation pond effluent is siphoned to the evaporation pond. Effluent from the evaporation pond is sprayed onto adjacent drainage land. Any effluent that does not percolate into the soil is channeled back into the pond for further treatment. The pumps that operate aeration and spray equipment are on a timer that runs the process on a timetable based on the season. Daily average wastewater treatment flows are 20,000 gallons per day (gpd) for Fleming Meadows, 10,000 gpd for Moccasin, and 7,000 gpd for Blue Oaks (Personal Communication, Mr. Brannon Gomes, March 2020). The plants operate under a Waste Discharge Requirement (WDR) permit and have met the conditions of the permit for over two decades.

NPDES and WDR Permit Holders in the Don Pedro Reservoir Watershed

There is one fish hatchery and no wastewater treatment plants with active NPDES permits in the watershed. The Sonora Regional WWTP and the Jamestown Sanitary District WWTP share a common treated effluent discharge location to the Quartz Storage Reservoir prior to distribution for reclamation by agricultural end-users. Up to 2014, the Sonora Regional WWTP, operated by Tuolumne Utilities District (TUD), held an NPDES permit to allow for discharge of excess treated effluent to Woods Creek. The NPDES permit was rescinded in 2014 and all treated effluent is now fully discharged to land disposal under compliance with a WDR (CRWQCB Order R5-2014-0008).

There are twenty-seven wastewater treatment facilities with active WDR permits within the watershed, including the Sonora Regional WWTP and Jamestown WWTP that previously were regulated under NPDES permits. The majority of wastewater treatment facilities with WDR permits discharge secondary treated and disinfected effluent to land application disposal (by percolation/evaporation pond or spray irrigation) or provide communal septic tank treatment with leach field disposal. The discharge practices and total allowable discharges for the NPDES and WDR permit holders are summarized in Table 3.1. Copies of the NPDES and WDR permits are provided in Appendix B.

Table 3.1. Wastewater Treatment Facilities in Don Pedro Reservoir Watershed with NPDES or WDR Permits

NPDES No.	Order No.	Agency	Facility Name	Treated Effluent Discharge Practices	Design Flow (MGD)
CAG135001	R5-2014-0161	CA Dept. of Fish & Wildlife, Fresno	Moccasin Creek Fish Hatchery	Discharges aquaculture wastewater to Moccasin Creek – flows to Don Pedro Reservoir.	25
CA0084727 [1]	R5-2008-0162	Tuolumne Utilities District	Sonora Regional WWTP	Secondary treated wastewater is used for irrigation of agricultural lands owned either by TUD or private parties under contract for the use of the reclaimed wastewater during the dry months and part of wet months, weather permitting.	2.6
CA0084727 [1]	5-01-062	Jamestown SD	Jamestown Sanitary District WWTF	Secondary treatment with chlorination. Discharge to Woods Creek/Quartz Reservoir with Sonora WWTP effluent for agricultural reuse.	1.01
WDR	86-021	Tuolumne Utilities District	Twain Harte WWTP	Aeration pond treatment with discharge to Sonora WWTP for further treatment and discharge.	0.5 [2]
WDR	R5-2019-0058	Tuolumne City SD	Tuolumne STP	Biolac extended aeration activated sludge treatment, storage lagoon, sludge lagoon, effluent storage reservoir (Grinding Rock Reservoir) and discharge to 13 acres of flood irrigated land and 101 acres of sprinkler irrigated land at Baker Ranch.	0.34
WDR	5-01-061	Pinecrest Permit Assoc. & US Forest Service	Pinecrest WWTP	Secondary treatment with chlorination. Discharge to evaporation/percolation ponds that lie within 50 feet of the North Fork of the Tuolumne River.	0.17
WDR	87-121	Groveland CSD	Groveland WWTF	Roto-strainer followed by an aerated equalization basin, contact basin, and chlorine disinfection. Treated effluent is discharged to two effluent storage reservoirs with spray irrigation to Pine Mountain Golf Course.	0.15
WDR	92-015	USDI National Park Service Yosemite National Park	Yosemite Nat. Park Tuolumne MDWS	Extended aeration treatment with chlorination. Treated effluent is discharged to two lined oxidation-evaporation ponds with spray field disposal.	0.1
WDR	5-00-203	Blind Bull	Atlas Business Park	Septic tanks at individual businesses with shared recirculating aeration cells and overflow to an oxidation/stabilization pond for evaporation/percolation.	0.09

Table 3.1. Wastewater Treatment Facilities in Don Pedro Reservoir Watershed with NPDES or WDR Permits

NPDES No.	Order No.	Agency	Facility Name	Treated Effluent Discharge Practices	Design Flow (MGD)
WDR	5-00-054	MHC NAC Inc.	Yosemite Lakes Campground	Extended aeration package treatment plant with polishing/percolation ponds and discharge to leach fields.	0.075
WDR	89-033	New Don Pedro Recreation Agency	New Don Pedro WW Facilities	DPRA operates three wastewater facilities at Fleming Meadows, Blue Oaks, and Moccasin Point recreation areas. Each treatment facility includes aerated stabilization ponds, effluent storage reservoirs, and spray fields for effluent disposal.	0.061
WDR	97-010-DWQ	USDI National Park Service Yosemite National Park	Yosemite National Park Hodgdon Meadow	Septic tank with discharge to a leach field.	0.025
WDR	96-216	Majistee Corporation	Yosemite Pine RV Park	Extended aeration package treatment plant with an effluent storage reservoir. Discharge to spray field in summer and to leach field in winter.	0.022
WDR	00-201	Yosemite Vista Estates	Yosemite Vista Estates	Extended activated sludge package treatment plant with two percolation ponds.	0.0215
WDR	2014-0153-DWQ	San Francisco City & County	Camp Mather	Septic tank with discharge to a leach field.	0.02
WDR	88-107	Peppermint Creek MHP	Peppermint Creek MHP WWTF	Aerated primary settling pond, aerated facultative pond, with leach field and spray field disposal.	0.02
WDR	97-010-DWQ	Dodge Ridge Corporation	Dodge Ridge Lodge	Six septic tanks with discharge to leach fields.	0.0163
WDR	85-306	Sacramento Test	Cascade MHP WWTF	Aerated pond treatment with disposal to two evaporation/percolation ponds.	0.016
WDR	2014-0153-DWQ	Evergreen Destination Holdings, LLC	Evergreen Lodge	18 individual septic systems with disposal to pressure-dosed leach fields.	0.01404
WDR	97-010-DWQ	USDI National Park Service Yosemite National Park	Yosemite Nat Park Whitewolf	Stabilization pond, chlorination, and discharge to spray field.	0.012

Table 3.1. Wastewater Treatment Facilities in Don Pedro Reservoir Watershed with NPDES or WDR Permits

NPDES No.	Order No.	Agency	Facility Name	Treated Effluent Discharge Practices	Design Flow (MGD)
WDR	97-010-DWQ	San Francisco City & County	O'Shaughnessy WWTP	Septic tanks with leach field and spray disposal field.	0.011
WDR	97-010-DWQ	Stanislaus Cnty. Office of Education	Foothill Horizons School	Two 1,500-gallon septic tanks and one 8,000-gallon septic tank with disposal to leach fields.	0.011
WDR	5-00-025	San Jose City	San Jose City Family Camp	Oxidation pond with chlorination. Treated effluent held in storage ponds then discharged to spray field irrigation.	0.01055
WDR	01-274	San Francisco City & County	Early Intake Wastewater System	10,000 gallon septic tank with sand filter leach field.	0.005
WDR	97-010-DWQ	Pete Pereira Co., LLC	Don Pedro Houseboats/Mini Mart	Aerobic sequencing batch reactor with disposal pond.	0.0025
WDR	97-010-DWQ	USDI National Park Service Yosemite National Park	Yosemite Institute Crane Flat	Septic tanks with leach field disposal.	0.002
WDR	97-010-DWQ	Lake Don Pedro Homeowners Association	Hacienda WWTP	Septic tank with evaporation pond.	0.002
WDR	97-010-DWQ	Tuolumne Utilities District	Mi-Wuk Village WW System	Three septic tanks with one leach field.	0.00167

[1] NPDES was rescinded in 2014 by Order R5-2014-0008. Both plants now operate under WDR permits.
[2] Included in Sonora WWTP NPDES design flow

Reclaimed Water

Tuolumne Utilities District (TUD) provides reclaimed water for land application. TUD stores secondary treated effluent in Quartz Reservoir, a 1,500 acre-foot pond, prior to distribution to users for land application. The total acreage of the land application areas is approximately 630 acres. The reclaimed water is used mainly for the spray or flood irrigation of fodder crops and pasture for animals not producing milk for human consumption. A small percentage of the reclaimed water is also used for the spray irrigation of non-food-bearing trees.

Another reclaimed water provider in the watershed is Groveland Community Services District. About 16 acres of lands within the watershed receive reclaimed water. Users include Pine Mountain Lake Golf Course and parks owned by GCSD. A reclamation permit for GCSD was not available.

Sanitary System Overflows

A sanitary sewer overflow (SSO) is any overflow, spill, release, discharge, or diversion of untreated or partially treated wastewater from a sanitary sewer system. SSOs often contain high levels of suspended solids, pathogenic organisms, toxic pollutants, nutrients, oil, and grease. SSOs pollute surface and ground waters, threaten public health, adversely affect aquatic life, and impair the recreational use and aesthetic enjoyment of surface waters. Typical consequences of SSOs include the closure of beaches and other recreational areas, inundated properties, and polluted rivers and streams. A record of SSOs is maintained by the California State Water Resources Control Board. Table 3.4 provides a summary of Category 1, 2 and 3 SSOs in Tuolumne County from 2014 to 2018. Overflows listed in each individual SSO report contains the data related to one specific location where sewage discharged is from the sanitary sewer system due to a failure (e.g., sewer pipe blockage or pump failure).

In Tuolumne County, the total volume of sanitary system overflows has decreased from 0.96 million gallons (MG) between 2009 and 2013 to 40,856 gallons from 2014 through 2018. SSOs reaching waterways have also decreased from 911,575 gallons between 2009 and 2013 to 12,600 gallons between 2014 and 2018. However, the total number of SSOs has increased to 37 between 2009 and 2013 to 57 from 2014 through 2018.

Table 3.2. Summary of Sanitary System Overflows in Tuolumne County from 2014-2018

Responsible Agency	Total Number of Sanitary Sewer Overflow Locations	Total Volume of Sanitary Sewer Overflows (gallons)	Total Volume Recovered (gallons)	Total Volume to Reach Surface Water (gallons)	Sanitary Sewer Overflow Dates
Groveland CSD	9	11,916	5,275	10,423	Feb 2014 March 2015 June 2016 Dec 2016 July - Aug 2017 March 2018
Tuolumne Utilities District	30	3,990	3,000	2	Jan 2014 - Dec 2018
Twain Harte CSD	4	2,884	108	779	March 2014 Nov 2015 Dec 2018
Jamestown SD	6	5,165	125	0	Oct 2014 May 2015 Oct 2015 March 2018 May 2018 Dec 2018
Tuolumne City SD	8	16,901	15,242	1,396	April 2014 Jan 2015 April 2015 Aug 2015 Nov 2015 Feb 2016 March 2017
Total	57	40,856	23,750	12,600	

Source: https://ciwqs.waterboards.ca.gov/ciwqs/readOnly/PublicReportSSOServlet?reportAction=criteria&reportId=sso_main

Sewer overflow constitutes a violation of Prohibition A.1 of Order No. 96-04, General Waste Discharge Requirements Prohibiting SSOs by Sewage Collection Agencies, which prohibits discharge of sewage from a sanitary sewer system at any point upstream of a sewage treatment plant, and may be subjected to a fine of up to $10,000 per day and $10 per gallon discharged, pursuant to California Water Code Section 13385.

Modesto Reservoir Watershed

There is one wastewater treatment facility with an active WDR permit and no facilities with active NPDES permits within the Modesto Reservoir watershed. Stanislaus County Department of Parks and Recreation operates the Modesto Reservoir WWTP that treats wastewater from the Regional Park facilities for park visitors. Facilities include eight restrooms with flush toilets, camper hook-ups, and showers. Sewage is treated at the plant by an aeration facility located at the campground on the southern shore of the reservoir. The County Department of Parks & Recreation has waste discharge requirements issued by the CVRWQCB, Order Number 94-360, issued December 9, 1994 and revised April 20, 2017. A copy of the order is included in Appendix B.

Two percolation ponds (one in use and one redundant) allow percolation to groundwater that drains away from the reservoir. The free board in the in-service pond is measured routinely. No sewage spills were reported during the study period. The auto-dial system at the main lift station is tested weekly. Between 2014 and 2018, approximately 50 campsite sewer connections were cleaned out either by use of a water hose with an expanding rubber bulb attachment or by a mechanical plumber's snake. These blockages were typically due to flushed items, soda cans, or miscellaneous debris. All of these blockages were attended to immediately and cleared before any sewage reached the reservoir.

The main distribution lines in the campsites and Marina were flushed approximately 8 to 12 times per year from 2014 through 2016 and approximately twice a month in 2017 and 2018 during the busy summer season by use of a gravity-flow water truck. All campsite sewer connections were flushed with a water hose weekly during the summer. This is part of the park preventive maintenance program.

Lower Tuolumne River Watershed

There is one wastewater treatment facility with an active WDR permit and no facilities with an NPDES permit within the Lower Tuolumne River Watershed study area. The City of Waterford WWTP capacity is 1 mgd. Expansions planned within the 2006 Master Plan have not been implemented. No treated wastewater is discharged into the River. Wastewater discharge is via the existing four percolation ponds." (Source: Personal communication with Stephanie Mendes, Chief Operator, City of Waterford. 8/27/20.) The City of Waterford Wastewater Treatment Plant is located along the Tuolumne River west of the Hickman Road Bridge and includes concrete lined treatment basins on the north side of the river and evaporation/percolation ponds approximately 500 feet south of the river. The City of Waterford operates and maintains the plant, which provides wastewater treatment and collection within the city limits for approximately 2,000 connections. The City of Waterford has waste discharge requirements issued by the CVRWQCB, Order Number 94-273, dated September 16, 1994. A copy of the order is included in Appendix B.

The City of Waterford WWTP capacity is 1 mgd. Expansions planned within the 2006 Master Plan have not been implemented. No treated wastewater is discharged into the River. Wastewater discharge is via the existing four percolation ponds." (Source: Personal communication with Stephanie Mendes, Chief Operator, City of Waterford. 8/27/20.)The WWTP is considered a Class I WWTP, consisting of a basic treatment system containing five aeration ponds, four percolation ponds, and one sludge drying bed. The existing system is a "one-pass" biological treatment system, which reduces the strength of the sewage by using aerated ponds, and disposes of the treated water through percolation basins. The percolation ponds are located on the opposite side of the Tuolumne River from the aeration basins and effluent from the aeration basins is conveyed to the percolation ponds via gravity pipeline below the river bed (City of Waterford, WWTP Master Plan 2006). Sludge from the plant is removed from the aerated lagoons with an excavator and put into the drying bed. Sludge is removed as needed, most recently three years ago.

The city received 12 notices of violation of their CVRWQCB waste discharge permit requirements between March 2015 and January 2016 for deficient reporting. The WDR requires the City (of Waterford) to conduct monthly testing of the 8-inch gravity pipe crossing the Tuolumne River for leakage and annual pressure testing. This pipe connects the WWTP aeration basins on the North side of the River to the percolation basins on the South side. The pipe is pressure tested quarterly. Test results are included in the monthly reports that are submitted to the Central Valley Regional Water Quality Control Board (Source: Personal communication with Stephanie Mendes, Chief Operator, City of Waterford. 8/27/20). No violations have been reported since January 2016. If the population of Waterford increases, the WWTP waste discharge permit will need to be updated and the treatment processes upgraded in order to meet current standards. In case of a spill, the city notifies the Office of Emergency Services (OES) and the Regional Water Quality Control Board (RWQCB).

Sanitary System Overflows

The total volume of sanitary system overflows in the Lower Tuolumne River watershed from 2014 through 2018 was 380 gallons, resulting from 10 SSO incidents, with no volume reaching the waterways. Table 3.3 summarizes recorded SSOs that occurred from 2014 through 2018.

Table 3.3. Summary of Sanitary System Overflows in Stanislaus County from 2014-2018

Responsible Agency	Total Number of Sanitary Sewer Overflow Locations	Total Volume of Sanitary Sewer Overflows (gallons)	Total Volume Recovered (gallons)	Total Volume to Reach Surface Water (gallons)	Sanitary Sewer Overflow Date
Hughson City	1	25	25	0	March 2014

Table 3.3. Summary of Sanitary System Overflows in Stanislaus County from 2014-2018

Responsible Agency	Total Number of Sanitary Sewer Overflow Locations	Total Volume of Sanitary Sewer Overflows (gallons)	Total Volume Recovered (gallons)	Total Volume to Reach Surface Water (gallons)	Sanitary Sewer Overflow Date
Waterford City	9	355	335	0	July 2014 April 2015 Dec 2015 Jan 2016 May 2016 Sept 2016 Dec 2017 Sept 2018
Total	10	380	360	0	

3.1.2 Water Quality Concerns

Wastewater contains numerous contaminants, including human pathogens, organic carbon, nutrients that stimulate algal growth, and, in some cases, elevated levels of salinity.

3.1.3 Watershed Management

Wastewater discharges are considered a "point source" discharge, and are managed accordingly by the RWQCB through their issuance of NPDES permits. Following receipt of a report of waste discharge, the RWQCB issues waste discharge requirements that prescribe how the discharge is to be managed.

Don Pedro Reservoir Watershed

Per their NPDES permit (described in Table 3.1), CDFW is required to perform BMPs at Moccasin Creek Fish Hatchery related to salinity minimization. S 2014 the CVRWQCB issued Order R5-2014-0008 rescinding the NPDES Permit based on TUD's expansion of storage capacity and irrigation areas and improvements to storage capacity at Quartz Reservoir. In September 2013, TUD submitted an updated water balance demonstrating its effluent storage and disposal system is capable of containing all wastewater on land. Therefore, the NPDES Permit and TSO are no longer necessary as Sonora WWTP no longer discharges to surface water.

Modesto Reservoir Watershed

The wastewater treatment plant at the Modesto Reservoir Regional Park is staffed by a California Grade I operator. The sewage lift stations are protected by impoundment berms, visual alarms, automatic lift station failure notification, and redundant pumps.

The aeration facility was sited 300 feet from the reservoir and the area is graded to drain away in order to prevent flow back into the reservoir in the event of a spill.

A comprehensive sewer response procedure was developed to protect the safety of the public, environment, and wildlife at Modesto Reservoir. All employees on duty must respond to a call on any sewage containment problems, spills, or system malfunctions and are directed to follow the procedure during clean-up and containment. Test procedures completed weekly throughout the entire year on manholes, dump stations, lift stations, alert systems, and aeration ponds, and minimize the potential for a spill. The permanent restrooms are maintained daily by park staff.

As part of the Modesto Reservoir Park preventive maintenance program, the main distribution lines in the campsites and Marina at Modesto Reservoir are flushed several times during the year by use of a gravity-flow water truck. In addition, all campsite sewer connections are flushed with a water hose weekly during the summer.

3.2 Septic Tank Systems

Rural areas are generally too dispersed to be served by wastewater treatment plants, and instead use septic leach fields or individual septic tank systems. On June 19, 2012, the State Water Resources Control Board (State Water Board) adopted Resolution No. 2012-0032, adopting the on-site wastewater treatment systems (OWTS) Policy. This Policy established a statewide, risk-based, tiered approach for the regulation and management of OWTS installations and replacements and sets the level of performance and protection expected from OWTS. Septic leach fields or individual septic tank systems are covered under this policy. The OWTS Policy took effect on May 13, 2013 with implementation beginning in 2018. A conditional waiver renewal and TMDL list amendment was approved in 2018. This identifies the Woods Creek homeless camp as not being as source of pathogens and grants more time for TMDL development.

The regional water quality control boards are required to incorporate the standards established in the OWTS Policy, or standards that are more protective of the environment and public health, into their water quality control plans within 12 months of the effective date of the OWTS policy (i.e., May 2014). Implementation of the OWTS Policy is overseen by the State Water Board and the regional water quality control boards. Local agencies (e.g., county and city departments and independent districts) have the opportunity to implement local agency management programs (LAMPs) if approved by the applicable regional water quality control board. CVRWQCB approved a LAMP for Tuolumne County Health Division on April 5, 2018 that provides for oversight of OWTS within the Tuolumne County that are not served by wastewater treatment systems operating under WDRs (CVRWQCB Resolution R5-2018-0010, 2018). CVRWQCB approved a LAMP for Stanislaus County Department of Environmental Services on June 9, 2017 that provides for oversight of OWTS in the county and its incorporated cities (CVRWQCB Order R5-2017-0069). The LAMPS for Tuolumne County and Stanislaus County are included in Appendix C. As of 2019, 94% (31) of approved LAMPs have submitted their annual report.

As part of the OWTS policy, the systems can be classified into one of five tiers (Tier 0 – Tier 4, in increasing order of severity):

- Tier 0: Existing OWTS
  Existing OWTS that are properly functioning, and do not meet the conditions of failing systems or otherwise require corrective action (for example, to prevent groundwater impairment) as specifically described in Tier 4, and are not determined to be contributing to an impairment of surface water as specifically described in Tier 3, are automatically included in Tier 0.
- Tier 1: Low-Risk New or Replacement OWTS
  New or replacement OWTS that meet low risk siting and design requirements as specified in Tier 1. Systems are considered Tier 1 where there is not an approved Local Agency Management Program per Tier 2.
- Tier 2: Local Agency Management Program for New or Replacement OWTS
  Local agencies may develop management programs and, upon approval, manage and approve the installation of new and replacement OWTS under that program.
- Tier 3: Advanced Protection Management Programs for Impaired Areas
  Existing, new, and replacement OWTS that are within 600 feet of listed impaired water bodies must meet the applicable specific requirements of Tier 3, unless they are addressed by a total maximum daily load (TMDL) and its implementation program, or other special provisions contained in a Local Agency Management Program.
- Tier 4: OWTS Requiring Corrective Action
  OWTS that require corrective action or are either presently failing or fail at any time while this Policy is in effect are automatically included in Tier 4 and must follow the requirements as specified. OWTS included in Tier 4 must continue to meet applicable requirements of Tier 0, 1, 2 or 3 pending completion of corrective action.

The tier classifications provide a consistent systematic means for management by the local agency.

3.2.1 Potential Contaminant Sources

Don Pedro Reservoir Watershed.

With the exception of the communities identified in Section 3.1 that have wastewater treatment/disposal systems, the remainder of the Don Pedro Reservoir watershed uses septic systems. These systems are scattered throughout the study area. Approximately three-quarters of Tuolumne County residents (about 54,900 people) do not have available sewer service and therefore must use onsite sewage treatment and disposal systems As of 2018, Tuolumne County estimated approximately 17,500 OWTS in the county that serve residents without sewer service (CVCRWQCB Resolution R5-2018-0010, 2018). The volume of wastewater introduced to a septic tank system from a typical household unit ranges from 50 to 70 gallons per day per person for systems built before 1994 and 40-60 gallons per day per person for systems build after 1994 (EPA OWTS Manual, 2002). It is estimated that about two million gallons of sewage are discharged into the ground per day in the County. There is generally a lack of information on existing septic tanks and the extent of impacts from failing systems.

Woods Creek is the only water body that has been identified by the State Water Board as impaired for pathogens in the Don Pedro Watershed. Therefore, the adopted OWTS policy requires any existing, new, or replacement septic systems located in the Woods Creek area to be placed in the stricter Tier 3 category that requires an advanced protection management program, prescribed in the Tuolumne County LAMP.

The most problematic systems are generally located in older communities with high septic system densities and lots with inadequate leach field area. Some of these subdivisions were developed primarily for use as vacation cabins but now have a high rate of year-round occupancy. Many of the septic systems were installed prior to the adoption of Chapters 13.04 and 13.08 of the Tuolumne County Ordinance Code (TCOC) (in 1975 and 1981, respectively), which now require a health review and soil investigations to demonstrate feasibility and long-term operation prior to approval (Tuolumne County, 1999). The County notes that some systems were installed in fractured rock and are potentially a threat to groundwater quality and local water wells. Those wells of most concern are generally associated with older residences drilled prior to the adoption of the local well construction ordinance in 1986 (Chapter 13.16 TCOC), which mandates minimum separation between leach fields and other sources of pollution (Tuolumne County, 1999). In 1999, Tuolumne County estimated an inventory of 497 problematic septic systems within the primary study area (Tuolumne County, 1999). In addition to problematic systems previously identified, most septic systems do not meet the ideal construction and design requirements laid out in OWTS policy.

Modesto Reservoir Watershed

No new growth occurred in the watershed since the last sanitary survey in 2014. The Modesto Regional Water Treatment Plant is served by a septic system located outside of the watershed. There is one rural residence located near the park which has a septic system (Personal Communication, Ms. Jessica Stillwell, November 2019).

Inside the watershed, the park has two year-round portable toilets and up to twenty-nine temporary portable toilets during higher usage periods. The portable toilets are maintained weekly from March 1 to November 15, and daily on holidays.

Lower Tuolumne River Watershed

Other than Hickman, La Grange, and Waterford, the study area is primarily rural and agricultural. Waterford has a wastewater treatment plant and disposal system, as identified in Section 2.3.1. The remainder of the study area uses septic systems and leach fields for wastewater disposal.

The installation and permitting of septic systems is regulated by the Stanislaus County Environmental Resources Department and the CVRWQCB. According to the department there are no known problems with the septic systems in the Lower Tuolumne River area, and development over the past 4 years has been minimal.

3.2.2 Water Quality Concerns

Not only can septic systems contribute to contamination of groundwater, but improperly located, designed, constructed, or maintained systems may pose a significant threat to surface water. Failing septic tanks may contribute microbial contaminants and nutrients to adjacent water bodies.

3.2.3 Watershed Management

Under SWRCB Resolution No. 2012-0032 OWTS Policy, state and regional water quality boards will regulate and coordinate with local agencies to implement the policy and manage new and replacement OWTS on a routine basis.

Don Pedro Reservoir Watershed

In the southern end of Tuolumne County, a broad area of shallow soil and volcanic rock surrounds Don Pedro Reservoir. Over the years, developers gained approval for many development projects on sites where shallow soils and underlying rock provided few suitable sites for septic systems. The Tuolumne County Environmental Health Department acknowledges that the area near Don Pedro Reservoir does not have good soil conditions for septic tanks, and new systems are engineered systems.

Beginning in September 2012, Tuolumne County initiated the Residential On-Site Septic System (ROSS) series of educational training programs to help homeowners use, maintain, and evaluate their septic systems. The ROSS program includes a two-hour workshop presentation and training guide that provides an overview of septic system design and guides homeowners to operate and maintain their systems. In the past, older non-engineered systems were not routinely inspected. For septic systems installed after 2005, a -third-party service provider is required to inspect septic systems (2014 WSS). The goal of this maintenance and monitoring program is to repair systems before they leak. The county is continuing their education program/efforts to date.

Modesto Reservoir Watershed

Sanitation facilities within the watershed are provided through flush toilets, portable chemical toilets, vault toilets, and showers connected to a sewage collection system. Vault and chemical toilets are serviced at intervals depending upon the volume of people visiting the reservoir.

Lower Tuolumne River Watershed

Septic systems within the study area are permitted and regulated by the Stanislaus County Health Services Agency or the Waterford Public Works department. However, septic system siting and design and construction standards are established by the RWQCB.

3.3 Urban Runoff

Storm water and dry weather runoff is present in the Don Pedro Reservoir watershed. The NPDES federal and state storm water permitting process is described in Section 3.17.

3.3.1 Potential Contaminant Sources

Don Pedro Reservoir Watershed

Storm water and dry weather runoff from the towns in the Don Pedro Reservoir Subwatershed are discharged to waterways (see Table 3.4). The only towns in the watershed that have a municipal storm drain system are Sonora, Twain Harte, Jamestown, Tuolumne City, and parts of Groveland. The other towns have culverts under roadways which carry storm water.

Table 3.4. Storm water Discharge Locations within the Don Pedro Reservoir Watershed

Town	Discharge location
Moccasin	Moccasin Creek leading to Don Pedro Reservoir
Big Oak Flat	Rattlesnake Creek leading to Don Pedro Reservoir
Groveland	Big Creek leading to Don Pedro Reservoir
Pine Mountain Lake	Tuolumne River leading to Don Pedro Reservoir
Tuolumne City	Turnback Creek leading to Tuolumne River leading to Don Pedro Reservoir
Twain Harte	Twain Harte Creek leading to Sullivan Creek leading to Don Pedro Reservoir
Mi-Wok	Melones Reservoir

Table 3.4. Storm water Discharge Locations within the Don Pedro Reservoir Watershed

Town	Discharge location
Sonora	Woods Creek leading to Don Pedro Reservoir
Jamestown	Woods Creek leading to Don Pedro Reservoir
Chinese Camp	Don Pedro Reservoir
Harden Flat	Tuolumne River leading to Don Pedro Reservoir

Tuolumne County field studies suggest that waterways that drain the watershed currently do not exhibit detectable levels of typical urban pollutants, which are well below regulatory action levels, and currently do not represent a significant threat to drinking water quality in downstream reservoirs. The pollutants found, such as sediments and pathogens, are more commonly associated with rural forms of development and legacy land use practices. With regard to storm water runoff, the impacts on receiving streams due to high storm water flow rates or volumes may be more significant than those attributable to the contaminants found in storm water discharges.

Lower Tuolumne River Watershed

The RWQCB has issued active NPDES permits for stormwater discharge to three facilities in the Lower Tuolumne River Watershed. An additional two facilities within the watershed had stormwater permits that were terminated within the past 10 years. It should be noted that the RWQCB does not regulate all facilities within these categories in the study area. Table 3.5 presents the facilities with NPDES storm water permits.

Table 3.5. Facilities with NPDES Stormwater Permits Located within the Lower Tuolumne River Watershed

Facility	Address	Standard Industrial Classification System	Acres	Status
Waterford Auto and Truck Dismounting	12616 Yosemite Boulevard, Waterford, CA 95386	Motor Vehicle Parts, Used	4	Active
Michel Ranch and Dairy	744 McEwen Road, Waterford, CA 95386	Dairy Farms	350	Terminated 2/14/2013
Waterford Unified Transportation	12916 Bently Street	School Buses	0.5	Active
Stanislaus Greer	750 Geer Rd, Modesto, CA 95357	Refuse System	Unknown	Terminated 8/29/2019

Table 3.5. Facilities with NPDES Stormwater Permits Located within the Lower Tuolumne River Watershed

Facility	Address	Standard Industrial Classification System	Acres	Status
Delaney Aggregates	28880 Lake Rd, La Grange, CA 95329	Construction Sand and Gravel	Unknown	Active

Some of the stormwater from the City of Waterford drains to the Modesto Irrigation District canals downstream from the Modesto Reservoir and the rest flows directly to the Lower Tuolumne River. MID has four individual storm drainage license agreements with the City of Waterford which allow the City to discharge storm waters from the drainage areas to Modesto Irrigation District's system through stormwater drainage facilities. There are four storm drainage areas located in Waterford that drain into Modesto Irrigation District canals. The stormwater that drains to the MID canal does not influence the Lower Tuolumne River watershed. Stormwater from the older section of Waterford and subdivisions built after 1990 flows directly to the Tuolumne River. The city complies with the NPDES permitting requirements for cities with a population less than 10,000. However, the city may be required to meet NPDES requirements in the future as their population grows.

There is one discharge location from the Stanislaus County Roads System that directly discharges into the Tuolumne River.

3.3.2 Water Quality Concerns

Urban runoff contains numerous contaminants as a result of vehicle emissions, vehicle maintenance wastes, outdoor washing, outdoor material storage, landscaping chemicals, household hazardous wastes, pet wastes, trash, and other manmade waste sources. Fertilizer usage in urban areas contributes nutrients to urban runoff. Urban runoff also delivers nutrients from leaves, woody debris, and insects, which degrade and release nutrients that are carried to receiving waters. Urban runoff is known to contribute to metal loads in the watershed.

Sources of fecal contamination in urban runoff include domestic and wild animals, in addition to human sources from illegal camping, illicit connections to the storm drain system, septic system leaks, or sewage spills to the storm drain system. Fecal coliforms are used as indicators of fecal contamination, and their presence (as evidenced by those communities that monitor their urban runoff) indicates that urban runoff carries a significant amount of fecal material into tributaries. The primary impact of fecal contamination on water bodies is the potential presence of pathogens that may be associated with feces. The actual amount of pathogens (or risk to human health) from urban runoff cannot be extrapolated from indicator organism data.

3.3.3 Watershed Management

Untreated storm water is discharged directly to creeks or rivers. Tuolumne County is not subject to Phase 2 of the NPDES storm water regulation as the population of each incorporated town is less than 10,000 (see Table 2.1). Therefore, towns within this county do not need an NPDES permit. Storm water permits would include a provision to develop a Storm Water Quality Improvement Program to address storm water pollutants that cause or contribute to exceedances of water quality standards and potential impairment of beneficial uses.

Tuolumne County does require storm water permits for new developments and also requires control for two aspects of development: quality and quantity of storm water. These permits require some level of treatment to be provided using subsurface or onsite detention/retention facilities. State law requires Construction General Permits for dischargers with projects that disturb one or more acres of soil under the General Permit for Dischargers of Storm Water Associated with Construction Activity (Construction General Permit Order 2009-0009-DWQ). Construction activity subject to this permit includes clearing, grading, and disturbances to the ground such as stockpiling or excavation, but does not include regular maintenance activities performed to restore the original line, grade, or capacity of the facility (SRWCB, 2012). The Construction General Permit requires development and implementation of Storm Water Pollution Prevention Plan (SWPPP). Staff in Tuolumne County have received QSP (Qualified SWPP Practitioner) training to assist with permitting. Once a year, the County also provides special training workshops on storm water issues to the general public (2014 WSS).

3.4 Recreational Use

Recreation is the primary activity within the Modesto Reservoir subwatershed, and a significant activity in the Don Pedro Reservoir subwatershed. Recreational activities can contribute to the degradation of water quality. For example, boating activities introduce the potential for fuel or oil spills into the reservoir. Additionally, body contact recreation, such as swimming, is a potential source of pathogen contamination, including bacteria, viruses, and protozoa. During the permitting for the MRWTP, the CDPH was made aware of the recreational activities at Modesto Reservoir and Don Pedro Reservoir.

3.4.1 Potential Contaminant Sources

Don Pedro Reservoir Watershed

Visitation to the Don Pedro Recreation Area averages 350,000 visitor days, per year. Both body contact and non-body contact recreation are permitted in Don Pedro Reservoir.

Boat launching facilities, boat rentals, and multiple full-service marinas are available at the reservoir as well as groceries, bait, tackle, and gasoline. Camping and picnicking are allowed in designated areas with developed campsites accessible through the park and many undeveloped areas accessible only by boat. California Department of Fish and Wildlife stock Don Pedro Lake with trout and salmon. Additionally, under contract with TID, Willow Creek Fisheries stock Florida Strain largemouth bass annually. Don Pedro Lake averages 65-70 CDFW permitted fishing tournaments each year.

There are a total of twenty-two permanent restroom units in the campgrounds, averaging three toilet closets/1 urinal per unit in areas adjacent to Don Pedro Reservoir as well as six portable units. Portable units are increased during peak usage weekend of July 4th to twenty-six units. Recreational uses and related maintenance activities are detailed in Table 3.6.

Table 3.6. Recreation and Maintenance Activities at Don Pedro Reservoir

Source	Description
Number and location of houseboats	257 privately-owned houseboats moored as follows: 66 at private houseboat dock (Fleming Meadows), 40 moored at Gillman Gulch, 10 at Lucas Bay, 54 at Buzzard Cove, 25 at Schoolhouse Cove, and 62 at Moccasin Bay (in slips and on buoys). Up to 40 rental houseboats: 20 at Moccasin Point, 20 at Fleming Meadows. .
Number of campsites	560 developed sites located in three campgrounds: 176 tent campsites and 90 full hook-up sites at Fleming Meadows, 161 tent sites, 34 partial hook-up sites, 2 full hook-up sites , and 1 group camp at Blue Oaks; 78 tent sites and 18 full hook-up sites at Moccasin Point. 6 partially developed boat-in campsites on lake shore (Wreck Bay area), and up to 120 dispersed area campsites on busiest holiday weekends.
Campsite reservation statistics	2014 – 5,287 reservations 2015 – 4,440 reservations 2016 – 7,0004 reservations 2017 – 9,292 reservations 2018 – 8,725 reservations 2019- 10,477 reservations
Paved parking spaces	Fleming Meadows: 873, Moccasin Point: 2211, Blue Oaks: 277.
Pertinent maintenance routines	Trash hauled from each Recreation Area 2-4 times per week between April 15 and September 30, and once per week the remainder of the year. Campground restrooms cleaned 1 to 2 times per day between April 15 and September 30, and 1-2 times per week the remainder of the year. 6 floating restrooms cleaned/serviced 2-3 times per week between April 15 and September 30, and pumped once per month.
Number of toilets	6 floating restrooms with 2 toilet closets per unit. 3 concrete vault toilets in dispersed areas (Wards Ferry, Graveyard Creek, and Wreck Bay), 33 campground

Table 3.6. Recreation and Maintenance Activities at Don Pedro Reservoir

Source	Description
	restroom units (12 with showers, average of 3 toilet closets/1 urinal per unit), 3 sewage dump stations and 5 sewage pump outs.
Recreation area amenities	Fleming Meadows: 1 snack bar, 2 stores/restaurants, 1 gas dock, houseboat rental/housekeeping, boat repair shop, and 150 mooring slips. Blue Oaks: houseboat repair yard and boat storage facility. Moccasin Point: boat storage, 1 store/restaurant, 1 gas dock and 70 boat mooring slips.
Housing	8 mobile home/RV pads (7 house employees at Riley Ridge); 6 mobile homes at Fleming Meadows (concessionaire housing); 6 mobile homes at Moccasin Point (2 for employees, 4 for concessionaire housing). 4 above ground water storage tanks (1 at Riley Ridge, 2 at Blue Oaks, 1 at Moccasin Point).
Wastewater treatment facilities	Fleming Meadows: 4 million gallons (mg), Blue Oaks: 2 mg, and Moccasin Point: 2 mg.
Water treatment	Fleming Meadows: 210 gallons per minute (gpm), swimming lagoon: 600 gpm, and Filter: 2.2 mg storage, Blue Oaks: 70 gpm.

Sources: Brannon Gomes, DPRA, 2020; DPRA Board of Control Monthly Report, January 2018; https://www.donpedrolake.com/recreation/camping;

The Fleming Meadows Recreation Area at Don Pedro Reservoir features a 2-acre swimming lagoon and sand beach area. Chlorinated and filtered potable water from the drinking water treatment plant is pumped into the swimming lagoon. The lagoon has a sandy bottom and therefore water is replenished frequently. Overflows from the lagoon drain into a creek, which drains into the Tuolumne River. However, there have been no overflows from the swimming lagoon into the watershed in the past four years (Personal communication with Brannon Gomes, February 2020). Water in the lagoon is treated with chlorine and filtered to protect the swimmers' health. The filters are backwashed up to four times a week, which uses approximately 40,000 gallons of water. The chlorinated backwash water is diverted into a sump and is applied to adjacent spray fields during the summer months (May through September). A vegetative buffer is maintained in the spray field during the months that it is in use.

Drainage from the spray field is unlikely to drain into the Tuolumne River because of its location approximately three miles from the lagoon. During summer months when the lagoon is in use, the spray field drainage evaporates within one-quarter of a mile from the lagoon and does not enter any waterways (2014 WSS).

Over the past several years, DPRA has taken a proactive approach for the protection of public health relative to the swimming lagoon. Water quality objectives for bacteria described in the CVRWCB's Basin Plan can be used as a guideline for setting water quality controls for the swimming lagoon. These objectives, which were adopted by the Regional Board in 2002 and are awaiting final adoption by the State

Board, are presented in Appendix D (Basin Plan Objectives for Bacteria). Requirements of the Basin Plan Objectives are summarized below:

- In all waters designated for contact recreation, the *E. coli* concentration, based on a minimum of not less than five samples equally spaced over a 30-day period, shall not exceed a geometric mean of 126/100 ml and shall not exceed 235/100 ml in any single sample.
- If any single sample limits are exceeded for *E. coli*, RWQCB may require repeat sampling on a daily basis until the sample falls below the single sample limit or for five days, whichever is less, in order to determine the persistence of the exceedance.
- When repeat sampling is required because of an exceedance of any one single sample limit, values from all samples collected during that thirty-day period will be used to calculate the geometric mean.

The current Basin Plan includes objectives for fecal coliform of 200 MPN / 100 mL (geometric mean), not to exceed 400 MPN / 100 mL in a single sample.

Approximately 30 campgrounds are located within the watershed. The campgrounds with water bodies have invasive species information posted on boards at entrances. There is a threat of invasive mussel introduction from boating on the reservoir. If introduced, mussels could threaten water delivery systems, irrigation networks, and freshwater ecosystems by clogging intake pipes and other conveyance structures.

The Don Pedro Reservoir has approximately 160 miles of shoreline including the numerous small islands within the lake. Steep shorelines are predominately intact rock or rock/rubble/boulder not prone to erosion. Mild slopes, less than eight percent, are generally soil. Where soils predominate, slopes are relatively flat and minor erosion along the shoreline occurs. Erosion along the soil/water interface at or below the normal maximum water elevation (830 ft) is common, but predominantly occurs only along the shoreline and not upslope. A factor that contributes to the lack of upslope erosion is that the shoreline is either federal land (Bureau of Land Management [BLM]) or owned by the TID. The land use rules and regulations, including the prohibition off boat docks, piers, bulkheads, or other constructions on the reservoir shoreline substantially reduces the potential for soil loss. The overwhelming majority of recreation activities occur at designated and well-managed sites. Any significant erosion or soil movement caused by recreation activities at these sites is quickly addressed by the DPRA. Developed recreation sites constitute less than ten percent of the shoreline. Access roads are well maintained and any repairs to roads or recreation areas follow BMPs for erosion control.

