The City *of*

SAN DIEGO

2020 Watershed Sanitary Survey

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2020 Watershed Sanitary Survey

(CDPH SYSTEM NUMBER 37-10020)

MARCH 1, 2021

Public Utilities Department

Contributing Agencies

California Regional Water Quality Control Board, San Diego Region
California Water Boards, State Water Resources Control Board
County of San Diego, Department of Environmental Health
County of San Diego, Department of Parks and Recreation
National Oceanic and Atmospheric Association
San Diego County Water Authority
San Diego History Center
San Diego Natural History Museum
State of California, Department of Forestry and Fire Protection
State of California, Department of Toxic Substances Control
State of California, Department of Water Resources, California Data Exchange Center
United States Department of Agriculture Forest Service, Cleveland National Forest
United States Census Bureau
United States Department of the Interior, Bureau of Land Management
United States Geological Survey

Cover Photographs

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ABBREVIATIONS

Acid Mine Drainage (AMD)

Acre (ac.)

Acre Feet (AF)

Acre Feet per Year (AFY)

Alvarado Water Treatment Plant (Alvarado WTP)

American Water Works Association (AWWA)

Animal Unit Month (AUM)

Aquatic Invasive Species (AIS)

Badger Water Treatment Plant (Badger WTP)

Best Management Practice (BMP)

California Department of Fish and Wildlife (CDFW)

California Department of Food and Agriculture (CDFA)

California Department of Forestry (CDF)

California Department of Forestry and Fire Protection (CAL FIRE)

California Department of Water Resources (DWR)

California Division of Mines and Geology (CDMG)

California Division of Safety of Dams (DSOD)

California Department of Transportation (Caltrans)

California Federal Regulation (CFR)

California Integrated Water Quality System Project (CIWQS)

California Safe Drinking Water Act (CSDWA)

California State Water Resources Control Board (SWRCB)

California Surface Water Treatment Rule (CSWTR)

California Sustainable Groundwater Management Act of 2014 (SGMA)

City of San Diego (CSD)

Climate Action Plan (CAP)

Colony Forming Units per Milliliter (cfu/mL)

Colorado River Quantification Settlement Agreement (QSA)

Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERLA)

Concentrated Animal Feeding Operation (CAFO)/Animal Feeding Operation (AFO)

Confined Animal Facilities (CAFs)

County of San Diego (CoSD)

Cubic feet per second (cfs)

Department of Toxic Substances Control (DTSC)

Department of Water Resources, California Data Exchange Center (DWR-CDEC)

Detection Limits for Reporting (DLRs)

Diegan Coastal Sage Scrub (DCSS)

Disinfection By-Product (DBP)

Disinfection/Disinfection By-Product (D/DBP)

Endangered Species Act (ESA)
Enhanced Surface Water Treatment Rule (ESWTR)
Escherichia Coli (E. coli)
Federal Safe Drinking Water Act (FSDWA)
Federal Surface Water Treatment Rules (FSWTRs)
Federal Water Pollution Control Act (FWPCA)/Clean Water Act (CWA)
Feet (ft)
Gallons (gal.)
Gallons per Day (GPD)
Geographic Information System (GIS)
Goldspotted Oak Borer (GSOB)
Groundwater Sustainability Agencies (GSAs)
Groundwater Sustainability Plans (GSPs)
Haloacetic Acid (HAA)
Harmful Algae Blooms (HABs)
Harmony Grove Water Reclamation Plant (Harmony Grove WRP)
Helix Water District (HWD)
Heterotrophic Plate Count (HPC)
Hydromodification Management Plan (HMP)
Hypolimnetic Oxygenation System (HOS)
Inch (in)
Information Collection Rule (ICR)
Integrated Regional Water Management (IRWM)
Irrigated Lands Regulatory Program (ILRP)
Joint Exercise of Powers Agreement (JEPA)
Julian Water Pollution Control Facility (Julian WPCF)
Jurisdictional Runoff Management Plan (JRMP)
Liters (L)
Local Agency Management Program (LAMP)
Long Running Annual Averages (LRAA)
Long Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR)
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Maximum Contaminant Level (MCL)
Maximum Contaminant Level Goal (MCLG)
Mean Sea Level (MSL)
Methyl Tert-Butyl Ether (MTBE)
Metropolitan Water District (MWD)
Micro Siemens per Centimeter (uS/cm)