Modesto Reservoir Watershed

The Modesto Reservoir Regional Park lies within the 11,500-acre Modesto Reservoir watershed (Figure 3-1), and comprises 6,040 acres of the watershed. Both body contact (i.e., swimming and water skiing) and non-body contact (i.e., boating) recreation are permitted in the waters of Modesto Reservoir. Camping and picnicking is allowed in designated areas. Developed campgrounds have designated campsites in addition to adjacent toilet facilities, both permanent and portable. Undeveloped campgrounds do not have designated campsites and are served only by vault or portable chemical toilets. A 50-foot setback buffer from the high water line is a requirement for the undeveloped camping areas. There are 186 developed campsites, including 150 full recreational vehicle (RV) hook-ups. There is an RV dumping station near the front entrance into the recreational area. Modesto Reservoir holds channel catfish, large and small mouth bass, rainbow trout, and black crappie, making it a popular fishing spot. A local outdoor activity club, the Yahi Bowmen archery club, uses the park for recreation.

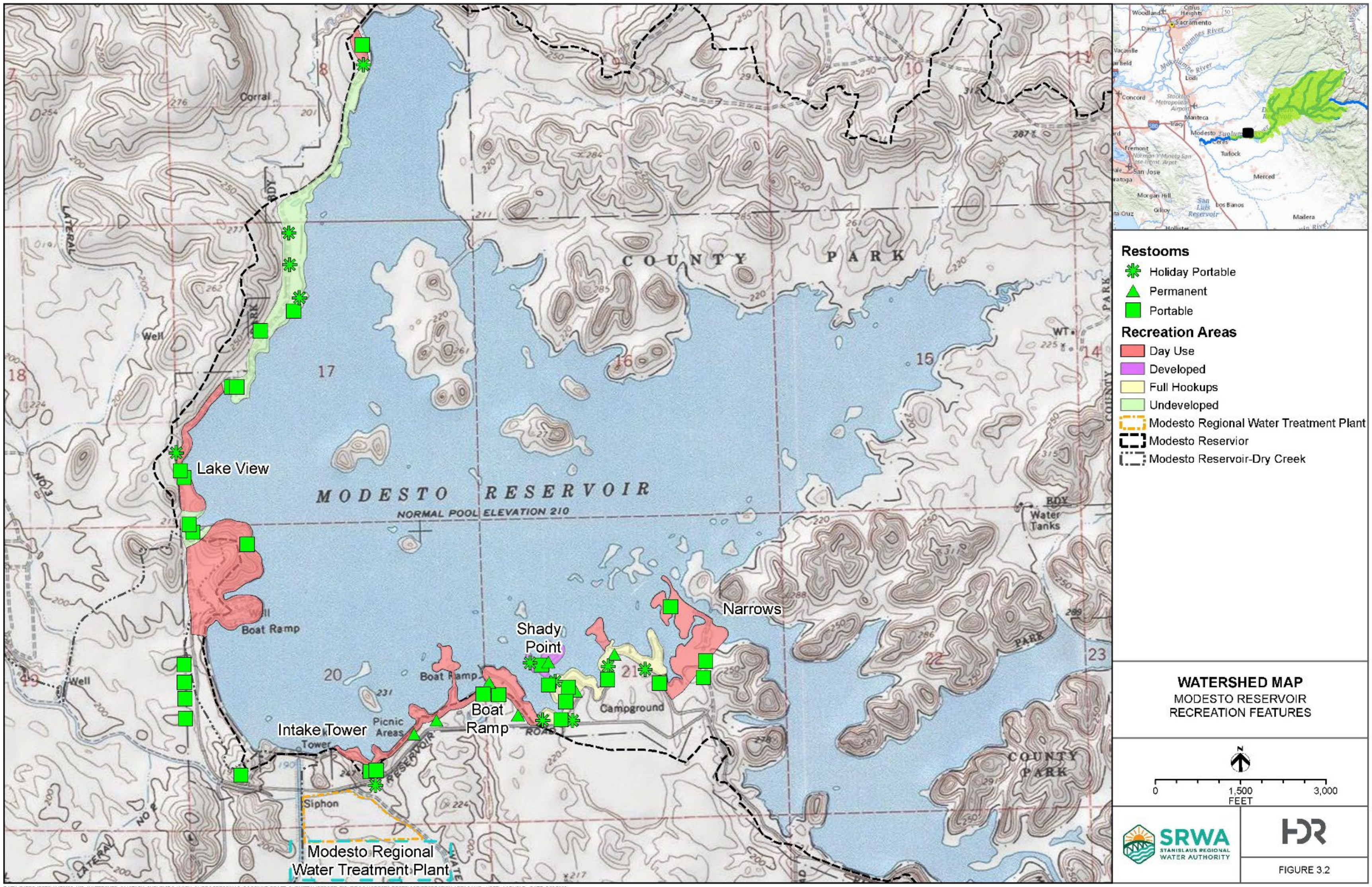


Figure 3-1-Modesto Reservoir Recreation Features

The total number of visitors for the report period are shown in Table 3.7. On average, approximately 50 percent of visitors stayed overnight. In March 2016, a new camping reservation website for the reservoir went live at www.recreation.gov, which created a change in the way Stanislaus County Parks and Recreation reports visitor counts. There may been some overlap in the 2016 visitor counts from reservations made at the recreation.gov site and the visitor counts reported directly from the County, causing numbers to possibly be slightly inflated. However, the County believes this number to be relatively small.

The area receives more visitors on weekends than during the weekdays, especially when temperatures are warmer or during three-day weekends. The developed campgrounds fill up quickly during the summer weekends, with the peak usually occurring during holiday weekends. Undeveloped campgrounds also fill up during peak weekends. Peak weekend usage visitor numbers can be as high as twenty times the daily average.

Table 3.7. Modesto Reservoir Visitor Counts, 2014-2018

Year	Annual Visitor Count	Holiday Visitor Count (Memorial Day, Fourth of July, Labor Day)
2014	52,408	15,309
2015	53,172	13,148
2016	148,336	33,960
2017	152,663	21,242
2018	87,839	17,619
Total	494,418	101,278
Source: Modesto Reservoir Annual Activity Reports, 2014-2018		

Boating is a popular activity, and accidents or collisions occur occasionally at the reservoir. The number of boating accidents that occurred during the report period and associated fuel or oil spill volume is shown in Table 3.8. There were no accidents between 2014 and 2018 that resulted in spills greater than 5 gallons.

Table 3.8. Boating Accident Summary

Year	Number of Accidents	Total Spill Volume (gal)
2014	0	-
2015	1	0
2016	2	0
2017	3	< 5
2018	0	-

In addition to fuel spill from accidents, boating activity can threaten water quality by introducing invasive mussel species to the reservoir. During the study period, there were no vessels identified as having been in a contaminated body of water, and no mussels were identified during inspections.

Lower Tuolumne River Watershed

The *Stanislaus County General Plan* provides an emphasis on the conservation and management of the county's natural resources in the Conservation/Open Element chapter. It also emphasizes the preservation of open space lands, which is defined as any parcel or area of essentially unimproved land or water. This element focuses on five main objectives (Stanislaus County, 2015):

1. Promote the protection, maintenance, and use of the County's natural resources, with special emphasis on scarce resources and those that require special control and management;
2. Prevent wasteful exploitation, destruction, and neglect of natural resources;
3. Recognize the need for natural resources to be maintained for their ecological values as well as for their direct benefit to people;
4. Preserve open space lands for outdoor recreation including scenic, historic and cultural areas; and SRWA

Several recreational areas exist within the study area. These recreational sites are operated by California Department of Parks and Recreation (CDPR) and Stanislaus County.

Basso Bridge River Access

Basso Bridge River Access is located off Route 132 west of the town of La Grange and is part of the La Grange Regional Park. The park is approximately two acres and includes one boat ramp, barbecues, picnic tables, a parking lot, and two restrooms (septic tank). The Basso Bridge River Access is also used primarily for the boat ramp and fishing. It is closed to fishing November 1 through December 31 each year during the salmon run (Brown and Caldwell, 2009).

La Grange Off-Highway Vehicle Use

La Grange Off-Highway Vehicle (OHV) Park is located approximately 2.5 miles south of La Grange along Highway J-59. The park includes 126 acres of trails. There are barbecues, picnic tables, undeveloped campsites, and two restrooms (septic tank). Erosion from OHV parks can result in elevated levels of sediment and turbidity in local intermittent streams during high precipitation events. These ephemeral streams can eventually drain to the Tuolumne River.

Fox Grove County Park

The developed portion of Fox Grove County Park is located on the south side of the Tuolumne River at Geer Road. The land is owned by CDFW and the facilities are operated by the Stanislaus County Parks and Recreation Department. The park is primarily a fishing access with approximately one mile of river frontage. The sixty-four-acre park includes a parking area, one boat ramp, barbecues, picnic tables, and four restrooms (septic tank and vault toilet). Fox Grove is closed to fishing November 1 through December 31 each year during the salmon run. The boat ramp is used by fisherman January through October.

Other recreationists, including swimmers and jet skiers, use the boat ramp primarily in the summer season, extended into the spring and fall if the weather is warm. In the fall, duck hunters use the boat ramp. Use of the park is not measured; however, the parking lot is full on summer weekends and holidays. The parking lot has 27 boat trailer parking spaces.

The undeveloped portion of the Fox Grove County Park, also owned by, is the parcel of land west of the Geer Road Bridge where the infiltration gallery and Raw Water Pump Station will be located. The public's walk-in access from Fox Grove Park for fishing is currently gated off for construction of intake facilities at the infiltration gallery.

The *Stanislaus County Parks Master Plan* was developed in 1994 to provide a comprehensive overview of the county's recreational resources and future plans (Stanislaus County, 2017a). The plan addresses future recreational projects that involve Fox Grove Regional Park that may directly affect project-related activities.

Regarding Fox Grove County Park, the master plan proposes a number of enhancements that include a possible new swimming hole within the sheltered cove, a new informal play area, additional picnic tables, and a nature trail. The goal would be to increase the number of amenities available for family outings that take place at the park. It is unclear when these enhancements would occur (Stanislaus County, 2017a).

3.4.2 Water Quality Concerns

Recreational use of the reservoir and shoreline can result in pathogenic organisms and sediment loading to the reservoir. Both body contact and non-body contact recreation on surface waters can lead to higher total and fecal coliforms. Additionally, higher *Giardia* and *Cryptosporidium* levels may also occur if a contaminated individual does not use a proper restroom facility. Waterside camping and picnicking can also lead to elevated coliform, *Giardia*, and *Cryptosporidium* counts, even if proper restroom facilities are used. Other contaminants associated with sediment, such as nutrients and organic carbon could also be introduced to the reservoir. It should be noted that camping is prohibited within fifty feet of the high-water mark. Boating accidents can lead to elevated levels of oil or petroleum products. If invasive mussel species are introduced, they can eventually clog intakes and water supply conveyance systems.

3.4.3 Watershed Management

Don Pedro Reservoir Watershed

DPRA is responsible for the operation and maintenance of recreation areas, including the marinas, campgrounds and swimming lagoon and oversight of concessionaires licensed to provide services on the reservoir. DPRA activities also include some non-recreational management issues such as debris management at the upstream end of the reservoir with collection, corralling, and wintertime disposal of woody debris that collects in the area where the Tuolumne River flows into the reservoir.

DPRA allows shoreline camping and camping at developed and undeveloped campsites, along the shoreline but having fire is prohibited (Personal communication with Mr. Brannon Gomes, February 2020).

DPRA maintains shoreline restrooms at five locations in addition to those at the developed recreation areas, and floating restrooms on anchored platforms at six locations throughout the reservoir, to avoid improper waste disposal. Floating restrooms are located in areas with significant recreation but no shoreline or developed services, including popular coves or areas of interest such as the Hatch Creek Arm where a water ski slalom course has been established.

DPRA implements a detailed and extensive land use policy consisting of rules and regulations governing uses of Don Pedro Reservoir area lands and waters (see Appendix E). The land use rules and regulations prohibit any placement of developed improvements along the Don Pedro shoreline and prohibit all vehicular access across area lands. The objective of this land use policy is to maintain well over 90 percent of the Don Pedro shoreline in its natural state, to benefit both wildlife and watershed.

The Don Pedro Recreation Agency administers the Don Pedro Reservoir Mussel Prevention Program. In 2008, after the discovery of Quagga Mussels in southern CA waterways and zebra mussels in San Justo Reservoir, DPRA developed a Mussel Threat Action Plan. Staff began attending mussel workshops and watercraft inspection training. Posters were placed throughout the recreation area. Mussel information flyers were distributed and links were added to the DPRA website. In addition, mussel handouts and stickers were given to customers with receipts and reservation confirmations, and the marina concessionaires began distributing mussel information to their customers. In 2012, with assistance from CDFW Central Region Mussel Program, DPRA initiated a mussel self-inspection program. Don Pedro is open 24 hours a day, 365 days a year, and operates with self-service pay stations much of the year. The self-inspection program requires permits to be displayed for all vessel launches. The self-inspection program relies on the honor system, and there is currently no penalty for failing to comply with the permit requirements. The small staff and unstaffed entrance stations limit the ability to intercept all vessels for mussel screening. All private & concessionaire houseboats must also comply with DPRA regulations. Mussel inspection is included as part of Don Pedro houseboat inspections.

Modesto Reservoir Watershed

The Stanislaus County Parks and Recreation Department manages the Modesto Reservoir Regional Park. To reduce the possibility of contamination from recreational uses, the Modesto Reservoir Management Plan (1998) established policies regarding uses that affect water quality including recreation, runoff, and animals (provided in Appendix F). Stanislaus County monitors the water quality at bathing beaches and has the authority to close a beach if they deem it necessary.

The Management Plan discusses several policies that are designed to reduce the possibility of human and pet fecal contamination. Boats equipped with sanitary facilities are not allowed on the reservoir. Boats are not allowed to anchor overnight, except in conjunction with the owner using campground facilities. The use of bilge pumps is prohibited except in areas equipped with facilities to dispose of the waste, or in emergency circumstances. Dogs and horses are not allowed on park lands. Camping in undeveloped areas must be at least fifty feet from the high-water mark. Fish cleaning is not allowed in areas where the waste would enter the reservoir.

The ranger station at the entrance to the reservoir is staffed based on traffic patterns, with extended hours during the summer. The entrance station is open every day from 7:00 am to 3:00pm during the off season and hours extend from 6:00 am to 10:00 pm during the peak season and on holidays. The park rangers inspect all boats entering the reservoir to ensure compliance with the restrictions on the type of boats allowed; however, boats that arrive when the ranger station is not staffed are not inspected. Pamphlets are handed out at the entrance station to explain what activities are permitted at the reservoir, the concerns about invasive species, and the necessity of regulations to protect the reservoir as a source of drinking water.

Public outreach materials are distributed at the entrance station and are on the County's website (Appendix G).

The area near the intakes to the water plant is restricted from public access. This area is protected in the water with a buoy system five hundred feet from the intakes, marking the area as restricted. The dam is restricted to prevent both vehicular and foot traffic.

Parks staff, with the help of volunteer workers, pick up litter and garbage and maintain the restrooms. Campground loops B, C, and D currently close during the winter to allow for tree pruning and other maintenance work to be completed. The closure does provide the added benefit of watershed protection.

Modesto Irrigation District took steps to enhance its quagga/zebra mussel monitoring program by aligning it more closely with the CDFW monitoring protocols. The District has worked closely with CDFW to implement a monitoring program that includes regular inspection of several permanent substrates around the reservoir, as well as two artificial substrates, one located within the reservoir and the other located within the treatment plant. Previously, MID performed regular veliger tow sampling during the quagga breeding season, followed by microscopic analyses. In 2014, as part of the North Central Valley Consortium, MID helped develop a Quagga and Zebra Mussel Prevention Plan in conjunction with CDFW in which it was determined that Modesto Reservoir is a low risk for mussel establishment. As required by the Plan, MID continues to routinely monitor its permanent and artificial substrates but no longer performs regular veliger tows. MID regularly updates its risk assessment based on changes in water quality to ensure compliance with monitoring requirements.

In addition to regular monitoring to prevent the spread of invasive species, such as the quagga mussel, staff at the Modesto Reservoir Regional Park perform vessel inspections with a trained dog and provide educational materials to visitors. The District has coordinated with Stanislaus County Parks & Recreation to assist them in their screening of boats entering the park, as well as providing CDFW posters that are placed around the reservoir on an annual basis. All boaters entering the park during operating hours receive a quagga informational handout from the entrance station. Entrance station staff also ask boaters if their vessel has been in the water in the last 30 days, and if so, what body of water. If the body of water is on the list of contaminated lakes, the visitor is asked not to put the vessel in the lake. Staff are also instructed to collect identification information on these vessels. In 2014, nearly 200 vessels were inspected, and from 2015 to 2018 the average vessel inspections increased to over 1,400 per year. To date there have been no detections of quagga mussels or veliger in Modesto Reservoir.

The District attends regular meetings with the CDFW and other agencies that provide oversight of upstream water bodies. The purpose of these meetings is to establish enforceable regulations that provide uniform monitoring for aquatic invasive species and consistent screening of watercraft entering reservoirs and other waterways, and to develop effective literature to inform the public of the risks and consequences of colonization of MID source water by aquatic invasive species.

Lower Tuolumne River Watershed

CDPR is responsible for managing 280 park units throughout the state of California (CDPR 2017). Fox Grove Regional Park is owned by the California Wildlife Conservation Board and operated by the Stanislaus County Department of Parks and Recreation. Fishing is prohibited in the park from Nov. 1-Dec. 31 of each year due to the salmon run.

3.5 Agricultural Crop Land Use

The potential risks to water quality associated with agricultural cultivation are increased erosion, loss of topsoil, and use of fertilizers, pesticides, and herbicides.

Beneficiaries of irrigation water supplies managed by MID are located in Stanislaus County. Farm and cropland characteristics for this county and for the entire State of California are shown in Table 3.9. Tuolumne County has relatively little cropland compared to Stanislaus and San Joaquin Counties (referenced for comparison on cropland characteristics per Table 3.9). Only a very small portion of agricultural land in Stanislaus County is located in the MID Modesto Reservoir watershed. No portion of agricultural land in San Joaquin County is located in the MID watershed.

3.5.1 Potential Contaminant Sources

Don Pedro Reservoir and Modesto Reservoir Watershed

Approximately seventy-nine percent of the total land in Tuolumne County is government-controlled (federal, state and local, other/water use), with the remaining land mostly hills and forests. Crop agriculture is relatively small component of the total land use (Tuolumne County, 2017).

In Tuolumne County, as summarized in Table 3.9, about 122,539 acres is considered farm land, of which only 1,519 acres (or one percent of total farmland) is for crops. (The remainder of the farmland is used for livestock, pastureland, or forest products). The primary crops grown in the county are fruits, trees, nuts, and berries. Although some nursery products and vegetables are grown in the county, they make up a smaller proportion of total crops.

Table 3.9. Farm and Cropland Characteristics

County	Farm Characteristics			Total Cropland		Percent Farm in Cropland	Harvested Cropland		Irrigated Land	Percent Land in Farms Irrigated	Market Value of Agriculture Products		Largest Crops
	No. of Farms	Land in Farms (acres)	Ave. Farm Size	No. of Farms	Acres		No. of Farms	Acres	Acres		Crops ($1,000s)	State Rank Crops	
San Joaquin	3,430	772,762	225	2,938	524,356	68%	2,847	482,847	487,147	63%	1,627,303	5	Fruits, tree nuts, berries
Stanislaus	3,621	722,546	200	2,810	404,702	56%	2,746	373,579	380,590	53%	1,339,470	8	Fruits, tree nuts, berries
Tuolumne	417	122,539	294	106	1,519	1%	91	913	2,597	2%	1,119	54	Fruits, tree nuts, berries
California	70,521	24,522,801	348	52,860	9,597,439	39%	49,533	7,857,512	7,833,593	32%	33,353,834		Fruits, tree nuts, berries

Note: Average size of farm is calculated by dividing the land in acres by the number of farms.
Source: https://www.nass.usda.gov/Publications/AgCensus/2017/Online_Resources/County_Profiles/California/index.php
https://www.nass.usda.gov/Publications/AgCensus/2017/Full_Report/Volume_1,_Chapter_2_County_Level/California/

Land use downstream of Don Pedro Reservoir is predominately irrigated agriculture, urban/suburban, and rural residential. MID serves several thousand acres of high value farmland in the Central Valley. Crop percentages vary year to year, but representative averages based on the 2015 MID Agricultural Water Management Plan are:

- Permanent Crops - 55 percent
- Pasture and Grains - 35 percent
- Other - 10 percent

Agricultural uses of the Modesto Reservoir and Upper Main Canal subwatersheds are depicted on Figures 2-3 and 2-4, including a large almond orchard located north of Modesto Reservoir. There are also small areas of pasture immediately north and south of the canal. Immediately north of both the MID Upper Main Canal and the Waterford Upper Main Canal (which branches off from and drains into the MID Upper Main Canal) are large areas of rangeland. These agricultural uses drain into the MID Upper Main Canal.

During the field survey in late 2019, the HDR team observed very recent conversions of grazing land into orchards on the north side of the MID Main Canal as well as on north side of the reservoir. HDR recommends MID verify that the grading completed with that conversion be completed in a manner that contains runoff from the orchard on the property and protects against direct discharge into the reservoir. The field survey also HDR identified an orchard on the south side of the canal immediately adjacent to the O&M road that appeared to drain directly into the canal.

The most commonly used pesticide on almonds is mineral oil; however, almonds are the primary crop to which diazinon and chlorpyrifos are applied. Based on 2016 DWR statewide agricultural land use data, almond cultivation in the Modesto Reservoir Watershed increased from approximately fifty acres (reported in the 2014 WSS) to approximately 2,668 acres.

Orchards also provide benefits to watershed runoff. Farmers proactively control and abate local rodent and squirrel populations. As a result, rodent fecal matter run off into the watershed during the first seasonal rainfall is also reduced.

Lower Tuolumne River Watershed

Agriculture is a major part of the economy of the study area. The potential risks to water quality associated with agricultural cultivation are increased erosion, loss of topsoil, and use of fertilizers, pesticides, and herbicides. According to the 2014 through 2018 Stanislaus County Crop Reports, almonds are the largest commodity produced in Stanislaus County, and the second is milk. A large portion of the cultivated lands in the study area are devoted to almonds; other common crops include a variety of other fruit and nut crops including stone fruits (peaches, apricots, cherries), grapes, and walnuts.

According to the 2018 Crop Report, Stanislaus County has approximately 645,879 total acres of field crops, including 32,000 acres of irrigated pasture and 421,449 acres of rangeland. Over the report period, there was an increase in the cattle and calf population from 327,031 in 2014 to 333,075 in 2018. Most of this agricultural acreage lies outside of the study area. Over three-quarters of the study area is classified as native vegetation, rangeland, non-irrigated pasture, or riparian vegetation. Pesticides and herbicides have been used in the study area due to agricultural activities and all the farmers are required to submit monthly reports of how much pesticide is being used in their farms to Stanislaus County Agricultural Commissioner (Brown and Caldwell, 2009). As noted in the section above for Don Pedro and Modesto Reservoirs, and as reflected in Table 3.10, the most used pesticide is mineral oil used for almond trees.

The most used pesticide for each of the top ten commodities or sites of application used in 2017 in Stanislaus County are identified in Table 3.10. Specific quantities are not available for the approximately 17 percent of the study area that is cultivated.

Table 3.10. Top Ten Pesticides used in Stanislaus County Pesticide (in pound).

Commodity/Site of Application	Pesticide Chemical	Pounds
ALMOND	MINERAL OIL	1,189,521
ALMOND	1,3-DICHLOROPROPENE	645,009
GRAPE, WINE	SULFUR	450,366
ALMOND	GLYPHOSATE, ISOPROPYLAMINE SALT	213,064
ALMOND	GLYPHOSATE, POTASSIUM SALT	178,818
LETTUCE, LEAF	POTASSIUM N-METHYLDITHIOCARBAMATE	149,674
ALMOND	CHLOROTHALONIL	147,456
ANIMAL PREMISE	BORIC ACID	116,909
CILANTRO	POTASSIUM N-METHYLDITHIOCARBAMATE	113,390
ALMOND	METHYLATED SOYBEAN OIL	107,849

Source: https://www.cdpr.ca.gov/docs/pur/pur17rep/top_5_sites_ais_lbs_2017.htm

In this study area, banned pesticides and herbicides including heavy metals (e.g. lead, arsenate and mercury) and organochlorides (DDT, chlordane, lindane, toxaphene) are prohibited and not being used. The enforcement of these bans is by surprise visits to the county stores to confirm they are not available for sale.

As with Don Pedro Reservoir and Modesto Reservoir Watersheds, in the lower Tuolumne River Watershed, almonds are the primary crop where diazinon and chlorpyrifos are used. Pesticide use occurs during the irrigation and/or during the crop dormant season. The Tuolumne River is identified as an impaired water body for diazinon.

Pesticides from trees and ground are transferred to surface water through stormwater runoff, migration with irrigation water, and localized atmospheric drift from application. Particles that enter the atmosphere through pesticide drift are removed only through natural degradation and fallout from rain. Although pesticides washed off the land during storms is a small percent of the amount applied, it is sufficient to cause toxicity to aquatic invertebrates. Other factors that may impact pesticide runoff and loading to the river include poor soil drainage characteristics, field slope, the presence and type of cover crop, and antecedent moisture conditions. (Brown and Caldwell, 2009).

Most of the growers adjacent to the lower Tuolumne River area have converted to drip irrigation or micro sprinklers, both of which result in virtually no runoff. Furrow or flood irrigation generates tailwater drainage that is either discharged directly or recycled to other fields. Relative to flood and furrow irrigation, sprinkler irrigation is likely to increase pesticide wash-off from foliage, but will generate less tailwater if used appropriately. Drip irrigation systems typically generate little or no runoff. If appropriately used, such irrigation methods are likely to minimize pesticide runoff from treated sites during the irrigation season (Brown and Caldwell, 2009).

3.5.2 Water Quality Concerns

The nonpoint source pollutants typically associated with agriculture are nutrients, animal waste, sediments, and pesticides. Agricultural nonpoint source pollution enters receiving waters by direct runoff to surface waters or seepage to groundwater. Runoff of nutrients can result from excessive application of fertilizers and animal waste to land and from improper storage of animal waste. Farming activities can cause excessive erosion, which results in sediment entering receiving waters. Improper use and over-application of pesticides cause pesticide pollution. Improper grazing management can cause erosion, soil compaction, and excessive nutrients, all of which impair sensitive areas. Over-irrigating can cause runoff of sediments and pesticides to enter surface water or seep into groundwater.

3.5.3 Watershed Management

Programs established to control nonpoint source pollution from agriculture in California include joint efforts by local, state, and federal agencies. The SWRCB and the California Coastal Commission oversee the statewide nonpoint source program, with assistance from the Department of Pesticide Regulation for pesticide pollution, and the Department of Water Resources for irrigation water management. The SWRCB nonpoint source program is described in Section 3.17.

The USDA Natural Resources Conservation Service (NRCS) and the University of California Cooperative Extension Service provide technical and financial services for farmers. NRCS provides conservation assistance through a nationwide network of resource conservation districts and local offices. Resource conservation districts also provide guidance, training, and technical assistance.

NRCS works through the local conservation districts and others to help landowners, as well as federal, state, tribal, and local governments, and community groups, conserve natural resources on private land. The NRCS has three strategies to implement their goals of high quality, productive soils, clean and abundant water, healthy plant and animal communities, clean air, an adequate energy supply, and working farms and ranchlands:

- Cooperative conservation: seeking and promoting cooperative efforts to achieve conservation goals.
- Watershed approach: providing information and assistance to encourage and enable locally-led, watershed-scale conservation.
- Market-based approach: facilitating the growth of market-based opportunities that encourage the private sector to invest in conservation on private lands.

3.6 Grazing Animals and Confined Animal Facilities

Grazing animals and confined animal facilities (CAF) may contribute to erosion, and can be a source of pathogenic microorganisms, especially if large numbers have access to creeks and reservoirs or if there is considerable runoff from grazing and CAF areas. Unobstructed grazing practices become problematic at a point when livestock congregate in close proximity to or within creek channels and/or contributing drainages where manure accumulates. The preferable method for mitigating grazing affects is to establish riparian buffer standards, which outline minimum setback requirements.

Table 3.11 shows the number of grazing cattle in 2017 and 2018 in Tuolumne and Stanislaus Counties (California Agricultural Statistics Review [CDFA], 2017-2018). There are far more cattle in Stanislaus County than Tuolumne. Almost all of them are located outside the Modesto Reservoir watershed. In Tuolumne County, the leading animal commodities by gross value are cattle (calves and beef), sheep, and lamb. In Stanislaus County, the leading animal commodities are chicken and dairy cattle.

Table 3.11. Cattle Inventory for Tuolumne and Stanislaus Counties, 2017-2018

County	2017			2018		
	All Cattle	Beef Cows	Milk Cows	All Cattle	Beef Cows	Milk Cows
Tuolumne	7,400	5,200	NA	7,500	5,300	NA
Stanislaus	400,000	29,000	175,000	400,000	29,000	175,000

Source: https://www.cdfa.ca.gov/Statistics/PDFs/2017-18AgReport.pdf

3.6.1 Potential Contaminant Sources

Don Pedro Reservoir Watershed

Per Table 3.11, there are approximately 7,500 cattle in Tuolumne County (as of 2018), although information on the number of dairy cows was not provided. Grazing areas were not identified during the field survey, however, during the prior WSS, cattle crossing signs were noted on Ferretti Road near Stanislaus National Forest and on Cherry Oil Road near Cherry Lake. Nearby grazing sites likely exist in the watershed but their locations are unknown.

Modesto Reservoir Watershed

Cattle grazing occurs on both private and County-owned lands within the Modesto Reservoir watershed (see Figures 2-3 and 2-4). The County administers the grazing leases for county land that is not used for recreational purposes. Historically, cattle used to graze up to the reservoir shoreline and enter the reservoir to drink water; however, their access to the reservoir is now limited.

Cattle graze on the reservoir property leased to the cattle owner by MID. The cattle are checked on at a daily basis by their owner. There are typically 100 cow/calf pairs on the north side of the reservoir, with year-round grazing done on the north side only. In 2014, the cattle owner obtained 200 additional acres for grazing. The new pasture has its own water supply, so cattle do not need to use Modesto Reservoir as their source water. However, they still have access to the reservoir shoreline in certain locations. Grazing in the inlet area occurs during the winter months with about 25 cow/calf pairs and all calves are over four months old.

There are four liquid feed stations and several salt licks, placed at strategic locations to attract cattle to those locations that do not drain into the reservoir. Two of these stations are located in the Modesto Reservoir Inlet area; all supplemental watering stations are in operating condition. The pumps for the watering stations were replaced in 2015 and are all solar powered, eliminating the potential for fuel spills. All fences are kept in good condition and fencing is monitored regularly and repaired or replaced as needed to keep cattle contained in the pasture. New fencing was installed on the north east side of the reservoir in spring of 2016. Cattle are vaccinated twice a year, in May and November. When a sick or old animal is found, it is immediately removed from the herd to prevent impacts to the rest of the herd and water quality in the reservoir. No cows/calves or bulls died or were lost during the report period. A vegetative buffer is maintained at the high-water line, and erosion areas are protected as needed.

Lower Tuolumne River Watershed

In this study area there are designated areas for animals (primarily cattle and horses) to graze, mostly on private ranches (Sawyer Dairy located directly adjacent to the river, south of Roberts Ferry Bridge and another southwest of Waterford, plus Peaslee Creek feedlot just east of where the creek goes under Lake Road). The cattle in feedlot and dairy operations generate water and wastewater. Previously it has been reported that the dairy operators aimed to minimize the runoff from the common waste (including coliform, ammonia, nitrates, and total dissolved solids). (Brown and Caldwell, 2009).

No updates have been received during this study period on operations or runoff from the Sawyer Dairy. Compliance is monitored though the reporting requirements associated with their WDR permit.

During the 2019 field survey, it was clear that, in areas greater than 15 miles upstream of the SRWA intake, cattle have the potential for contact with the Tuolumne River or tributaries. Any access appears to be via private ranching, not from confined cattle facilities.

3.6.2 Water Quality Concerns

Cows and other grazing animals with access to the reservoir can directly deposit manure and its associated contaminants in the streams. During the wet season, runoff from areas that are grazed could potentially contain sediment, due to trampling of the shoreline by cows, and organic matter, nutrients, and pathogenic microorganisms from the manure. Calves younger than four months are more likely to carry *Cryptosporidium*, and shed larger numbers of oocysts than older cattle; calves younger than four months are restricted from the reservoir at certain times of the year (see Section 3.6.3). In addition, runoff from CAFs or feedlots can contain organic matter, nutrients, and pathogenic microorganisms.

3.6.3 Watershed Management

Grazing sites in the Don Pedro watershed are managed through private or county leases or through the BLM or USFS for sites located on federal land. CAFs that exist in the Don Pedro Reservoir watershed are managed by the CVRWQCB.

Grazing sites in the Modesto Reservoir watershed are managed through county leases, which require the rancher to implement BMPs for cattle grazing. Provisions include:

- Not allowing calves less than four months of age on the reservoir between September 1 and February 1;
- Allowing calving only on the pastures north of the reservoir;
- A maximum of 150 cow-calf pairs, with no more than thirty-five in the inlet areas;
- Maintain a properly functioning good vegetative buffer strip between the cattle and the water’s edge; and
- Locating the salt licks and supplemental feed stations away from the water.

The time period when calves are prohibited from grazing is intended to avoid the wet season, when runoff could wash contaminants from manure into the reservoir. MID preferred to restrict calves through March 1, to encompass more of the wet season; however, it takes a few years for a rancher to alter the calving time period (2014 WSS).

3.7 Wild Animals

Wild animals congregate near bodies of water, similar to domestic animals, and can contribute to increased nutrients, pathogenic organisms, viruses, and sediment levels in the water.

3.7.1 Potential Contaminant Sources

Don Pedro Reservoir Watershed

Animals present in the Don Pedro Reservoir watershed include squirrels, rabbits, mule deer, mountain lions, California mountain king snakes, rattlesnakes, chipmunks, coyote, black bears and bobcats.

Several bird and wildlife species were recently identified as part of the FERC licensing process for the Don Pedro Project (TID/MID, 2010). The special status species include nineteen species of birds (including pelicans, herons, owls, sparrows, and hawks), several species of bats, the American badger, Sierra Nevada mountain beaver, and several other mammals. Also identified were 28 other species of birds (including ducks, geese, pheasants, quail, grouse, pigeons, and crows) and twenty-one mammal species, such as opossum, rabbit, squirrel, coyote, raccoon, fox, weasel, muskrat, skunk, beaver, mink, ermine, bear, deer, bobcat, and wild pig.

Modesto Reservoir Watershed.

Wild animals generally found in the Modesto Reservoir watershed include coyotes, squirrels, jackrabbits, waterfowl, seagulls, osprey, bald eagles, hawks and doves. Because of the increased geese population, Stanislaus County Department of Parks and Recreation now has a permit to addle up to 180 geese eggs per year. Park staff apply corn oil to the goose egg shells to prevent geese from hatching. In addition, the park holds an early season (October) goose hunt to reduce the local population. Geese populations have been managed over the last several years.

Lower Tuolumne River Watershed

The Lower Tuolumne River watershed and the surrounding areas have riparian habitat, and a different variety of animals live within the area, such as gray fox, beavers, muskrats, cottontails, wood rats, bullfrogs, turtles, coyotes, jackrabbits, and deer. In addition to animals, more than 115 bird species live along the river including but not limited to woodpeckers, hummingbirds, orioles and western bluebirds. Wild animals are known to be a potential source of *Giardia*, *Cryptosporidium*, viruses, and bacteria. (Brown and Caldwell, 2009).

3.7.2 Water Quality Concerns

Wild animals are a potential source of *Giardia*, *Cryptosporidium*, viruses, bacteria and other pathogenic microorganisms. Birds, in particular, can be a significant source of pathogens to water bodies because of the direct nature of their deposits, and tendency to roost in large numbers on water surfaces. Birds are a particular concern if there is a large year-round population of waterfowl (as opposed to a migratory bird population).

3.7.3 Watershed Management

Management of wild animals in the watershed occurs through CDFW, county animal control officers and the U.S. Forest Service.

3.8 Solid and Hazardous Waste Disposal Facilities

Despite the rural nature of the study area, there are a relatively large number of closed landfills in the Don Pedro Reservoir watershed, because of the efficiency of locating landfills adjacent to communities. There are none in the Modesto Reservoir and Upper Main Canal subwatershed.

3.8.1 Potential Contaminant Sources

A list of landfills in the Don Pedro Reservoir watershed for Tuolumne and Stanislaus counties are presented in Table 3.12 and Table 3.13. There are seven active solid waste facilities in the watershed.

Table 3.12. Operation Status and Number of Landfills in the Don Pedro Watershed (Tuolumne County)[1]

SWIS Number	Name	Unit	Activity	Regulatory Status	Operational Status
55-AA-0001	Big Oak Flat Landfill	1	Solid Waste Disposal Site	Permitted	Closed
55-AA-0002	Tuolumne County Central Sanitary LF	1	Solid Waste Landfill	Permitted	Closed
55-AA-0003	Pinecrest Transfer Station	1	Limited Volume Transfer Operation	Notification	Active
55-AA-0005	Sierra Conservation Center[2]	1	Solid Waste Disposal Site	Permitted	Closed
55-AA-0006	Sonora Mining Corporation	1	Treatment Unit (in situ)	Exempt	Closed
55-AA-0008	Kennedy Meadows Resort[2]	1	Solid Waste Disposal Site	TBD	Closed
55-AA-0010	Cal Sierra Transfer Station	1	Large Volume Transfer/Proc Facility	Permitted	Active
55-AA-0011	Big Oak Flat Transfer Station	1	Medium Volume Transfer/Proc Facility	Permitted	Active
55-AA-0012	Blue Mountain Minerals[2]	1	Solid Waste Landfill	Exempt	Active
55-AA-0013	Triple J Farms	1	Composting Operation (Ag)	Notification	Active
55-AA-0014	Sonora Mill Temp. Debris Sorting & Removal	1	Emergency Trans/Proc Operation	Notification	Active
55-AA-0015	Green Works LLC	1	Composting Operation (Green Waste)	Notification	Active
55-CR-0007	Columbia County Dump (Pioneer Park)	1	Solid Waste Disposal Site	Pre-regulations	Closed
55-CR-0010	Old Jamestown County Dump	1	Solid Waste Disposal Site	Pre-regulations	Closed

Table 3.12. Operation Status and Number of Landfills in the Don Pedro Watershed (Tuolumne County)[1]

SWIS Number	Name	Unit	Activity	Regulatory Status	Operational Status
55-CR-0011	Mather Ranger Station Dump	1	Solid Waste Disposal Site	Unpermitted	Closed
55-CR-0018	Sonora City Dump	1	Solid Waste Disposal Site	Pre-regulations	Closed
55-CR-0020	Turner Dump	1	Solid Waste Disposal Site	TBD	Closed
55-CR-0037	Rotelli Private Dump	1	Solid Waste Disposal Site	TBD	Closed
55-CR-0038	Soulsbyville Dump	1	Solid Waste Disposal Site	Unpermitted	Closed

[1] Data from https://www2.calrecycle.ca.gov/SWFacilities/Directory/
[2] Location of landfill is just outside of Don Pedro Watershed

Table 3.13. Operation Status and Number of Landfills in the Don Pedro Watershed (Stanislaus County)[1]

SWIS Number	Name	Unit	Activity	Regulatory Status	Operational Status
50-AA-0002	Geer Road Landfill[2]	1	Solid Waste Disposal Site	Permitted	Closed
50-CR-0007	Winchester Disposal Site[2]	1	Solid Waste Disposal Site	Pre-regulations	Closed

[1] Data from https://www2.calrecycle.ca.gov/SWFacilities/Directory/
[2] Location of landfill is just outside of Don Pedro Watershed

Lower Tuolumne River Watershed

Most collection and removal of garbage and refuse in Stanislaus County is conducted by franchised and permitted waste haulers. There are no active solid waste or hazardous waste disposal facilities located within the Lower Tuolumne River Watershed. The Geer Road Landfill, located adjacent to the north bank of the Tuolumne River west of Geer Road near Fox Grove Park, stopped accepting waste in July 1990 and has since closed. The landfill is located downstream from the TID infiltration gallery that will supply the SRWASRWA WTP and continues to be regulated by a WDR. Volatile organic compounds (VOCs) were detected in groundwater samples near the landfill, resulting in the installation of a water extraction/treatment system in 1991. Effluent discharge from the groundwater extraction/treatment system is not expected to contribute to further groundwater degradation because the treated groundwater is of better water quality than local groundwater beneath the landfill. The constituents of concern for the groundwater extraction and treatment system are total dissolved solids, arsenic, iron, manganese, and VOCs. Groundwater quality is monitored through 22 shallow monitoring wells and 12 deep zone monitoring wells (CVRWQCB NOA of General Order R5-2015-0012 Geer Road Landfill, 2020)

3.8.2 Water Quality Concerns

Authorized solid waste disposal sites are permitted and monitored and are unlikely to be significant source of contamination under normal operation. However, improper maintenance, negligent operation, or natural disasters, such as earthquakes or fires, may lead to a release of leachate containing bacteria, pathogens, metals, or other contaminants. The release of leachate may also occur at closed, unpermitted landfills.

3.8.3 Watershed Management

The California Department of Resources, Recycling, and Recovery (CalRecycle) is the agency that manages landfills within California. The Waste Permitting, Compliance and Mitigation Division oversees, manages, and tracks waste generated each year. Landfills are also subject to CVRWQCB waste discharge requirements.

CalRecycle provides funds to clean up solid waste disposal sites and co-disposal sites (those accepting both hazardous waste substances and nonhazardous waste). These funds are available when the responsible party cannot be identified, or is unable or unwilling to pay for a timely remediation, and where clean-up is needed to protect public health and safety or the environment.

3.9 Hazardous Materials Storage

Due to the rural nature of the Don Pedro Reservoir watershed, there are relatively few underground storage tanks within the watershed, and none are present in the Modesto Reservoir and Upper Main Canal subwatershed.