Micrograms per Liter (UG/L)
Miles (mi.)
Milligrams per liter (MG/L)
Million gallons (MG)
Million gallons per day (MGD)
Million gallons per year (MGY)
Milliliters (mL)
Minimum Detection Level (MDL)
Miramar Water Treatment Plant (Miramar WTP)
Municipal Separate Storm Sewage System (MS4)
Nanograms per Liter (ng/L)
National Pollution Discharge Elimination System (NPDES)
Nephelometric Turbidity Unit (NTU)
Non Chapter 15 Program (Non 15)
Nonpoint Source (NPS)
Non-StormWater Discharges (NSWDs)
Onsite Wastewater Treatment Systems (OWTS)
Otay Water Treatment Plant (Otay WTP)
Parts per Billion (ppb)
Pico Curies per Liter (pCi/L)
Pine Valley Water Pollution Control Facility (Pine Valley WPCF)
Polychlorinated biphenyl (PCB)
Polycyclic aromatic hydrocarbon (PAH)
Program Planning Subcommittee (PPS)
Quantification Settlement Agreement (QSA)
Regional Stormwater Management Committee (RMC)
Regional Water Quality Control Boards (RWQCBs)
Regional Water Quality Control Board, San Diego Region (RWQCB9)
Resource Conservation and Recovery Act of 1976 (RCRA)
R.M. Levy Water Treatment Plant (Levy WTP)
Ramona Municipal Water District (RMWD)
San Diego Association of Governments (SANDAG)
San Diego County Department of Environmental Health (SDCDEH)
San Diego County Water Authority (SDCWA)
San Diego County Water Authority Emergency Storage Program (ESP)
San Diego Geographic Information System (SanGIS)
San Diego Regional Stormwater Management Committee (RMC)
San Diego Water Company (SDWC)
San Dieguito Water District (SDWD)
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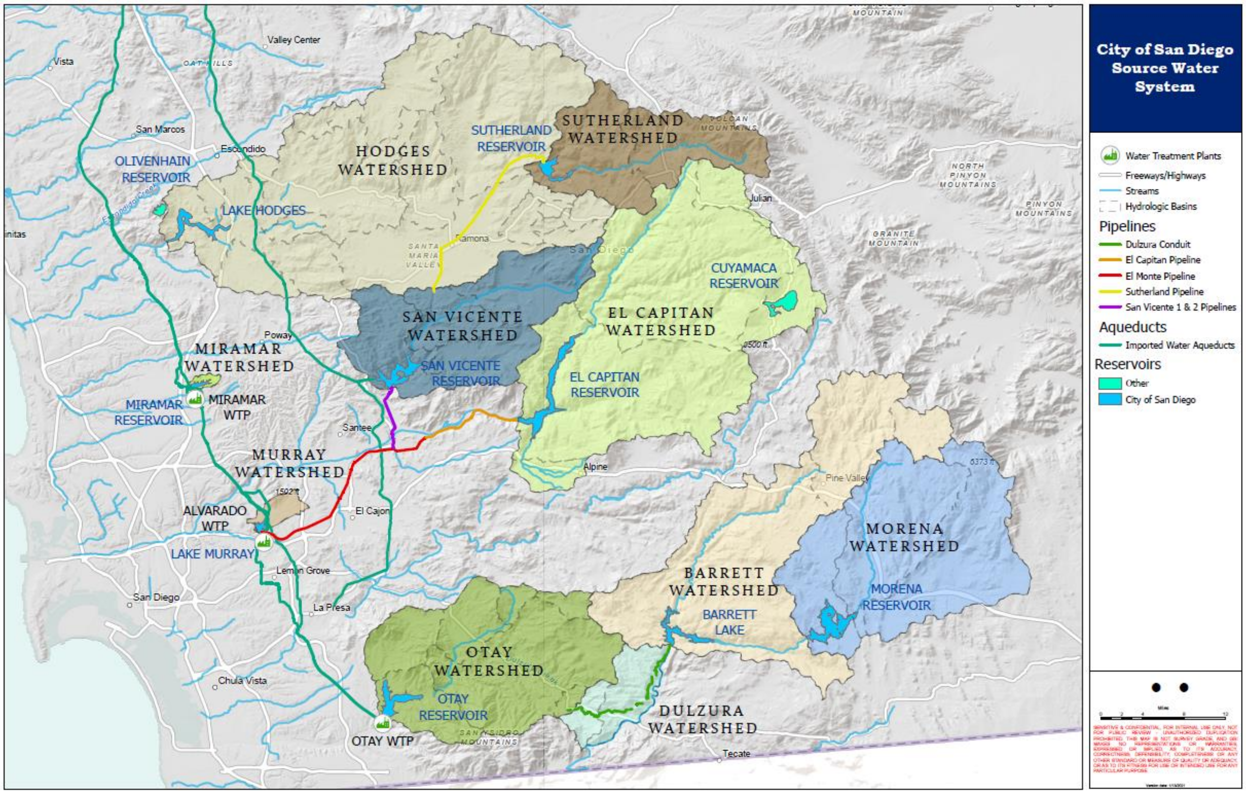
Sanitary Sewage Overflow (SSO)