3.9.1 Potential Contaminant Sources

Don Pedro Reservoir Watershed

Leaking Underground Storage Tanks (LUST) pose a threat to water quality. While gasoline and chemical spills from LUST and USTs can impact groundwater quality, runoff from precipitation and groundwater plumes from contaminated sites can also affect surface waters. The RWQCB requires a permit to install any UST. A list of active LUSTs, closed LUSTs and currently permitted (active) USTs in the Don Pedro Reservoir Watershed is presented in Table 3.14.

The largest number of LUST and UST sites is within the City of Sonora, which is not located in close proximity to the reservoir.

Table 3.14. Leaking and Permitted Underground Storage Sites in the Don Pedro Reservoir Watershed (2014-2018)[1]

City	Active LUST	Closed LUST	Permitted UST
Big Oak Flat	0	1	0
Chinese Camp	0	1	0
Groveland	0	1	2
Jamestown	1	1	4
La Grange	0	0	1
Long Barn	0	0	1
Mi Wuk Village	0	0	2
Sonora	3	11	13
Tuolumne	0	3	2
Twain Harte	0	1	2

1 Data from http://geotracker.waterboards.ca.gov/

Modesto Reservoir Watershed

At the fueling station adjacent to the boat ramp on the east side of the reservoir, fuel is stored in an aboveground concrete vault. Gas pumps are located at the end of a floating dock. Connection is made between the pumps and the tank with galvanized pipe; a rubber hose is used at all flex points in the pipeline. A review of the Modesto Reservoir Watershed showed zero active and zero closed LUST and UST sites. Two closed LUST sites are located near, but outside of the reservoir watershed along Highway 132.

Lower Tuolumne River Watershed

Stanislaus County Environmental Resources Department has regulated all the fuel storage tanks in the area. According to GeoTracker website (see reference in Table 3.14) as of March 2020, there are no open leaking underground fuel tank sites in the study area.

3.9.2 Water Quality Concerns

The storage of hazardous materials in underground tanks could pose a risk to the water quality of the water bodies within the watershed depending on the size of the leak and proximity to the local water body. Regulation of tanks by the counties and the monitoring of leaking storage tanks by the CVRWQCB mitigate contamination risks. A complete file review would need to be conducted to assess whether the current system is working and if any open sites pose an immediate threat to surface water.

3.9.3 Watershed Management

The tanks are permitted and regulated by the Environmental Health Departments for Stanislaus and Tuolumne Counties. The CVRWQCB typically handles cases in which a leaking storage tank is involved. Cases are monitored closely for remediation activities and are not closed until the leak is properly remediated. A majority of the cases in the watershed are expected to be contained within a small area and therefore are not likely to impact the watershed.

3.10 Hazardous Materials Spills and Traffic Accidents

Hazardous materials spills include fuel spills from traffic accidents, the rupture of containerized hazardous materials under transport, as well as those resulting from non-vehicle-related sources.

3.10.1 Potential Contaminant Sources

Don Pedro Reservoir Watershed

The California Office of Emergency Services (CALOES) spill records pertaining to the watershed during the report period are shown in Table 3.15. Sanitary sewer overflows were presented in Table 3.2Tables 3.2 and Table 3.33.3 and, therefore, are not included here.

Table 3.15. Summary of Hazardous Material Spills Involving Waterways in the Don Pedro Reservoir Subwatershed[1]

Spill Date	City	Reporting Agency	Spill Site	Did Spill Reach Waterway?	Type	Volume (gallons)
1/9/2014	Sonora	PG&E	Other	No	Petroleum	1 Gallon
1/26/2014	Tuolumne	NRC	Waterways	Yes	Petroleum	Unknown
2/6/2014	Sonora	Cal Fire San Andreas Dispatch	Residence	Yes	Chemical	100 Gallons
3/15/2014	Groveland	CHP-Merced	Road	Yes	Petroleum	200 Gallons
5/6/2014	Sonora	CALFIRE	Residence	Yes	Vapor, Other	250 Gallons
5/9/2014	Twain Harte	CALFIRE	Road	Yes	Petroleum	Unknown
8/6/2014	Groveland	Equity Lifestyle Property	Merchant/Business	Yes	Sewage	35 Gallons
11/24/2014	Sonora	CST Brands	Service Station	No	Petroleum	1 Gallon
2/5/2015	Sonora	Sonora Police Dept	Waterways	Yes	Unspecified	Unknown
5/29/2015	Groveland	City of San Francisco Hetch Hetchy Power and Water	Industrial Plant	Yes	Petroleum	15 Gallons
8/20/2015	Jamestown	CHP Sonora	Road	No	Petroleum	15 Gallons
11/22/2015	Twain Harte	CHP Merced	Road	No	Vapor	6 Gallons
12/4/2015	Jamestown	Tuolumne Co Env Health	Waterways	Yes	Unspecified	Unknown
12/10/2015	Sonora	Sonora Police Dept.	Waterways	Yes	Chemical	5 Gallons
5/13/2016	Sonora	Waste Management	Road	No	Petroleum	25-50 Gallons
5/18/2016	Columbia	Waste Management - Sonora	Residence	No	Petroleum	10 Gallons

Table 3.15. Summary of Hazardous Material Spills Involving Waterways in the Don Pedro Reservoir Subwatershed[1]

Spill Date	City	Reporting Agency	Spill Site	Did Spill Reach Waterway?	Type	Volume (gallons)
5/19/2016	Jamestown	Waste Management Cal Sierra Disposal	Road	No	Petroleum	20 Gallons
8/8/2016	Groveland	Concerned Citizen	Other	Yes	Other	500 Tons
10/30/2016	Twain Harte	Tuolumne County Sheriff's Department	Road	Yes	Petroleum	5 Gallons
2/10/2017	Pinecrest	Pinecrest Permittees Association	Treatment/Sewage Facility	Yes	Sewage	200 Per Minute Gallons
2/28/2017	Groveland	Tuolumne County Environmental Health	Other	Yes	Sewage	2,400 Gallons Per Day
3/21/2017	Twain Harte	CHP Sonora	Road	Yes	Petroleum	Unknown
5/2/2017	Twain Harte	Waste Management	Road	No	Petroleum	3 Gallons
7/21/2017	Sonora	GeoCon	Service Station	No	Petroleum	10 Gallons
8/30/2017	Sonora	Pacific Gas & Electric	Merchant/Business	No	Petroleum	50 Gallons
2/7/2018	Sonora	Sonora Police Department	School	Yes	Chemical	5 Gallons
3/2/2018	Groveland	PG&E	Residence	Yes	Petroleum	15 Gallons
3/22/2018	Groveland	Cal Fire - Tuolumne/ Calaveras	Waterways	Yes	Vapor	1,500 Gallons
5/19/2018	Tuolumne	Black Oak Casino	Merchant/Business	No	Chemical	2 Pounds
5/25/2018	Sonora	Tuolumne County Environmental Health Department	School	Yes	Other	135,000 Gallons

Table 3.15. Summary of Hazardous Material Spills Involving Waterways in the Don Pedro Reservoir Subwatershed[1]

Spill Date	City	Reporting Agency	Spill Site	Did Spill Reach Waterway?	Type	Volume (gallons)
6/16/2018	Tuolumne	PGE SF	Residence	No	Petroleum	18 Gallons
8/23/2018	Sonora	Sonora Police Dept	Waterways	Yes	Sewage	Unknown
9/4/2018	Sonora	Sonora PD	Road	Yes	Sewage	1,000 Gallons
9/30/2018	Sonora	BP	Service Station	No	Petroleum	18 Gallons
10/15/2018	Twain Harte	Waste Management	Road	Yes	Petroleum	100 Gallons
11/20/2018	Sonora	Waste Management Cal Sierra Disposal	Road	No	Petroleum	1 Gallon

[1] Reference (CALOES, 2019): https://www.caloes.ca.gov/governments-tribal/plan-prepare/hazardous-materials/spill-release-reporting

Modesto Reservoir Watershed

There are no underground storage tanks and no road sections within the park that are prone to accidents in the Modesto Reservoir Regional Park. However, spills from boating accidents have occasionally occurred and are reported annually (Table 3.8).

Lower Tuolumne River Watershed

CALOES maintains a database of hazardous materials spills. This list can be accessed through the California Response Information Management Systems online Service. Table 3.16 presents a summary of spills that involved waterways in the study area during 2014-2018.

Table 3.16. Summary of Hazardous Material Spills Involving Waterways in the Lower Tuolumne River Subwatershed[1]

Spill Date	City	Reporting Agency	Spill Site	Did Spill Reach Waterway?	Type	Volume (gallons)
3/21/2014	La Grange	Dept. Fish and Wildlife	Waterways	Yes	Petroleum	50 Gallons
10/5/2015	Waterford	Stanislaus County Dept of Environmental Resources	Road	No	Petroleum	2-3 Gallon
11/24/2015	La Grange	Turlock Irrigation District	Waterways	No	Petroleum	4 ft x 8 ft

[1] Reference (CALOES, 2019): https://www.caloes.ca.gov/governments-tribal/plan-prepare/hazardous-materials/spill-release-reporting

3.10.2 Water Quality Concerns

Fuel spills from vehicle or other accidents on the reservoirs or on the road would result in hydrocarbon contamination. Sewage spills result in pathogen contamination, including bacteria, viruses, and protozoa. Transported hazardous materials could include fuel, pesticides, solvents, and a variety of other materials.

3.10.3 Watershed Management

MID is on the contact list in both the Stanislaus and Tuolumne County emergency response trailers. Counties may be made aware of hazardous materials spills or other significant events by any of various agencies that first encounter the problem, based on the agencies' jurisdictions, the location of the incident, and the nature of the incident. A county may also be notified by the sheriff's dispatch center, CDFW, Caltrans, or by their own road maintenance or flood control staff.

The Modesto Reservoir Marina requires the following pre-open procedures be performed at the beginning of each day at the gas station:

1. Visually check for any fuel leaks around the Convault-manufactured tanks and the piping or fuel lines from the Convaults to the fueling pumps. Look for any signs of fuel in the water.
2. Visually check fuel pump leak alarm.
3. Report any leaks or alarms to the on-duty supervisor immediately.
4. Take Convault fuel level readings.
5. Visually check that the fire extinguisher and personal flotation device are present.

3.11 Mine Runoff

Most of the mines within the study area are historic gold mines in the foothills and higher elevations of the Don Pedro Reservoir watershed. The Modesto Reservoir and Upper Main Canal subwatersheds have no mining operations.

3.11.1 Potential Contaminant Sources

Tuolumne County is traversed from north to south by the Mother Lode ore belt. Historic mining activities have left a legacy of heavy metals near former mining sites. The Clean Water Action Section 303(d) lists for Don Pedro Reservoir a TMDL for mercury associated with historic resource extraction (mining) activities. Section 303(d) of the Clean Water Act is described further in Section 3.17.

It is anticipated that in addition to mercury, other heavy metals, such as arsenic, may also be currently discharged in storm water runoff from some of these old mine sites; thereby leading to water quality degradation (Tuolumne County Water Quality Plan, 2005).

Numerous mines are present in the watershed and were identified from various sources. Past and present mines in the vicinity of the project areas are summarized in Table 3.17.

Table 3.17. Mines within Don Pedro Reservoir, Modesto Reservoir, and Lower Tuolumne Rover Subwatersheds (2020)

Mineral	Status[1]	Number of Mines
Asbestos	Prospect	1
Barium-Barite	Occurrence	1
Beryllium	Occurrence	1
Chromium	Occurrence	7
	Past Producer	11
	Producer	9
	Prospect	5

Table 3.17. Mines within Don Pedro Reservoir, Modesto Reservoir, and Lower Tuolumne Rover Subwatersheds (2020)

Mineral	Status[1]	Number of Mines
Copper	Occurrence	2
	Past Producer	6
	Prospect	6
	Unknown	2
Diatomite	Producer	1
	Prospect	1
Gold	Occurrence	190
	Past Producer	203
	Producer	97
	Prospect	38
	Unknown	177
Gold, Silver	Occurrence	2
	Past Producer	1
	Plant	1
	Producer	4
Graphite	Producer	1
	Prospect	1
Gypsum-Anhydrite	Occurrence	1
Lead	Occurrence	1
Limestone, Dimension	Occurrence	4
	Prospect	7
Limestone, General	Prospect	1
Magnesite	Occurrence	1
	Past Producer	2
	Producer	3
	Prospect	2
Manganese	Occurrence	3
	Producer	2
	Unknown	1
Molybdenum	Occurrence	1
Sand and Gravel, Construction	Occurrence	1
	Past Producer	3
	Producer	15
	Unknown	7

Table 3.17. Mines within Don Pedro Reservoir, Modesto Reservoir, and Lower Tuolumne Rover Subwatersheds (2020)

Mineral	Status[1]	Number of Mines
Silver, Gold	Producer	1
Slate, Dimension	Occurrence	1
Stone	Occurrence	1
	Past Producer	1
	Producer	2
	Unknown	1
Stone, Crushed/Broken	Occurrence	1
	Producer	1
Stone, Dimension	Unknown	1
Talc-Soapstone	Occurrence	1
Tungsten	Occurrence	6
	Past Producer	5
	Producer	2
	Prospect	5
	Unknown	2
Tungsten	Occurrence	1
Uranium	Producer	1
	Past Producer	1
Total	**----**	**857**

[1]Status definitions are as follows:

a. Occurrence = Ore mineralization in outcrop, shallow pit or pits, or isolated drill hole. Grade, tonnage, and extent of mineralization essentially unknown. No production has taken place and there has been no or little activity since discovery with the possible exception of routine claim maintenance.

b. Prospect = A deposit that has gone beyond the occurrence stage. That is subsequent work such as surface trenching, adits, or shafts, drill holes, extensive geophysics, geochemistry, and/or geologic mapping has been carried out. Enough work has been done to at least estimate grade and tonnage. The deposits may or may not have undergone feasibility studies that would lead to a decision on going into production.

c. Producer = A mine in production at the time the data was entered. An intermittent producer that produces on demand or seasonally with variable lengths of inactivity is considered a producer.

d. Past Producer = A mine formerly operating that has closed, where the equipment or structures may have been removed or abandoned.

e. Unknown = At the time of data entry, either the development status was unknown or the data source this record came from did not specify this value.

Source: https://mrdata.usgs.gov/metadata/

Mines in the watershed that appear on the California Department of Conservation list of mines that are regulated under the Surface Mining and Reclamation Act (SMARA) in Tuolumne and Stanislaus Counties are identified in Table 3.18 and Table 3.19.

The Office of Mine Reclamation publishes a list of mines regulated under SMARA called the AB 3098 list. AB 3098 mines have an approved reclamation plan and have annual state inspections. A mine will only be listed on the AB 3098 list if they meet all of the following conditions:

- The operation has an approved reclamation plan;
- The operation has an approved financial assurance;
- The operation has filed its annual report;
- The operation has paid its reporting fee;
- The operation has had its annual inspection by the lead agency which reflects the operation is in full compliance with the law.

Table 3.18. Mines Regulated Under SMARA in Tuolumne County (AB 3098)[1]

Identification Number	Mine	Owner
91-55-0002	BLUE MOUNTAIN MINERALS	BLUE MOUNTAIN MINERALS, PR, LLC
91-55-0003	SIERRA ROCK PRODUCTS, INC.	SIERRA ROCK PRODUCTS, INC.
91-55-0004	PINE MOUNTAIN QUARRY	CROOK LOGGING, INC.
91-55-0005	TABLE MOUNTAIN QUARRY	GEORGE REED, INC.
91-55-0007	MONTEZUMA SAND & GRAVEL	MONTEZUMA SAND & GRAVEL
91-55-0009	COOPER CLAY QUARRY	V.A. RODDEN, INC.
91-55-0011	COOPERSTOWN QUARRY	FISHER INDUSTRIES

[1] Source (AB3098 List, 2019): ftp://ftp.consrv.ca.gov/pub/omr/AB3098%20List/AB3098List.pdf

Table 3.19. Mines Regulated Under SMARA in Stanislaus County (AB 3098)[1]

Identification Number	Mine	Owner
91-50-0006	WATERFORD PLANT	SANTA FE AGGREGATES INC.
91-50-0007	LA GRANGE PLANT	SANTA FE AGGREGATES INC.
91-50-0008	FRANK B. MARKS & SON, INC.	FRANK B. MARKS & SON, INC.
91-50-0009	CREE PIT	CALAVERAS MATERIALS, INC.
91-50-0013	ROBERTS FERRY ROAD PIT	7/11 MATERIALS, INC
91-50-0016	REED-WATERFORD PIT	GEORGE REED, INC.
91-50-0021	GREEN PIT	CALMAT CO. DBA VULCAN MATERIALS COMPANY
91-50-0022	7/11 MATERIALS PIT	7/11 MATERIALS, INC
91-50-0023	OHE SAND & GRAVEL	OHE'S SAND & GRAVEL
91-50-0026	WATERFORD - DEARDORFF	SANTA FE AGGREGATES INC.

Table 3.19. Mines Regulated Under SMARA in Stanislaus County (AB 3098)[1]		
Identification Number	**Mine**	**Owner**
91-50-0027	HOURET SAND & GRAVEL	HOURET ROCK
91-50-0028	DELANEY AGGREGATES MINE	JIM BRISCO ENTERPRISES

[1] Source (AB3098 List, 2019): ftp://ftp.consrv.ca.gov/pub/omr/AB3098%20List/AB3098List.pdf

The chief mineral commodity in the vicinity is gold. The immensely rich placers of Columbia and Springfield northwest of Don Pedro Reservoir produced approximately $55,000,000 in gold prior to 1899. The pocket mines of Sonora, Bald Mountain and vicinity have also been highly productive and exceptionally long-lived.

Marble and limestone products have been next to gold in value. The Columbia marble beds northwest of the Don Pedro Reservoir had a long history of production prior to 1941, and two plants are at present processing the stone from these deposits.

From the 1860s to the 1940s, roughly 10,000 tons of chromite ore and several hundred tons of crude magnesite ore were mined. Most of the chromite came from the McCormick Mine, located northwest of the Don Pedro Reservoir. All of the magnesite production in Tuolumne County occurred in the 1920s and came from two sites in the northern portion of the Red Hills located northwest of the Don Pedro Reservoir.

Tuolumne County also contains deposits of copper, soapstone, scheelite (an ore of tungsten), limestone, marble, platinum, silver, sulphur, decorative stone, slate, sand and gravel.

Chrysotile (white asbestos) is found in veins in serpentinized ultramafic rocks, generally along the Melones Fault, near margins of serpentinite bodies. This mineral is known to occur in the watershed but is not commercially exploited.

Gold mined in Stanislaus County has come predominantly from placers. Quaternary gravels of the Tertiary Tuolumne River channel near Waterford were among the most productive. In the early 1900s, large-scale dredging of Quaternary gravels began along the Tuolumne River between La Grange and Waterford, and most of the gold produced in Stanislaus County from 1932 through 1959 came from this area. In the late 1940s, gold mining declined sharply (Koschmann and Bergendahl, 1968).

As of 1994 sand and gravel mining exceeded the economic importance of gold mining in the state. Large-scale in-channel aggregate mining began in the Tuolumne River corridor in the 1940s, when aggregate mines extracted sand and gravel directly from large pits located within the active river channel. Off-channel aggregate mining along the Tuolumne River has also been extensive. Aggregate in Stanislaus County is currently classified as Aggregate Resources (potentially useable aggregate that may be mined in the future but for which no mining permit has been granted) and

Aggregate Reserves (aggregate resources for which mining and processing permits have been granted) (Higgins and Dupras, 1993). An estimated 540 million tons (338 million cubic yards) of aggregate resources are located in six different geographic areas of Stanislaus County (Higgins and Dupras, 1993). The lower Tuolumne River corridor is the largest of the six areas and contains an estimated 217 million tons (135 million cubic yards) in the channel and terraces (Higgins and Dupras, 1993). The Gravel Mining Reach of the lower Tuolumne (RM 34.2 to 40.3) is currently the focus of development by commercial aggregate producers. Floodplain and terrace pits in the reach are typically separated from the channel by narrow berms that can breach during high flows, resulting in capture of the river channel. The January 1997 flood caused extensive damage to dikes separating deep gravel mining pits from the river, breaching or overtopping nearly every dike along the 6-mile-long reach.

Jamestown Mine

The Jamestown Mine is approximately one mile from Jamestown, north of Highway 108. The property discharges to Woods Creek, a tributary to the Tuolumne River. The Jamestown Mine is an inactive gold mine that operated most recently from 1986 to 1994. The mine facility consists of three mine pits, including the Harvard Mine Pit, the Tailings Management Facility (TMF), a Waste Rock Storage Area, the Process Water Retention Pond (a lined surface impoundment), and several storm water retention ponds. Groundwater monitoring detected evidence that the mine facilities (principally the TMF and the RSA) were discharging mining wastes into surface water and groundwater (CVRWQCB, 2007a). The CVRWQCB issued a Cleanup and Abatement Order in December 1998.

The TMF was an approximately 120-acre lined mine tailings impoundment. Polluted water from the TMF drained to the Process Water Retention Pond, to the Supernatant Pond (an unlined evaporation pond on the TMF surface) and interstitially in the tailings. The TMF water handling system was not dewatering the TMF. To close the TMF, approximately 300 ac-ft of water needed to be removed. Under the remediation plan, TMF water was transferred to the Harvard Mine Pit.

The Harvard Mine Pit is an open mine pit excavated to extract gold. The pit is approximately 520 feet deep and had a seventy-two acre footprint. During active mining, groundwater was pumped to dewater the mine pit and surrounding area. When active mining ceased in 1994, the dewatering pumps were turned off and the pit started slowly refilling with poor quality water impacted through interaction with the shattered mineralized wall rock and with mineralized waste rock in the adjacent Rock Storage Area. Water in the Harvard Mine Pit and water in the TMF were of similar poor quality. As long as water levels in Harvard Mine Pit remained below groundwater levels and below the level of nearby Woods Creek, water in the pit was contained. Because it operated as a groundwater sink, the Harvard Mine Pit was used to contain wastewater. The RWQCB classified the Harvard Mine Pit as a Group B mine waste containment unit. In order for the pit to act as a waste containment unit, it was maintained as a groundwater sink and could not release waters to un-impacted down gradient groundwater.

TMF water (mostly from the Supernatant Pond) was discharged to the Harvard Mine Pit in the first year of remediation, and additional TMF water, mostly interstitial tailings water and groundwater, was discharged to the Harvard Mine Pit during the five-year remediation period.

As a result of a settlement agreement following a lawsuit, Shaw Environmental, Inc. capped the TMF, investigated releases at the mine facility, and performed closure of Detention Pond 5. Shaw is also performing ten years of maintenance of the TMF cover. In accordance with the Final Closure Plan, the TMF was graded to a one percent grade draining to a rock-lined spillway in the southwest portion of the site. The spillway was constructed to meet 1,000-year storm requirements.

Lower Tuolumne River Watershed

There are approximately three mine operators with six mine site Mines in Lower Tuolumne Watershed, that are mainly sand and gravel mining. The mines are sand and gravel, which can cause increase in level of sedimentation and turbidity. (B&C, 2008)

Mining in the study area consists of sand and gravel mining. There are approximately three mine operators located in the study area with approximately six mine site locations. Sand and gravel mining can result in elevated levels of sediments and turbidity if the berms separating the mining pits from the river are breached during high flows, typically over 10,000 cfs. There has been no aggregate mining within the river channel since SMARA was enacted in 1975.

The most recent mine approved by the Stanislaus County Planning Department is the Santa Fe Deardorff Mine located off the south bank of the Tuolumne River approximately 1-mile downstream from Roberts Ferry. The surface mine is located on 100 acres, however, in accordance with the Williamson Act, the owners will restore 38 acres of land to orchard after the mining is completed. Table 3.20 identifies the mine operators of active surface mines in the study area.

Table 3.20. Mine Operators of Active Surface Mines in the Study Area

Mine Operator	Business Address	Phone Number
7/11 Materials Inc.	1601 Culpepper Avenue, Modesto, CA 95351	209-529-4050
Santa Fe Aggregates Inc.	1620 N carpenter Road, Modesto, CA 95351	209-524-7321
Calaveras Materials Inc.	1100 Lowe Road, Hughson, CA 95326	209-883-0448

Table 3.20. Mine Operators of Active Surface Mines in the Study Area

Mine Operator	Business Address	Phone Number
George Reed, Inc.	140 Empire Avenue, Modesto, CA 95352	209-523-0734
Source (AB3098 List, 2019): ftp://ftp.consrv.ca.gov/pub/omr/AB3098%20List/AB3098List.pdf		

3.11.2 Water Quality Concerns

Permit conditions for active mines allow only inert or non-hazardous waste releases. Active mining operations can meet these conditions by controlling the acidity of their discharges and by other management practices.

3.11.3 Watershed Management

The California Office of Mine Reclamation periodically publishes a list of mines regulated under the Surface Mining and Reclamation Act that meet provisions set forth under California's Public Resources Code (listed above). Mining operations not on the list are precluded from selling sand, gravel, aggregates, or other mined materials to state or local agencies. The CVRWQCB maintains a list of active mines in the Sacramento and San Joaquin River Basins that pose a risk to water quality. The California Office of Mine Reclamation maintains a list of Principal Areas of Mine Pollution, which includes nearly 2,500 mining operations and their water quality problems.

In 2007, the State Water Resources Control Board considered a new draft policy for mercury discharge offsets for discharges to the San Francisco Bay and Sacramento-San Joaquin River Delta and tributaries (SWRCB, 2007b). This policy describes offsets as "voluntary abatement efforts by a discharger to remove a specified pollutant from a different existing source, to compensate for all or a portion of the discharger's own discharge of that same pollutant." Offsets may be used to: meet current load allocations; to allow an increase as a result of expansion that would otherwise result in an increase in their mercury loading; or initiate a new discharge that would otherwise result in new mercury loading. Several public "scoping meetings" were held in 2007 but in the intervening years there has been no further action on the policy.

3.12 Timber Harvest

The Modesto Reservoir, Lower Tuolumne and Upper Main Canal subwatersheds have no timber harvest operations; within the study area, timber harvest occurs in the higher elevations of the Don Pedro Reservoir watershed.

3.12.1 Potential Contaminant Sources

Tuolumne County has historically had among the highest timber production of the central and southern Sierra counties. Logging was especially prevalent from World War II through the 1980s. However, with the declines in the timber industry and restrictions on harvesting, timber harvesting in the county has declined dramatically over the last two decades.

An estimate of timber production in Tuolumne County is provided in Table 3.21 showing the general decline in production. All owners of private timberlands in California must obtain an approved Timber Harvest Plan/Permit (THP) before harvesting commercial timber species (Z'berg-Nejedly Forest Practices Act of 1973). THP must be prepared by a registered professional forester (RPF) who is responsible for the contents of the plan. A harvesting plan must be conducted by a licensed timber operator (LTO). The CAL FIRE is responsible for approving a THP.

Table 3.21. Timber Harvest (in Thousand Board Feet) in Tuolumne County (2014-2018)

Ownership	2014	2015	2016	2017	2018
BLM and Other Public	0	60	0	0	0
Private and Tribal	67,847	2,420	55,593	41,042	31,061
Forest Service	62,621	86,352	25,664	23,594	25,467
Total	130,468	88,832	81,257	64,636	56,528

Source: http://www.bber.umt.edu/FIR/harvestT1.aspx?co=06109

3.12.2 Watershed Management

CAL FIRE monitors logging activities on state and private lands, and the U.S. Forest Service monitors logging within the national forests.

3.13 Fires

Wildfires often result in erosion and can be a source of sediments and contaminants to adjacent water bodies.

3.13.1 Potential Contaminant Sources

Don Pedro Reservoir Watershed

Tuolumne and Stanislaus Counties reported several major wildfires between 2014 and 2018. Fires are summarized in Table 3.22. and Table 3.23. Because the area is heavily forested, fire activities must be closely monitored to predict water quality changes and take necessary actions to reduce the likelihood of wildfires.

In late 2013, the Rim Fire burned over 400 square miles in the Tuolumne River and Merced River watersheds, primarily near the Don Pedro and Hetch Hetchy Reservoirs. The USGS performed monitoring and testing to understand the impacts of the Rim Fire on the volume and quantity of runoff water following a fire, particularly to define the turbidity currents. Turbidity events were measured, including vertical profiling, to observe movement through the reservoir. Major findings included that the depth of the turbidity event is driven by temperature and sediment content, and the current passed through the reservoir length over 1-2 weeks. Turbidity currents were generally well mixed through the vertical profile. Finally, the submerged old dam, upstream of the new dam, appears to block turbidity currents from reaching the new dam. (Wright and Marineau, 2019).

Modesto Reservoir Watershed

No major fires occurred in the Modesto Reservoir Watershed during the report period (CAL FIRE, 2019). Based on the limited trees and shrubs around the reservoir, the amount of ash produced from a rangeland fire would be minimal.

CAL FIRE holds practice fire training events each year on the west side of Modesto Reservoir and runoff from the practice fire events has potential to enter the reservoir if not properly contained. A practice fire held in 2016, followed by a rain event, caused some fire area runoff to enter the reservoir. In response, the MID irrigation crew constructed a berm to prevent further runoff from entering the reservoir. MID requests that CAL FIRE ensure that runoff from future practice burn events does not enter the reservoir if events are held in areas that are not bermed or if the existing berm erodes away. CAL FIRE is supposed to notify MID prior to any practice fire events, however notification has not been guaranteed in past years.

Lower Tuolumne River Watershed

The Lake Fire began in July 2017 near Highway 132 and Lake Road in Stanislaus County. The fire burned 62 acres before it was extinguished in January 2018 (CAL FIRE, 2019). The post-fire potential impacts to source water quality are described in the subsequent section. Following the commissioning of the SRWA WTP, SRWA may consider heightened monitoring of source water quality following significant future fires within the watershed.

TID implements Fire Zone Standards such as tree and brush clearing to minimize the probability of fire origination. These standards were updated to include changes adopted by the CPUC in 2017.

Table 3.22. Wildfires Reported in Tuolumne County (2014-2018) [1]

Fire	Year	Location	Approximate size (acres)
59 Fire	2014	Near Bonds Flat Rd & La Grange Rd (J59), west of Don Pedro Reservoir	487
Hetch Hetchy Fire	2014	Off La Grange Rd (J59) at Hetch Hetchy power lines, northwest shore of Don Pedro Reservoir	269
Jackson Fire	2014	Hwy 49 & Jacksonville Rd near the community of Moccasin	70
Montgomery Fire (Mariposa)[3]	2014	Near Ponderosa Way & Tuolumne River Rd, south of Coulterville	79
Big Creek Fire	2015	Off Hwy 120 and Sprague Rd near Groveland	204
Tulloch Fire	2015	South of Hwy 108 & Tulloch Rd, south of Lake Tulloch[2]	112
Oak Fire	2015	Off Old Oak Ranch Rd & Big Hill Rd in the Cedar Ridge area, northeast of Sonora	108
Butte Fire[3]	2015	East of Jackson[2]	70,868
Tulloch Fire	2016	Off New Peoria Flat Road and Old Melones Road, west of Sonora[2]	85
Frymire Fire	2016	Off Frymire Rd & Morrison Rd, east of Oakdale[2]	32
Marshes Fire	2016	Off Hwy 49 and Marshes Flat Road north on Don Pedro Reservoir	1080
Red Fire	2017	Red Hills Road & Six Gulch Road, 2 miles southwest of Chinese Camp	38
Jacksonville Fire	2017	Jacksonville Road, south of Jamestown	690
Twist Fire	2017	Twist Road south of Algerine Road, Jamestown	124
Falls Fire	2017	Off Merced Falls Rd, northwest of Lake McClure	20
Table Fire	2017	On Table Mountain, west of Table Mountain Road and Chicken Ranch Road, Jamestown	39
Flat Fire	2018	Hwy 49 & Marshes Flat Rd, in the Community of Moccasin	163
Donnell Fire	2018	Near Hwy 108, Donnell Lake area in Carson-Iceberg Wilderness	36,450
Tulloch Fire	2018	Hwy 108 and Tulloch Rd, east of Oakdale	573

1 Data from https://fire.ca.gov/incidents/IncidentSearch?q=tuolumne
2 Not in the Don Pedro Watershed
3 Not in Tuolumne County, but included due to potential to impact the watershed area.

Table 3.23. Wildfires Reported in Stanislaus County (2014-2018) [1]

Fire	Year	Location	Approximate size (acres)
Lake Fire	2014	Hwy 132 and Lake Rd near LaGrange	37
El Portal Fire (Mariposa) [3]	2014	Near Hwy 140 and community of El Portal[2]	4,689
Montgomery Fire (Mariposa) [3]	2014	Near Ponderosa Way & Tuolumne River Rd, south of Coulterville[2]	79
Sullivan Fire	2015	Sullivan Rd and Orestimba Rd, 10 miles west of Newman[2]	40
Coe Fire	2016	Henry W. Coe State Park, Del Puerto Canyon, 20 miles west of Gustine[2]	120
Diablo Fire	2016	Off Diablo Grande Parkway and Morton Davis Circle, 9 miles southwest of Patterson[2]	100
Maze Fire	2016	Off of Maze and Kasson, west of Modesto[2]	140
Old Fire	2016	Off Old Yosemite Rd, 8 miles east of Greenly Hill[2]	150
Orange Fire	2017	Off Sonora Rd & Orange Blossom Rd, east of Oakdale[2]	65
Lake Fire	2017	Off Hwy 132 & Lake Rd	62
Williams Fire	2017	10 miles east of Oakdale[2]	19
Summit Complex	2017	The Summit Complex consists of 3 fires burning on the Summit Ranger District of the Stanislaus National Forest	5,247
Creek Fire	2017	Bourland area of the Stanislaus National Forest	1,749
Milton Fire	2017	Off Milton Rd and Sonora Rd north of Woodward Reservoir Park[2]	13
Stuhr Fire	2018	Interstate 5 and Stuhr Rd, south of Patterson[2]	63

[1] Data from https://fire.ca.gov/incidents/IncidentSearch?q=stanislaus
[2] Not in the Don Pedro Watershed
[3] Not in Stanislaus County, but included due to potential to impact the watershed area.

3.13.2 Water Quality Concerns

Wildfires can impact water quality during and long after a fire is contained. During a burn, ash can settle on a water supply reservoirs. The resulting loss of soil surface cover and forest duff, such as needles and small branches, can make the watershed more vulnerable to erosion. Erosion can bring in sediments and contaminants to adjacent water bodies. Increased sediment loads following a fire can impact both ecological health of water bodies and drinking water operations by increasing turbidity, total suspended and dissolved solids and potentially shortening reservoir residence time. Nutrient loads into water bodies, particularly phosphorus and nitrogen have also been reported to increase after wildfires. Other implications to water suppliers include changes to typical snowmelt timing and volume, increases in dissolved organic carbon and metals (including iron and manganese), or source water chemistry changes that impact treatment. (https://ca.water.usgs.gov/wildfires/wildfires-water-quality.html)

MID performed sampling in the watershed upstream of Don Pedro Reservoir following the 2013 Rim Fire. Sampling data results are included in Appendix G. The finished water quality produced by the MRWTP has not diminished as a result of post-Rim Fire changes to source water quality.

3.13.3 Watershed Management

CAL FIRE has primary responsibility for wild land fires and counties have primary responsibility for structural fires. After a wild land fire, CAL FIRE assists with hydroseeding, mulching, and other slope stabilization techniques. CAL FIRE attempts to restore the disturbed area. Erosion mitigation response conducted after a wildfire depends on how much vegetation was removed, soil type, steepness of slope, and other factors.

In the Don Pedro Reservoir watershed, only the incorporated city of Sonora is located in a Local Responsibility Area where Tuolumne County would have primary jurisdiction. The remaining watershed is located either in a State Responsibility Area, where CAL FIRE would have primary jurisdiction, or a Federal Responsibility Area, where the U.S. Forest Service would have primary jurisdiction. The entire watershed is designated a very high fire hazard severity zone.

The western half of the Modesto Reservoir sub-watershed is located in a Local Responsibility Area, where Stanislaus County would have primary jurisdiction; the eastern half and the Upper Main Canal sub-watershed is located in a State Responsibility Area, where CAL FIRE would have primary jurisdiction. The fire hazard severity zone for the entire area is Moderate.

3.14 Geologic Hazards

Earthquake, flooding, and other geologic risks are assessed in this section, including in Table 3.24.

Table 3.24. Regional Faults in Proximity to the Project Site

Fault	Approximate Distance from Proposed Project Area	Last Known Major Displacement
San Joaquin Fault (Potentially active)	19 miles west	11,700-700,000 years ago; without historical record
Ortigalita Fault Zone, Cottonwood Arm Section (potentially active)	22 miles southwest	11,700-700,000 years ago; without historical record
Foothills Fault System, Southern Reach Section (potentially active)	23 miles east	11,700-700,000 years ago; without historical record
Greenville Fault Zone (active)	35 miles west	1980, M[1] 5.8
Calaveras Fault Zone, Central Calaveras Section (active)	50 miles west	1979, M[1] 5.7 2007, M[1] 5.6
San Andreas Fault Zone, Santa Cruz Mountains Section (active)	63 miles southwest	1989, M[1] 7.2 1906, M[1] 7.9

3.14.1 Potential Contaminant Sources

Don Pedro Reservoir Watershed

Geologic hazards in Tuolumne County are associated with potential seismic activity along the Foothills fault zone and associated ground shaking. Hazardous situations could also result from development on unstable slopes within the County. Development on erosive soils, without proper environmental protection could result in significant soil loss, increased sediments in water bodies and visual impacts (Tuolumne County General Plan, 1996).

Modesto Reservoir Watershed

There are no areas of the Modesto Reservoir Regional Park that are prone to landslides (2014 WSS). Several known faults exist in the extreme eastern part of Stanislaus County. These faults could cause ground shaking of an intensity approaching "X" (ten), of XII, on the Modified Mercalli Scale, which would result in very serious damage to most structures (Stanislaus County, 2008).

Lower Tuolumne River Watershed

No earthquake faults are known to exist within the valley portion of the County. In the extreme eastern part, outside the study area, exist the Bear Mountain and Melones faults; however, they are considered to be inactive. Earthquakes originating in other parts of California could produce ground shaking resulting in moderate damage to structures in the study area, with less intensity in the eastern half of the County.

3.14.2 Water Quality Concerns

Earthquakes or landslides could result in increased sediment loads to the reservoir. Other contaminants associated with the sediment, such as organic carbon and nutrients, would also increase in the raw water supply as a result of an earthquake or landslide.

A large earthquake along one of the faults could potentially create problems for the water supply system and result in disruptions in service.

3.14.3 Watershed Management

Geologic hazards in the watershed are managed by various Stanislaus and Tuolumne County departments.

3.15 Unauthorized Activity

Unauthorized activities that may be potential contaminant sources are: illegal dumping, illegal drug manufacture and disposal, and unsanctioned recreational activities (e.g., off-road vehicle use or illegal camping).

3.15.1 Potential Contaminant Sources

Don Pedro Reservoir Watershed

Unauthorized activities within the watershed include illegal dumping, off-road vehicle use or illegal camping, marijuana cultivation, and illegal drug manufacture and disposal. These activities are extremely difficult to track and quantify. As identified in the previous sanitary survey update, a common problem in the area may be waste from methamphetamine and drug labs. Waste can include solvents, explosives, metals, salts and medical waste.

According to the Tuolumne County Plan to Combat Homelessness, a January 2017 point in time count found 160 homeless individuals (107 families) in Tuolumne County. Approximately 67 percent of the homeless individuals in this count were unsheltered and living in places such as cars, camps, and other open places. Large appliances, trash cans, scrap metal, and an assortment of items have been reported at various dump sites, including at Big Hill, Wards Ferry, and Yankee Hill Roads, as well as several federal land sites managed by the Bureau of Land Management.

Modesto Reservoir Watershed

The Modesto Reservoir Regional Park has not experienced problems with illegal dumping (including illegal drug disposal), or unsanctioned recreational activities (e.g., off-road vehicle use or illegal camping) (Personal Communication, Mr. Diego Casillas, February 2020).

Lower Tuolumne River Watershed

SRWA is not aware of the presence of illegal dump sites in the subwatershed.

CAL OES maintains a database on hazardous materials spills. No spills involving illegal drug activity were recorded between 2014 and 2018. Spills that involved waterways are discussed in Section 3.10 Hazardous Materials Spills and Traffic Accidents.

Based upon the drone survey that was completed between the SRWA Intake and the City of Waterford (approximately 7 miles upstream) there are no indications of any of this type of activity in proximity of the river.

3.15.2 Water Quality Concerns

Illegal dumping could include food waste, hazardous materials and other erodible materials. Illegal camping generally results in the improper disposal of fecal waste.

3.15.3 Watershed Management

Don Pedro Reservoir Watershed

As documented in the 2014 WSS, the County began GPS mapping of problem dump sites in the County in an effort to data log the location, area, and size of dump sites. The County also had plans for cameras to be installed at the most problematic dumping locations. At that time, most dump sites were located on BLM land and BLM prioritized cleanup for dumps near the Reservoir. This information and general input as to the increase or decrease of illegal dumping in recent years was not able to be confirmed for this WSS.

DPRA maintains a program of inspection and cleanup of illegal dump sites around the reservoir. They have multiple 2 yards bin throughout their facilities to store trash from their campsites, and they regularly dispose of the wastes from visitors. (Personal communication with Mr. Brannon Gomes, February 2020) DPRA has the manpower and equipment available to respond quickly to any illegal dumping and they self-patrol regularly. Whenever possible, DPRA identifies the person responsible and reports to the Sheriff. They have a number of reported illegal dumping sites in Tuolumne County listed in Table 3.25 below.

Table 3.25. Statistics on Reported Illegal Dumping Sites in Tuolumne County

Year	Illegal dumping cases	Premise Dumping Violation Cases
2014	3	66
2015	0	40
2016	0	45
2017	1	36
2018	12	34

Source: Personal communication with Ms. Sara Pinckney – February 2020 (Community Development Department, County of Tuolumne)

Fines are levied for illegal dumping depending on the dumping site location. In Tuolumne County, the fines are $100 for the first citation, $500 for the second and $1,000 for the third. Fines in Tuolumne County have not typically been levied and perpetrators are given warnings and an opportunity to cleanup. According to the federal Bureau of Land Management, dumping illegally on federal land can carry a fine of up to $1,000. However, prosecution is difficult without eyewitness accounts of illegal dumping in action (2014 WSS).