Santa Fe Irrigation District (SFID)
Santa Maria Wastewater Treatment Plant (Santa Maria WWTP)
Secondary Maximum Contamination Levels (SMCL)
Site Cleanup Program (SCP)
Square Miles (sq. mi.)
Standard Urban Stormwater Management Plan (SUSMP)
State of California Division of Safety of Dams (DSOD)
Threshold Odor Number (TON)
Total Dissolved Solids (TDS)
Total Nitrogen (TN)
Total Organic Carbon (TOC)
Total Phosphorus (TP)
Total Suspended Solids (TSS)
Total Trihalomethane (TTHM)
Trihalomethane (THM)
Underground Storage Tank (UST)
United States Department of Agriculture (USDA)
United States Department of Agriculture Natural Resources Conservation Service (NRCS)
United States Department of the Interior Bureau of Land Management (BLM)
United States Environmental Protection Agency (U.S. EPA)
United States Fish and Wildlife Service (USFWS)
United States Forest Service (USFS)
United States Geological Survey (USGS)
United States Geological Survey Mineral Resources Data System (MRDS)
Volatile Organic Compounds (VOCs)
Waste Discharge Requirement (WDR)
Water Pollution Control Facility (WPCF)
Wastewater Reclamation Facility (WRF)
Water Quality Improvement Plan (WQIP)
Water Reclamation Plant (WRP)
Water Resources Engineering (WRE)
Water Treatment Plant (WTP)
Water Treatment Plants (WTPs)
Watershed Sanitary Survey (WSS)

SUMMARY



The Watershed Sanitary Survey (WSS) covers the source water system used by the City of San Diego (CSD). The initial WSS was completed in 1996; this report is the fifth five-year update. The purpose of the survey is to identify actual or potential sources of local source water contamination which might adversely affect the quality and treatability of water used as the domestic supply for the CSD service area. The WSS update will be used to evaluate source water quality issues and as a basis for future watershed management and planning efforts.

Since 1901, the CSD municipal source water system has developed into a complex evolving system of water rights and agreements, along with infrastructure for the conveyance, storage, and treatment of water all governed by an intricate system of federal and state laws. The system is dependent on both local runoff, which accounted for about 11% of total drinking water production by the CSD from 2015-2020, and more importantly, imported water as a source.

Although the system is primarily dependent on imported water as a source, the very nature of this complex and expansive system allows for the capture and storage of local runoff which can have a profound effect on source water quality since the CSD has a policy of maximizing the use of local water.

The CSD local source water system consists of nine reservoirs with a combined capacity of over 550,000 acre-feet (AF), over 900 square miles (sq. mi.) of watershed lands tributary to these reservoirs, and raw water conveyances connecting the reservoirs to one another and to three water treatment plants. San Vicente Reservoir Dam is the largest of the CSD dams and the reservoir has the greatest storage capacity and surface area at capacity. Hodges Reservoir has the largest watershed. El Capitan Reservoir receives the highest average annual runoff followed closely by Hodges.

From a management perspective, the local source water system is divided into four independent systems based on the location of the source water treatment.

- The San Diego River System comprising the El Capitan, Murray, San Vicente, and Sutherland Watersheds which supplies the Alvarado Water Treatment Plant (Alvarado WTP).
- The Otay-Cottonwood System comprising the Barrett, Dulzura, and Otay Watersheds which supplies the Otay Water Treatment Plant (Otay WTP).
- The Miramar System which supplies the Miramar Water Treatment Plant (Miramar WTP).
- The Hodges System has no CSD-owned treatment facility, however, in 2012, construction of the Hodges-Olivenhain Pipeline and pump station connecting Hodges to Olivenhain was completed as part of the San Diego County Water Authority (SDCWA) Emergency Storage Project. The connection provides the ability to transfer water between Hodges Reservoir and the SDCWA Aqueduct System via Olivenhain Reservoir, subsequently, the CSD now can utilize the storage capacity of Hodges Reservoir to augment overall emergency and impound storage.

The climate of the region is classified as semi-arid (steppe) in the west and Mediterranean hot summer in the east. Mountain streams provide a limited and extremely variable water supply. Average annual local runoff collected by the source water system is approximately 100,000 acre-feet per year (AFY). Nearly all precipitation occurs from October through April. Occasional winter snowfalls occur in the highest elevations while summers are dry and hot.

The local source water system is in southern and central San Diego County on the western slope of the Peninsular Ranges. The terrain within local source water system is generally mountainous. The geology of the area is dominated by Mesozoic metavolcanic, metasedimentary, and plutonic rocks. Several earthquake fault zones and numerous faults exist in the area. The earthquake potential combined with the age of much of the source water system infrastructure creates a significant threat of damage to the source water system. Most of the land area within local watersheds has slopes of between 16% and 50% creating the likelihood of transport of soils and contaminants to water bodies. Dominant soil types are highly susceptible to erosion especially if the vegetation is disturbed or the hydrography is modified. Several natural geological contaminants occur in the area including arsenic, asbestos, mercury, and radon. Naturally occurring geologic hazards are not considered to be an issue in the CSD source water quality, although, elevated levels of arsenic have been detected in two tributaries in the Otay Watershed and elevated levels of mercury have been detected in fish samples taken from Hodges Reservoir. It is anticipated that levels of mercury in Hodges Reservoir should be mitigated with the installation of a hypolimnetic oxygenation system (HOS) in spring of 2020.

Several native vegetation categories exist within local watersheds with scrub and chaparral dominating. Native vegetation is adapted to infrequent fires, drought tolerant, and is not considered a significant consumer of water.

Diverse assemblages of wildlife species including reptiles, birds, and mammals are commonly found within the boundaries of the local source water system. Many species are common to both upland and lowland areas occurring from sea level to the mountains where suitable habitat is available. Native wildlife species in general are not considered to be a significant source of contamination, although several source water reservoirs located adjacent to suburban areas with consequential large residential populations of waterfowl continue to be considered a minor source of bacterial contamination. The establishment of the invasive quagga mussel in several CSD reservoirs remains a source of biofouling.

Land development has occurred in all CSD watersheds. About 23% of the total land area in the watersheds has been developed. Since 2015, the total area of developed in the watersheds increased slightly by about 2%. Developed land dominates the Murray watershed followed by Hodges at just over 50%. Hodges watershed has the most acreage of developed land. Sutherland watershed had the largest increase in land development followed by El Capitan. Land ownership data from 2015 indicates public agencies account for about 60% ownership of the land area in the watershed, with the CSD owning about 7%, and private ownership accounts for the remaining 40%. Previous ownership trends demonstrate a change of less than 1% land ownership away from private toward public as public agencies purchase land parcels in the watersheds identified as critical. Private ownership continues to dominate the Hodges and Murray watersheds with San Vicente, Sutherland, and Otay watersheds at near 50%. Overall, about 47% of private land within the watersheds remains undeveloped with the largest area in the Hodges watershed. Since 2015, 412 new construction permits were recorded for onsite wastewater treatment systems located within all the watersheds except for Murray and Miramar with 62% located in the Hodges watershed.