Modesto Reservoir Watershed

Illegal dumping and unauthorized recreation activities are the responsibility of the Stanislaus County Sheriff Department. During summer holiday weekends, MID employs the Sheriff's Department and park personnel to patrol the reservoir twenty-four hours a day, including water coverage. The Service Level Agreement between Stanislaus County Sheriff's Department and the Stanislaus County Parks Department for Law Enforcement Services (2008) includes a goal of an on-site full-time deputy during high season weekends and holidays. During periods of light use, the reservoir is patrolled during daylight hours only. The agreement also calls for the sheriff to conduct routine drives through the park in the off-season and scheduled attendance for special events as necessary.

Lower Tuolumne River Watershed

Designated public access points are maintained by the County and include trash cans and public restrooms. Stanislaus County recognizes the potential for unwanted, unused, or expired pharmaceutical controlled substances to be introduced to the environment through improper disposal. To address this public safety, public health, and environmental hazard, the Stanislaus County Sheriff Department provides and operates a system of secure drop boxes for citizens to dispose of unwanted, unused, or expired prescription drugs (Stanislaus County, 2020).

3.16 Anticipated Growth within the Watershed

3.16.1 Don Pedro Reservoir Watershed

Significant growth is not anticipated in the Don Pedro Reservoir watershed. Based on population projections in 2006, regions above the shoreline of Don Pedro Reservoir were expected to experience additional growth through 2040. However, following the economic downturn in 2008, projected growth was significantly reduced. According to California Department of Finance Demographic Research Unit population estimates and projections , the growth rate in Tuolumne County has held mostly held steady (i.e., decreased less than one percent per year over the report period), and this trend is expected to continue in the future, through 2060 according to DRU projections (CA DOF-DRU, 2020). Three-quarters of the Don Pedro Reservoir Watershed is in the Stanislaus National Forest or Yosemite National Park and, as such, will not experience growth.

3.16.2 Modesto Reservoir Watershed

The primary land use of the Modesto Reservoir subwatershed is the Modesto Reservoir Regional Park, and no changes in park size or management are anticipated. The current lease between MID and the cattle rancher extends to 2018. The non-park lands in the Modesto Reservoir and Upper Main Canal subwatershed are currently used for agriculture and no residential or other type of development of these lands are planned.

3.16.3 Lower Tuolumne River Watershed

The population growth rate in Stanislaus County increased above one percent per year from 2015 to 2017. According to California Department of Finance Demographic Research Unit population estimates and projections, the growth rate in Stanislaus County is expected to increase by less than one percent per year, through 2060 (CA DOF-DRU, 2020).

3.17 Watershed Protection Regulatory Update

Federal and state laws protect water quality from point and nonpoint sources. The federal Clean Water Act requires states to adopt water quality standards and to submit those standards for approval by the US EPA. Clean Water Act Section 303(d) requires states to list surface waters not attaining (or not expected to attain) water quality standards after the application of technology-based effluent limits, and states must prepare and implement a Total Maximum Daily Load (TMDL) for all listed waters. For point source discharges to surface water, the Clean Water Act authorizes the US EPA or approved states to administer the NPDES Program. In California, the SWRCB and RWQCBs administer many of the Clean Water Act’s provisions.

The Porter-Cologne Water Quality Control Act is the principal state law governing water quality regulation in California. The Porter-Cologne Act established a comprehensive program to protect water quality and the beneficial uses of water, and established the SWRCB and nine RWQCBs which are charged with implementing its provisions, and which have primary responsibility for protecting water quality in California. The SWRCB provides program guidance and oversight, allocates funds, and reviews RWQCB decisions. The RWQCBs have primary responsibility for individual permitting, inspection, and enforcement actions within each of nine hydrologic regions. The Sacramento-San Joaquin Delta falls under the jurisdiction of the Central Valley RWQCB. The RWQCBs regulate point source discharges primarily through issuance of NPDES and waste discharge requirement permits. The SWRCB and RWQCBs also have numerous nonpoint source-related responsibilities.

Most of the surface water bodies that are currently listed as impaired on the state's Section 303(d) list are impaired due to nonpoint source discharges. Over the past several years, SWRCB and RWQCB programs have shifted from focusing on site-specific problems to a watershed-based approach targeting non-point sources of pollution.

As part of the new watershed-based approach, the state is identifying impaired water bodies pursuant to the Clean Water Act. In addition, TMDL development, which focuses on river reaches, has begun to be used to address runoff. Basin Plan amendments are designed to establish water quality objectives for specific pollutants in lieu of focusing on only the particular water bodies where impairment has been caused by a particular pollutant. The SWRCB and RWQCB have developed a Watershed Management Initiative to integrate programs and control both point and nonpoint sources within a watershed. These programs are described further below.

3.17.1 Clean Water Act Section 303(d) List and TMDL Development

Under Section 303(d) of the Clean Water Act, California is required to compile a list of impaired waters that fail to meet applicable water quality standards or that cannot support their designated beneficial uses. Water bodies are listed due to deleterious impacts from a pollutant or pollutants and may be delisted when evidence reveals that such impacts have ceased or never existed. The waters on the list do not meet water quality standards, even after point sources of pollution have installed the minimum required levels of pollution control technology. Applicable water quality standards include the designated beneficial uses, the adopted water quality objectives, and the state's anti-degradation policy. (Brown and Caldwell, 2009).

For 303(d) listed water bodies, a pollutant watershed budget is established, which defines the maximum amount of pollutants, or TMDL, that can be assimilated by that water body. If the sum of allowable pollutants from both point and nonpoint sources exceeds this maximum amount, a TMDL implementation (or clean-up) plan is required. By providing watershed-specific information, TMDLs will help target specific sources and corresponding corrective measures and will provide a framework for using more stringent approaches that may be necessary to achieve water quality goals and maintain beneficial uses. TMDLs are established at the level necessary to implement the applicable water quality standards. A TMDL requires that all sources of pollution and all aspects of a watershed's drainage system be reviewed, not just the pollution coming from discrete conveyances (i.e., point sources). TMDLs must include numeric targets, source analysis, determination of the carrying capacity of the water body, establishment of load allocations for sources in the watershed, a margin of safety, and a public process. When loads are exclusively from point source discharges, and when one action by the RWQCB addresses all the significant loads, TMDL requirements can be included directly in NPDES permits. More often, TMDLs involve loads from a combination of point and nonpoint sources and they are established through Basin Plan amendments. (Brown and Caldwell, 2009).

The RWQCBs must establish priority rankings for water bodies on the lists, and submit the Section 303(d) list and TMDL priorities to the US EPA for approval. The RWQCBs developed this list in 2010, and the US EPA gave final approval to California's Section 303(d) List of Water Quality Limited Segments in October 2011. (Brown and Caldwell, 2009).

Based on a review of the US EPA-approved 2010 final list and its associated TMDL Priority Schedule, Hetch Hetchy and Don Pedro Reservoir have been identified as CWA §303(d) state impaired for mercury, and the lower Tuolumne River (Don Pedro Reservoir to San Joaquin River) as state impaired for mercury, temperature, chlorpyrifos, diazinon, Group A Pesticides, and unknown toxicity (CRWQCB 2010). Group A Pesticides consist of aldrin, dieldrin, chlordane, endrin, heptachlor, heptachlor epoxide, hexachlorocyclohexanes (including lindane), endosulfan, and toxaphene.

Additionally, the 2010 final list includes Sullivan Creek (Phoenix Reservoir to Don Pedro Reservoir) and Woods Creek (north side of Don Pedro Reservoir) as state impaired for Escherichia coli (*E. coli*). The US EPA-approved 2010 303(d) list does not identify the upper Tuolumne River as impaired for any pollutants or stressors. Table 3.26 summarizes the water bodies on the 303(d) final list and the expected TMDL completion date.

Table 3.26. Section 303(d) List of Water Quality Limited Segments

Water body Segment	Pollutant/Stressor	Potential Sources	Expected TMDL Completion Date
Hetch Hetchy Reservoir	Mercury	Source Unknown	2021
Woods Creek (north side of Don Pedro Reservoir)	*Escherichia coli (E. coli)*	Source Unknown	2021

Table 3.26. Section 303(d) List of Water Quality Limited Segments

Water body Segment	Pollutant/Stressor	Potential Sources	Expected TMDL Completion Date
Sullivan Creek (Phoenix Reservoir to Don Pedro Reservoir)	*Escherichia coli (E. coli)*	Source Unknown	2021
Don Pedro Lake	Mercury	Resource Extraction	2020
Lower Tuolumne River (Don Pedro Reservoir to San Joaquin River)	Diazinon	Agriculture	2010
	Group A Pesticides	Agriculture	2011
	Chlorpyrifos	Agriculture	2021
	Mercury	Resource Extraction	2021
	Temperature	Source Unknown	2021
	Unknown Toxicity	Source Unknown	2022
Dry Creek (tributary to Tuolumne River at Modesto)	Chlorpyrifos	Agriculture	2021
	Diazinon	Agriculture	2021
	Escherichia coli (E. coli)	Source Unknown	2021
	Unknown Toxicity	Source Unknown	2021

The TMDL program serves as the RWQCB's focal point for addressing California's most difficult, long-term surface water quality problems. TMDL planning activities are closely coordinated with the RWQCB's regulatory programs to ensure compatibility with those programs and feasibility of implementation. TMDLs are incorporated into water quality control plans. The US EPA requires that NPDES permits be revised to be consistent with any approved TMDL (40 CFR 122). The TMDL program is also coordinated with the agricultural waiver program.

3.17.2 Watershed Management Initiative

The SWRCB and RWQCB developed the Watershed Management Initiative to integrate surface and groundwater regulatory programs within a watershed, to control both point and nonpoint sources, and to draw solutions from all interested parties within a watershed. The SWRCB and RWQCB developed this initiative to protect water quality within a watershed context, considering a mix of point and nonpoint source discharges, ground and surface water interactions, and water quality/water quantity connections.

In 1996, the SWRCB, the RWQCBs and the US EPA prepared a Watershed Management Initiative Plan. The plan is now updated as needed by the RWQCB or by a directive from the SWRCB. The Central Valley RWQCB Watershed Management Initiative Integrated Plan State of the Watershed for the San Joaquin River and the Delta was last updated in 2001 but sections have been updated as needed, last in November 2004.

3.17.3 Regulation of Point Sources of Potential Contaminants

It is the responsibility of the SWRCB and RWQCBs to preserve and enhance the quality of the state's waters through the development of water quality control plans and the issuance of waste discharge requirements. The RWQCBs regulate point source discharges (i.e., discharges from a discrete conveyance) under the Porter-Cologne Act primarily through issuance of NPDES and waste discharge requirement permits. NPDES permits serve as waste discharge requirements for surface water discharges. Waste discharge requirements and NPDES permits in the study area fall under the jurisdiction of the CVRWQCB. (Brown and Caldwell, 2009).

Anyone discharging or proposing to discharge materials to land in a manner that allows infiltration into soil and percolation to groundwater (other than to a community sanitary sewer system regulated by an NPDES permit) must file a report of waste discharge to the local RWQCB (or receive a waiver). Following receipt of a report of waste discharge, the RWQCB issues waste discharge requirements that prescribe how the discharge is to be managed. (Brown and Caldwell, 2009).

For all the municipal, industrial and construction discharges of wastes to surface waters an NPDES is required, which is usually issued by RWQCBs on a 5 year basis. Every permit is issued regarding a specific discharge. A general permit will be issued to cover multiple facilities in the same categories. (Brown and Caldwell, 2009).

The beneficial uses and receiving water objectives to protect those uses are established in the Water Quality Control Plan for the Sacramento River and San Joaquin River Basins, known as the Basin Plan (CVRWQCB, 1998) and most recently revised in 2018. The CVRWQCB establishes effluent limitations for wastewater dischargers based on the beneficial uses and the water quality objectives of the water body that receives the discharge. Effluent limitations are specific to each discharge and vary throughout the Central Valley. If a discharge is to an ephemeral stream or a stream that the CVRWQCB determines does not have any assimilative capacity for a contaminant, the discharger must meet the receiving water quality objectives in the effluent. If there is dilution capacity available in the receiving water, the CVRWQCB establishes effluent limitations that allow for a mixing zone and dilution of the effluent in the receiving water. The CVRWQCB establishes effluent limitations for a number of contaminants in waste discharge permits. However, the Basin Plan does not contain water quality objectives for some of the key drinking water constituents of concern (disinfection byproduct precursors, pathogens, nutrients) and the current objectives are not based on drinking water concerns (salinity, chloride). Therefore, there are limited data on the quality of wastewater effluent for many of these constituents because the dischargers are not required to conduct monitoring.

3.17.4 Regulation of Non-Point Sources of Potential Contaminants

Currently, discharges from nonpoint sources such as agriculture, silviculture, urban runoff, past mining activities, dairies, and individual wastewater disposal systems (i.e., septic systems) cause the most significant and widespread surface and groundwater quality problems. Nonpoint source pollution is not typically associated with discrete conveyances; it includes landscape scale sources such as storm water and agricultural runoff, and dust and air pollution that find their way into water bodies.

Urban runoff in the Central Valley and Delta is regulated by the CVRWQCB through municipal separate storm sewer system (MS4) NPDES permits. These permits require large (greater than 250,000 population) and medium (100,000 to 250,000 population) municipalities to develop storm water management plans and conduct monitoring of storm water discharges and receiving waters. The permits also require programs to control runoff from construction sites, industrial facilities, and municipal operations; eliminate or reduce the frequency of non-storm water discharges to the storm water system; educate the public on storm water pollution prevention: and better control and treat urban runoff from new developments. Since 2003, small communities—defined as having a population of at least 10,000, and a population density of at least 1,000 persons per square mile, that lie within an urbanized area (defined as a population of between 50,000 and 100,000, and a population density of at least 1,000 persons per square mile)—have been required to develop storm water management plans. None of the Tuolumne County communities fall within this designation, although the State Water Board also has discretion to apply the criteria to jurisdictions with smaller population or lower density. In addition, none of the Stanislaus County communities located in the Modesto Reservoir watershed require storm water management plans.

Some of the most significant surface water quality problems result from nonpoint source discharges from agricultural lands. The nonpoint source pollutants typically associated with agriculture are nutrients, animal waste, sediments, and pesticides. Agricultural nonpoint source pollution enters receiving waters by direct runoff to surface waters or seepage to groundwater. Runoff of nutrients can result from excessive application of fertilizers and animal waste to land, and from improper storage of animal waste. Farming activities can cause excessive erosion, which results in sediment entering receiving waters. Improper use and over application of pesticides cause pesticide pollution. Improper grazing management can cause erosion, soil compaction, and excessive nutrients, all of which impair sensitive areas. Over application of irrigation water can cause runoff of sediments and pesticides to enter surface water or seep into groundwater. Sediment, pesticides, and excess nutrients all affect aquatic habitats by causing eutrophication, turbidity, temperature increases, toxicity, and decreased oxygen.

This page intentionally left blank

4 Water Quality

The purpose of this section is to identify changes in raw water quality that may impact the ability to meet current and anticipated drinking water regulations. Additionally, this section identifies water quality changes that may indicate deterioration of the source waters. This section includes a regulatory review, and an evaluation of raw and finished water quality data.

4.1 Regulatory Overview

This section summarizes the state and federal drinking water regulations that relate directly to contaminant concentrations in the watershed. The regulations apply to treated water, as opposed to raw water, but provide the basis for the water quality review of the watershed. The regulations discussion in this report include microbiological water quality, disinfectants and disinfection by-products, chemical contaminants, and emerging contaminants.

Drinking water standards are mandated at the federal and state level by the US EPA and the (SWRCB) DDW, respectively. US EPA is responsible for developing and implementing drinking water regulations under the federal SDWA of 1974. States can either adopt the federal regulations or develop their own regulations with more stringent standards. The SWRCB DDW has authority to implement drinking water regulations within the state. For several contaminants, California has implemented standards for contaminants not regulated by the EPA or developed more stringent standards than EPA.

State requirements are identified and discussed only when they are more stringent than the corresponding federal regulations. The numeric maximum contaminant levels (MCLs) and secondary standards are summarized in Appendix H.

4.1.1 Federal Regulations

Federal water quality regulations are summarized in Table 4.1.

Table 4.1. Summary of US EPA Water Quality Regulations

Regulation	Major Requirements
National Primary Drinking Water Regulations	• Currently established for over 85 contaminants, including turbidity, microorganisms, radionuclides, disinfectants, disinfection byproducts, inorganic contaminants, and organic contaminants. • The majority of the contaminants have maximum contaminant levels (MCLs) and maximum contaminant level goals (MCLGs), with treatment technique requirements for the remaining. • Fifteen additional contaminants have secondary (aesthetic) standards.
Total Trihalomethanes Rule *Promulgated in 1979*	• Established an MCL of 100 µg/L for the sum of four trihalomethanes (THMs): chloroform, bromodichloromethane, dibromochloromethane, and bromoform. • Compliance determined as a running annual average (RAA) of quarterly samples.
Surface Water Treatment Rule *Promulgated in 1989*	• Requires that a detectable disinfectant residual be present in all portions of the distribution system (heterotrophic plate count [HPC]) less than 500 colony forming units [CFU]/mL equivalent to a detectable residual). • Requires 3-log *Giardia* inactivation/removal. Conventional systems receive a 2.5-log credit and direct filtration systems receive a 2-log credit for meeting filter effluent turbidity requirements. Remaining requirements must be met through disinfection. • Requires 4-log virus inactivation/removal. Conventional systems receive a 2-log credit and direct filtration systems receive a 1-log credit for meeting filter effluent turbidity requirements. Remaining requirements must be met through disinfection. • Requires combined filter effluent turbidity not exceed 0.5 NTU (nephelometric turbidity units) in more than 5 percent of samples each month.
Total Coliform Rule *Promulgated in 1989*	• Requires that less than 5 percent of distribution samples collected each month be positive for total coliform. • Requires a detectable disinfectant residual at all points in the distribution system (HPC less than 500 CFU/mL considered equivalent to a detectable residual).
Interim Enhanced Surface Water Treatment Rule (IESWTR) *Promulgated in 1998*	• Establishes an MCLG of zero for *Cryptosporidium*. • Requires combined filter effluent turbidity of less than 0.3 NTU in 95 percent of samples collected each month. • Establishes requirements for individual filter effluent turbidities, with associated requirements for a Comprehensive Performance Evaluation of underperforming filters. • Requires that new finished water reservoirs be covered. • Requires sanitary surveys at three year intervals for community water systems and every five years for non-community water systems and community water systems that have outstanding performance based on prior sanitary surveys. • Requires disinfection benchmarking.

Table 4.1. Summary of US EPA Water Quality Regulations

Regulation	Major Requirements
Stage 1 Disinfectants/ Disinfection By-Products (D/DBP) Rule *Promulgated in 1998*	• Establishes MCLs for the following disinfection by-products (DBPs): THMs (80 µg/L), haloacetic acids [HAAs] (60 µ/L), bromate (10 µg/L) and chlorite (1 milligram per liter [mg/L]). THM and HAA compliance is based on an RAA of distribution system samples. • Establishes maximum residual disinfectant levels (MRDLs) for the following disinfectants: free chlorine (4 mg/L), chloramines (4 mg/L), and chlorine dioxide (0.8 mg/L). Compliance based on an average of distribution system samples. • Establishes enhanced coagulation requirements requiring total organic carbon (TOC) removals based on raw water TOC and alkalinity. Purpose is to optimize removal of DBP precursors.
Modified Lead and Copper Rule *Promulgated in 2000* *Proposed additional revisions in 2019.*	• Action levels [ALs] (0.015 mg/L for lead and 1.3 mg/L for copper) established in the 1991 Lead and Copper Rule. Under Lead and Copper Rule, lead and copper do not have MCLs; instead, they are called ALs. MCLG for lead of zero. • Compliance requires that less than 10 percent of distribution system samples exceed action levels. • Establishes additional requirements, including demonstration of optimal corrosion control, lead service line replacements, public education, monitoring, analytical methods, etc. • 2019 proposed revisions maintain current MCLG and AL, but adds a trigger level of 0.010 mg/L that requires more proactive planning in communities with lead service lines.
Arsenic Rule *Promulgated in 2001*	• Establishes an MCL of 10 µg/L for arsenic.
Filter Backwash Recycle Rule *Promulgated in 2001*	• Requires that any recycle stream be returned prior to or at the point of primary coagulant addition. • Requires that information on recycle streams be provided to the CDPH for evaluation.
Long-term 1 Enhanced Surface Water Treatment Rule (LT1ESWTR) Promulgated in 2002	• Extended requirements of the IESWTR to utilities serving less than 10,000 persons.
Long-term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR) *Promulgated in 2006*	• Assigns utilities to one of four “bins” based on raw water *Cryptosporidium* concentrations. • Each bin has associated requirements for additional *Cryptosporidium* treatment. • Includes a toolbox of options for receiving *Cryptosporidium* reduction credits, including watershed control, disinfection, and filtration. • Bin assignment is based on the average of the 12 consecutive highest months within a two-year period of monthly *Cryptosporidium* samples.

Table 4.1. Summary of US EPA Water Quality Regulations

Regulation	Major Requirements
Stage 2 D/DBP Rule *Promulgated in 2006*	• Does not change the MRDLs or MCLs established in the Stage 1 Rule. • Requires an initial distribution system evaluation (IDSE) to identify sites with high DBP levels. • Systems with no samples with THM/HAA levels exceeding 40/30 ug/L can apply for an IDSE waiver. • Compliance schedule is based on population of the public water system. • Requires compliance with 80 µg/L THM and 60 µg/L HAA based on a location running annual average (LRAA) at each site.
Revised Total Coliform Rule (RTCR) *Promulgated in 2013*	• New approach to monitoring assessments and implementation when new sample positives occur.
Perchlorate *Proposed in 2013* *Promulgated in 2014*	• Established interim health advisory for clean ups at 15 ppb.

4.1.2 State Regulations

SWRCB DDW implements drinking water regulations within the state. DDW regulations are set forth in the SWRCB Drinking Water Program Title 22 Chapter 15. The most recent updated version of the Title 22 of the California Code of Regulations (CCR) was published April 16, 2019.

DDW regulations relevant to water purveyors are summarized in Table 4.2. Only regulations and requirements that are in excess of federal requirements are mentioned.

Table 4.2. Summary of SWRCB DDW Water Quality Regulations and Guidelines.

Regulation	Major Requirements
State Primary Drinking Water Standards	• State MCLs are more stringent than Federal levels for 20 contaminants. • The state has enforceable standards, not regulated by Federal EPA, for 16 contaminants. • The state also has notification levels (NLs) for 31 chemicals. NLs are health-based standards for contaminants without a current MCL. Exceedance may require public notification or switching to an alternative source.
Fluoridation	• Established optimal fluoride levels and control ranges for treated water based on air temperature.
Cryptosporidium Action Plan *Revised in 2019*	• Sedimentation/clarification basin effluent turbidity goal of 1 to 2 NTU, monitored $\geq$ once/day • Combined filter effluent turbidity <0.1 NTU. • Reclaimed backwash water turbidity <2 NTU, monitored $\geq$ once/day. • Filter effluent turbidity after filter backwash or filter-to-waste <0.3 NTU.

4.2 Constituents of Concern to Water Purveyors

This section describes the primary sources of each constituent of concern and the state and federal regulations that apply to each contaminant.

4.2.1 Microbiological Water Quality

One major function of water treatment is to remove or inactivate pathogenic organisms. Primary sources of microbiological contaminants are grazing and wild animals, wastewater treatment and septic spills, and to a lesser degree, body-contact recreation within surface water sources. Pathogen concentrations are reduced through a combination of removal by filtration processes and chemical disinfection. Chemical oxidants may also provide other benefits in addition to disinfection, including the destruction of compounds that cause taste and odor problems.

Both state and federal regulations are focused on the removal of four major pathogens/pathogen groups: coliform bacteria, *Giardia*, viruses, and *Cryptosporidium*. For three of the pathogen groups, removal requirements are dependent on the level of microbial contamination of the source water. Turbidity is used as a surrogate for microbial water quality and is also discussed below.

Coliform Bacteria

Coliform bacteria are used as an indicator of pathogenic contamination. Total coliform is a measure of the concentration of a specific group of bacteria in water that use organic carbon for energy and are lactose-fermenting. Their presence alone is not a cause for concern, but their source should be identified and controlled if possible. Fecal coliforms are a subgroup of total coliform that are found in the intestinal tracts of warm-blooded animals, including humans. The presence of these bacteria in water samples is indicative of the presence of fecal matter and possible pathogenic organisms, which may be of human origin. *Escherichia coli* (*E. coli*) is a type of fecal coliform bacteria commonly found in the intestines of animals and humans. The presence of *E. coli* in water is a strong indication of recent sewage or animal waste contamination.

Coliform bacteria are directly regulated under the Total Coliform Rule and Revised Total Coliform Rule, which requires that less than five percent of distribution system samples collected each month be positive for the presence of coliform bacteria. Positive samples require additional action, including further testing for fecal coliform, as well as collection of additional distribution system samples. The 2018 Basin Plan for the Central Valley Region includes a Water Quality Objective (< 200 MPN per 100 mL, geometric mean) for fecal coliform in waters designated for contact recreation, but does not provide a Water Quality Objective for total coliform or *E. coli*.

Source water total coliform levels are also used by the SWRCB to determine *Giardia* and virus removal requirements through treatment, as described in the following section.

Giardia, Viruses, and *Cryptosporidium*

Cryptosporidium parvum and *Giardia lamblia*, commonly known as *Cryptosporidium* and *Giardia*, are naturally occurring protozoa in the intestines of most mammals, including humans. Surface water contamination from these protozoa can occur as a result of surface runoff through urban areas, woodlands, and pastures; on-site septic tank/sewage disposal system leakage/failure; sewage treatment plant/disposal system overload or malfunction; or, raw sewage deep well injection.

Giardia and viruses are regulated under the California SWTR, with removal guidelines based on source water total coliform levels, as shown in Table 4.3. Systems using conventional treatment that meet filter effluent turbidity requirements receive treatment credits of 2.5-log for *Giardia* and 2-log for viruses. Credits for direct filtration systems are 2.0-log *Giardia* and 1-log virus. Credits for alternative filtration technologies are determined by SWRCB. MID's WTP has two treatment trains. One uses conventional treatment and one uses direct filtration with membrane filtration. SRWA's WTP will use conventional treatment.

Table 4.3. California SWTR Reduction Guideline[1] for *Giardia* and Viruses

Median Monthly Total Coliform Concentrations (MPN[2]/100 mL)	*Giardia* Cyst Log Reduction Guideline	Virus Log Reduction Guideline
< 1,000	3	4
> 1,000 – 10,000	4	5
>10,000 – 100,000	5	6

[1] Source: Surface Water Treatment Rule Guidance Manual available at https://www.epa.gov/sites/production/files/2015-10/documents/guidance_manual_for_compliance_with_the_filtration_and_disinfection_requirements.pdf. Although DDW follows these guidelines that were part of the California SWTR Guidance Document, these are not requirements included in Title 22 CCR.
[2] MPN = most probable number

Reduction of *Cryptosporidium* is regulated under the LT2ESWTR. The results from source water monitoring required under this rule are used to assign one of four "bins" according to average levels of *Cryptosporidium* in the source water. As shown in Table 4.4, the bin assignments have associated treatment requirements ranging from no additional treatment to a required 3 logs additional treatment (for direct filtration). The reduction requirements listed in Table 4.4 apply to the water purveyors if a conventional or direct treatment process is used. Requirements for alternative filtration technologies are determined by SWRCB.

Table 4.4. US EPA LT2ESWTR Bin Assignment for *Cryptosporidium* Reduction Requirements

Average Cryptosporidium Concentration	Bin Classification	Additional Treatment Requirements for Direct Filtration	Additional Treatment Requirements for Conventional Filtration
<0.075 /L	Bin 1	No additional treatment	No additional treatment
≥ 0.075 /L and < 1.0 /L	Bin 2	1.5-log additional treatment	1-log
≥ 1.0 /L and < 3.0 /L	Bin 3	2.5-log additional treatment	2-log
≥≥ 3.0 /L	Bin 4	3-log additional treatment	2.5-log

Source : https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P10058CI.txt

The CVRWQCB Basin Plan (revised May 2018), includes a Drinking Water Policy with a narrative objective for *Cryptosporidium* and *Giardia* using numeric triggers tied to USEPA's drinking water requirements based on *Cryptosporidium* concentrations. Policy language includes "water shall not contain *Cryptosporidium* or *Giardia* in concentrations that adversely affect the public water system component of the municipal beneficial use."

Turbidity

Turbidity is a concern because it can reduce the effectiveness of disinfection by shielding microorganisms. It is also used as a surrogate measure for potential pathogenic contamination and as a measure of filtration performance for pathogen removal.

The IESWTR included requirements for filtered water turbidities. In particular, it introduced monitoring of individual filter effluents, rather than just combined filter effluent. The rule requires, for conventional treatment, that individual filter effluent turbidities not be greater than 1.0 nephelometric turbidity units (NTU) in any two consecutive (15-minute interval) samples at any time, or greater than 0.5 NTU after the filter has been in operation for four hours. Individual filters exceeding these standards are subject to a Comprehensive Filter Evaluation. The rule also requires that combined filter effluent turbidities be less than 0.3 NTU in 95 percent of samples collected each month, and the turbidity of the combined filter effluent must at no time exceed 1 NTU.

4.2.2 Disinfectants and Disinfection By-Products

Disinfection By-Products (DBPs) are produced through the reaction of chemical disinfectants with natural organic matter (NOM) present in the source water. DBPs are a concern due to a number of confirmed or suspected health effects, including increased rates of cancer, miscarriages and developmental defects. The DBPs of greatest concern to MID and SRWA are bromate, trihalomethanes (THMs),), and haloacetic acids (HAAs). Bromate forms through the interaction of ozone with bromide in the source water. The current US EPA MCL for bromate is 0.01 mg/L.

THMs and HAAs form through the interaction of chlorine with NOM from the source water. The Stage 1 D/DBP Rule specifies that systems that use conventional filtration remove certain amounts of organic materials, measured as TOC. Required Removals are based on source water TOC and alkalinity. SRWA and MID qualify for a variance under the rule because of the low raw water TOC, alkalinity, and filtered water TOC, hence removing the requirement for enhanced coagulation. Table 4.5 summarizes the TOC removal requirements.

Table 4.5. TOC Removal (Stage 1 D/DBP Rule)

Source Water TOC (mg/L)	Source Water Alkalinity, mg/L as CaCO3		
	0-60	>60 to 120	>120
>2.0 to 4.0	35%	25%	15%
>4.0 to 8.0	45%	35%	25%
>8.0	50%	40%	30%

Under the Stage 2 D/DBP Rule, both THMs and HAAs are regulated based on samples collected at locations within the distribution system, which were identified from the Initial Distribution System Evaluation (IDSE) and which represent maximum THM and HAA concentrations. Compliance is based on a locational running annual average (LRAA) of quarterly samples collected at each sample location.

MID works with the City of Modesto to maintain DBP regulatory compliance. Because the City is the sole recipient of MRWTP surface water and the City's groundwater wells do not generate appreciable DBPs, MID understands that if the City were to have compliance issues, MID would likely have to adjust its treatment approach to further reduce DBP precursors. MID collects quarterly samples for THM and HAA5s at the Terminal Reservoir Pump Station (TRPS) as the water enters the distribution system, and monthly samples of bromate and bromide. The City of Modesto monitors DBPs at eight sites.

The MCLs for DBPs limits are summarized in Table 4.6. This table also includes maximum residual disinfectant levels (MRDLs),), which regulate the disinfectant concentrations in the distribution system based on a system-wide annual average.

Table 4.6. US EPA Stage 1 and 2 D/DBP Rules Disinfectants and Disinfection by-Product Limits

DBP (Disinfection By-Product)	MCL (Maximum contaminant level)
Trihalomethanes	0.080 mg/L
Chloroform	(MCLG = 0.07 mg/L)
Bromodichloromethane	(MCLG = 0 mg/L)
Dibromodichloromethane	(MCLG = 0.06 mg/L)
Bromoform	(MCLG = 0 mg/L)
Haloacetic acids	0.060 mg/L
Monochloroacetic acid	(MCLG = 0.07 mg/L)
Dichloroacetic acid	(MCLG = 0 mg/L)
Trichloroacetic acid	(MCLG = 0.02 mg/L)

Table 4.6. US EPA Stage 1 and 2 D/DBP Rules Disinfectants and Disinfection by-Product Limits

Mono- and dibromoacetic acids	--
Chlorite	USEPA MCL = 1.0 mg/L (MCLG = 0.8 mg/L)
Bromate	USEPA MCL= 0.01 mg/L MCLG = 0 mg/L
Disinfectants	**MRDL (Maximum residual disinfectant level)**
Chlorine	4 mg/L (as Cl_2)
Chloramines	4 mg/L (as Cl_2)
Chlorine Dioxide	0.8 mg/l (as ClO_2)

4.2.3 Chemical Contaminants

Chemical contaminants are regulated under the National Primary Drinking Water Regulations. In addition to the primary standards, secondary standards have been established for 15 additional parameters. US EPA does not enforce these secondary MCLs. They are established only as guidelines to assist public water systems in managing their drinking water for aesthetic considerations, such as taste, color and odor and are not considered to present a risk to human health at the secondary level.

The federal and state primary and secondary drinking water standards are listed in Appendix I. Each contaminant generally has an established MCL: the highest level of the contaminant allowed in drinking water. Some contaminants have a treatment technology requirement in lieu of or in addition to the MCL. A number of the contaminants, where state standards are more stringent than federal, are associated with agriculture, including pesticides and herbicides.

The state also establishes health-based Notification Levels (NLs) for selected emerging contaminants for which MCLs have not yet been established. Detection of contaminant levels that exceed the NL may require utilities to take further action, such as public notification or switching to an alternative source.

4.2.4 Emerging Contaminants

Emerging contaminants are chemical and microbial contaminants that are not currently regulated, but may be regulated in the future. Two main sources of information are the US EPA's Contaminant Candidate List (CCL) and Information Collection Rule (ICR). Additional contaminants have been identified by SWRCB.

EPA is mandated to produce a new CCL every five years. The CCL has undergone four revisions, referred to as CCL1 (1998), CCL2 (2005), CCL3 (2009), and CCL4 (2016). CCL5 is pending. Nominations for the included contaminants ended in December 2018. The purpose of the CCL is to identify contaminants not yet subject to regulation but that are known or anticipated to occur in public water systems and may require future regulation under the SDWA. The list includes, among others, pesticides, disinfection byproducts, chemicals used in commerce, waterborne pathogens, pharmaceuticals, and biological toxins. The most recent CCL 4 includes 97 chemicals or chemical groups and 12 microbiological contaminants. CCL 5 is under development by the US EPA at the time of this report publishing.

Contaminants requiring further information on occurrence have been monitored under the Unregulated Contaminant Monitoring Rule (UCMR). EPA collects data for contaminants suspected to be present in drinking water, but that do not have health-based standards set under the Safe Drinking Water Act (SDWA). Every five years EPA reviews the list of contaminants, largely based on the CCL, and regulates monitoring for those contaminants. The study period for this sanitary survey spans two UCMR rounds. UCMR 3 monitored for 30 contaminants (28 chemicals and 2 viruses) from 2013-2015. Table 4.7 summarizes UCMR 3 contaminants. UCMR 4 monitors for 30 chemical contaminants (nine cyanotoxins and one cyanotoxin group; two metals; nine pesticides; three brominated haloacetic acid ((HAA)) disinfection byproducts groups, three alcohols, and three semivolatile organic chemicals) from 2018-2020. Table 4.8 summarizes UCMR 4 contaminants for monitoring. The USEPA estimates proposal of UCMR5 during the summer of 2020, with the final rule published late 2021.

Table 4.7. US EPA UCMR 3 Monitoring List

List 1 Assessment Monitoring	List 2 Screening Survey	List 3 Pre-Screen Testing
1,2,3-trichloropropane 1,3-butadiene chloromethane (methyl chloride) 1,1-dichloroethane bromomethane (methyl bromide) chlorodifluoromethane (HCFC-22 bromochloromethane (halon 1011 1,4-dioxane vanadium molybdenum cobalt strontium chromium[1] chromium-6 Chlorate perfluorooctanesulfonate acid (PFOS perfluorooctanoic acid (PFOA) perfluorononanoic acid (PFNA) perfluorohexanesulfonic acid (PFHxS) perfluoroheptanoic acid (PFHpA) perfluorobutanesulfonic acid (PFBS)	17-β-estradiol 17-α-ethynylestradiol (ethinyl estradiol) 16-α-hydroxyestradiol (estriol) equilin estrone testosterone 4-androstene-3,17-dione	enteroviruses noroviruses

[1] Monitoring for total chromium – in conjunction with UCMR 3 Assessment Monitoring – is required under the authority provided in Section 1445(a)(1)(A) of SDWA.

During UCMR 4, PWSs monitor for 10 List 1 cyanotoxins during a 4-consecutive month period from March 2018 through November 2020. PWSs monitor for 20 List 1 additional contaminants during a 12-month period from January 2018 through December 2020. There are three sampling locations:

- Entry points to the distribution system (EPTDS)
- Source Water Intake Locations (SR)
- Stage 2 Disinfectants and Disinfection Byproducts Rule Sampling Locations (D/DBPR)

Table 4.8. US EPA UCMR 4 Monitoring List

Sample		Sampling point [1]
Cyanotoxin Chemical Contaminants	total microcystin microcystin-LA microcystin-LF microcystin-LR microcystin-LY microcystin-RR microcystin-YR nodularin anatoxin-a cylindrospermopsin	EPTDS
Metals	germanium manganese	EPTDS
Pesticides and One Pesticide Manufacturing Byproduct	alpha-hexachlorocyclohexane chlorpyrifos dimethipin ethoprop oxyfluorfen profenofos tebuconazole total permethrin (cis- & trans-) tribufos	EPTDS
Brominated Haloacetic Acid (HAA) Groups[2,3]	HAA5 HAA6Br HAA9	D/DBPR HAA location(s)
Alcohols	1-butanol 2-methoxyethanol 2-propen-1-ol	EPTDS
Three Other Semivolatile Chemicals	butylated hydroxyanisole o-toluidine quinoline	EPTDS
Indicators	total organic carbon (TOC) bromide	SR

Table 4.8. US EPA UCMR 4 Monitoring List

Sample	Sampling point [1]

[1] Sampling Locations
Entry points to the distribution system (EPTDS)
Source Water Intake Locations (SR)
Stage 2 Disinfectants and Disinfection Byproducts Rule Sampling Locations (D/DBPR)
[2] TOC and bromide samples must be collected at the same time as HAA samples. These indicator samples must be collected at a single source water intake using methods already approved for compliance monitoring.
a. TOC methods include: SM 5310 B, SM 5310 C, SM 5310 D (21st edition), or SM 5310 B-00, SM 5310 C-00, SM 5310 D-00 (SM Online), EPA Method 415.3 (Rev. 1.1 or 1.2).
b. Bromide methods include: EPA Methods 300.0 (Rev. 2.1), 300.1 (Rev. 1.0), 317.0 (Rev. 2.0), 326.0 (Rev. 1.0) or ASTM D 6581-12.
[3] Regulated HAAs (HAA5) are included in the monitoring program to gain a better understanding of co-occurrence with currently unregulated disinfection byproducts.
a. HAA5 includes: dibromoacetic acid, dichloroacetic acid, monobromoacetic acid, monochloroacetic acid, trichloroacetic acid.
b. HAA6Br includes: bromochloroacetic acid, bromodichloroacetic acid, dibromoacetic acid, dibromochloroacetic acid, monobromoacetic acid, tribromoacetic acid.
c. HAA9 includes: bromochloroacetic acid, bromodichloroacetic acid, chlorodibromoacetic acid, dibromoacetic acid, dichloroacetic acid, monobromoacetic acid, monochloroacetic acid, tribromoacetic acid, trichloroacetic acid.

Source: https://www.epa.gov/dwucmr/fourth-unregulated-contaminant-monitoring-rule

SWRCB and its predecessor CDPH have identified a number of emerging contaminants. Arsenic, methyl tert-butyl ether (MTBE), chromium-6, nitrates and nitrites are now regulated. Others include manganese, N-Nitrosodimethylamine (NDMA) and other nitrosamines, perchlorate, PFAS and 1,2,3-trichloropropane.

Arsenic. Public health concerns about arsenic in drinking water resulted in the adoption of federal and state MCLs. California revised the arsenic MCL of 0.010 mg/L (equivalent to 10 micrograms per liter, µg/L) in 2008, following a 10-µg/L federal MCL established in January 2006. Previous California and federal MCLs for arsenic were 50 µg/L. In the general U.S. population, the main source of arsenic exposure is via ingestion of food containing arsenic. Intake from air, soil, and drinking water is usually much less. It has been estimated that the average daily dietary intake of arsenic by adults in the United States is 40 micrograms per day. MID and SRWA are in compliance with MCLs.

MTBE. The gasoline additive MTBE was regulated as a drinking water contaminant in California in 2000. MTBE generally enters source waters from leaking underground gasoline storage tanks and pipelines. The primary state MCL for MTBE is 13 µg/L, with a secondary standard of 5 µg/L due to taste and odor concerns. MTBE concentrations at the intake to MRWTP were non-detect (less than 0.5 µg/L) in all samples. SRWA sampled the source water six times between 2016 and 2018 for MTBE. All samples were non-detect.

Chromium-6. Chromium-6 occurs naturally in the environment from the erosion of natural chromium deposits. It can also be produced by industrial processes, released to the environment by leakage, poor storage, or inadequate industrial waste disposal practices. In August, 2017, under a court order, the SWRCB adopted a resolution to remove the previously established MCL of 10 µg/L for chromium-6. The MCL for chromium-6 was set at 10 µg/L in 2014. The state MCL for total chromium of 50 µg/L remains in place. Total chromium measures both trivalent and chromium-6 in water together and does not indicate how much of either type exists. Trivalent chromium is not considered toxic and is an essential nutrient in trace amounts. MID is in compliance with the total chromium MCL of 50 µg/L. Monitoring for total chromium is required annually. The most recent MID sampling results for Chromium-6 and total chromium shows undetected values for both factors. SRWA data also reflects source water values less than the current MCL.