The overall estimated population for San Diego County has increased about 7.8% from the 2010 census estimates base and is largely organized in urban centers. The Hodges watershed has the largest population and urban center with the highest density. Murray and Miramar watersheds have the highest average density. The CSD reservoirs are popular locations for recreational users. Water contact recreational activities are permitted at all CSD reservoirs. There has been a significant increase of about 36% in overall permitted activity usage at CSD reservoirs with San Vicente Reservoir having the largest number of permitted users accounting for about 26% of total users.

A total of 429 active facilities regulated by the California State Water Resources Control Board (SWRCB) are located throughout all the CSD watersheds with the majority in the Hodges watershed where about 82% are located. Since 2015, the overall number of wastewater treatment facilities remained constant with facilities located in the El Capitan, San Vicente, Barrett, and Hodges watersheds. The number of Underground Storage Tank Sites (USTs) decreased by about 29% with about 69% of the remaining USTs located in the Hodges watershed. The number of concentrated animal facilities (CAFs) increased significantly by 60%. CAFs are in the Sutherland and Hodges watersheds with about 94% located within the Hodges watershed.

Agriculture accounts for about 6% of the total land area in the CSD watersheds a slight decrease of less than 1% since 2015. Agriculture occurs in all the watersheds except for Murray and Miramar; house and hobby farms are not included in this report. Agriculture occurs primarily in the Hodges watershed where about 61% of the agricultural land area is located. Within the watersheds there are 274 enrollees in the Irrigated Lands Regulatory Program located in the El Capitan, San Vicente, Sutherland, and Otay watersheds with 93% in the Hodges watershed.

Grazing on public land is a small percentage of grazing pressure in CSD watersheds. Data for grazing pressure on private land is not available and is not included in this report. It is estimated that Sutherland and Hodges watersheds host the most grazing use on private lands (CSD staff communication, USFS Staff). Grazing pressure on public land remained constant in the watersheds since 2015. Grazing occurs in the Barrett and Hodges watersheds with about 92% of the public land available for grazing within the watersheds located in the Barrett watershed.

A total of 60 cleanup and burn sites are located throughout the CSD watersheds. Cleanup sites are located within all watersheds except for Sutherland, Morena, and Miramar watersheds with about 60% located in the Hodges watershed. Leaking Underground Storage Sites (LUSTs) are in the El Capitan, Murray, and Hodges watersheds. Since 2015, the number of LUSTs decreased by 53% with 88% of the remaining sites split evenly between El Capitan and Hodges watersheds. The number of Sanitary Sewer Overflows (SSOs) increased by 36%. SSOs occurred in the Murray, San Vicente, Otay, and Hodges watersheds. SSOs occurred most frequently in the Hodges watershed where 63% of the total number of spills were located. The estimated total spill volume increased by 266% with 96% of the total volume in the Hodges watershed; two major spills accounted for 94% both of which reached surface water near Hodges Reservoir.

The number of fires that occurred in the watersheds increased by about 8%. Fires occurred in the San Vicente, Sutherland, Barrett, Otay, and Hodges watersheds. Fires occurred most frequently in the Hodges watershed where 50% of the total number were located. The total number of acres burned increased by 941%; the 2020 Valley fire in the Barrett watershed accounted for 875% of that increase.

Source water quality monitoring data indicates that constituents are typical of raw source water in Southern California with little change since the 2015 WSS. As part of the WSS update, five years of water quality monitoring data from the watersheds, reservoirs, and WTP influents are compared to source water quality parameters established by the Regional Water Quality Control Board, San Diego Region (RWQCB9) for inland surface waters. Water quality monitoring data is also compared to parameters established by the SWRCB for finished drinking water to evaluate which currently regulated constituents require treatment to achieve current and proposed regulatory standards for drinking water. Comparison of raw source water quality to drinking water standards is for reference purposes only, as the potable drinking water standards do ***NOT*** apply to raw source water. Tables include constituents with detections repeatedly (arithmetic mean) above water quality parameters. For a summary of all water quality data, see appendices.

Summary of Watershed Source Water Constituents with Detections Repeatedly Above Water Quality Parameters 2016 - 2020

CSD

			Basin Plan Inland Surface Waters Quality [1]		2016 - 2020 Summary of Aggregated Direct Tributaries			
Group/Constituents	**Units**	**CSD MDL**	**Criteria**	**Objectives**	**El Capitan Mean**	**San Vicente Mean**	**Otay Mean**	**Hodges Mean**
General Physical								
Total Filterable Residue @ 180 C (TDS)	MG/L	10	300	300/500 [2]	818	348	3260	1620
Microbiological								
Enterococcus	/100 ML	1	60 [3]		-	68	610	140
Inorganic Constituents								
Ammonia-N	MG/L	0.031	0.025		-	0.031	-	0.039
Chloride	MG/L	0.5	250	50/250 [4]	187	108	1520	301
Fluoride	MG/L	0.02	1	1	-	-	1.74	-
Nitrate (as NO3)	MG/L		5		-	-	15.5	-
Phosphorus	MG/L	0.078	0.025 [5]	0.025 [5]	0.089	0.095	0.116	0.188
Sulfate (SO4)	MG/L		65	65/250 [6]	123	-	268	311
Total Nitrogen	MG/L	0.156		0.25 [5]	0.922	1.18	4.6	1.56

End Notes:

Listed analytes include only analytes with Basin Plan Inland Surface Water Quality Criteria or Objectives. For summary of all water quality monitoring data, see appendices.

Data is aggregated from all reservoir direct tributaries. For summary of data from individual sources, see appendices.

CSD MDL: City of San Diego Water Quality Laboratory minimum detection level, DLR: detection level for reporting, MCL: maximum contaminant level, SMCL: Secondary MCL

[1] Water Quality Control Plan for the San Diego Basin (9) with amendments effective on or before May 17, 2016. Water Quality Objectives concentrations not to be exceeded more than 10% of the time during any one year period.

[2] TDS Objective value is 300 MG/L for El Capitan and San Vicente watersheds, 500 MG/L for Otay and Hodges watersheds

[3] Beach Action Values (BAV): Amendment to the Domestic Water Permit issued by SWRCB to CSD, August 27, 2018

[4] Chloride Objective value is 50 MG/L for El Capitan and San Vicente watersheds, 250 MG/L for Otay and Hodges watersheds

[5] P= 0.025 mg/L in any standing body of water. Nitrogen threshold determined by monitoring or if data are lacking, ratio of N:P = 10:1 is used. These values not to be exceeded more than 10% of the time.

[6] Sulfate Objective value is 65 MG/L for El Capitan and San Vicente watersheds, 250 MG/L for Otay and Hodges watersheds

Summary of Reservoir Source Water Constituents with Detections Repeatedly Above Water Quality Parameters 2016 - 2020