Manganese. The primary natural source of the manganese is the erosion of crustal rock. SWRCB's drinking water notification level for manganese is 0.5 milligram per liter (0.5 mg/L). When manganese is present in water served to customers at concentrations greater than the NLNL, certain requirements and recommendations apply. The NLNL applies to all public water systems, whether or not they are covered by the current regulation of manganese. Currently manganese is regulated by a 0.05-mg/L secondary maximum contaminant level (MCL), a standard established to address issues of aesthetics (discoloration), not health concerns. In California, secondary MCLs are enforceable. MID and SRWA raw water samples did not exceed the NLNL.

Nitrates and Nitrites. Nitrates can be found in drinking water supplies as well as treated wastewater. Their presence in groundwater is generally associated with septic systems, confined animal feeding operations, or fertilizer use. These sources can pose risks to urban drinking water supplies. Nitrite can interfere with the ability of red blood cells to carry oxygen to the tissues of the body, producing a condition called methemoglobinemia. The MCLs, 10 mg/L for nitrate as nitrogen (N); 10 mg/L for nitrate plus nitrite as N; and 1 mg/L for nitrite as N. MID and SRWA source water samples are less than the MCLs.

N-Nitrosodimethylamine (NDMA) and other nitrosamines. In 1998, NDMA was found in a drinking water well in northern California, and was subsequently found elsewhere (groundwater recharge projects and as a byproduct of drinking water treatment). NDMA and other nitrosamines are among the chemicals known to the state to cause cancer. The contribution of NDMA and other nitrosamines to the body from food and from what is produced inside the body (endogenous) is much larger than that from drinking water, which has a contribution less than 0.1%.

Notification levels for NDEA, NDMA, and NDPA are established at 10 ng/L, to take into account the very low detection limits and their potential presence in association with drinking water treatment. An MCL for NDMA is not available, so the notification level provides information to local governing agencies and consumers. Available data indicates that SRWA raw water is below the NLNL for NDMA. MID tested for NDMA as part of UCMR 2 sampling and found all treated water samples below the NL.

Perchlorate. Perchlorate and its salts are used in solid propellant for rockets, missiles, and fireworks, and elsewhere (e.g., production of matches, flares, pyrotechnics, ordnance, and explosives). Their use can lead to releases of perchlorate into the environment. The existing state MCL remains at 6 µg/L (established October 2007), though the Office of Environmental Health Hazard Assessment revised the public health goal (PHG) from 6 µg/L to 1 µg/L. US EPA published a proposed rule in June 2017 to establish an MCL of 56 µg/L. MID and SRWA raw water available data is below the existing MCL.

1,2,3-Trichloropropane. TCP, included in CCL3 and UCMR 3, is exclusively a man-made chlorinated hydrocarbon, typically found at industrial or hazardous waste sites. TCP is often present at sites contaminated by other chlorinated solvents. On December 14, 2017, the SWRCB DDW adopted a regulation promulgating a state MCL for 1,2,3-trichloropropane (1,2,3-TCP) of 0.005 micrograms per liter (µg/L, or 5 parts per trillion or 5 ppt). 1,2,3-TCP was monitored for SRWA source water Phase 1 monitoring (2016-2017). It was non-detect (<0.005 µg/L) in 4 of 4 samples. Four raw water samples from Modesto Reservoir taken during 2018 were also all non-detect. No recent data is available for Don Pedro Reservoir.

1,4-Dioxane. 1,4 Dioxane has been mainly used in industries such as plastics manufacturing of plastics, construction materials, and pharmaceuticals, as well as animal or vegetable oil extraction. 1,4-Dioxane was used as a stabilizer for solvents and is a probable human carcinogen. In November 2010, California revised the drinking water notification level for 1,4-dioxane from 3 µg/L to 1 µg/L. The response level, at which the source is recommended for removal from service, is 35 µg/L. Drinking water systems are not required by state regulations to monitor for 1,4-dioxane. 1,4-dioxane data was collected as part of UCMR3. No recent data is available for Don Pedro or Modesto Reservoirs, or for the Lower Tuolumne River during this study period.

Per- and Poly-fluoroalkyl Substances (PFAS) - The fluorinated compounds that are blamed for causing contamination of the water cycle system have become a concern. They got popular because of their ability to resist stain, grease and water. Since these chemicals have been used in a wide variety of products, they have been found in the blood of 99% of people tested. After independent review of the available information on the risks, DDW established Notification Levels (NLs) for PFOS and PFOA (6.5 and 5.1 ppt respectively). These levels are consistent with OEHHA's recommendations. In addition, SWRCB set new response levels (RLs) of 10 parts per trillion (ppt) for PFOA and 40 ppt for PFOS (February 2020). Previously, the RL was 70 ppt for the total concentration of the two contaminants combined. If a water system receives a State Water Board order for testing and finds that the PFOA or PFOS concentration exceeds their RL, the system is required to take the water source out of service, provide treatment, or notify their customers in writing. PFOA and PFOS were added to

SRWA's ongoing source water monitoring program, which is expected to continue through construction of the WTP. To date, two rounds of bi-annual sampling have included these parameters and results were below the detection limit of 2.0 ng/L. Data is not available for MID. These compounds are likely to be included in the future UCMR round.

Microplastics - Consistent with Health and Safety Code section 116376 and within its authority, the State Water Board is reviewing existing research and studies to accomplish the following tasks:

- On or before July 1, 2020: Adopt a definition of microplastics in drinking water;
- On or before July 1, 2021:
- Adopt a standard methodology for testing of microplastics in drinking water;
- Adopt requirements for four years of testing and reporting of microplastics in drinking water, including public disclosure of those results;
- Consider issuing quantitative guidelines (e.g., notification level) to aid consumer interpretations of the testing results, if appropriate;
- Accredit qualified laboratories in California to analyze microplastics in drinking water.

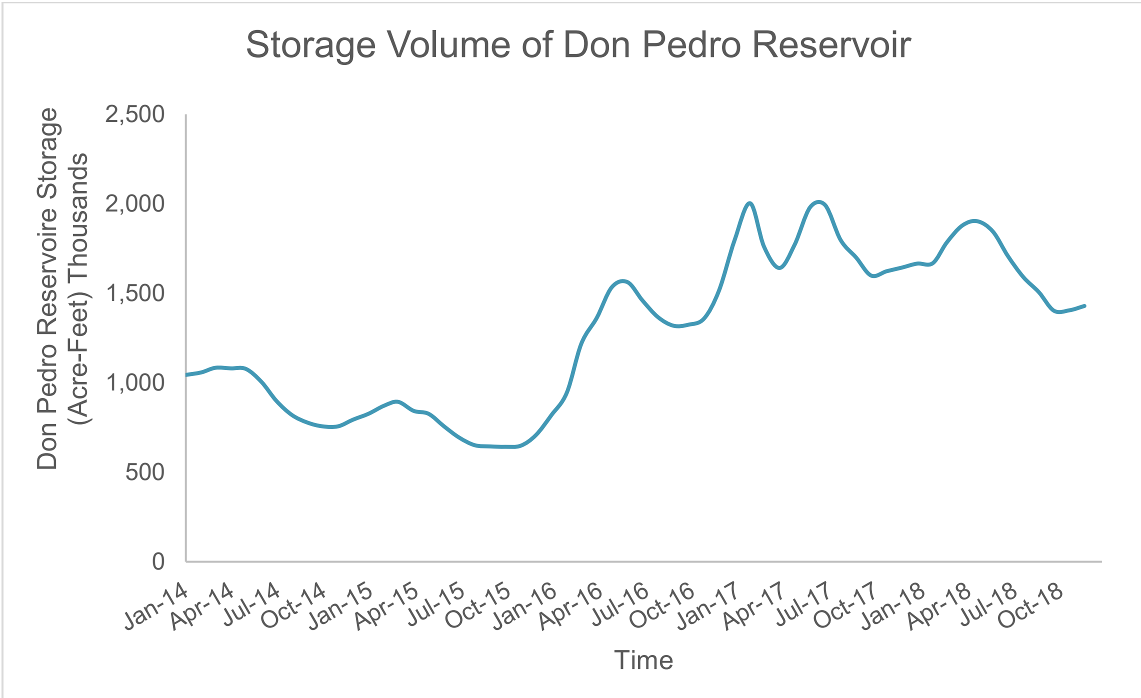
4.3 Reservoir Water Levels

Don Pedro Reservoir, a 2,030,000 acre-foot (ac-ft) reservoir, serves as the primary water storage facility and Modesto Reservoir, a 28,000 ac-ft reservoir, stores water for irrigation and domestic use. TID and MID manage Don Pedro Reservoir to provide flood control, irrigation water supply, municipal and industrial water supply, power generation, fisheries protection, recreation, and other uses. The daily volume of the Don Pedro Reservoir from 2014 – 2018 that results from delivering these benefits is shown in Figure 4-1. Although the Don Pedro Reservoir is located at a significantly lower elevation where snowfall is less common, the mainstream Tuolumne River derives much of its flow from those higher elevations where significant snow accumulates. Some smaller tributaries that are almost exclusively rain-driven flow directly into Don Pedro Reservoir, but these streams generally provide only minimal inflow to the reservoir.

The average annual full natural flow of the Tuolumne River upstream of Don Pedro Dam is approximately 1.8 to 1.9 million ac-ft (California Data Exchange Center [CDEC] 2010). Annual amounts can vary widely, but the total releases from the Don Pedro Dam have averaged approximately 1.6 million ac-ft annually (1975 to 2018), due to upstream diversions. The pattern of inflow to Don Pedro Reservoir is highly regulated, and water derived from spring snowmelt is often released from upstream reservoirs over a longer period than would occur naturally. During the period from

2014 to 2018, releases from Don Pedro ranged from 665,730 ac-feet in 2014 to 4,621,930 ac-feet in 2017.

Flood storage capacity is maintained in the Don Pedro Reservoir of at least 340,000 ac-ft from early October through April.

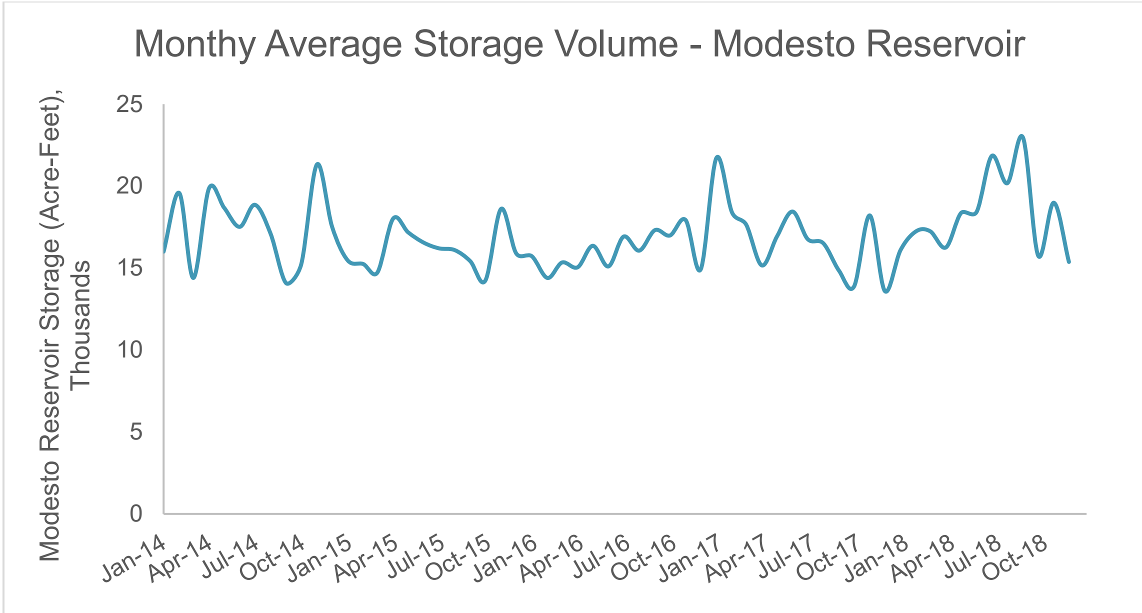


(http://cdec.water.ca.gov/dynamicapp/QueryMonthly?end=2018-12&s=DNP).

Figure 4-1. Storage Volume of the Don Pedro Reservoir

Figure 4-2 shows fluctuations in the Modesto Reservoir storage volume from January 2014 to December 2018. Figure 4-3 shows total annual inflows to Modesto Reservoir. Water levels in the Modesto Reservoir vary depending on precipitation (see Figure 4-4 for total daily precipitation), irrigation and domestic water storage needs, and hydroelectric generation. Depending upon operational needs, MID will divert water any time of the year, even during the non-irrigation season, but not continuously all year round. During wet years, if Don Pedro is full and there is water available, MID has the capability to raise the level of Modesto Reservoir to maximum pool. Water from Modesto Reservoir does infiltrate and provides a valuable recharge resource for the Modesto sub basin aquifer.

MID uses the full capacity of Modesto Reservoir (and the irrigation canals) to minimize flooding in the Tuolumne River during periods of high flow. MID may generate hydroelectric power from Don Pedro Releases at any time of the year and will divert water used for this purpose into Modesto Reservoir for the next irrigation season. Inflows to Modesto Reservoir occur throughout the year, other than during an annual two week shut down period.



(http://stratus.water.ca.gov/dynamicapp/QueryMonthly?s=MDO&end=2014-02-07&span=24months)

Figure 4-2. Monthly Average Storage Volume of the Modesto Reservoir

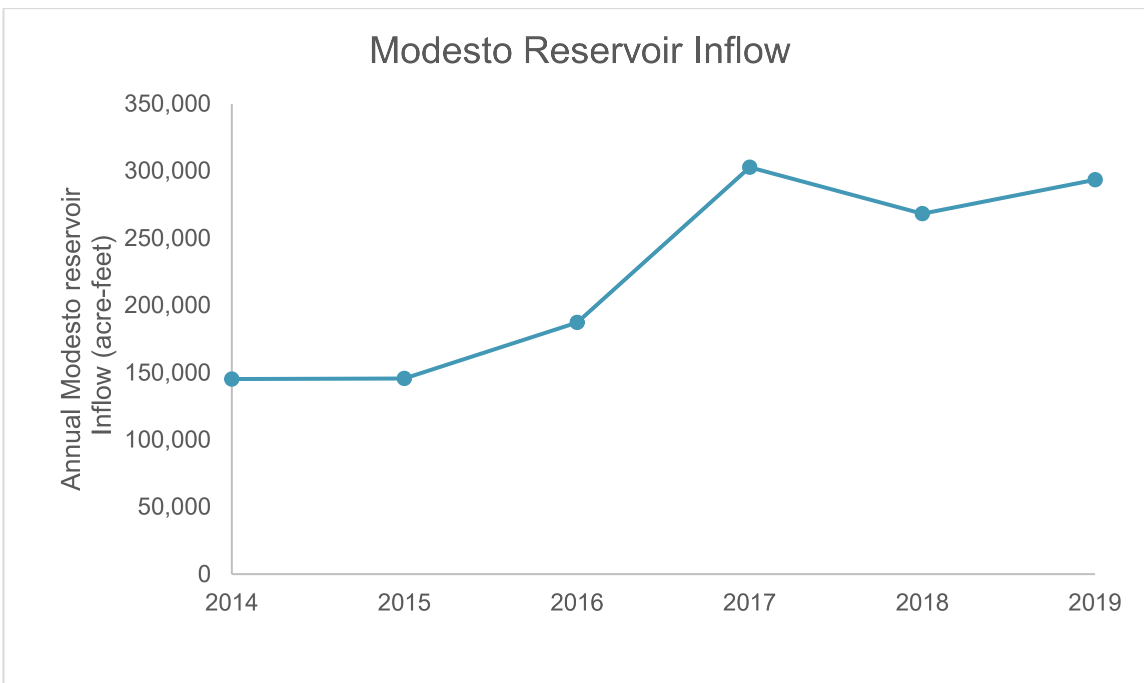
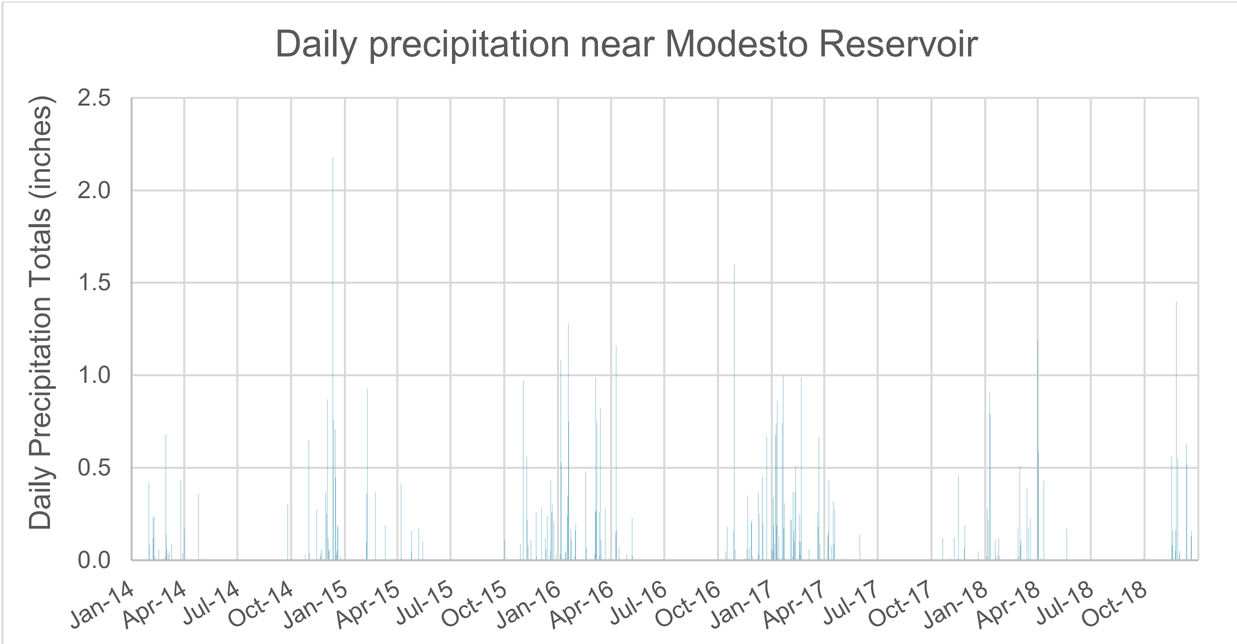


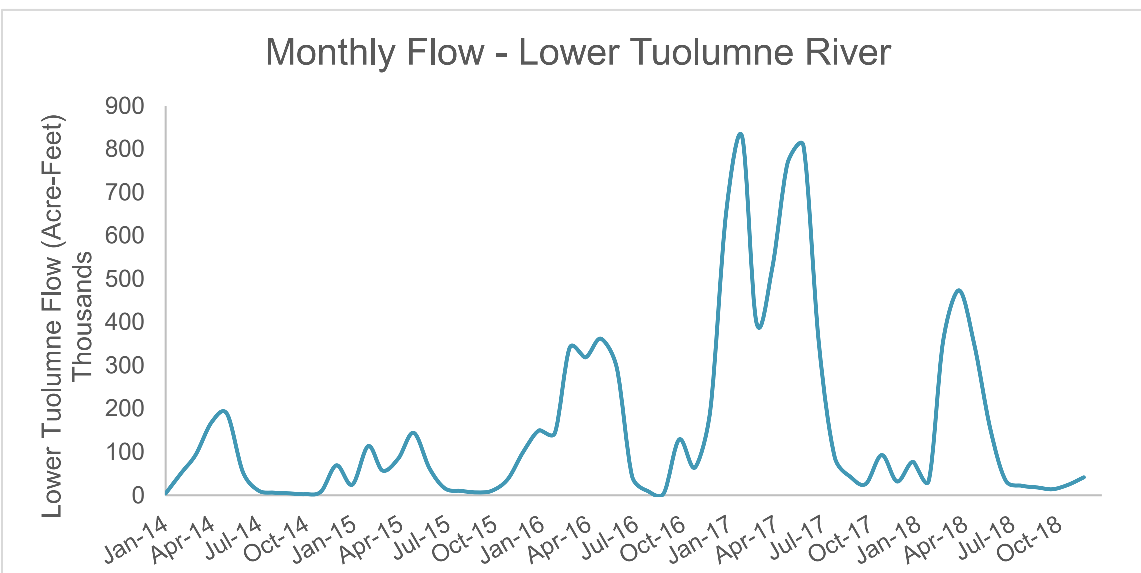
Figure 4-3. Annual Inflow to the Modesto Reservoir



(https://api.wunderground.com/history/airport/KMOD/2018/1/1/CustomHistory.html?dayend=31&monthend=12&yearend=2018&req_city=&req_state=&req_statename=&reqdb.zip=&reqdb.magic=&reqdb.wmo=)

Figure 4-4. Daily Precipitation around Modesto Reservoir, data from Waterford, CACA.

Figure 4-5 summarizes the monthly flow in the Lower Tuolumne River, downstream of Don Pedro reservoir and the LaGrange dam diversion.



(http://cdec.water.ca.gov/reportapp/javareports?name=FNFSUM.2018)

Figure 4-5. Total Monthly Lower Tuolumne River Flow below LaGrange

4.4 Review of Water Quality Data

This section summarizes the water quality conditions and trends, based on available data from 2014-2018 at the Don Pedro Reservoir, the Modesto Reservoir, and the Lower Tuolumne River.

MID, as a wholesaler, has only one physical service connection and as such conducts additional monitoring than what is required by regulations as a quality control check. MID examines at least three samples per 24-hour period for bacteriological quality when the conventional/membrane plant is operating alone and at least four samples per 24-hour period when the plants are running in conjunction. Samples are taken at plant influent Raw Water Vault, Wet Well, Combined Membrane Filtrate (when the membrane plant is operating), and Terminal Reservoir. MID performs bacteriological monitoring as per its bacteriological sample siting plan (BSSP) plan dated May 2017.

4.4.1 Don Pedro Reservoir

This section briefly summarizes the water quality information reviewed during the preparation of the 2014 watershed sanitary survey. No significant sampling effort has been performed during the study period; however updates to the data are noted where applicable.

In conjunction with the 2013 relicensing process for the power generation facility at the Don Pedro Dam, a water quality study was performed at the Don Pedro Reservoir (Water Quality Assessment Study Report, January 2013). The goals of the study were (1) to characterize existing water quality conditions in Don Pedro Reservoir and the lower Tuolumne River downstream of the dam and (2) to determine the water's consistency with the CVRWCB's Basin Plan Objectives for multiple beneficial uses.

Surface water samples were collected from upstream, within, and downstream of the Don Pedro Reservoir. Existing data characterize the surface water quality as very good, noting a low specific conductivity and hardness, prone to acidification, and with limited potential sources of local contamination. Most constituents were reported from non-detectable to just above reporting limit concentrations. Further, there does not appear to be a pattern of increasing chemical concentrations from upstream to downstream of Don Pedro Dam.

The designated beneficial uses by the CVRWQCB for the Don Pedro Reservoir area include municipal and domestic supply; agricultural supply; hydropower generation; water contact recreation; water non-contact recreation; cold freshwater habitat; warm freshwater habitat; migration of aquatic organisms; spawning; reproduction and/or early development; and wildlife habitat. A summary of the comparison of the available data to the Basin Plan's Water Quality Objectives, is as follows:

- **Nitrogen and Phosphorous**. The Basin Plan requires that water shall not contain biostimulatory substances which promote aquatic growth in concentrations that cause nuisance or adversely affect designated beneficial uses. The low nutrient levels measured historically suggest that biostimulatory substances are not currently present in sufficient quantities to cause nuisance conditions related to algal blooms or decreased water clarity. MID and TID are unaware of any instances where algal bloom or decreased water clarity has been reported as a nuisance.

- **Chemical Constituents**. Don Pedro reservoir water quality was found to be consistent with drinking water standards.
- **Color**. MID and TID are unaware of any instances where the color of the water in the Don Pedro Reservoir area has been reported as a nuisance or has adversely affected drinking water quality.
- **pH**. Source water quality was found to be consistent with the objective.
- **Pesticides**. Significant pesticide use does not occur within the Don Pedro Reservoir area. MID and TID are unaware of any instances where pesticide use has been reported to cause a nuisance or adversely affect drinking water quality or other designated beneficial uses of the Don Pedro Reservoir.
- **Sediment and Settleable Solids**. The Basin Plan requires that suspended sediment load and suspended sediment discharge to surface waters shall not alter surface waters in such a manner as to cause a nuisance or adversely affect its beneficial uses. There was a high sediment load into the Don Pedro Reservoir as a result of run off from the Rim Fire. MID and TID are not aware of adverse effects on designated beneficial uses of the Don Pedro Reservoir.
- **Tastes and Odor.** Secondary MCLs are routinely applied at the point of use (i.e., “at the tap”) and the existing water treatment methods at the WTP are adequate to meet these secondary water quality criteria.
- **Toxicity**. All samples were far below this secondary MCL indicating that drinking water beneficial use is being met in the Don Pedro Reservoir Area for copper.
- **Mercury and Methylmercury.** Existing mercury data was detected at concentrations that were far less than the MCL of 0.002 mg/L indicating that drinking water beneficial use is being met in the Don Pedro Reservoir Area for mercury. Historically, however, evidence does exist of fish mercury bioaccumulation.
- **Turbidity**. Indications are that drinking water beneficial use is being met in the Don Pedro Reservoir Area for turbidity.
- **Dissolved Oxygen**. DO values were generally above the Basin Plan Objectives. These results were expected, since large, deep reservoirs/lakes generally form strong thermoclines with oxygen poor hypolimnions in the late summer/fall period.

- **Dissolved Oxygen**. DO values were generally above the Basin Plan Objectives.

- **Microbiological Constituents**. Microbials were consistent with the Basin Plan Water Quality Objectives. *Cryptosporidium* data was not available for the Don Pedro Reservoir area.

Annual water quality sampling results for the Don Pedro Reservoir area from 2015-2017 are shown in Table 4.9. There are a few sampling points reported in Don Pedro for water quality objectives (fecal coliform) or benchmark (total coliform, *E. coli*), which are summarized in Table 4.9 below.

Table 4.9. Annual Don Pedro Reservoir Area Water Quality Sampling Results 2015-2017

Parameter	DLR1	Date			
		2/3/2015	2/4/2016	1/29/2018	4/11/2017
Chemicals					
Total Hardness (as CaCO3) (mg/l)				13	
Calcium (mg/l)				3.3	
Magnesium (mg/l)				1.2	
Sodium (mg/l)				1.3	
Total Alkalinity (as CaCO3) (mg/l)		14	40	<20	26
Hydroxide (mg/l)		<1	<1	ND	<1
CaRBONATE (MG/L)		<1	<1	ND	<1
Bicarbonate (mg/l)		14	40	18.1	26
Sulfate (mg/l)	0.5	1.9	2.5	9.2	2.4
Chloride (mg/l)		2.7	1.8	5.8	1
Nitrate (as NO3) (mg/l)	2	0.8			
Nitrate (as N) (mg/l)	0.4	ND	0.4	<0.4	<0.4
Fluoride (Natural Source)	0.1	<0.1	<0.1	0.11	<0.1
pH		7.9	6.3	7.2	6.7
Specific Conductance (E.C)		47	56	36.7	44
TDS (mg/l)		30	40	33	40
Apparent color (Units)				<5	
Odor Threshold (TON)	1			<1	

Table 4.9. Annual Don Pedro Reservoir Area Water Quality Sampling Results 2015-2017

Parameter	DLR1	Date			
		2/3/2015	2/4/2016	1/29/2018	4/11/2017
Lab Turbidity (NTU)				0.7	
MBAS (mg/l)		<0.10		<0.05	
Inorganic Chemicals					
Aluminum (µg/l)	50			<50.0	
Antimony (µg/l)	6			<6.0	
Arsenic (µg/l)	2			<2.00	
Barium (µg/l)	100			<100	
Beryllium (µg/l)	1			<1.0	
Cadmium (µg/l)	1			<1.0	
Chromium (µg/l)	10			<10.0	
Copper (µg/l)	50			<50.0	
Iron (µg/l)	100			<100	
Manganese (µg/l)	20			<20.0	
Mercury (µg/l)	1			<1.0	
Nickel (µg/l)	10			<10.0	
Selenium (µg/l)	5			<5.0	
Silver (µg/l)	10			<10.0	
Thallium (µg/l)	1			<1.0	
Zinc (µg/l)	50			<50.0	

[1] Detention Limit for Reporting

Table 4.10. Total Coliform, Fecal Coliform and E. Coli Samples from Don Pedro Area During 2015-2017

Date	Total Coliform (MPN/100)	Fecal Coliform (MPN/100)	Fecal Coliform (MPN/100)
7/9/2015	79	7.8	4.5
7/14/2016	1.3	<1.8	<1.8
7/13/2017	7.8	<1.8	<1.8

4.4.2 Modesto Reservoir

The water quality conditions at Modesto Reservoir are characterized by the water quality data collected from the MRWTP treatment plant intake from 2013-2017, as well as direct sampling within the reservoir. Data were provided by MID and Stanislaus County. This section presents the data analysis of physiochemical constituents in Modesto Reservoir, which include turbidity, temperature, pH, alkalinity, total dissolved solids, calcium, total organic carbon (TOC), DBPs, metals, toluene, and ethylbenzene. Microbiological data is discussed at the end of the section. Where applicable, discussion of a potential change in trend of a water quality parameter is included.

Figure 4-6 is a map of sample locations in Modesto Reservoir. Table 4.11 lists water quality parameters collected and analyzed by MID, and a description of where the samples were collected. MID analyzes the samples for additional constituents, but only those that are relevant to this watershed sanitary survey are included in Table 4.11. MID's treatment plant is described in Section 2.

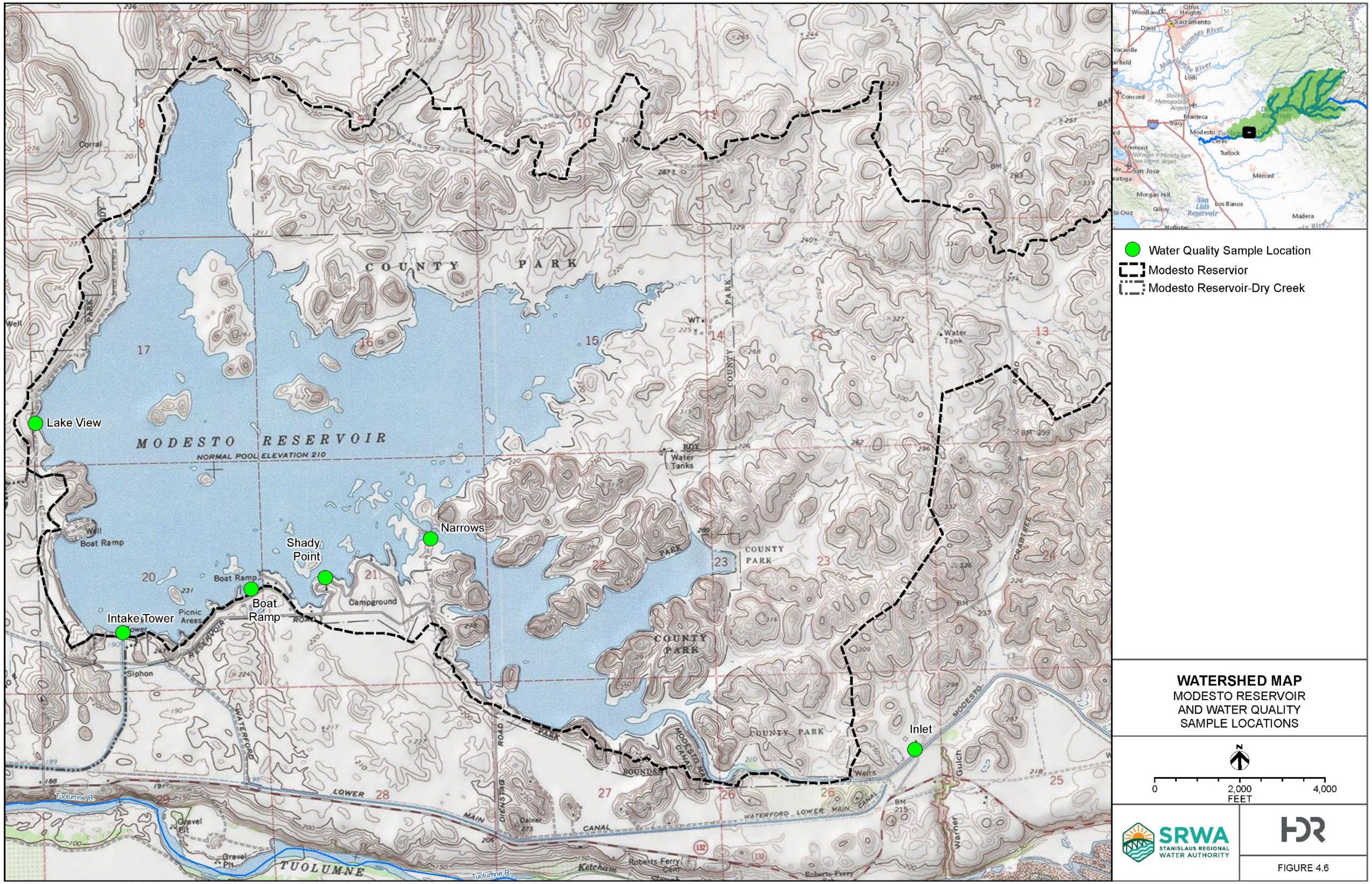


Figure 4-6. Modesto Reservoir Water Quality Sample Locations

This page intentionally left blank

Table 4.11. Water Quality Parameters Provided by MID and Water Quality Sample Locations

Sample Location	Description	Constituents Analyzed
West boat ramp (Modesto Reservoir)	See Figure 4-6 for location	Total coliform, *E. coli*
Lake View (Modesto Reservoir)	See Figure 4-6 for location	Total coliform, *E. coli*
Shady Point (Modesto Reservoir)	See Figure 4-6 for location	Total coliform, *E. coli*
Narrows (Modesto Reservoir)	See Figure 4-6 for location	Total coliform, *E. coli*
Inlet (Modesto Reservoir)	See Figure 4-6 for location	Total coliform, *E. coli*, TOC, MTBE. BTEX [1], *Giardia* [1], *Cryptosporidium* [1]
Raw water (main lab)[2]	Raw water sample tap connected to a 72-inch pipeline that brings raw water from Modesto Reservoir to MID water quality testing laboratory	Total organic carbon, metals, algae, MTBE. BTEX [1], *Giardia*[1], *Cryptosporidium*[1]
Raw water (operators lab)[2]	Sample tap in MID operators' laboratory connected to the same 72-inch pipeline described above	Turbidity, pH, alkalinity, calcium, total dissolved solids, temperature and Langelier Index, Heterotrophic Plate Count, Total coliform, *E. coli*
Filtered water [2]	Sample tap downstream of filters	Total organic carbon, turbidity, chlorine residual, Heterotrophic Plate Count[1], Total coliform[1], *E. coli*[1]
Finished water [2]	Sample tap downstream of water treatment plant	Turbidity, pH, alkalinity, total dissolved solids, MTBE, BTEX[1], chlorine residual, Heterotrophic Plate Count[1], Total coliform [1], *E. coli*[1]
Terminal Reservoir[2,3]	Sample tap at a 10 million gallon storage facility, about 16 miles from the water treatment plant on the east edge of Modesto	MTBE, BTEX, total trihalomethanes, haloacetic acids, bromate, bromide, Total coliform, *E. coli*, chlorine residual, Heterotrophic Plate Count

[1] The sampling stopped as of 2017.
[2] MID sample location.
[3] Inlet to City of Modesto distribution system.

Turbidity

Turbidity is a measure of cloudiness of water and is an indicator of microbiological water quality and filter efficiency. Turbidity in raw water ranged from 1.6 to 25.7 NTU, whereas filtered water turbidity was at least 100 fold lower, ranging from 0.03 to 0.083 NTU (Figure 4-7 and Figure 4-8). As discussed in Table 4.11, the Interim Enhanced Surface Water Treatment Rule (IESWTR) requires combined filter effluent turbidity of less than 0.3 NTU in at least ninety-five percent of samples collected each month. Ninety-fifth percentile turbidity values in filtered water were about 0.06 NTU, less than 0.3 NTU, indicating that regulatory requirements were met in filtered water samples. Turbidity spikes were noted in raw water during winter months. Storm events in winter that can stir up sediments could be a cause for such spikes. As shown in Figure 4-7, raw water turbidity spikes did result in corresponding spikes in the filtered water; however filtered water “spikes” were all less than 0.1 NTU. Figure 4-8 includes combined membrane filtrate (CMF) data, as measured from the membrane process, where data from the filtered turbidity analyzer was not available.

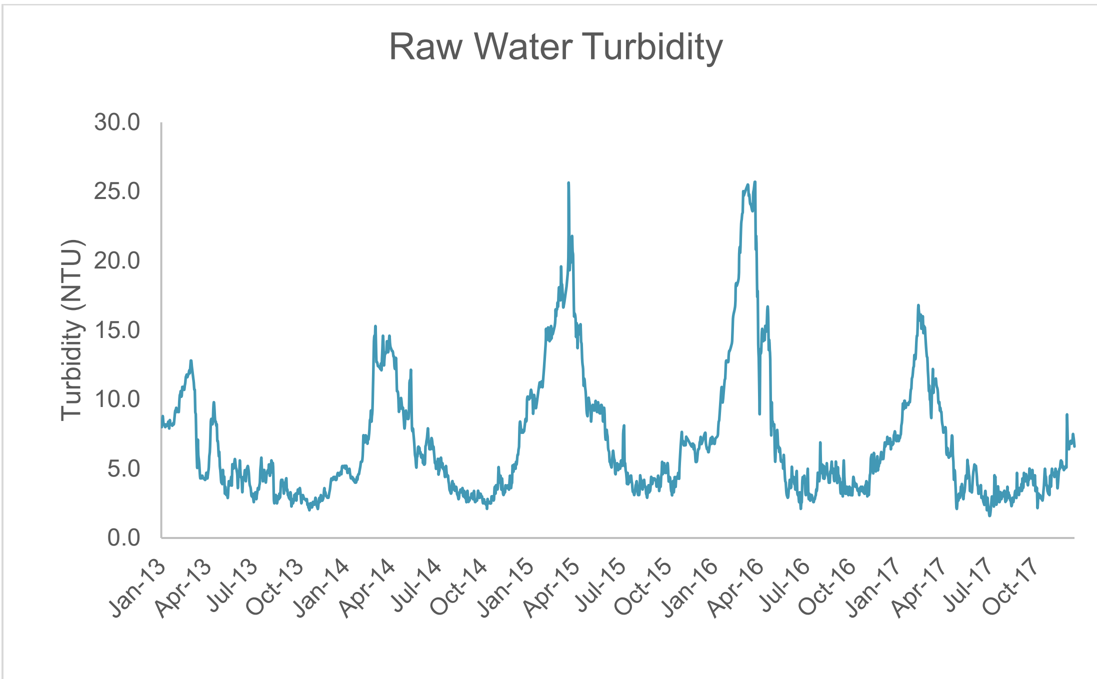


Figure 4-7. Raw Water Turbidity

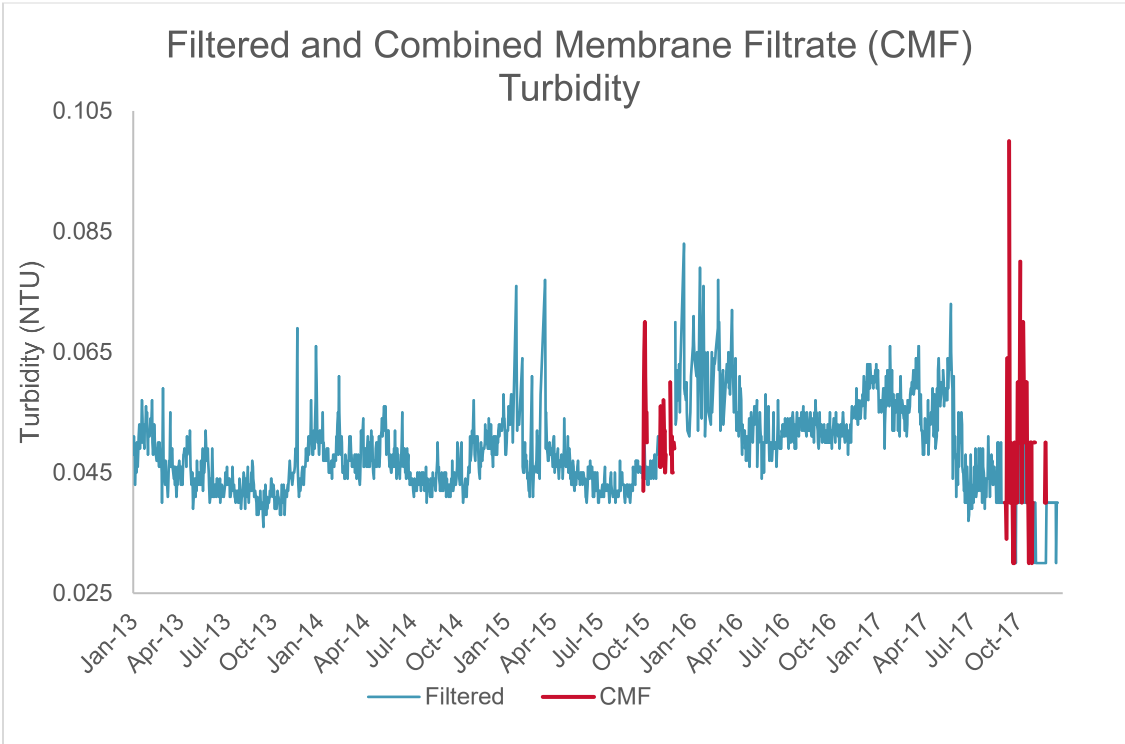


Figure 4-8. Filtered and Combined Membrane Filtrate Water Turbidity.

Temperature, pH and Alkalinity

Raw water temperature variations are shown in. Water temperatures in winter ranged from 6.1 to 13°C, whereas water temperatures in the summer and fall ranged from 15° to 23°C.

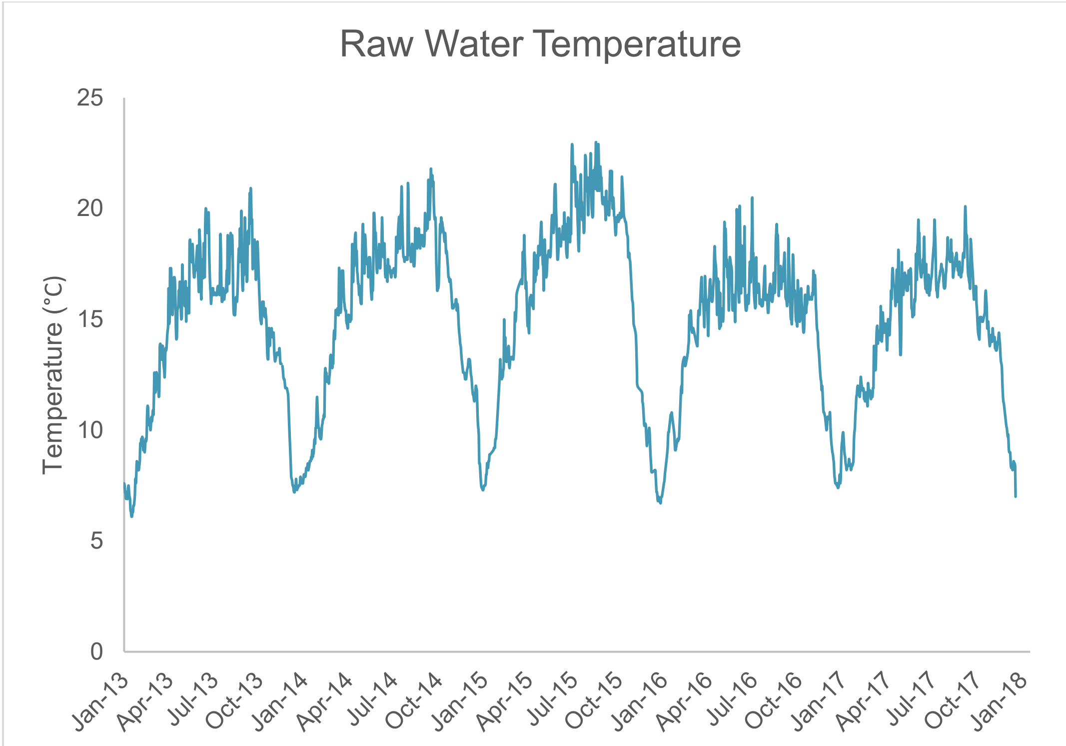


Figure 4-9. Raw Water Temperature

Raw water pH values ranged from 6.4 to 7.5, with a median value of 6.9 standard units (Figure 4-10). Finished water pH ranged from 6.8 to 8.8, with a median value of 8.5 standard units. Average finished water pH was 8.5. Lime and CO_2 are added after filtration to increase the bicarbonate alkalinity of the finished water for corrosion control. Bicarbonate alkalinity is a desirable buffer for corrosion control. The pH target for lime and CO_2 is between 8.0-8.3 units. This range was selected to provide a finished pH that meets the secondary standard. Sodium hydroxide is added as the water leaves the plant to increase the pH to a target goal of 8.5 units. Lime and CO_2 are less expensive than sodium hydroxide for pH control and provides $CaHCO_3$ buffer, so MID tries to minimize the feed of sodium hydroxide. MID has added supplemental pH monitoring upstream of the clearwell to minimize delays in dose monitoring.

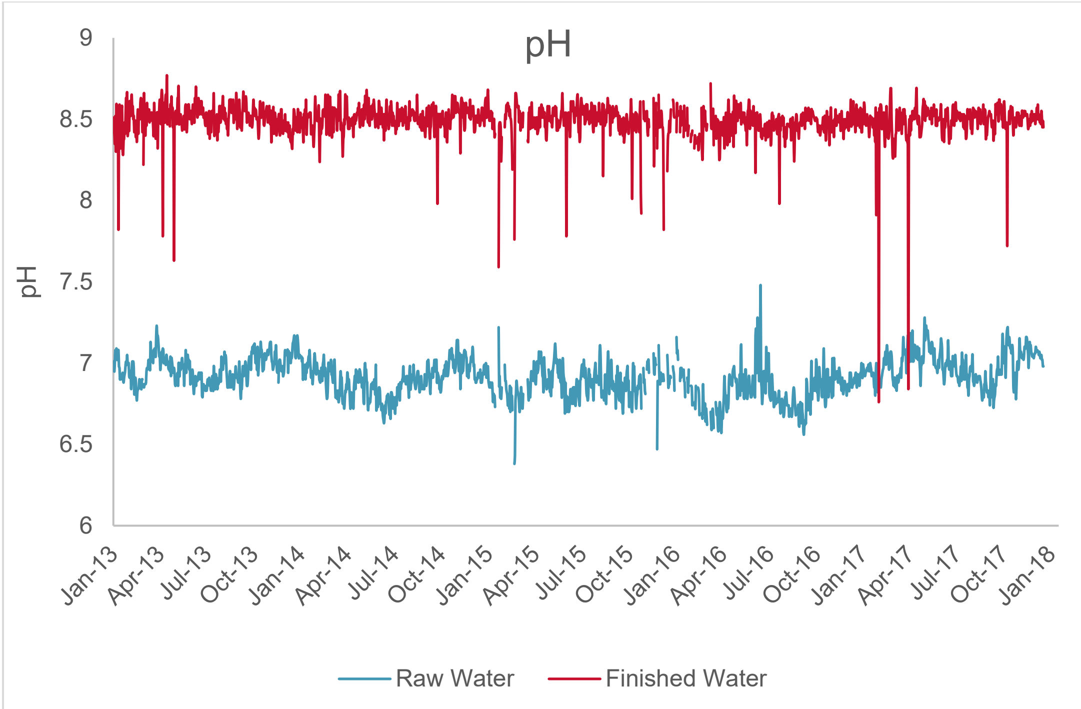


Figure 4-10. Raw and Finished Water pH

Raw and finished water alkalinity is presented in Figure 4-11. Raw water alkalinity ranged from 8.5 to 18.9 mg/L as $CaCO_3$, with an average value of 13.4 mg/L as $CaCO_3$. This indicates that the pH buffering capacity of the raw water is very low. Alkalinity spikes were noted in the summer. MID adds lime and carbon dioxide for alkalinity adjustment to the finished water. Treated water alkalinity ranged from 13 to 41 mg/L as $CaCO_3$, with an average of 35 mg/L as $CaCO_3$. Alkalinity values decreased between December 2015 and March 2016 due to an outage in the lime feed system. While the lime feed system was out of service, MID fed NaOH in lieu of lime to meet a pH of approximately 8.5 units. Without the buffering ability of bicarbonate ion provided by the addition of lime, alkalinity was temporarily lowered.

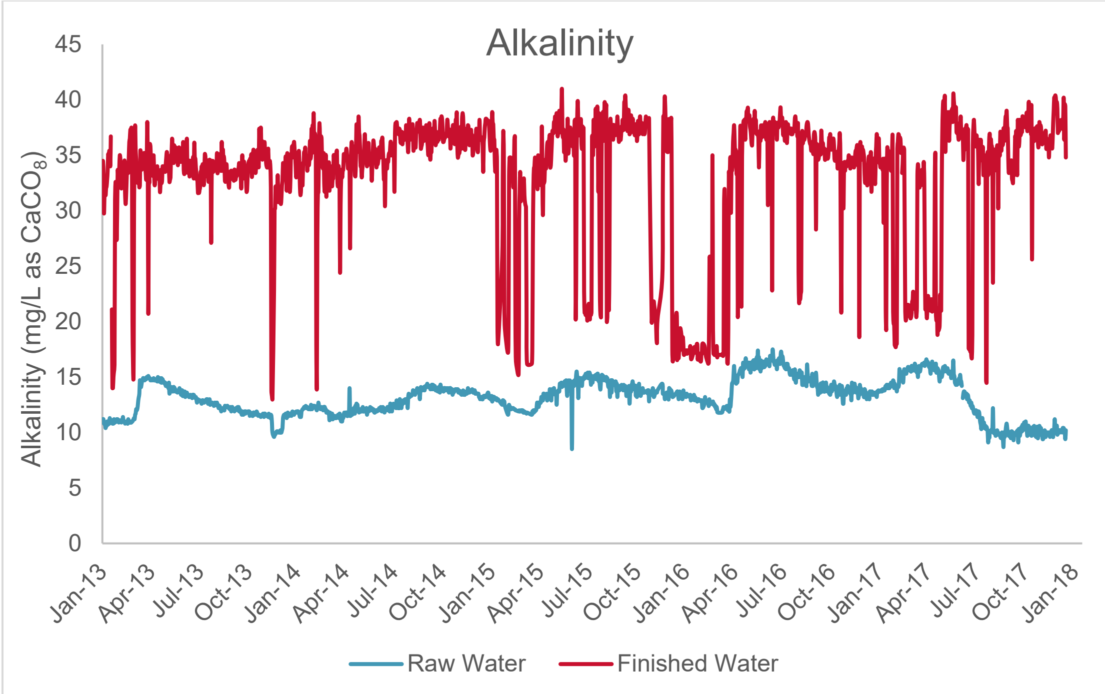


Figure 4-11. Raw and Finished Water Alkalinity

Total Dissolved Solids, Calcium and Langelier Index

The concentration of total dissolved solids (TDS) represents the sum of all dissolved organic and inorganic constituents in water. Primary sources for TDS in receiving waters include agricultural runoff and discharge from industrial or wastewater treatment plants. The most common chemical constituents contributing to TDS are calcium, phosphates, nitrates, sodium, potassium and chloride. Total dissolved solids showed a time trend similar to alkalinity; peaking during summer months (Figure 4-12). All samples were well below the TDS secondary standard of 500 mg/L. TDS concentrations almost doubled in finished water samples compared to raw water samples. This doubling is due to the addition of lime (calcium hydroxide) to adjust treated water alkalinity and pH.

Calcium trends in raw and finished water are shown in Figure 4-13. Based on Figures 4-12 and 4-13, almost fifty percent of TDS concentrations were contributed by calcium, both in raw and finished water. Periods of low TDS and calcium indicate when the plant's lime feed system was not operational, as discussed above.

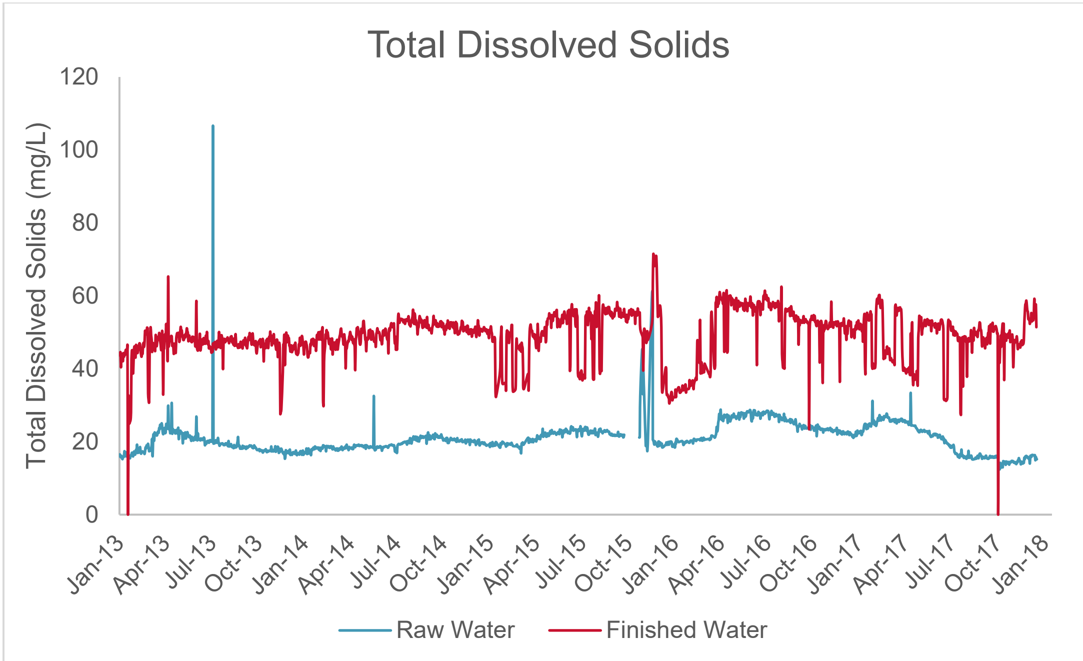


Figure 4-12. Raw and Finished Water Total Dissolved Solids

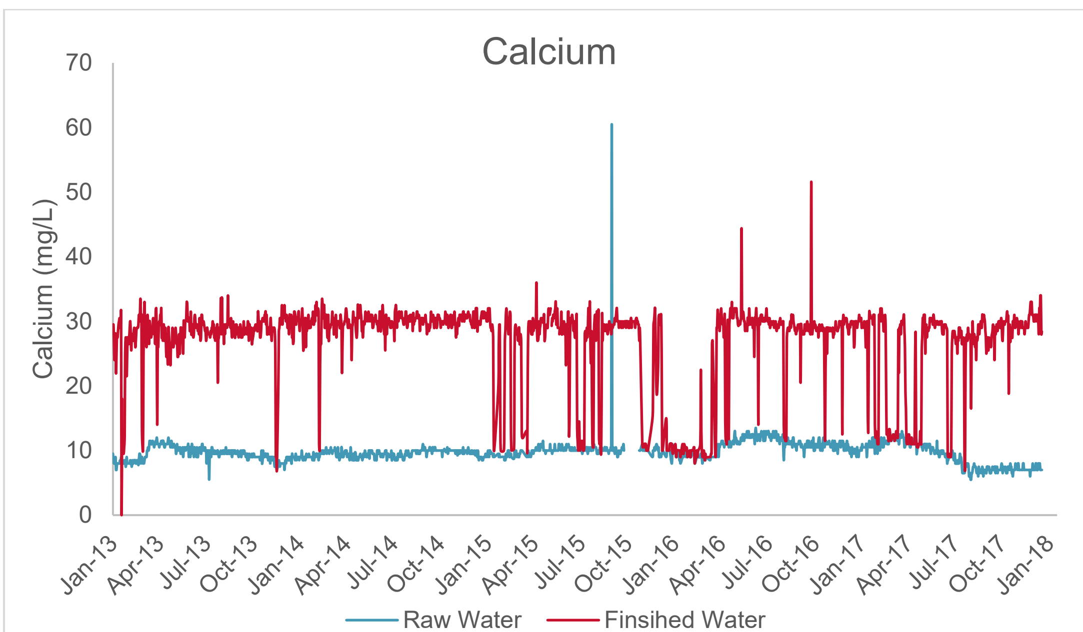


Figure 4-13. Raw and Finished Water Calcium

The Langelier Index is an approximate indicator of the degree of saturation of calcium carbonate in water. This Index is one of several tools used by water operators for stabilizing water to control both internal corrosion and the deposition of scale. When this value is negative, it means that the water is under saturated with calcium carbonate and will tend to be corrosive in the distribution system. All MID water raw samples Langelier index values were negative, while some treated water samples were positive. Langelier value trends in raw and finished water are shown in Figure 4-14. When the alkalinity drops, the Langelier Index lowers, and temporarily increases corrosion potential of the treated water.

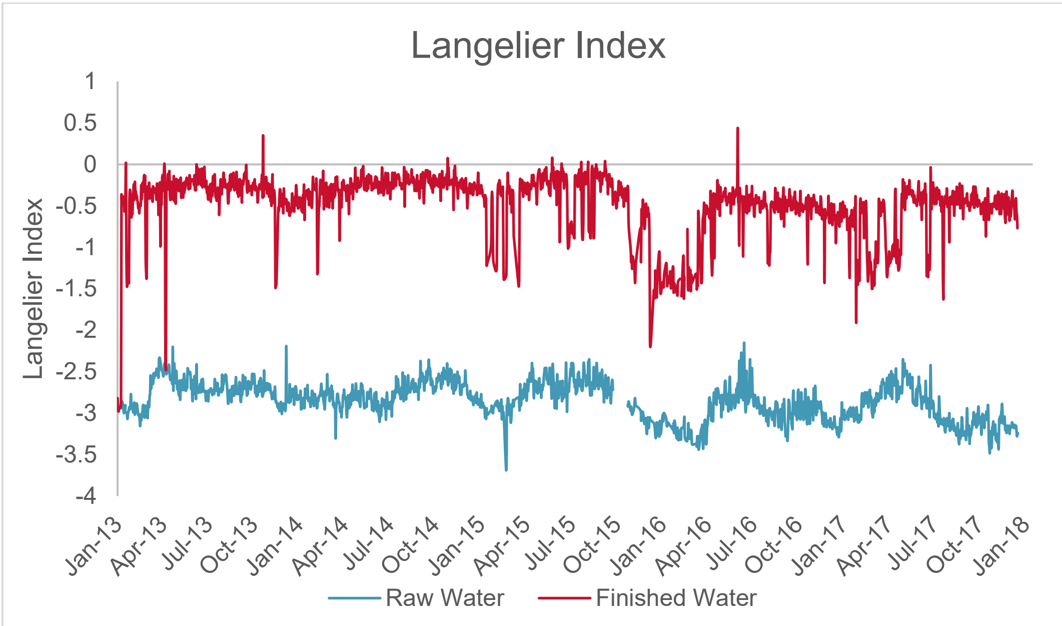


Figure 4-14. Langelier Index in Raw and Finished Water

Total Organic Carbon and Disinfection By-products

TOC is a measure of soluble and insoluble organic carbon compounds in water that are primarily contributed by decaying NOM such as humic and fulvic acids. Disinfectants added to water react with NOM to form DBPs. Because TOC is a measure of NOM present in water, this TOC concentration is considered to be a direct indicator of the potential to form DBPs during drinking water disinfection. In addition to reducing the potential to form DBPs, enhancing existing treatment to reduce TOC levels can also result in added benefits that include reduced potential for bacterial regrowth in the distribution system, improved taste and odor, reduction in disinfectant demand, and reduced levels of unknown or unregulated DBPs.

TOC trends in raw and filtered water are shown in Figure 4.16. TOC concentrations peaked in spring potentially due to increase in runoff and snow melt. The average TOC concentration in raw water from 2013-2017 was 1.9 mg/L. The average from 2009-2012 was 1.7, reflecting an increase of 12 percent. The average TOC removal percentage between raw water and filtered water was approximately twenty percent, whereas the average TOC removal from 2009 – 2012 was close to twenty-five percent. All filtered water TOC samples were below 2.8 mg/L, whereas filtered water TOCs were below 2.1 mg/L during 2009-2012. Overall, comparing this study period with the prior sanitary survey period, the data suggests a slight degradation in water quality relative to organic constituents. This is potentially due to the impact of the flushing after drought and the Rim fire within the watershed.

In 2018, there was fear that Moccasin Dam would break due to leaks coming from the dam. In anticipation of a break, flow out of Don Pedro Reservoir into the Tuolumne River was increased to make room for the potential water coming from Moccasin Dam. This increase in flow contributed to a short but noticeable increase in organics coming into Modesto Reservoir. This data is outside the study period and thus not reflected in

Figure 4-15.

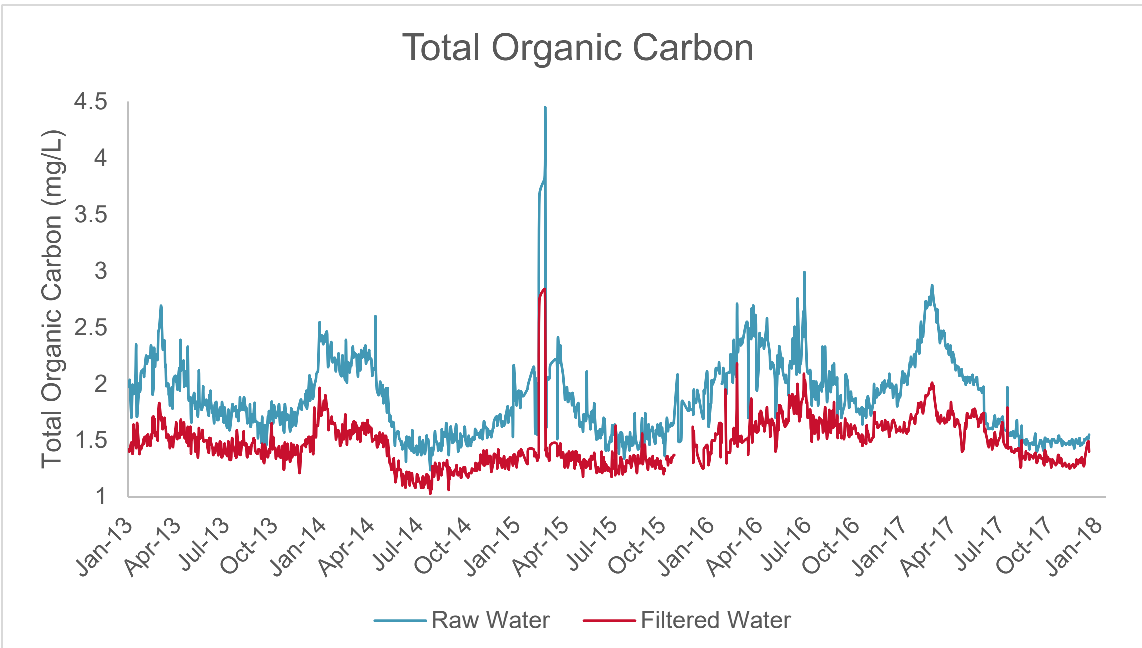


Figure 4-15. Raw and Filtered Water Total Organic Carbon

Plots of total trihalomethanes (TTHM) and HAA concentrations in the TRPS are shown in Figure 4-16. As expected, TTHM and HAA concentrations were below regulatory standards in the TRPS, before water enters the distribution system. City of Modesto has been required to monitor DBPs in the distribution system since 2012. From 2013 to 2017, MID's quarterly DBP samples averaged 47.7 ug/L for TTHM (60 percent of the LRAA MCL) and 32.6 ug/L for HAA5s (54 percent of the LRAA MCL)). During the previous watershed sanitary survey study period (2009 – 2012), the average TTHM was 42.4 ug/L and HAA5 was 32.1 ug/L. percent of the MCLs. While there was no apparent overall increase in HAA5s, the 12 percent increase in average TTHM concentration could be linked to the corresponding increase in source water TOC. MID is confident that they can continue to meet DBP requirements for the next several years. In the past Modesto has performed flushing as needed and are currently in the process of staffing a flushing crew. Regular flushing helps minimize water age, which controls the formation of DBPs.

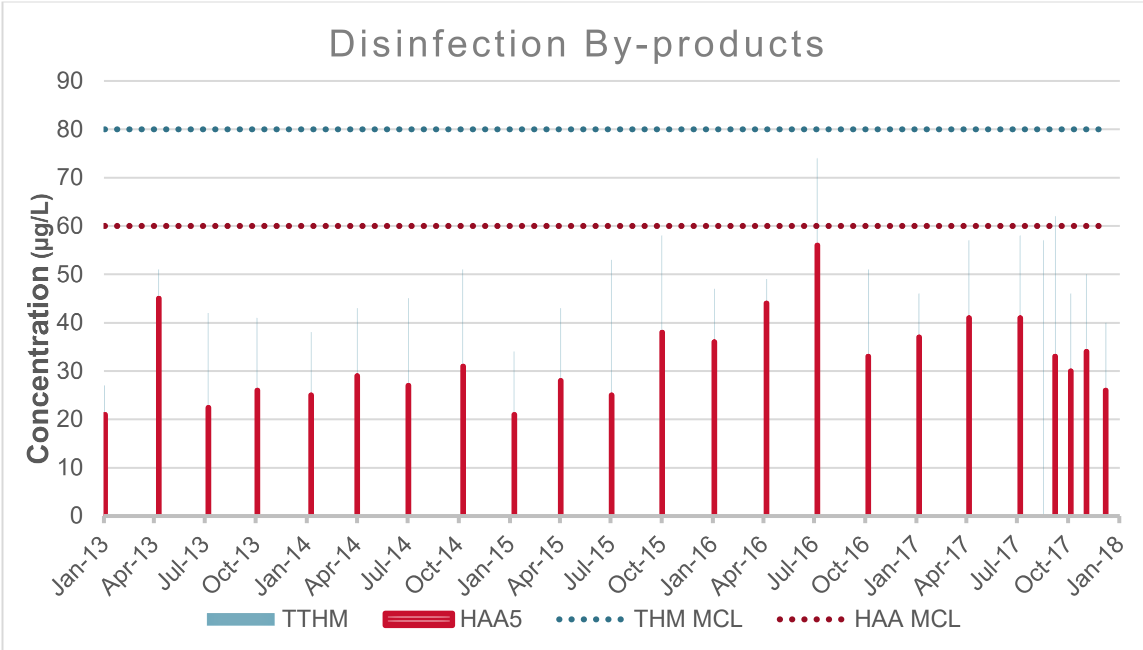


Figure 4-16. Disinfection By-Product Concentration (MRWTP Terminal Reservoir Pump Station)

Raw Water Metals and Other Constituents

The concentrations of metals and constituents with a primary/secondary drinking water MCLs are summarized in Table 4.12, alongside the MCL or most stringent applicable limit or objective. Source water concentrations exceeded the MCL/sMCL for finished water as follows:

- Aluminum: 1 of 7 samples exceeded MCL of 1 mg/L by 20%. (Mean value is 0.35 mg/L)
- Iron: 6 samples range from 0.08 to 0.29 mg/L, just shy of the sMCL of 0.3 m/L

Finished water concentrations did not exceed MCLs, indicating sufficient removals were achieved through treatment.

Table 4.12. MID Raw Water Constituents

Analyte	Units	MCL	RWQCB Basin Plan Objectives / Most Stringent Criteria	Results[1]						
				7/2/2013	6/11/2014	7/15/2014	3/17/2015	7/8/2015	6/30/2016	8/17/2017
Aluminum	mg/l	1 [2]	Not Applicable	0.21	0.32	0.29	1.2	0.24	0.16	0.055
Antimony	µg/L	6	6	ND	ND	ND	ND	ND	ND	ND
Arsenic	µg/L	10 [2]	10	ND	0.22	ND	ND	ND	ND	ND
Barium	µg/L	1000 [2]	Not Applicable	ND	13	ND	22	ND	ND	ND
Beryllium	µg/L	4 [2]	4	ND	ND	ND	ND	ND	ND	ND
Cadmium	µg/L	5 [2]	0.83	ND	ND	ND	ND	ND	ND	ND
Calcium	mg/L	NO STANDARD	Not Applicable	3.1	2.7	2.9	3.1	3.8	4.3	2.4
Chromium Total	µg/L	100	11	ND	0.33	ND	ND	ND	ND	ND
Cobalt	µg/L		Not Applicable		ND		ND			
Copper	µg/L	1300 [4]		7	6	8	10	8.3	6.8	5.2
Hardness as CaCO3	mg/L	NO STANDARD	Not Applicable		11		13			
Iron	mg/L	0.3 [3]	Not Applicable	0.2	0.29	0.24	ND	0.24	0.15	0.076
Lead	µg/L	15 [2]	0.543	ND	0.44	ND	1.3	ND	ND	ND
Magnesium	µg/L	NO STANDARD	Not Applicable	1.4	1.1	1.2	ND	1.5	1.7	0.83
Manganese	mg/L	0.05 [2]	Not Applicable	ND	0.0062	ND	ND	ND	ND	ND
Mercury	µg/L	2	0.053	ND	ND	ND	ND	ND	ND	ND
Molybdenum	µg/L		Not Applicable		ND		ND			
Nickel	µg/L	100 [2]	16.1	ND	0.53	ND	ND	ND	ND	ND

Table 4.12. MID Raw Water Constituents

Analyte	Units	MCL	RWQCB Basin Plan Objectives / Most Stringent Criteria	Results[1]						
				7/2/2013	6/11/2014	7/15/2014	3/17/2015	7/8/2015	6/30/2016	8/17/2017
Potassium	mg/L	NO STANDARD	Not Applicable	ND	ND	ND	ND	ND	ND	ND
Selenium Total	µg/L	50	5	ND	0.25	ND		ND	ND	ND
Silver	µg/L	100 [3]	0.37	ND	ND	ND	ND	ND	ND	ND
Sodium	mg/L	NO STANDARD	Not Applicable	1.7	1.5	1.5	1.8	1.7	2.1	1.3
Titanium	mg/L	NO STANDARD					ND			
Thallium	µg/L	2	1.7	ND	ND	ND	ND	ND	ND	ND
Vanadium	µg/L	50 [5]	Not Applicable		ND		ND			
Zinc	µg/L	5000 [3]	37	ND	2.2	ND	ND	ND	ND	ND

[1] All samples collected from raw water sample tap. [2] California MCL. [3]Secondary Standards. [4]Action level. [5] USEPA Notification Level.

*All other numbers are USEPA MCL values.

MTBE and BTEX

MTBE is a member of a group of chemicals commonly known as fuel oxygenates. Oxygenates are added to fuel to increase its oxygen content. MTBE was used in gasoline throughout the United States to reduce carbon monoxide and ozone levels caused by auto emissions. However, since 1999, MTBE has been phased out in California because of groundwater contamination. Releases of MTBE to ground and surface water can occur through leaking underground storage tanks and pipelines, spills, emissions from marine engines into lakes and reservoirs, and to some extent from air deposition. The US EPA has not set a national standard for MTBE. SWRCB has an MCL of 13 µg/L and secondary standard of 5 µg/L. SWRCB does not have a combined BTEX MCL, but regulates individual organic compounds that make up BTEX (Benzene – 1 µg/L; Toluene – 150 µg/L; Ethylbenzene – 300 µg/L and Xylene – 1750 µg/L), which total 2,201 µg/L.

MID sampled the raw water at the treatment plant inlet after the Memorial Day, Independence Day, and Labor Day holidays from 2014 – 2016. All nine samples were non-detect for MTBE, benzene, ethylbenzene, Toluene, and Xylenes. Finished water samples reflect non detect for MTBE and for the individual BTEX compounds, except one annual sample for ethylbenzene at 0.52 µg/L, far below the MCL of 300 µg/L. Since 2017, with permissions from SWRCB DDW, MID has stopped sampling for MTBE and BTEX in the raw and finished water following holiday weekends. The finished water is sampled once per year for MTBE and BTEX in accordance with Title 22 requirements.

Chemical Constituents

MCLs specified in Title 22 of the California Code of Regulations for certain chemical constituents must be met for finished water. It is expected that the new WTP will be designed to include treatment processes to address contaminants measured above their MCLs. Appendix KL shows Title 22 constituents at the Modesto Regional WTP from 2014 to 2018.

Microbiological Constituents

This section provides a summary and assessment of microbiological constituents in the Modesto Reservoir. Constituents analyzed include total coliform, *E. coli*, heterotrophic plate count (HPC), *Cryptosporidium* and *Giardia*. Typically, elevated concentrations of microbiological parameters are detected in the summer when water temperatures are the warmest and recreational use is the highest. Analysis of MID’s raw water shows the source water quality for microbials has remained stable over the past 525 years.

In 2017, MID performed a statistical analysis of the past 20 years of bacteriological monitoring and found several items:

- Extensive reservoir sampling on a weekly basis and also before and after holiday/heavy use weekends provided no useful data with regards to raw water quality entering the plant. MID requested to cease weekly reservoir sampling and to reduce holiday sampling from two days before and after the high use weekend to just one day after high use weekends. DDW obliged.
- Additional drinking water samples taken at various locations throughout the plant that are not required by permit or regulation were excessive and also not producing useful information. MID requested to cease daily sampling of filtered and finished water but still continues to sample raw, Terminal Reservoir, Wet Well and Combined Membrane Filtrate daily when the corresponding plant is running.

Table 4.13 reflects MID's bacteriological monitoring practice. MID, as a wholesaler, has only one physical service connection and as such conducts additional monitoring than what is required by regulations as a quality control check. MID examines at least three samples per 24-hour period for bacteriological quality when the conventional/membrane plant is operating alone and at least four samples per 24-hour period when the plants are running in conjunction. Samples are taken at plant influent Raw Water Vault, Wet Well, Combined Membrane Filtrate (when the membrane plant is operating), and Terminal Reservoir. MID performs bacteriological monitoring as per its bacteriological sample siting plan (BSSP) plan dated May 2017.

Table 4.13. MID Bacteriological Monitoring

Location	Frequency
Raw	Daily
Ozone Basin, conventional treatment	Weekly
Terminal Reservoir Pump Station 5010038-003	Daily
Conventional Dissolved Air Floatation	Weekly
Membrane Floc/Sed Basin	Weekly
Solids Thickener Return	Weekly, when in use
Wet Well (Plant Service Water)	Daily
Membrane Filtrate	Daily
Shady Point	See note below [1]
Boat Ramp	See note below[1]

Table 4.13. MID Bacteriological Monitoring

Location	Frequency
Lake View	See note below[1]
Inlet	See note below[1]
Narrows	See note below[1]

[1] In 2017, sampling frequency was reduced from two days before and after high use weekends in the summer to just one day after long holiday weekends in summer.

Total coliforms, E. coli, HPC

Bacteriological monitoring consists of daily total coliforms, *E. coli*, and weekly heterotrophic plate count (HPC) for the raw and treated water. Results of raw water samples 2013-2017 for monthly average total coliforms range from 2 to 2,420 MPN/100mL, and for monthly average *E. coli* range from 0.0 to 34.4 MPN/100mL. All total coliform and *E. coli* results were Non Detect for Filtered, Finished, Wet Well, Combined Membrane Filtrate and Terminal Reservoir water samples. MID submits all records to the DDW every month.

TOTAL COLIFORM

Figure 4-17 shows raw water total coliform trends from 2013 to 2017. Raw water bacteriological samples were collected daily at the WTP. The average raw water total coliform concentration was 140 MPN/100 mL. The Basin Plan does not include an objective for total coliform. This data shows that the bacteriological counts in the raw water are typically low. This data also shows that there does not appear to be a significant seasonal variation in bacterial counts based on the reservoir usage, although the bacterial counts are somewhat higher during the recreational season. The correlation noted in prior sanitary surveys between coliform and either temperature or precipitation appears to continue, although weaker, during the recent five-year period. Total coliforms in raw water peaked in summer months when precipitation was lower compared with other months of the year. Total coliform data confirms no change to requirements for *Giardia* and virus removals of 3 log reduction and 4 log reduction, respectively.

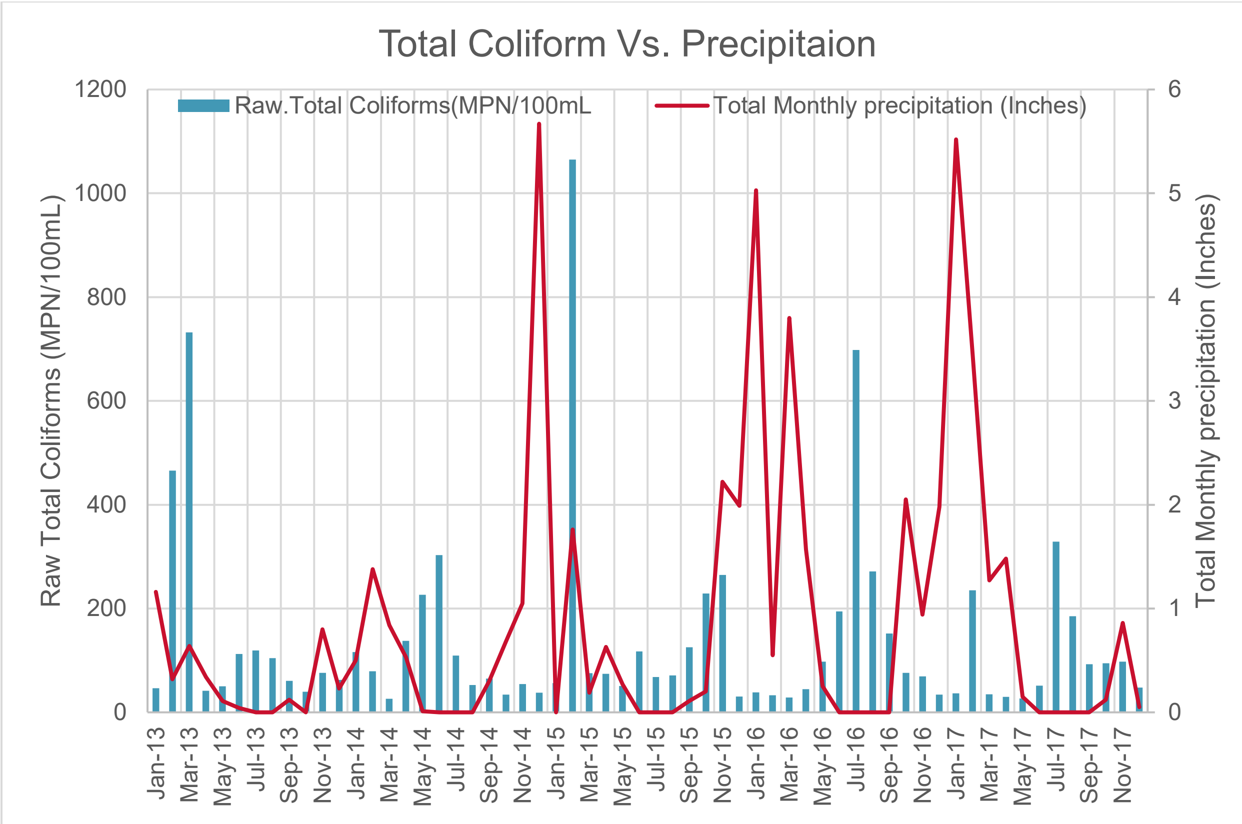


Figure 4-17. Total Coliform in Raw Water and Correlation with Precipitation

Figure 4-18 shows the raw water total coliform concentrations in Modesto Reservoir during summer weekends (including Memorial, Independence and Labor Day weekends). The Shady Point samples had the highest 75th percentile of 5,916 MPN total coliform/100mL and median total coliform concentrations of 3,041 MPN total coliform/100mL over the holiday periods, closely followed by the Lake View and Narrows samples. Recreational use variations around the reservoir could potentially impact water quality at different locations in the reservoir, although data are insufficient to make this correlation. The Shady Point sample location is close to a fully developed campground, whereas the Lake View sample point is close to day use campgrounds.

MID performed an evaluation of the past twenty years of reservoir data (raw water bacteriological quality) to determine if high bacteriological counts in this area affect the water quality entering the treatment plant. The result of this evaluation was that the supplemental sampling performed around holiday weekends generated little correlation or useful indication of the water quality at the treatment plant. As a result, MID's monitoring is reduced within Modesto Reservoir.

Similar to the 2014 sanitary survey, median total coliform concentrations in raw water at Shady Point were approximately twice as high during holiday weekends compared to the rest of the year. MID's review of the data over several years indicates that total coliform concentrations in the raw water at MRWTP are not significantly influenced by peaks at water quality sample locations within the Modesto Reservoir.

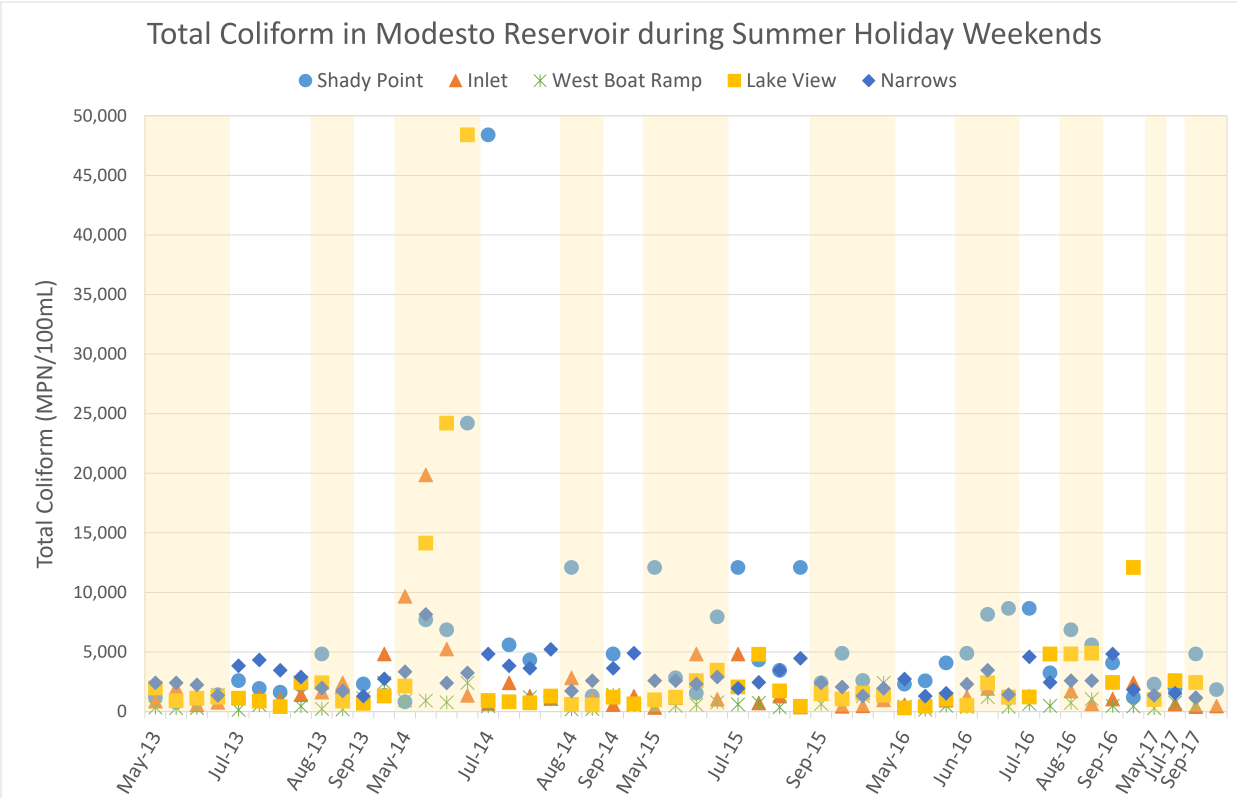


Figure 4-18. Comparison between Total Coliform in Modesto Reservoir during Summer Weekends

E. COLI

Figure 4-19 shows daily *E. coli* data in raw water from 2013 to 2017. The Basin Plan objective for contact recreation waters is 126 MPN *E. coli*/ 100 mL (geometric mean). Raw water *E. coli* data shows that Modesto Reservoir concentrations are far below the Basin Plan objectives. The highest measured *E. coli* concentration during the past five years was 36 MPN /100 mL. The 2014 sanitary survey noted a mild correlation between the raw water temperature and *E. coli* concentration. This correlation continues between 2013 and 2017.