			Federal/California Drinking Water Standards [1]			Basin Plan Inland Surface Waters Quality [2]		2016 - 2020 Source Water Quality at Surface								
Group/Constituents	Units	CSD MDL	DLR	Primary MCL	Secondary SMCL	Criteria	Objectives	El Capitan Mean	Murray Mean	San Vicente Mean	Sutherland Mean	Barrett Mean	Morena Mean	Otay Mean	Miramar Mean	Hodges Mean
General Physical																
Color, Apparent (Unfiltered)	COLOR	1			15	20	20	16	-	-	33.1	40.9	59.1	-	-	42.8
Odor Threshold @ 60 C (TON)	ODOR	1	1		3		none	18	17	11.5	-	-	-	20.5	10.5	> 24
pH	PH					6.5-8.5 [4]		-	-	-	8.64	-	-	-	-	-
Total Filterable Residue (TDS)	MG/L	10			1000	300	300/500/1500 [5]	354	507	547	-	477	765	579	489	690
Turbidity, Laboratory	NTU	0.07	0.1		5	20	20	1.41	1.34	0.363	3.78	5.44	16.2	1.2	0.551	6.13
Microbiological																
Escherichia Coli	/100 ML	1		Present		190 [6]		-	66.8	< 10	-	-	-	35	32	12.8
Total Coliform	/100 ML	1		Present				3590	2290	2660	2740	8760	5370	2940	757	7160
Radiologicals																
Gross Beta	PCI/L		4	50 [7]				6.5	-	4.74	-	-	-	4.46	-	6.9
Uranium	PCI/L		1	20				-	1.9	1.9	-	-	-	-	1.3	-
Metals [3]																
Aluminum (Al)	UG/L	5	50	1000	200			-	-	-	75.6	-	379	-	-	81.6
Arsenic	UG/L	1	2	10				-	-	-	-	-	6.25	-	-	-
Barium (Ba)	UG/L	2	100	1000				-	-	-	-	-	-	206	-	-
Boron	UG/L	5	100			500	750/1000 [8]	-	132	138	-	-	205	-	139	165
Iron (Fe)	UG/L	100	100		300	300	300/1000 [9]	-	-	-	133	-	240	-	-	-
Manganese (Mn)	UG/L	0.5	20		50	50	50/100 [10]	27.1	-	-	57.2	83.2	85.7	-	-	64.8
Vanadium	UG/L	1	3					-	-	-	5.75	-	20.1	-	-	-
Inorganic Constituents																
Ammonia-N	MG/L	0.031				0.025		-	-	-	0.041	0.129	0.098	0.092	-	0.078
Fluoride	MG/L	0.02	0.1	2		1	1	0.211	0.256	0.286	0.226	0.329	0.526	0.491	0.272	0.277
Phosphorus	MG/L	0.078				0.025 [11]	0.025 [11]	0.065	0.055	0.038	0.066	0.11	0.195	0.05	0.035	0.107
Sulfate (SO4)	MG/L	0.5	0.5		500	65	65/250/500 [12]	65.7	161	188	42.7	69.6	162	113	158	198
Total Nitrogen	MG/L	0.156					0.25 [11]	0.505	0.346	0.386	1.06	1.33	1.73	0.61	0.278	1.14
Organic Constituents, Regulated																
Bromodichloromethane	UG/L	0.4	1			100		-	-	-	-	-	-	-	1.62	-
Chlorodibromomethane	UG/L	0.4	1					-	1.01	-	-	-	-	-	1.8	-
Chloroform (Trichloromethane)	UG/L	1	1			100		-	1.03	-	-	-	-	-	1.34	-

End Notes:

Listed analytes include only analytes with Federal/California DLRs, MCLs and SMCLs and/or Basin Plan Inland Surface Water Quality Criteria or Objectives. For summary of all water quality monitoring data, see appendices

Shaded values exceed drinking water standards only.

CSD MDL: City of San Diego Water Quality Laboratory minimum detection level, DLR: detection level for reporting, MCL: maximum contaminant level, SMCL: Secondary MCL

[1] DLR, MCL, SMCL are obtained from California OEHHA and SWRCB and apply to drinking water and are for reference only. California MCL and SMCL values may be more stringent than federal standards for drinking water.

[2] Water Quality Control Plan for the San Diego Basin (9) with amendments effective on or before May 17, 2016. Water Quality Objectives concentrations not to be exceeded more than 10% of the time during any one year period.

[3] Trace metal values were from filtered and unfiltered samples. Differences in values were negligible.

[4] Waters designated Fresh or Warm changes in normal ambient pH levels shall not exceed 0.5 units

[5] TDS Objective value is 300 MG/L for El Capitan and San Vicente reservoirs, 500 MG/L for Sutherland, Barrett, Morena, Otay, Miramar and Hodges reservoirs, 1,500 MG/L for Lake Murray

[6] Beach Action Values (BAV): Amendment to the Domestic Water Permit issued by SWRCB to CSD, August 27, 2018

[7] DDW considers 50 pCI/L to be the level of concern for beta particles.

[8] Boron Objective value is 1,000 UG/L for El Capitan, Lake Murray, San Vicente, Barrett and Morena reservoirs, 750 UG/L for Sutherland, Otay, Miramar and Hodges reservoirs

[9] Iron Objective value is 1,000 UG/L for Lake Murray reservoir, 300 UG/L for El Capitan, San Vicente, Sutherland, Barrett, Morena, Otay, Miramar and Hodges reservoirs

[10] Manganese Objective value is 50 UG/L for Lake Murray reservoir, 1,000 UG/L for El Capitan, San Vicente, Sutherland, Barrett, Morena, Otay, Miramar and Hodges reservoirs

[11] P= 0.025 mg/L in any standing body of water. Nitrogen threshold determined by monitoring or if data are lacking, ratio of N:P = 10:1 is used. These values not to be exceeded more than 10% of the time.