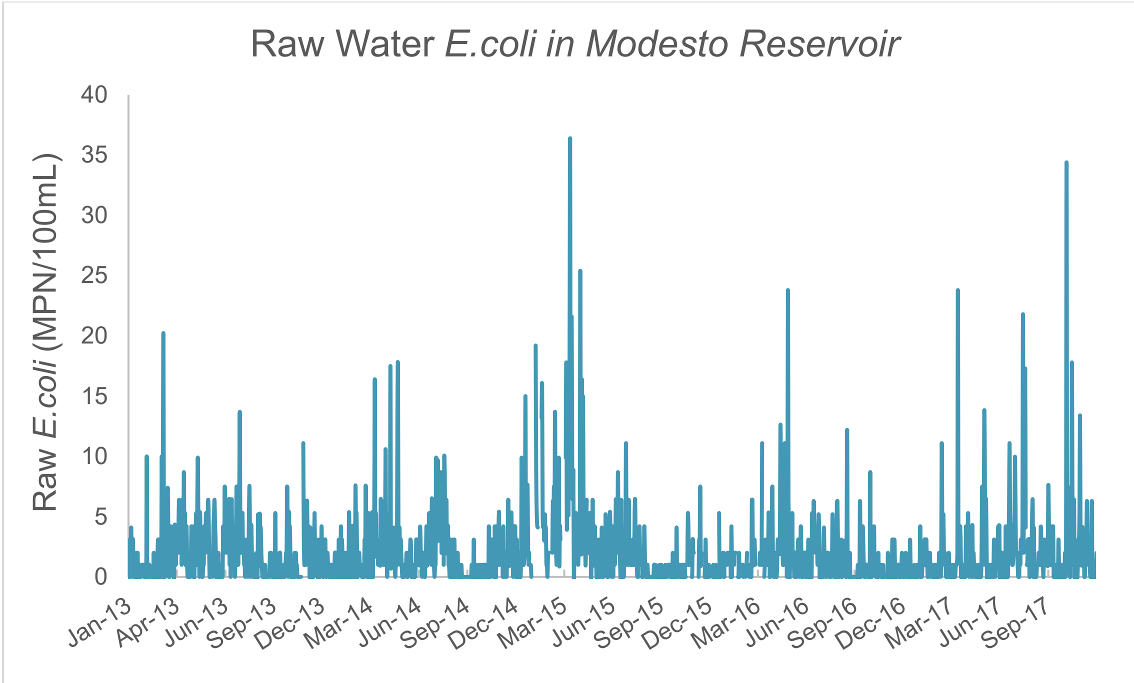


Figure 4-19. Raw Water *E. coli* in Modesto Reservoir Trends During the five year period.

The average yearly *E. coli* trends in raw water between 2013 and 2017 are consistent with the prior data since 2005, when MID began to measure *E. coli* in lieu of fecal coliform. The daily *E. coli* trend over the past five years holds steady in concentration; similar to the trend over the past twelve years. Annual averages over the past twelve years were below 3.1 MPN *E. coli*/ 100 mL.

HETEROTROPHIC PLATE COUNT

HPC bacteria obtain energy from organic carbon and are ubiquitous to most surface waters. HPC measures a range of bacteria that are naturally present in the environment. HPC trends for Modesto Reservoir WTP raw water are shown in Figure 4-20. The average raw water HPC concentration for this study period was 66 colony forming units (cfu)/mL, which represents a decrease from the 2009 – 2013 average of 80 cfu / mL.

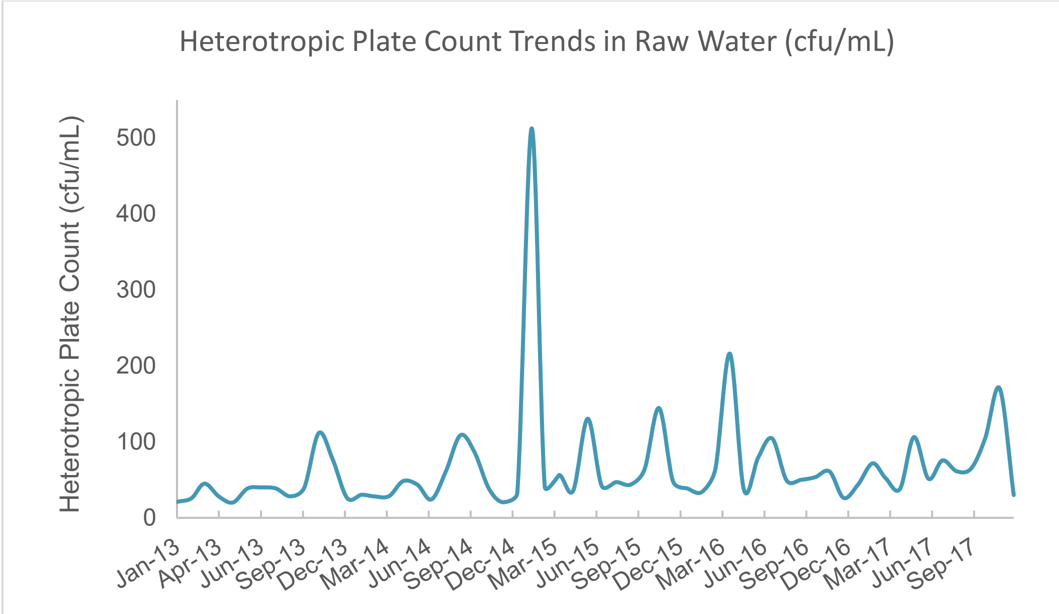


Figure 4-20. Average Monthly Heterotrophic Plate Count in Raw Water during the Five-Year Period

Cryptosporidium and Giardia

Table 4.14 shows *Cryptosporidium* and *Giardia* concentrations in raw water. Similar to observations made in previous sanitary surveys, the data show little or no evidence of *Cryptosporidium* or *Giardia* contamination.

Following the first round of LT2 monitoring, MID was classified as Bin 1, the highest quality classification, and continued to sample *Cryptosporidium* and *Giardia* on a monthly basis. After the second round of LT2 monitoring and a second classification of Bin 1, MID requested from DDW to cease such monthly monitoring. As a result, *Cryptosporidium* and *Giardia* sampling stopped in May 2017. Prior to 2017, *Cryptosporidium* and *Giardia* samples were collected and analyzed monthly from the raw water tap and from the inlet when water is flowing in the canal. Data from 2013 – 2017 indicates a maximum annual mean concentration of 0.008 oocysts per liter, far below the historic indicator for needing supplemental disinfection treatment.

Table 4.14. Modesto *Cryptosporidium* and *Giardia* Concentrations in Raw Water

Date	Sample Location			
	Raw (WTP)		Inlet (Modesto Reservoir)	
	Giardia Cysts (concentration/10 liter sample volume)	Cryptosporidium Oocysts (concentration/10 liter sample volume)	Giardia Cysts (concentration/10 liter sample volume)	Cryptosporidium Oocysts (concentration/10 liter sample volume)
1/14/2013	0	0	N/A	N/A
2/11/2013	0	0	N/A	N/A
3/18/2013	0	0	0	0
4/8/2013	0	0	0	0
5/6/2013	0	0	0	0
6/10/2013	0	0	0	0
7/9/2013	0	0	0	0
8/5/2013	0	0	0	0
9/9/2013	0	0	0	0
10/8/2013	0	0	0	0
11/4/2013	0	0	N/A	N/A
12/9/2013	0	0	N/A	N/A
1/13/2014	0	0	N/A	N/A
2/10/2014	0	0	N/A	N/A
3/11/2014	0	0	N/A	N/A
4/15/2014	0	0	N/A	N/A
5/12/2014	0	0	0	0
6/16/2014	0	0	0	0
7/14/2014	0	0	0	0
8/11/2014	0	0	0	0
9/8/2014	0	0	0	0
10/13/2014	0	0	N/A	N/A
11/10/2014	0	0	N/A	N/A
12/8/2014	0	0	N/A	N/A

Table 4.14. Modesto *Cryptosporidium* and *Giardia* Concentrations in Raw Water

Date	Sample Location			
	Raw (WTP)		Inlet (Modesto Reservoir)	
	Giardia Cysts (concentration/10 liter sample volume)	Cryptosporidium Oocysts (concentration/10 liter sample volume)	Giardia Cysts (concentration/10 liter sample volume)	Cryptosporidium Oocysts (concentration/10 liter sample volume)
1/13/2015	0	0	N/A	N/A
2/9/2015	0	0	N/A	N/A
3/9/2015	0	0	N/A	N/A
4/13/2015	0	0	0	0
5/11/2015	0	0	0	0
6/8/2015	0	0	0	0
7/13/2015	0	0	0	0
8/10/2015	0	0	0	0
9/13/2015	0	0	0	0
10/13/2015	0	0	N/A	N/A
11/12/2015	0	0	N/A	N/A
12/14/2015	0	0	N/A	N/A
1/12/2015	0	0	N/A	N/A
2/9/2015	0	0	N/A	N/A
3/9/2015	0	0	N/A	N/A
4/13/2015	0	0	0	0
5/11/2015	0	0	0	0
6/8/2015	0	0	0	0
7/13/2015	0	0	0	0
8/10/2015	0	0	0	0
9/14/2015	0	0	0	0
10/12/2015	0	0	N/A	N/A
11/9/2015	0	0	N/A	N/A
12/14/2015	0	0	N/A	N/A

Table 4.14. Modesto *Cryptosporidium* and *Giardia* Concentrations in Raw Water

Date	Sample Location			
	Raw (WTP)		Inlet (Modesto Reservoir)	
	Giardia Cysts (concentration/10 liter sample volume)	Cryptosporidium Oocysts (concentration/10 liter sample volume)	Giardia Cysts (concentration/10 liter sample volume)	Cryptosporidium Oocysts (concentration/10 liter sample volume)
1/12/2016	0	0	N/A	N/A
2/8/2016	0	0	N/A	N/A
3/7/2016	0	0	N/A	N/A
4/11/2016	0	0	N/A	N/A
5/9/2016	0	0	0	0
6/7/2016	0	0	0	0
7/11/2016	0	0	0	0
8/9/2016	0	0	0	0
9/13/2016	0	1	0	0
10/10/2016	0	0	N/A	N/A
11/7/2016	0	0	N/A	N/A
12/12/2016	0	0	N/A	N/A
1/9/2017	0	0	N/A	N/A
2/6/2017	0	0	N/A	N/A
3/6/2017	0	0	N/A	N/A
4/10/2017	0	0	0	0
5/8/2017	0	0	N/A	N/A

4.4.3 Lower Tuolumne River

The SRWA is in the process of developing a new surface water treatment plant (WTP) to supply the cities of Turlock and Ceres with treated water from the Tuolumne River as a supplement to their groundwater supply. The proposed intake for the WTP is an existing infiltration gallery, four to five feet below the river bottom, adjacent to the Tuolumne River near the town of Hughson.

SRWA began a source water monitoring program in the fall of 2016 to characterize the water quality at the proposed intake's location that took place in two phases:

Phase 1 (November 2016 to October 2017) and Phase 2 (October 2017 to October 2018). The purpose of Phase 1 testing was to analyze water quality characteristics at the proposed intake location, to create a list of monitoring parameters to assist in the design of the WTP, and to meet source water monitoring requirements for a new domestic water supply permit. Phase 2 focused on the seasonal changes in water quality and how they can affect the required treatment process. FishBio was hired to carry out sampling and field testing and Eurofins Eaton Lab (Eurofins) and their subcontracted laboratories provided courier and analytical services (Trussell Tech 2018). The testing plan for both phases are described in Table 4.15.

Table 4.15. SRWA Phase 1 & 2 Source Water Monitory Program Sampling Schedule

Category	Phase 1		Phase 2	
	Sampling Frequency	Estimated Total Number of Samples	Sampling Frequency	Estimated Total Number of Samples
General Water Characteristics (Physical and Chemical)	Quarterly	4	Semi-annual (Spring, Fall)	2
Select Field and Other General Parameters: (pH, Temperature, Dissolved Oxygen, Alkalinity, Bromide, Conductivity, Iron, Manganese, TOC, DOC)	Monthly	12	Monthly	12
Turbidity	Twice Per Month	48	Biweekly	24
Inorganic Chemicals with DDW MCLs	Quarterly	4	Semi-annual (Spring, Fall)	2
Organic Chemicals with DDW MCLs	Quarterly	4	Semi-annual (Spring, Fall)	2
Radionuclides with DDW MCLs	Quarterly	4	Semi-annual (Spring, Fall)	2
Microbial Parameters:				
Cryptosporidium, *Giardia*	Monthly	24	Monthly	12
Total Coliform, *E. coli*	Twice Per Month	48	Biweekly	24
Nitrogen Compounds (NH3, NO2, NO3)	Monthly	12	Semi-annual (Spring, Fall)	2
Select Unregulated Pesticides and SOCs	Quarterly	4	Semi-annual (Spring, Fall)	2

Table 4.15. SRWA Phase 1 & 2 Source Water Monitory Program Sampling Schedule

Category	Phase 1		Phase 2	
	Sampling Frequency	Estimated Total Number of Samples	Sampling Frequency	Estimated Total Number of Samples
Unregulated Constituents of Interest Related to Dairy, Poultry, and Ranch Operations	Quarterly	4	Semi-annual (Spring, Fall)	2
Unregulated Constituents Interest Related to Algae Occurrence				
Algae Identification, Algae Enumeration, Chlorophyll A	Quarterly	4	-	-
Microcystin Screens Cyanotoxins	2x/year	2	Summer, Fall	2

The proposed WTP will be subject to state and federal drinking laws, so water quality results were characterized for comparison with regulatory MCLs and regulated indicators of treatment techniques (Trussell Tech 2018). Table 4.16 summarizes the water quality sample data from Phase 1 and Phase 2 and compares them to the regulatory drinking water standards. Appendix J includes excerpts from the SRWA Source Water Quality Assessment TMs 1 and 2, which provide the complete monitoring results from Phase 1 and 2.

Table 4.16. Water Quality Summary 2016-2018 of Lower Tuolumne Watershed

Analyte	Reg List	MCL/ NL	Statistics	Period	
				Oct 2016 - Oct 2017[1]	Oct 2017 - Oct 2018[1]
General Water Characteristics (Physical and Chemical)					
Alkalinity, Total mg/L as CaCO3	-	-	Min	11	14
			Max	26	36
			Median	20	23
			Mean	18.5	24.6
			N	15	7
Ammonia mg/L as N	-	-	Min	<0.050	<0.050
			Max	0.059	0.0667
			Median	<0.050	<0.050
			Mean	0.051	0.064
			N	12	6

Table 4.16. Water Quality Summary 2016-2018 of Lower Tuolumne Watershed

Analyte	Reg List	MCL/ NL	Statistics	Period	
				Oct 2016 - Oct 2017[1]	Oct 2017 - Oct 2018[1]
Bromide mg/L	-	-	Min	<0.005	<0.005
			Max	0.0088	0.026
			Median	<0.005	0.010
			Mean	0.0061	0.0136
			N	12	5
Calcium mg/L	-	-	Min	2.7	3.9
			Max	5.9	6.9
			Median	4.6	5.4
			Mean	4.5	5.4
			N	4	2
Chloride mg/L	sMCL	250	Min	<0.1	<0.1
			Max	2.9	5.2
			Median	<0.1	3.1
			Mean	1.5	3.1
			N	4	2
Color units	sMCL	15	Min	5	15
			Max	20	50
			Median	7.5	32.5
			Mean	10	32.5
			N	4	2
Dissolved Oxygen mg/L	-	-	Min	9.2	7.2
			Max	11.7	11.4
			Median	10.2	10.0
			Mean	10.3	9.7
			N	24	24

Table 4.16. Water Quality Summary 2016-2018 of Lower Tuolumne Watershed

Analyte	Reg List	MCL/ NL	Statistics	Period	
				Oct 2016 - Oct 2017[1]	Oct 2017 - Oct 2018[1]
Total Iron mg/L	sMCL	0.3	Min	0.032	0.1
			Max	0.68	1.4
			Median	0.24	0.215
			Mean	0.33	0.4475
			N	15	8
Magnesium mg/L	-	-	Min	0.97	1.6
			Max	2.6	3.2
			Median	1.6	2.4
			Mean	1.7	2.4
			N	4	2
Total Manganese mg/L	sMCL/NL	0.05/0.5	Min	0.01	<0.002
			Max	0.21	0.043
			Median	0.015	0.031
			Mean	0.03	0.027
			N	15	8
Nitrate mg/L as N	pMCL	10	Min	<0.10	<0.10
			Max	0.53	1.1
			Median	0.13	0.67
			Mean	0.22	0.59
			N	12	6
Nitrite mg/L as N	pMCL	1	Min	<0.050	<0.050
			Max	<0.050	<0.050
			Median	<0.050	<0.050
			Mean	<0.050	<0.050
			N	12	4

Table 4.16. Water Quality Summary 2016-2018 of Lower Tuolumne Watershed

Analyte	Reg List	MCL/ NL	Statistics	Period	
				Oct 2016 - Oct 2017[1]	Oct 2017 - Oct 2018[1]
Odor TON	pMCL	3	Min	2	2
			Max	2	2
			Median	2	2
			Mean	2	2
			N	4	2
Organic carbon, Dissolved mg/L	-	-	Min	1.8	1.6
			Max	4.4	2.4
			Median	2.1	2.0
			Mean	2.4	2.0
			N	15	7
Organic carbon, Total mg/L	-	-	Min	1.8	1.6
			Max	7.3	2.5
			Median	2.3	1.9
			Mean	2.8	1.9
			N	14	11
pH (Field Measurement) pH units	-	-	Min	7.2	6.3
			Max	8.2	7.8
			Median	7.7	7.3
			Mean	7.6	7.3
			N	19	24
Specific Conductance (Field Measurement) µS/cm	sMCL	900	Min	20.8	27.8
			Max	68.2	125
			Median	44.8	61.1
			Mean	46.4	71.9
			N	24	24

Table 4.16. Water Quality Summary 2016-2018 of Lower Tuolumne Watershed

Analyte	Reg List	MCL/ NL	Statistics	Period	
				Oct 2016 - Oct 2017[1]	Oct 2017 - Oct 2018[1]
Sulfate mg/L	sMCL	250	Min	1.0	1.6
			Max	3.6	3.3
			Median	2.0	2.45
			Mean	2.1	2.45
			N	4	2
Temp.°C	-	-	Min	7.6	9.3
			Max	16.6	28
			Median	12.1	14.4
			Mean	12.7	17.2
			N	24	24
Total Solids, Dissolved (TDS) mg/L	sMCL	500	Min	25.0	36
			Max	54.0	65
			Median	37.5	50.5
			Mean	38.5	50.5
			N	4	2
Total Solids, Suspended (TSS) mg/L	-	-	Min	<10	<10
			Max	<10	<10
			Median	<10	<10
			Mean	<10	<10
			N	4	2
Turbidity (Field Measurement) NTU	sMCL	5	Min	0.59	1.5
			Max	15.4	25.6
			Median	2.9	2.8
			Mean	4.4	5.0
			N	24	24

Table 4.16. Water Quality Summary 2016-2018 of Lower Tuolumne Watershed

Analyte	Reg List	MCL/ NL	Statistics	Period	
				Oct 2016 - Oct 2017[1]	Oct 2017 - Oct 2018[1]
Inorganic Contaminants					
Aluminum mg/L	pMCL/sMCL	1/0.2	Min	0.046	0.068
			Max	0.53	1.1
			Median	0.11	0.584
			Mean	0.2	0.584
			N	4	2
Barium mg/L	pMCL	1	Min	0.0078	0.017
			Max	0.018	0.026
			Median	0.014	0.0215
			Mean	0.013	0.0215
			N	4	2
Microbiological Parameters					
Coliform, Total MPN/100 mL	-	-	Min	380	1100
			Max	>2420	16640
			Median	2400	>2420
			Mean	1953	3411
			N	24	24
Cryptosporidium oocysts/L	-	-	Min	0	0
			Max	0.1	0
			Median	0	0
			Mean	0.008	0
			N	12	12
E. coli MPN/100 mL	-	-	Min	6.3	4.1
			Max	460	630
			Median	40	23
			Mean	73.4	62.3
			N	24	24

Table 4.16. Water Quality Summary 2016-2018 of Lower Tuolumne Watershed

Analyte	Reg List	MCL/ NL	Statistics	Period	
				Oct 2016 - Oct 2017[1]	Oct 2017 - Oct 2018[1]
Giardia cysts/L	-	-	Min	0	0
			Max	0.4	0.182
			Median	0	<0.095
			Mean	0.075	<0.095
			N	12	12

[1](SRWA Source Water Characterization at Infiltration Gallery Location)

Color

During Phase 1 of testing, color values ranged from 5-20 apparent color units (ACU), and only one of four samples exceeded the sMCL of 15 ACU. During Phase 2, two samples were measured at values of 50 and 15 that equal and exceed sMCL of 15 ACU. The Basin Plan States that water shall be free of discoloration that causes a nuisance or adversely affects beneficial uses. Color is expected to be addressed by ozonation and coagulation (Trussell Tech, 2019).

Taste and Odor

The Basin Plan requires that waters shall not contain taste- or odor-producing substances in concentrations that impart undesirable tastes or odors to domestic or municipal water supplies. During both sampling phases, the odor threshold remained below the sMCL of 3 odor units, with all samples measured at 2 units.

Metals, Iron

During Phase 1 of testing, total iron concentrations ranged from 0.032 to 0.68 mg/L, with six of the 15 measured above the sMCL of 0.3 mg/L. Dissolved iron, however, remained below this sMCL, ranging from below detection limit (<0.020 mg/L) to 0.098 mg/L. During Phase 2, total iron only exceeded the sMCL in one of the seven samples, with concentrations ranging from 0.1 to 1.40 mg/L. Dissolved iron remained below the sMCL with a maximum concentration of 0.160 mg/L. It is expected that particulate iron would largely be removed by the future WTP through a combination of coagulation-settling-filtration and dissolved iron will be oxidized to the particulate form during ozonation (Trussell Tech, 2018 and 2019).

The median values for total iron remained below the sMCL during both periods. The maximum reported concentration during the May 2006 to October 2008 (6.5 mg/L) sampling was much higher than during 2016-2017 Phase 1 sampling (0.68 mg/L).

Manganese

In Phase 1, total manganese concentrations ranged from 0.010 to 0.21 mg/L, with only one of the 15 samples above the sMCL of 0.05 mg/L. Dissolved manganese concentrations ranged from below detection (<0.0020 mg/L) to 0.013 mg/L.

In Phase 2, total manganese concentrations were below the sMCL of 0.05 mg/L in all seven samples, but above the Water Research Foundation recommended finished water treatment goal of 0.015 mg/L to avoid aesthetic problems. Two of the seven Phase 2 samples had dissolved manganese concentrations just below this target finished water limit.

The median values for total manganese remained below the sMCL and NL for both periods, but were above the finished water quality target level of 0.015 mg/L. The maximum concentration during 2006-2008 (0.85 mg/L) was much higher than the 2016-2017 period (0.21 mg/L).

Nitrogen and Phosphorus

All of the nitrogen species that were monitored remained well below their respective pMCL for all monitoring periods included in this update. Despite phosphorus being included in the sampling plan, total phosphorous was not monitored during Phase 1 due to omission of the sampling bottles by the analytical laboratory (Eurofins). Total phosphorous was measured on a semiannual basis during Phase 2. Total phosphorus measurements were low, with 0.028 mg/L on 4/11/18 and below the reporting limit (<0.02 mg/L) on 10/10/18. These low phosphorus values do not present concerns regarding potential wastewater or fertilizer contamination, nor the potential for algae blooms. Regarding use as a potable water supply, the phosphorus and nitrogen constituent concentrations appear to be low enough that potential for algae is considered low.

Sediment and Settleable Solids

Median values for total suspended solids (TSS) remained low for both monitoring periods, with the highest maximum concentration of 62 mg/L occurring during the May 2006 to October 2008 sampling. All values for TSS measured during Phases 1 and 2 were below the detection limit, <10 mg/L. The Basin Plan stipulates that suspended sediment load and suspended sediment discharge to surface waters shall not alter surface waters in such a manner as to cause a nuisance or adversely affect its beneficial uses. Regarding use as a potable water supply, the TSS should be effectively removed through treatment.

Salinity

The source water consistently had values below their respective sMCLs of sulfate, chloride, and electrical conductivity for both monitoring periods. All concentrations for total dissolved solids (TDS) monitored in all testing periods were well also below the sMCL of 500 mg/L.

The WTP will include treatment to address contaminants measured in the raw water above their Title 22 regulatory MCLs.

Chemical Constituents

MCLs specified in Title 22 of the California Code of Regulations for certain chemical constituents must be met for finished water. It is expected that the new WTP will be designed to include treatment processes to address contaminants measured above their MCLs.

Inorganic Contaminants: During Phase 1 of testing, only three of the 20 parameters were above the detection limit in each quarterly sample. Of these three, aluminum was the only one measured above its sMCL of 0.2 mg/L. Only one of the four samples, the maximum concentration of 0.53 mg/L, was measured above the sMCL but still remained below the pMCL of 1 mg/L. For Phase 2, 13 of the 20 contaminants monitored were below the reporting limit in at least one of the semi-annual samples. Again, the only contaminant measured above its MCL was aluminum. Only one of the two samples was above both the sMCL and the pMCL. Aluminum is expected to easily be removed through treatment (Trussell Tech, 2018 and 2019).

Organic Contaminants: The only organic contaminant listed in Title 22 that was measured above the detection limit in Phase 1 was simazine. It was detected in two of the four samples, the highest measured at 0.00069 mg/L, which falls below the pMCL of 0.004 mg/L. In Phase 2, none of the listed contaminants were above the detection limit (Trussell Tech, 2018 and 2019).

Dissolved Oxygen

During Phase 1 of testing, all measured concentrations of dissolved oxygen were well above the Basin Plan objective of 7.0 mg/L, with a minimum value of 9.2 mg/L. For the Tuolumne River between La Grange and Waterford, the Basin Plan dissolved oxygen target is above 8.0 mg/L from October 15th to June 15th. In Phase 2, three samples dropped below 8.0 mg/L in the months of July and August 2018, with a minimum value of 7.2 mg/L, satisfying the water quality objective for that time period (Trussell Tech, 2018 and 2019).

Radionuclides

The California Code of Regulations Title 22 establishes finished water standards for radionuclides. The WTP design will include treatment to meet these regulatory limits.

Regulated radionuclides include radium-226, radium-228, gross alpha particle activity, uranium, beta/photon emitters, strontium-90, and tritium. This list includes radionuclides that are naturally occurring and human made. In Phase 1 of testing, none of the contaminants listed above were detected in any of the samples. However, in Phase 2, a concentration of 0.88 pCi/L of uranium was detected in one of the two samples, which was well below the pMCL of 20 pCi/L. All other radionuclides listed were below the detection limit for this testing period (Trussell Tech, 2018 and 2019).

Pesticides

The section of the Tuolumne River downstream from Don Pedro Reservoir to the San Joaquin River is included in the State of California's CWA § 303(d) list regarding the following agricultural pesticides: chlorpyrifos, diazinon, and the Group A Pesticides (aldrin, dieldrin, chlordane, endrin, heptachlor, heptachlor epoxide, hexachlorocyclohexane - including lindane, endosulfan, and toxaphene). The monitoring samples were tested for these pesticides as well as other synthetic organic chemicals reported in historical data. None were detected in Phases 1 or 2 of testing.

High-use pesticides, pesticides applied at a rate of 5,000 lbs/year or greater or applied to an area of 10,000 acres or greater, were also tested for in both phases. These pesticides include chloropicrin, chlorothalonil, methyl bromide, oxyfluorfen, paraquat dichloride, and pendimethalin. Oxyflouren was only analyzed once during the second phase of testing due to switching analytical methods when the CCL4 program ended (Trussell Tech 2018). None of the high use pesticides tested for were detected in any samples for both phases.

Pesticides identified on one of the future regulatory lists (Unregulated Contaminant Monitoring Rule, Candidate Contaminant List, California Notification Level, or archived Notification) or with an EPA health advisory level were also monitored (Trussell Tech 2018). In Phase 1 of testing, only one of the 12 pesticides monitored, diuron, was measured above its detection limit during quarterly sampling, in only two of the four samples. It had a maximum concentration of 0.000066 mg/L which is substantially below the lifetime health advisory level of 0.015 mg/L. During Phase 2, none of the pesticides were detected. Both hexazinone and tebuconazole were analyzed in only one of the two samples due to switching analytical methods when the CCL4 program ended (Trussell Tech, 2018 and 2019).

Waters designated for use as domestic or municipal supply, per the Basin Plan, shall not contain concentrations of pesticides in excess of the MCLs set forth in California Code of Regulations, Title 22, Division 4, Chapter 15.

Mercury

The section of the Tuolumne River included in the State of California's CWA Section 303(d) list regarding the non-point discharge of pollutants/stressors is the section below the outlet of Don Pedro Reservoir to the San Joaquin River. Mercury, a pollutant associated with historic resource extraction (mining) activities, is included on this list.

For both Phases 1 and 2 of testing, mercury was measured below its MCL of 0.002 mg/L for all samples, indicating that drinking water beneficial use for mercury is being met in Lower Tuolumne River study area.

Microbiological Constituents

Per the LT2ESWTR, water systems serving greater than 10,000 people are required to collect monthly samples of their source water for a period of two years, and analyze for *Cryptosporidium, E. coli*, and turbidity. The LT2ESWTR states that sample collection should be evenly spaced throughout the two-year monitoring period, and that samples should be collected within two days before or two days after the dates included in the sampling schedule.

The *Cryptosporidium, E. coli,* and turbidity data included in this submittal were generally collected on the second Monday or Wednesday of each month. The sampling schedule for the data included in this submittal is shown in Table 4.17. The sample scheduled for 8/15/18 (Table 4.17, #22) was collected, but not tested, due to delay by courier causing holding time exceedance. Re-sampling was completed on 8/29/18, but a similar issue was encountered. The subsequent sample (Table 4.17, #23) was collected as scheduled on 9/12/18, and the successful re-sample for #22 was collected on 9/26/18. The LT2ESWTR also requires matrix spike samples be prepared for *Cryptosporidium* analysis at a frequency of one matrix spike sample for every 20 field samples. In compliance with this requirement, an extra bulk of raw water was collected two times, spiked with *Cryptosporidium* oocysts, and analyzed to characterize method performance in the raw water matrix. These matrix spikes were analyzed with samples collected on 12/12/16 and 12/11/17.

Table 4.17. Sample Collection Schedule for *Cryptosporidium*, E. coli, and Turbidity

Sample No.	Collection Date	Day of the week	Sample No.	Collection Date	Day of the week
1	11/14/2016	Monday	13	11/13/2017	Monday
2	12/12/2016	Monday	14	12/11/2017	Monday
3	1/9/2017	Monday	15	1/8/2018	Monday
4	2/13/2017	Monday	16	2/12/2018	Monday
5	3/13/2017	Monday	17	3/12/2018	Monday
6	4/10/2017	Monday	18	4/11/2018	Wednesday
7	5/8/2017	Monday	19	5/16/2018	Wednesday
8	6/12/2017	Monday	20	6/13/2018	Wednesday

Table 4.17. Sample Collection Schedule for *Cryptosporidium*, E. coli, and Turbidity

Sample No.	Collection Date	Day of the week	Sample No.	Collection Date	Day of the week
9	7/10/2017	Monday	21	7/11/2018	Wednesday
10	8/14/2017	Monday	22*	8/15/2018 (9/26/18)	Wednesday
11	9/11/2017	Monday	23	9/12/2018	Wednesday
12	10/9/2017	Monday	24	10/10/2018	Wednesday

*The sample scheduled for 8/15/18 was collected but not tested due to exceeded holding time because of delay by courier. A similar issue was encountered with the resample on 8/29/18. The subsequent sample (#23) was collected as scheduled on 9/12/18, and the successful re-sample for #22 was collected on 9/26/18.

Cryptosporidium

Table 4.18 summarizes the *Cryptosporidium* concentrations measured in the samples collected between November 2016 and October 2018.

Table 4.18. Summary of *Cryptosporidium* Concentrations

Sample No.	Collection Date	Cryptosporidium Concentration (oocysts/L)	Sample No.	Collection Date	Cryptosporidium Concentration (oocysts/L)
1	11/14/2016	0.000	13	11/13/2017	0.000
2	12/12/2016	0.000	14	12/11/2017	0.000
3	1/9/2017	0.000	15	1/8/2018	0.000
4	2/13/2017	0.100	16	2/12/2018	0.000
5	3/13/2017	0.000	17	3/12/2018	0.000
6	4/10/2017	0.000	18	4/11/2018	0.000
7	5/8/2017	0.000	19	5/16/2018	0.000
8	6/12/2017	0.000	20	6/13/2018	0.000
9	7/10/2017	0.000	21	7/11/2018	0.000
10	8/14/2017	0.000	22*	8/15/2018 9/26/2018	- 0.000
11	9/11/2017	0.000	23	9/12/2018	0.000
12	10/9/2017	0.000	24	10/10/2018	0.000

*The sample scheduled for 8/15/18 was collected but not tested due to exceeded holding time because of delay by the courier. A similar issue was encountered with the re-sample on 8/29/18. The subsequent sample (#23) was collected as scheduled on 9/12/18, and the successful re-sample for #22 was collected on 9/26/18.

Bin classification for the SRWA WTP shows that WTP source water falls into the Bin 1. Therefore, additional *Cryptosporidium* treatment above the required 2-log removal is not required. With only a single detection of 1 *Cryptosporidium* oocyst, the highest 12-month mean *Cryptosporidium* concentration was 0.008 oocysts/L, which is well below the Bin 1 cutoff of 0.075 oocysts/L.

E. Coli and turbidity

The LT2ESWTR requires large PWSs to sample at least monthly for *E. coli* and turbidity, in addition to *Cryptosporidium*. Samples were collected for *E. coli* and turbidity at the same time and from the same location as the *Cryptosporidium* samples (Table 4.18). In addition, *E. coli* and turbidity were analyzed once more each month (bi-weekly frequency) to characterize the microbial quality of the Tuolumne River. All results of the *E. coli* and turbidity monitoring are summarized in Table 4.19, and those correlated with the *Cryptosporidium* monitoring data are indicated using bold font and the sample numbers from Table 4.18.

Table 4.19. Summary of E. coli and Turbidity Concentrations

Sample No.[1]	Collection Data	E. Coli Conc. (MPN/100ml)	Turbidity (NTU)	Sample No.	Collection Data	E. Coli Conc. (MPN/100ml)	Turbidity (NTU)
	10/31/2016	260	1.3		10/23/2017	60	1.4
1	**11/14/2016**	**17**	**0.72**	**13**	**11/13/2017**	**40**	**0.88**
	11/28/2016	26	0.65		11/27/2017	53	1.1
2	**12/12/2016**	**46**	**1.2**	**14**	**12/11/2017**	**20**	**0.94**
	12/27/2016	6.3	0.99		12/28/2017	33	0.85
3	**1/9/2017**	**460**	**5.5**	**15**	**1/8/2018**	**25**	**0.68**
	1/23/2017	41	12		1/22/2018	7.5	0.72
4	**2/13/2017**	**79**	**5.6**	**16**	**2/12/2018**	**26**	**0.5**
	2/27/2017	39	7.2		2/26/2018	6.3	0.53
5	**3/13/2017**	**17**	**8.8**	**17**	**3/12/2018**	**4.1**	**0.77**
	3/27/2017	25	5.4		3/26/2018	84	2.7
6	**4/10/2017**	**7.5**	**2.5**	**18**	**4/11/2018**	**23[2]**	**17**
	4/24/2017	24	1.9		4/25/2018	23[2]	12
7	**5/8/2017**	**96**	**1.3**	**19**	**5/16/2018**	**23[2]**	**2.7**
	5/22/2017	20	1.5		5/30/2018	23[2]	1.2
8	**6/12/2017**	**31**	**1.2**	**20**	**6/13/2018**	**23[2]**	**3.5**
	6/26/2017	120	1.3		6/28/2018	630	2.5
9	**7/10/2017**	**43**	**0.58**	**21**	**7/11/2018**	**200**	**3**
	7/24/2017	55	0.83		7/25/2018	1[3]	2.6
10	**8/14/2017**	**75**	**0.75**	**22[4]**	**8/15/2018**	**9.7**	**2.9**
	8/28/2017	120	0.64		8/29/2018	7.4	1.7
11	**9/11/2017**	**91**	**1.4**	**23**	**9/12/2018**	**8**	**1.5**
	9/25/2017	23	1.7		9/26/2018	5	1.8
12	**10/9/2017**	**39**	**0.72**	**24**	**10/10/2018**	**60**	**20**
					Overall Average	58.1	3.5

1 Samples that correlate with the *Cryptosporidium* monitoring data samples from Table 4.15 are indicated using bold font and the sample numbers from Table 4.18

2 Actual value is greater than the number reported (upper detection limit), as reported by the laboratory

3Value represents the reporting limit, as reported by the laboratory.

4 The *Cryptosporidium* sample scheduled for 8/15/18 was collected but not tested due to exceeded holding time because of delay by courier; however, the corresponding samples were analyzed for *E. coli* and turbidity. The successful *Cryptosporidium* resample for #22 was collected on 9/26/18.

Algae

SRWA sampled for algae indictors during both Phase 1 and Phase 2 of testing. Phase 1 included quarterly samples for algae identification and enumeration, and

Chlorophyll A. Phase 1 and 2 included annual sampling for ten cyanotoxins, including microcystins and cylindrospermopsin, and none were detected.

The ozone system planned for the treatment process is expected to address potential taste and odor concerns resulting from algae, as well as oxidation of the organic material resulting from algae.

4.5 Potential for Invasive Species

4.5.1 Invasive Species

To date, no invasive mussel species have been found in Don Pedro Reservoir, Modesto Reservoir, or in the upper Tuolumne River. However, the potential for these species to become introduced remains a concern. MID, DPRA, and TID continue to proactively coordinate with other agencies including CDFW, SFPUC, and Stanislaus County Parks and Recreation through the North Central Valley Consortium (Consortium). The Consortium developed a Prevention Program Plan (Plan), published January 2019, to prevent the introduction and spread of aquatic invasive species, specifically quagga and zebra mussels. The Prevention Program seeks to prevent introduction through assessment of vulnerability of a water body, public education, monitoring, and management of recreational activities.

Aquatic invasive mussels typically include four species: quagga mussels (*Dreissena rostriformis bugensis*), zebra mussels (*Dreissena polymorpha*), golden mussels (*Limnoperna fortunei*), and Conrad's false mussels (*Mytilopsis leucophaeta*). Of these species, quagga and zebra mussels have been a source of significant operational problems and maintenance expenditures for water operators in the eastern United States for decades. Zebra mussels arrived in North America from Europe in the 1980s followed shortly thereafter by their close relative, the quagga mussel. Quagga mussels were found in four western states in 2007, quickly expanding their geographic reach in the western United States. The zebra mussel was found in California for the first time in January 2008 at the San Justo Reservoir in San Benito County. These mussels could threaten California's water delivery system, irrigation network and freshwater ecosystems by clogging intake pipes and other conveyance structures. Figure 4-21 depicts the confirmed locations of quagga and zebra mussels in California. They have been found in over 40 California water bodies (CDFW, 2017).

The Consortium vulnerability assessment evaluated both establishment and introduction risks to both Don Pedro Reservoir and Modesto Reservoir. Risk of *establishment* reflects the vulnerability of a waterbody suitability to sustain a long-term mussel population and considers parameters of the water quality. Risk of *introduction* reflects the likelihood that a waterbody, even with favorable (high risk) conditions, would be introduced and considers recreational activities and current management. (Ex. areas closed to the public are low risk of introduction.) Both

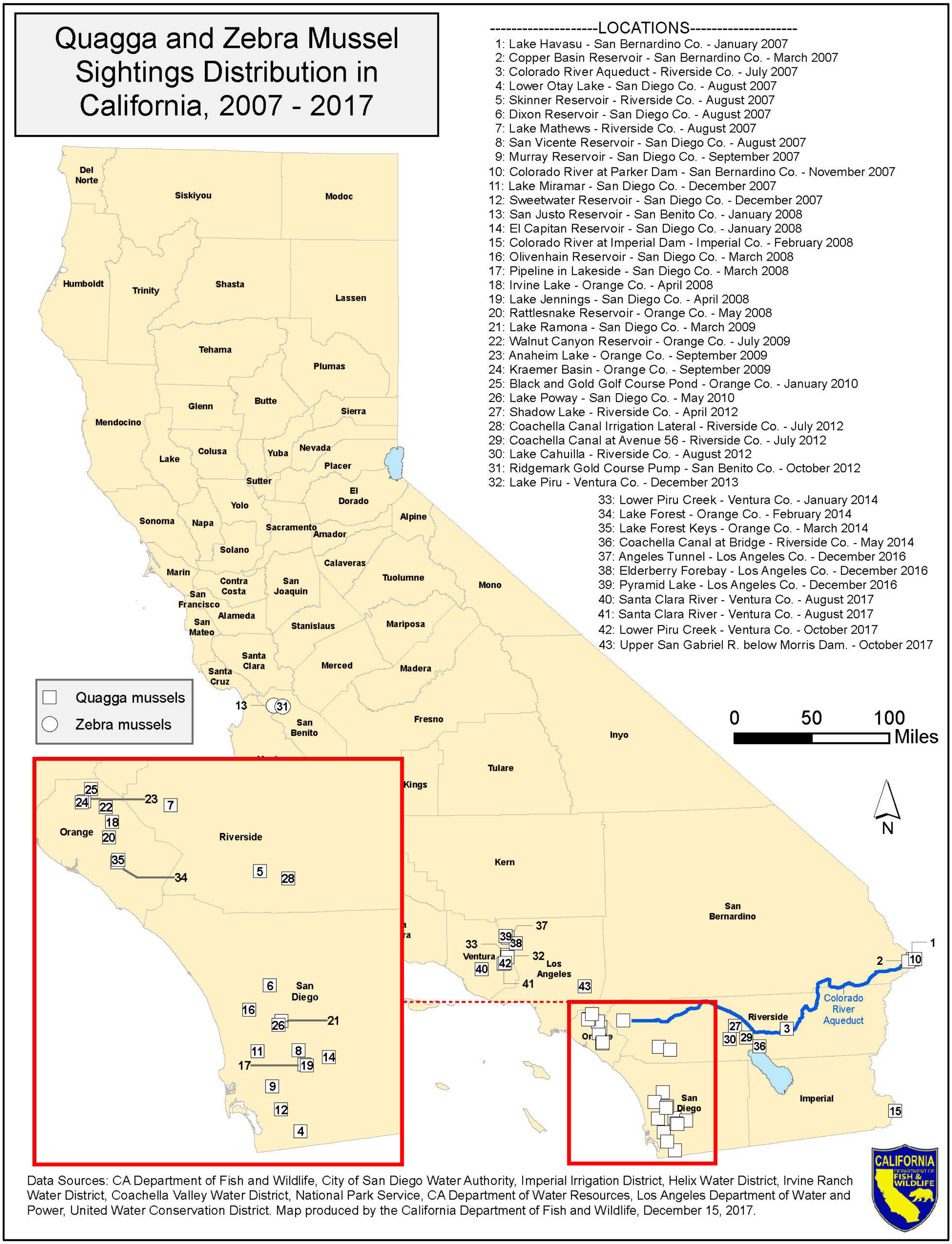


Figure 4-21. Confirmed Quagga and Zebra Mussel Sightings

Modesto and Don Pedro Reservoirs are documented as having a low overall establishment risk and high introduction risk, due to public access, and use of self-inspection. Other invasive species that occur in California include the New Zealand mud snail and Asian clam. Asian clams are present in Modesto Reservoir, and have been observed in the ozone contactor of the conventional half of the MRWTP and in the Raw Water Head Tank of the membrane half of the plant. According to the USGS fact sheet (https://nas.er.usgs.gov/queries/FactSheet.aspx?speciesID=92), Asian clams have the ability to impact treatment through their potential to clog pipes and disrupt water flow.

4.5.2 Water Quality and Treatment Concerns

As prodigious water filterers, the mussels remove substantial amounts of phytoplankton, zooplankton and suspended particulate from the water, which reduces the food sources for zooplankton and small fish, altering the lake ecosystem. With the filtering out of suspended particulates and phytoplankton, water clarity increases allowing sunlight to penetrate the water deeper triggering increased vegetation growth that can affect oxygen levels resulting in fish die offs. Quagga/zebra mussels accumulate organic pollutants within their tissues to levels more than 300,000 times greater than typical concentrations in the environment. The mussels' wastes significantly lower the oxygen levels, lowering the pH to an acidic level and generating toxic by-products. The mussels have also been associated with outbreaks of botulism poisoning in wild birds (CDFW, 2012).

Quagga/zebra mussels clog water intake structures, such as pipelines and screens, reducing pumping capabilities for power and water treatment facilities. Recreation-based industries and activities are also affected by the mussels which take up residence on docks, breakwalls, buoys, boats and beaches. For boaters, quagga/zebra mussels increase drag, clog engines causing overheating and can affect steering mechanisms.

4.5.3 Watershed Management

In 2013, MID joined the Consortium (http://www.stancounty.com/parks/pdf/zebra-quagga-mussel-prevention.pdf) for quagga and zebra mussel prevention. The Prevention Plan Program developed by the Consortium included a vulnerability assessment of the water bodies to determine the likelihood of mussels being introduced and establishing a population.

Because boating is common in both the Don Pedro and Modesto Reservoirs, the water bodies are vulnerable to the introduction of invasive species such as quagga and zebra mussels. Mussels are introduced to water bodies from the hulls of boats and through ballast water collected in mussel-invaded waters. The larval mussel life stage is free-floating and microscopic; consequently, they can freely enter ballast water as well as bilges, live wells, or other equipment that holds water. Although they range from microscopic to the size of a fingernail, the mussels are prolific breeders and attach themselves to hard and soft surfaces, such as boats and aquatic plants. They can survive out of water for up to a week.

DPRA administers a mussel prevention program at Don Pedro Reservoir which includes staff training on watercraft inspection, public education, boater screening interviews, and staff and self-performed inspections. MID continues to coordinate with Stanislaus County Parks and Recreation to maintain consistent invasive species monitoring and inspection practices for the Modesto Reservoir. MID encourages and supports the self-inspection program for maximum effectiveness; however, MID has no enforcement capabilities. Appendix G includes examples of literature developed by the Consortium that is used by member agencies to inform the public of the risks and consequences of colonization of source water by aquatic invasive species.

4.6 Implications of Source Water Quality on Treatment Capability

This section reviews the treatment capability of the existing MRWTP and the planned SRWA WTP in light of source water quality.

4.6.1 MRWTP

The MRWTP treats up to 81 MGD through parallel treatment trains of conventional and membrane filtration. Post ozonation in each treatment train is designed to meet Disinfection CT (disinfectant concentration [C] multiplied by contact time of disinfectant with water [T]) requirements are achieved through ozonation (pre-ozonation on the conventional train and post-ozonation on the membrane train) and chlorine contact within the clearwell. Ozone use minimizes DBP formation and while enhancing drinking water quality to customers. A dissolved air flotation unit provides backwash water treatment for the conventional plant while a standalone flocculation/sedimentation unit treats membrane backwash water. The lime chemical feed was upgraded for improved control of pH and alkalinity. MID has the capability of feeding sodium hypochlorite as a pre-treatment step if invasive species or algal blooms become a concern in the future.

Based on the water quality review performed in association with this watershed sanitary survey, the MRWTP treatment scheme(s) are expected to be sufficiently capable of treating its source water to meet regulations. Key results from the source water evaluation include:

- *Cryptosporidium* data confirm that the WTP remains in Bin 1, according to LT2ESWTR, which requires no additional treatment for *Cryptosporidiun* removal.

- Source water total coliform levels do not require supplemental disinfection within treatment.
- Increasing source water TOC levels and corresponding treated water DBP levels should be monitored. If needed in the future, MID may consider adjusting treatment practices to increase removals of DBP precursors (organic material).

4.6.2 SRWA RSWSP

Although the design is not finished, it is anticipated that the Regional SWSP treatment process would use conventional coagulation, flocculation, and sedimentation for turbidity and disinfection by-product (DBP) precursor removal; intermediate ozone for primary disinfection; biologically active filtration with GAC and sand as the media; free chlorine for final disinfection; and lime and carbon dioxide addition for finished water stabilization. SRWA should continue to monitor raw TOC and consider the implications for meeting DBPDBP requirements. Treatment plant design considerations and requirements include:

- Color removal: 50 units should be reduced to 15 units with coagulation and ozone.
- Iron removal: 1.4 mg/L should be reduced to 0.3 mg/L. It is expected that dissolved iron will be oxidized to the particulate form and subsequently removed through filtration.
- DOC: Maximum concentrations of 4.4 mg/L and average concentrations of 2.4 mg/L may need to be reduced to < 2.0 mg/L with coagulation, ozone, and biological filtration to meet target DBP goals.
- pH: Treatment capability to boost pH may be needed for treated water stability.
- Aluminum: Removals from1.1 mg/L down to 0.2 mg/L (sMCL), by optimized pH and coagulation, is recommended.
- Total Coliform: The mean value sampled was 3400 MPN/100 mL, with a maximum of up to 16,000 MPN/100 mL. The WTP design should consider the potential impact of coliform levels on pathogen reduction.
- Manganese: It is expected that particulate manganese would largely be removed by the future WTP through a combination of coagulation, settling, and filtration. Control of pH will be used to prevent colloidal manganese from forming.

5 Conclusions and Recommendations

This section presents a summary of significant contamination sources in each subwatershed, and related recommendations.

5.1 Don Pedro Reservoir

5.1.1 Recreational Activities

Recreational activities around Don Pedro Reservoir include fishing, boating, sailing, water skiing and camping, attracting an average of about 300,000 visitors per year. Annual visitor counts have returned to historical averages over the last few years, above average reservoir water levels. Recreational activities in Don Pedro Reservoir are managed by DPRA.

The swimming lagoon has been identified as a potential contamination source in the past, however DPRA continues to take proactive steps to protect public health, and consequently the risk of contamination is very low.

5.1.2 Wastewater

In Tuolumne County, the total volume of sanitary system overflows in the last five years (2014-2018) has decreased from 0.96 million gallons (MG) to 40,856 gallons over the previous five years (2009-2013), as documented in the 2014 Sanitary Survey. SSOs reaching waterways have also decreased from 911,575 gallons between 2009 and 2013 to 12,600 gallons between 2014 and 2018. However, the total number of SSOs over the four-year period has increased to 57 from 37.

Following an SSO, the California Emergency Management Agency (CalEMA), local health officer or director of environmental health, and the Regional Water Board are alerted. Over the last four years, neither DPRA nor MID were alerted of any SSOs that are currently listed on the CVRWQCB website.

5.1.3 Septic Systems

Most Tuolumne County residents use septic tank and leach field systems and it is estimated 2 MGD of effluent is discharged into the ground every day from over 17,000 septic systems. Tuolumne County Environmental Management is responsible for all onsite sewage disposal systems in the county. Sewer connections within city limits and some unincorporated areas of the county are served by a utilities district.

The presence of shallow soils and porous volcanic rocks in Tuolumne County may pose a potential threat to surface waters from septic tank systems. The Tuolumne County Groundwater Protection Report (1999) provided an inventory of 497 problematic septic systems within the primary study area. Although more recent estimates of these problematic systems are not available, the Tuolumne County Urban Management Plan recognizes the need to address failing septic systems.

The 2012 SWRCB OWTS policy established a statewide, risk-based, tiered approach for the regulation and management of OWTS installations and replacements and sets the level of performance and protection expected from OWTS. Although there is no indication that the risk of septic system contamination is greater than was previously reported in the 2009 Watershed Sanitary Survey, the new policy automatically triggered increased scrutiny of OWTS systems in the Don Pedro watershed. The Tuolumne County Board of Supervisors and Tuolumne Utilities District discussed the issue of failing septic systems during recent public meetings in anticipation of stricter state-wide regulations resulting from the OWTS policy, which will likely force the County to address failing septic systems. In addition, higher scrutiny will apply to septic systems located in the vicinity of Quartz Reservoir, Woods Creek at Pulpit Rock Road, and Sullivan Creek, which have been deemed impaired by the RWQCB.

While septic systems provide a potential source of nitrate contamination from septic system leach fields in Tuolumne County, MID has never detected nitrate at or above the detection limit for reporting (DLR) in treated drinking water.

5.1.4 Mine Runoff

Over 100 mines are identified within the watershed with potential impacts on surface waters via wet weather runoff. Don Pedro Reservoir is listed on the 303(d) list and TMDL Priority Schedule for mercury contamination associated with historic resource extraction (mining) activities although there are no currently active mercury sites. Mercury was detected at all locations at concentrations far less than both the MCL of 0.002 mg/L and the CTR benchmark of 50 ng/L. In addition to mercury, other heavy metals could potentially be discharged in storm water runoff from some of these old mine sites and lead to water quality degradation.

The raw water data from the summer 2012 sampling effort in the Don Pedro Reservoir area indicated that one of eight iron samples had a concentration higher (314 ug/L) than the current secondary MCL for treated water (300 ug/L). The sample average was 18 ug/L. A sample taken on January 2018 showed an iron level of 100 ug/L. The MRWTP treatment processes include pre-oxidation followed by coagulation and conventional filtration or membrane filtration both of which can function as a mechanism for the removal of iron. The proposed SRWA treatment plant will have intermediate ozone that will oxidize the iron and allow it to be removed in the filters.

The concentration of dissolved copper exceeded the surface water quality criterion from the California Toxics Rule in two of the eight samples. Both samples (6.25 ug/L and 8.16 ug/L) were near the bottom of the reservoir. Copper in drinking water is regulated as an MCL for total copper, however, all raw water sample concentrations were far below the current MCL action level of 1300 ug/L.

All available data for other metal concentrations were below the MCLs or other more stringent surface water quality criteria. The California Office of Mine Reclamation develops a list of mines regulated under the Surface Mining and Reclamation Act and a list of Principal Areas of Mine Pollution. The CVRWQCB maintains a list of active mines in the Sacramento and San Joaquin River Basins that pose a risk to water quality. In addition, the CVRWQCB has proposed a new draft policy for mercury discharge offsets for discharges to the San Francisco Bay and Sacramento-San Joaquin River Delta and tributaries, but no action on the policy has occurred since 2007.

5.1.5 Unauthorized Activities

Unauthorized activities continue to be present in the watershed, including illegal dumping, off-road vehicle use or illegal camping, marijuana cultivation, and illegal drug manufacture and disposal. Potential contamination from unauthorized activities is difficult to quantify and is dependent on the nature of the activity and the type of waste (if any) discarded. Although unauthorized activities have neither increased nor decreased since the last sanitary survey, these activities remain a potential threat to water quality.

Tuolumne County monitors and cleans up dump sites, often in concert with BLM as most sites are located on federal land. DPRA also maintains a program of inspection and clean-up of illegal dump sites around the reservoir. Both Tuolumne County and BLM have the authority to levy fines, although perpetrators are difficult to identify and, even if caught, are typically given warnings and an opportunity to cleanup.

5.1.6 Invasive Species

To date, no invasive mussel species have yet been found in Don Pedro Reservoir or in the upper Tuolumne River. However, the potential for these species to become introduced remains a concern.

DPRA administers a mussel prevention program at Don Pedro Lake. All DPRA permanent campground and lake operations staff have completed watercraft inspection training. Public education strategies are in place through posters, website information, and handouts. DPRA conducts screening interviews with boaters prior to launch and periodic random and suspect vessel inspections. Because DPRA operates with self-service pay stations much of the year, it initiated and oversees a mussel self-inspection program, which requires permits to be displayed for all vessel launches. However, the self-inspection program is run on the honor system and there is no penalty for failing to comply with the program. DPRA also conducts a monthly Artificial Substrate Mussel Monitoring Program.

5.2 Modesto Reservoir

The overall water quality in Modesto Reservoir is good. MID has been diligent in maintaining water quality records from their sampling efforts. Significant sources of contamination for Modesto Reservoir include recreational activities and the resident geese population. Water quality issues discussed below include algae, invasive species, and *Cryptosporidium* and *Giardia*.

5.2.1 Recreational Activities

The Stanislaus County Parks and Recreation Department manages the Modesto Reservoir Regional Park, which comprises approximately half of the Modesto Reservoir subwatershed. Both swimming and boating are allowed in Modesto Reservoir; the annual visitor count averaged 98,000 persons between 2014 and 2018 with up to 153,000 visitors recorded in a single year. In 1998 MID prepared a Modesto Reservoir Management Plan that is still in effect, which restricts and guides use of the reservoir to reduce the possibility of contamination from recreational activities. Maintenance improvements and repairs have been made in a variety of areas at the reservoir over the last several years. In 2014/2015 Modesto reservoir (Parks Department) added 8 permanent vaulted restrooms. The number of campgrounds stayed the same.

Recreational activities seem to have had little impact on water quality based on the water quality monitoring and data collected over the last four years. The activities that can impact water quality include swimming, camping, and boating. The Shady Point monitoring site had the highest concentrations of total coliform and *E. coli*, which could be attributed in part to the proximity to campground facilities, although other factors, such as a localized geese population and shallow water depth, could also be responsible for lower water quality. MID and SWRCB DDW collectively agree that Shady Point is a good monitoring site representing the worst case scenario with respect to *E. coli* contamination because it has a shallow shelf near the campground where the water is warmed by the sun, providing a good incubator for bacteria. The water depth at the sampling location is often less than 1 foot. Boating accidents have the potential to introduce contaminants to the watershed, but there have been very few accidents in the last four years.

As with other microbiological data, HPC levels peaked when water temperature was the highest. The average raw water HPC concentration for this study period was 80 cfu/mL, a 48 percent increase over the 2004 – 2008 average.

Stanislaus County monitors the water quality at bathing beaches and has the authority to close a beach if they deem it necessary.

5.2.2 Wildlife

The resident population of Canadian Geese at Modesto Reservoir directly impacts water quality. A flock of resident geese nest near the Shady Point monitoring site, which is also a popular camping area and is the campground closest to the outlet works. The ground near the Shady Point site is littered with goose droppings. Fluctuating reservoir levels cause recent droppings to be submerged. Recreational activities stir up fecal matter and release solids into the water above this shallow outcropping.

Canadian Geese numbers have grown so much in recent years that the CDFW issued the Stanislaus County Parks & Recreation Department a depravation permit that allows them to destroy 80 nest and 560 eggs each year. In 2015, 658 adult geese were counted at west and north shores and in 2018, 619 adult geese were counted on those same shorelines. The program has helped control the geese population. They survey the geese twice a year usually February and March and they oil eggs March - June. Usually 2/3 staff members survey and oil eggs for this program.

In addition to addling, a goose hunt is held at the Reservoir every October to further reduce the goose population.

5.2.3 Grazing

Successful cattle grazing BMPs implemented by MID and the County have continued to minimize *Cryptosporidium* and *Giardia* contamination.

Most of the land around the Upper Main Canal drains into the Tuolumne River downstream of the Modesto Reservoir Watershed. Only a small portion of area around the Upper Main Canal drains into the Modesto Reservoir sub-watershed and this land is used primarily for rangeland. The most recent grazing lease has eliminated problematic areas from grazing, restricts cattle access to the reservoir, and prohibits the presence of calves younger than four months during the wet season.

5.2.4 *Cryptosporidium* and *Giardia*

Following the first round of LT2 monitoring, MID was classified as Bin 1, the highest quality classification, and continued to sample *Cryptosporidium* and *Giardia* on a monthly basis. After the second round of LT2 monitoring and a second classification of Bin 1, MID requested from DDW to cease such monthly monitoring. As a result, *Cryptosporidium* and *Giardia* sampling stopped in May 2017. Prior to 2017, *Cryptosporidium* and *Giardia* samples were collected and analyzed monthly from the raw water tap and from the inlet when water is flowing in the canal. Data from 2013 – 2017 indicates a maximum annual mean concentration of 0.008 oocysts per liter, far below the historic indicator for needing supplemental disinfection treatment.

Watershed protection and the use of ozone as a primary disinfectant, in conjunction with free available chlorine to maintain a disinfectant residual provide multiple barriers of defense against pathogenic protozoa in drinking water.

5.2.5 Algae

There has been no evidence of an algal bloom recurring as witnessed in the early 2000s. MID will continue to monitor algae (not only Uroglena) bi-weekly or more frequently as needed if any blooms are detected in the reservoir or if any water treatment challenges arise as a potential result of raw water algae.

5.2.6 Invasive Species

There has been no detection of invasive mussel species in the Modesto Reservoir over the past four years. However, there have been Asian clam shells observed in the MRWTP ozone contactor and membrane Raw Water Head Tank. The Asian clam is a very small and round bi-valve clam. It is typically less than 1.5 inches in size, and can spread rapidly. A single clam can reproduce alone, and can release hundreds of juveniles per day. Asian clams cause a number of major problems for waterways in which they become established, including the excretion of significant amounts of inorganic nutrients, particularly nitrogen that can stimulate the growth of algae and foul the water.

During 2012 and 2013 MID took steps to enhance its Quagga/Zebra mussel monitoring program by making it more closely align with the CDFW monitoring protocols. The monitoring program includes regular inspection of several permanent substrates around the reservoir, as well as two artificial substrates, one located within the reservoir and the other located within the treatment plant. During the quagga breeding season, MID performs regular veliger tow sampling, followed by microscopic analyses. The District has coordinated with Stanislaus County Parks & Recreation to assist them in their screening of boats entering the park, as well as providing posters that are placed around the reservoir on an annual basis. The turnout at the entrance and at the west boat ramp for mussel inspections were installed March 2018 and the sign was also installed April 2018

The District attends regular meetings with the CDFW and other agencies that provide oversight of upstream water bodies. The purpose of these meetings is to establish enforceable regulations that provide uniform monitoring for aquatic invasive species and consistent screening of watercraft entering reservoirs and other waterways, and to develop effective literature to inform the public of the risks and consequences of colonization of MID source water by aquatic invasive species.

5.3 2018 Update of Previous Watershed Sanitary Survey Recommendations

Table 5.1. 2018 Update of Previous Watershed Sanitary Survey Recommendations

Responsible Agency	Previous Recommendations	Completed/Action Taken
RECREATION		
MID/ Stanislaus County	MID should work with Stanislaus County to mitigate the goose problem at Modesto Reservoir, including continued monitoring of the goose population to determine if current control efforts are effective and representative of need.	Addling of eggs and seasonal goose hunting are continuing successfully.
MID/ DRPA/USFS	MID should continue to work with the DPRA to maintain consistent invasive species monitoring and inspection practices for both the Don Pedro and Modesto Reservoirs. In addition, MID should encourage regular re-evaluation for maximum effectiveness of the self-inspection program and possible associated penalties for failure to comply. To minimize risk of introducing mussels through raft boats on the Tuolumne River just upstream of Don Pedro Reservoir, MID and DPRA should continue to work with the USFS to help them initiate a Mussel Prevention Program similar to the DPRA program.	At Modesto Reservoir, the turnout at the entrance and at the west boat ramp for mussel inspections were installed March 2018 and the sign was also installed April 2018
WASTEWATER AND SEPTIC SYSTEMS		
MID/ DPRA/Tuolumne County	MID, together with DPRA, should consider working with Tuolumne County to maintain and update information on the location and number of problematic septic tank systems in the watershed. MID/ DRPA would use this information to quantify the potential impacts of problematic septic system on surface water quality. Although the long detention time in Don Pedro Reservoir would likely allow for die-off of pathogens before they can make it to the MRWTP, DPRA/ MID should continue to support Tuolumne County's efforts to enforce current septic system regulations and any new requirements arising from the recent adoption of the OWTS Policy. Support measures could include working with and/or providing input on the local agency management plan currently being developed by Tuolumne County. MID and DPRA could also generate annual letters of support to Tuolumne County encouraging continued enforcement of septic system regulations.	MID supports enforcement actions by the County.

Table 5.1. 2018 Update of Previous Watershed Sanitary Survey Recommendations

Responsible Agency	Previous Recommendations	Completed/Action Taken
MID	MID should work with DRPA to establish notification procedures from the CVRWQCB of any wastewater SSOs that occur in the watershed. In the past four years, MID did not receive notification for SSO spills, although it was estimated that over 0.9 MG were discharged to waterways.	SSO spills have been documented and are much less than the previous 5 years (12,500 gal) discharged to waterways.
WATER QUALITY SAMPLING AND STUDIES		
MID	MID currently monitors the source water in the Modesto Reservoir according to the MRWTP permit requirements. In addition, sampling at the Don Pedro Reservoir was performed in August 2012. MID should maintain communication with DPRA regarding any future water quality testing performed at the Don Pedro Reservoir. Available future water quality data should be compared to the 2012 sampling as a basis for water quality assessment in Don Pedro Reservoir. In addition, MID should request from DPRA to receive seasonal data or bacterial count reports for the Don Pedro Reservoir swimming lagoon.	No additional water quality data from Don Pedro Reservoir has been received. The swimming lagoon is being managed well by DPRA and seasonal data is no longer needed.
MID/ TID/USGS	In order to track potential raw water quality changes resulting from the Rim Fire in the Don Pedro watershed, MID contracted HDR to perform an evaluation and develop a water quality monitoring plan for upstream and downstream of the Don Pedro Reservoir (Appendix G). MID should implement the monitoring plan and work cooperatively with the USGS and TID on any supplemental watershed monitoring they perform.	This is no longer needed.
MID	Algae monitoring at Modesto Reservoir has been curtailed due lack of available staff during construction of the Phase II treatment plant. When possible, MID should continue to monitor algae weekly. At a minimum, MID should resume algae monitoring if algal blooms are detected in the Modesto or Don Pedro Reservoirs or if any water treatment challenges arise as a potential result of raw water algae.	MID is performing bi-weekly monitoring for algae and cyanotoxins as needed. MID no longer monitors for just Uroglena and they have not seen a bloom since 2004 & 2005.

Table 5.1. 2018 Update of Previous Watershed Sanitary Survey Recommendations

Responsible Agency	Previous Recommendations	Completed/Action Taken
OTHER		
MID/ Tuolumne County Environmental Health Department	MID should consider working with communities upstream of Don Pedro Reservoir on public education efforts toward the reduction of nonpoint source mercury runoff. Public information could be shared regarding the safe disposal or recycle of mercury-containing products, such as electronic equipment with monitors (including televisions), fluorescent lighting, thermometers, thermostats, old-paint (pre-1991), and batteries (pre-1995). NPDES discharges fall under the authority of the RWQCB and MID has very limited ability to alter their policies.	No action is needed by MID.
MID/ Tuolumne County	While MID has no authority over the monitoring and enforcement strategies for illegal activities outside of District property, MID should continue to support Tuolumne County's efforts to prevent illegal activities in the watershed, including illegal dumping and the manufacturing or disposal of illegal drugs. MID should consider working with Tuolumne County to institute free dump days (similar to the program in Calaveras County).	Tuolumne County ordinances are in place and the county monitors and abates illegal dumping. Dumping notifications are provided so that no action is needed by MID

5.4 Current Recommendations

A prioritized list of recommendations regarding watershed management measures that MID and SRWA could implement to help control potential contaminant sources, and to identify water quality constituents of concern, are described below organized by agency

MID Recommendations:

1. MID should continue to work with DRPA to establish notification procedures from the CVRWQCB of any wastewater SSOs that occur in the watershed. In the past four years, MID did not receive notification for SSO spills, which totaled 12,500 gallons discharged to waterways, much less than the last 4 years.
2. MID currently monitors the source water in the Modesto Reservoir according to the MRWTP permit requirements. In addition, sampling at the Don Pedro Reservoir should be performed at least once every 5 years. The latest data available is from sampling performed in August 2012 and limited analysis of samples taken by DPRA (2015-2018). MID should maintain communication with DPRA regarding any future water quality testing performed at the Don Pedro Reservoir. Available future water quality data should be compared to the 2012,

and 2015-2018 sampling as a basis for water quality assessment in Don Pedro Reservoir.

3. MID should continue to work with the DPRA and Stanislaus County Parks and Recreation to maintain consistent invasive species monitoring and inspection practices for both the Don Pedro and Modesto Reservoirs. In addition, MID should encourage regular re-evaluation for maximum effectiveness of the self-inspection program and possible associated penalties for failure to comply. To minimize risk of introducing mussels through raft boats on the Tuolumne River just upstream of Don Pedro Reservoir, MID and DPRA should continue to work with the USFS to help them initiate a Mussel Prevention Program similar to the DPRA program.
4. MID is currently performing bi-weekly algae monitoring at Modesto Reservoir and this should continue. Cyanotoxins monitoring should be performed if algae blooms are suspected.
5. MID should continue all sampling required by DDW and be prepared to add analysis for future constituents of concern and UCMR5 constituents as it relates to MID.
6. MID should begin monitoring for microplastics as soon as DDW issues requirements and approved methods are available.
7. Ten percent higher TOC levels observed in Modesto Reservoir in the last 5 years, could lead to higher DBP levels in the distribution system for the City of Modesto. For now, MRWTP has been able to meet all water quality goals with the slightly higher TOC. MID should continue to monitor TOC and be prepared to develop strategies to remove additional TOC, if needed.
8. MID should confirm that new cropland or converted lands do not have the potential to drain contaminants directly into the water ways.

SRWA Recommendations:

1. SRWA should continue the Phase 2 Extended Monitoring Sampling Program (semi-annual sampling) shown in Appendix L. In addition, the Tuolumne River supply should continue to be sampled for PFAS (as initiated March 2019) as well as add sampling for UCMR5 constituents.
2. SRWA should begin monitoring for microplastics as soon as DDW issues requirements and approved methods are available.
3. SRWA should start algae monitoring, if algal blooms are detected in: Don Pedro Reservoir, the Tuolumne River, or if any water treatment challenges arise as a potential result of raw water algae. Cyanotoxins monitoring should be performed if algae blooms are suspected of occurring.

4. The mean total coliform value from samples collected during Phase 2 sampling in the Lower Tuolumne River was 3,400 MPN/100 mL, with a maximum of up to 16,000 MPN/100 mL. The SRWA should continue to monitor coliform levels and evaluate any potential impacts on the design of SRWA's WTP. The proposed SRWA treatment plant that includes coagulation, flocculation, sedimentation, ozone, and biological filters is a robust treatment train that is expected to meet and exceed treated water quality standards.
5. SRWA should coordinate with MID in future watershed water quality sampling efforts following forest fires in shared watershed areas.
6. SRWA should, upon commissioning of the new SRWA WTP, engage with local authorities who have regular interactions with the watershed and Tuolumne River to inform them of the new SRWA plant and source water quality objectives. The goal is to establish proactive communication around the identification of unauthorized activities that could impact water supply. Local authorities may include County law enforcement and Fish and Wildlife.
7. SRWA should post signage at Fox Grove Park, which is near the plant intake, to alert and raise awareness of the potential impacts to the drinking water supply source from illegal dumping and other unpermitted activities. SRWA should coordinate with the County and Fish and Wildlife to consider other high risk areas for potential additional signage.

This page intentionally left blank

6 References

Agricultural Water Management Plan for the Modesto Irrigation District-Last Update: Dec 2015- https://www.mid.org/water/irrigation/documents/MID2015AWMPFinal.pdf

Bureau of Business and Economic Research at the University of Montana. Harvest and Industry - Timber Harvest for Tuolumne County, CA. Accessed February 2020 from: http://www.bber.umt.edu/FIR/harvestT1.aspx?co=06109

California Data Exchanger Center- http://cdec.water.ca.gov/reportapp/javareports?name=FNFSUM.2015

California Data Exchanger Center- http://cdec.water.ca.gov/reportapp/javareports?name=FNFSUM.2016

California Data Exchanger Center- http://cdec.water.ca.gov/reportapp/javareports?name=FNFSUM.2017

California Data Exchanger Center- http://cdec.water.ca.gov/reportapp/javareports?name=FNFSUM.2018

California Department of Conservation, Office of Mine Reclamation. AB 3098 List. Accessed March 2020 from: https://www.conservation.ca.gov/dmr

California Department of Finance, Demographic Research Unit. Accessed February 2020 from: http://www.dof.ca.gov/forecasting/demographics/Projections/

California Department of Fish and Wildlife website. Accessed January 2020. http://www.dfg.ca.gov/invasives/quaggamussel/incidentdescription.html

California Department of Forestry and Fire Protection (CAL FIRE). Incident Information. Accessed July 2019 from: https://www.fire.ca.gov/incidents/

California Department of Pesticide Regulation. Pesticide Use Reporting – 2017 Summary Data. Accessed February 2020 from: https://www.cdpr.ca.gov/docs/pur/pur17rep/top_5_sites_ais_lbs_2017.htm

California Department of Public Health. California Regulations to Drinking Water. Title 22. Accessed 2019 from: https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/lawbook/RWregulations_20181001.pdf

California Department of Resources Recycling and Recovery. Solid Waste Information System. Database accessed 2019 from: https://www2.calrecycle.ca.gov/swfacilities/Directory

California Department of Water Resources. 2016 California Statewide Agricultural Land Use. Published November 2019, https://gis.water.ca.gov/app/CADWRLandUseViewer/

California Office of Emergency Services. Spill Release Reporting. Accessed 2019 from: https://www.caloes.ca.gov/governments-tribal/plan-prepare/hazardous-materials/spill-release-reporting

California Regional Water Quality Control Board – Central Valley Region. Cleanup and Abatement Order No. R5-2009-0712. June 2016.

California Regional Water Quality Control Board for the Sacramento and San Joaquin River Basins – Central Valley Region, Region 5, California. 1995. Last updated October 2016. https://www.waterboards.ca.gov/centralvalley/water_issues/basin_plans/sacsjr.pdf

California Regional Water Quality Control Board Central Valley Region, The Water Quality Control Plan (Basin Plan) For The California Regional Water Quality Control Board Central Valley Region. Fifth Edition, Revised May 2018.

California Regional Water Quality Control Board Central Valley Region, Notice of Applicability of General Order R5-2015-0012 Geer Road Landfill, 750 Geer Road, Modesto, Stanislaus County. file:///C:/Users/amcreynold/Downloads/R5-2015-0012-059_27Jan2020_NOA.pdf

California Regional Water Quality Control Board Central Valley Region, Order R5-2014-0008 Rescinding Waste Discharge Requirements Order R5-2008-0162 and Time and Schedule Order R5-2010-0908 (NPDES No. CA0084727). https://www.waterboards.ca.gov/centralvalley/board_decisions/adopted_orders/tuolumne/r5-2014-0008.pdf

California Regional Water Quality Control Board Central Valley Region, Resolution R5-2017-0069 Resolution to Approve the Local Agency Management Program for Stanislaus County Department of Environmental Services. https://www.waterboards.ca.gov/centralvalley/board_decisions/adopted_orders/stanislaus/r5-2017-0069_lamp.pdf

California Regional Water Quality Control Board Central Valley Region, Order R5-2018-0010 Approving the Local Agency Management Program for Tuolumne County Environmental Health Division. https://www.waterboards.ca.gov/centralvalley/board_decisions/adopted_orders/tuolumne/r5-2018-0010.pdf

California Regional Water Quality Control Board, Central Valley Region. Waste Discharge Requirements for the Jamestown Trust I, through its Trustee, County of Tuolumne, Robert Cameron, Gary Wilson, Discharge of Wastewater to Harvard Mine Pit, Tuolumne County. Order No. R5-2007-0083 2007.

California Regional Water Quality Control Board, Sacramento and San Joaquin River Watersheds Pesticide Basin Plan Amendment Fact Sheet.

California Water Boards-State Water Resources Control Board Division of Drinking Water-STATE OF CALIFORNIA DOMESTIC WATER SUPPLY PERMIT Issued To

Modesto Irrigation District Public Water System No. 5010038-Permit Number: 01-10-18P-001- June 2018

California Water Boards. Confined Animal Facilities - Dairy Program Regulations and Requirements. June 2019. https://www.waterboards.ca.gov/centralvalley/water_issues/confined_animal_facilities/program_regs_requirements/dairy/

Center for Economic Development, California State University, Chico. Tuolumne County Profile 2012. 2012.

Don Pedro Recreation Agency. Don Pedro Recreation Agency Board of Control Monthly Report. January 2018.

Don Pedro Recreation Agency. Don Pedro Recreation Agency Regulations and Ordinances. Amended August 2011.

Email Communication, John Mauterer, MID Irrigation Department. August 28, 2020.

Environmental Protection Agency. Surface Water Treatment Rule Guidance Manual. Accessed July 2013 from: http://water.epa.gov/lawsregs/rulesregs/sdwa/lt2/compliance.cfm

Higgins, CT and Dupras, DL. Mineral Land Classification of Stanislaus County, California. California Department of Conservation, Division of Mines and Geology, 1993.

https://www.waterboards.ca.gov/centralvalley/water_issues/basin_plans/sacsjr_201805.pdf

Modesto Irrigation District and Turlock Irrigation District. Pre-Application Document for the Don Pedro Project, FERC No. 2299. February 2011.

Modesto Irrigation District. Agricultural Water Management Plan 2015 Update. Prepared by Provost and Pritchard Consulting Group. December 2015.

Modesto Irrigation District. Watershed Sanitary Survey Update, Modesto Reservoir Watershed. Prepared by Brown And Caldwell. December 2009.

Modesto Irrigation District. Watershed Sanitary Survey Update, Modesto Reservoir Watershed. Prepared by HDR. April 2014.

Modesto Irrigation District-Watershed Sanitary Survey Sampling changes-ftp://ftp.mid.org/outgoing/DWP/Watershed%20Sanitary%20Survey/Sampling%20Schedule%20Changes/

North Central Valley Consortium. Quagga and Zebra Mussel Prevention Plan. January 2019.

Personal communication with Ms. Sara Pinckney, community Development Department, County of Tuolumne, February 2020

Personal Communication, Mr. Brannon Gomes, Don Pedro Recreation Agency. February and March 2020.

Personal Communication, Mr. Diego Casillas, Stanislaus County Parks and Recreation, February 2020.

Personal Communication, Ms. Jessica Stillwell, Modesto Irrigation District. November 2019

Personal Communication, Ms. Stephanie Mendes, Chief Operator, City of Waterford. August 27, 2020

San Francisco Public Utilities Commission. 2013 Annual Sanitary Survey Updated Report for the Hetch Hetchy Water Supply. Executive Summary. April 2012.

San Francisco Public Utilities Commission. 2014 Annual Sanitary Survey Updated Report for the Hetch Hetchy Water Supply. Executive Summary. April 2013.

San Francisco Public Utilities Commission. 2015 Annual Sanitary Survey Updated Report for the Hetch Hetchy Water Supply. Executive Summary. April 2014.

San Francisco Public Utilities Commission. 2016 Annual Sanitary Survey Update for the Hetch Hetchy Water Supply. Executive Summary. April 2015.

San Francisco Public Utilities Commission. 2017 Annual Sanitary Survey Update for the Hetch Hetchy Water Supply. Executive Summary. April 2016.

San Francisco Public Utilities Commission. 2018 Annual Sanitary Survey Update for the Hetch Hetchy Water Supply. Executive Summary. April 2017.

San Francisco Public Utilities Commission. Aquatic Pesticide Application Plan. September 17, 2013. Accessed December 2013 from: http://www.waterboards.ca.gov/water_issues/programs/npdes/docs/aquatic/weedcontrol/apap/sfpuc_noi_apap.pdf

Stanislaus County Building Permits Division. Sewer and Water Hook-Up Contact Information. http://www.stancounty.com/planning/bp/sewer-and-water.shtm

Stanislaus County Parks and Recreation Department. Modesto Reservoir Website. Accessed June-August 2013 from: http://www.stancounty.com/ER/PARKS/reservoir.shtm

Stanislaus County Parks and Recreation Department. Modesto Reservoir Annual Activity and Visitor Count Reports. 2009-2012.

Stanislaus County. Agricultural Crop Report. 2014.

Stanislaus County. Agricultural Crop Report. 2015.

Stanislaus County. Agricultural Crop Report. 2016.

Stanislaus County. Agricultural Crop Report. 2017.

Stanislaus County. Agricultural Crop Report. 2018.

Stanislaus County. Stanislaus County Code, Chapter 9.94 Prescription Medication Disposal Program. Accessed February 2020 from: http://qcode.us/codes/stanislauscounty/view.php?topic=9-9_94&frames=on

State Water Resources Control Board. General Waste Discharge Requirements for Existing Milk Cow Dairies. Adopted Order R5-2007-0035

State Water Resources Control Board. GeoTracker Data Management System. Accessed July 2013 from: http://geotracker.waterboards.ca.gov/

State Water Resources Control Board. Industrial Storm Water General Permit. Adopted Order 97-03-DWQ

Technical Memorandum-Stanislaus Regional Water Authority Surface Water Supply Project, Historical Water Quality Assessment- Prepared by Trussell Technologies- Aug 2016

Technical Memorandum-Stanislaus Regional Water Authority Surface Water Supply Project, Source Water Quality Assessment TM1-Prepared by Trussell Technologies - Feb 2018

Technical Memorandum-Stanislaus Regional Water Authority Surface Water Supply Project, Source Water Quality Assessment TM2- Prepared by Trussell Technologies - Feb 2019

Tuolumne County. Official website. Accessed June-July 2013. http://www.tuolumnecounty.ca.gov/Tuolumne County. Letter of Comment on Proposed OWTS Policy. Letter Sent to SWRCB by Board of Supervisors November 1, 2011.

Tuolumne County. Tuolumne County Crop and Livestock Report. 2017.

Tuolumne County. Tuolumne County Plan to Combat Homelessness. Adopted July 2019.

Tuolumne County. Tuolumne County Water Quality Plan; Project Assessment and Evaluation Plan. State Water Resources Control Board Agreement No. 03-240-555-0. Prepared by ESA. May 2005.

Tuolumne River Hazardous Materials Spill Reports- https://w3.calema.ca.gov/operational/malhaz.nsf/$defaultview

Tuolumne-Stanislaus Integrated Regional Water Management Plan-Prepared by Kennedy/Jenks Consultants- August 2013

United States Department of Agriculture-Forest Resources of the United States, 2017- A Technical Document Supporting the Forest Service 2020 RPA Assessment-March 2019

USGS. Official website. Accessed March 2020. https://ca.water.usgs.gov/wildfires/wildfires-water-quality.html. California Water Science Center. Water Quality after a Wildfire.

Wright, Scott A. and Marineau, Mathieu. Turbidity Current Observations in a Large Reservoir Following a Major Wildfire. American Society of Civil Engineers, 2019.

7 Limitations

7.1 Report Limitations

This document was prepared solely for MID and the Stanislaus Regional Water Authority (SRWA) in accordance with professional standards at the time the services were performed and in accordance with the contract between MID and HDR Engineering, Inc. dated October 2018. This document is governed by the specific scope of work authorized by MID; it is not intended to be relied upon by any other party except for regulatory authorities contemplated by the scope of work. We have relied on information or instructions provided by MID, SRWA and other parties and, unless otherwise expressly indicated, have made no independent investigation as to the validity, completeness, or accuracy of such information.

This page intentionally left blank

Appendix A. SFPUC WEIP 2015-2016 Annual Report

Appendix B. NPDES and WDR Permits

Appendix C. Local Agency Management Programs for Tuolumne and Stanislaus Counties

Appendix D. Basin Plan Objectives

Appendix E. DPRA Rules and Regulations

Appendix F. Modesto Irrigation District Domestic Water Supply Permit and Modesto Reservoir Management Plan

Appendix G. Invasive Species Public Education Materials (North Central Valley Consortium Quagga and Zebra Mussel Self-Inspection Permit and Mussel Information Sheet)

Appendix H. Post Rim Fire Monitoring Data Collected by MID

Appendix I. Summary of Federal and California State Water Quality Regulations

Appendix J. Excerpts from Stanislaus Regional Water Authority Surface Water Supply Project – Source Water Quality Assessment (2018, 2019)

Appendix K. Modesto Regional WTP – Title 22 Constituents

Appendix L. Proposed Phase 2 Extended Monitoring Program for SRWA

Appendix M. Photos

Appendix N. SRWA/MID 2020 Watershed Sanitary Survey - DDW Report Comments and Responses