[12] Sulfate Objective value is 65 MG/L for El Capitan and San Vicente reservoirs, 250 MG/L for Sutherland, Barrett, Morena, Otay, Miramar and Hodges reservoirs, 500 MG/L for Lake Murray

Summary of WTP Influent Source Water Constituents with Detections Repeatedly Above Drinking Water Quality Parameters 2016 - 2020								
			Federal/California Drinking Water Standards [1]			2016 - 2020 WTP Influent Source Water		
Group/Constituents	**Units**	**CSD MDL**	**DLR**	**Primary MCL**	**Secondary SMCL**	**Alvarado Mean**	**Otay Mean**	**Miramar Mean**
General Physical								
Odor Threshold @ 60 C (TON)	ODOR	1	1		3	1.44	1	1.47
Turbidity, Laboratory	NTU	0.07	0.1		5	0.643	0.874	0.713
Microbiological								
Escherichia Coli	/100 ML	1		Present		5.15	6.35	< 1
Total Coliform	/100 ML	1		Present		89.2	43.6	6.8
Radiologicals								
Gross Beta	PCI/L		4	50 [3]		-	4.08	-
Uranium	PCI/L		1	20		1.4	-	1.2
Metals [2]								
Boron	UG/L	5	100			127	166	130
Manganese (Mn)	UG/L	0.5	20		50	-	33.1	-
Inorganic Constituents								
Chlorate	UG/L		20			-	139	-
Chlorite	MG/L		0.02	1.0		-	1.06	-
Fluoride	MG/L	0.02	0.1	2		0.242	0.333	0.227
Sulfate (SO4)	MG/L	0.5	0.5		500	156	135	152
Organic Constituents, Regulated								
Bromodichloromethane	UG/L	0.4	1			3.92	5.14	7.21
Bromoform	UG/L	0.4	1			-	1.22	1.93
Chlorodibromomethane	UG/L	0.4	1			2.74	4.43	6.97
Chloroform (Trichloromethane)	UG/L	1	1			3.3	4.28	5.85
cis-1,2-Dichloroethylene (c-1,2-DCE)	UG/L	0.4	0.5	6		-	-	0.533
Dichloroacetic Acid (DCAA)	UG/L	1	1			-	-	1.04
trans-1,2-Dichloroethylene (t-1,2-DCE)	UG/L	0.4	0.5	10		-	-	1.58

End Notes:

Listed analytes include only analytes with Federal/California DLRs, MCLs & SMCLs. For summary of all water quality monitoring data, see appendices.

CSD MDL: City of San Diego Water Quality Laboratory minimum detection level, DLR: detection level for reporting, MCL: maximum contaminant level, SMCL: Secondary MCL

[1] DLR, MCL, SMCL are obtained from California OEHHA and SWRCB and apply to drinking water and are for reference only. California MCL and SMCL values may be more stringent than federal standards for drinking water.

[2] Trace metal values were from filtered and unfiltered samples. Differences in values were negligible.

[3] DDW considers 50 pCi/L to be the level of concern for Beta particles.

The CSD water treatment plants (WTPs) treat raw source water by conventional technologies using coagulation, flocculation, sedimentation, filtration, and disinfection. From 2015-2020 overall drinking water production decreased about 10% to 873,519 AF while local source water use increased by about 8% to 97,317 AF. All three WTPs were recently reconditioned and Alvarado WTP and Otay WTP expanded their treatment capacity. The reconditioning included a change in primary disinfection from chlorine to ozone in Alvarado WTP and Miramar WTP; and from chlorine to chlorine dioxide in the Otay WTP. In addition, all three WTPs were modified for the addition of fluoride. The distribution system contains over 3,000 miles of pipeline that covers over 400 sq. mi.

The CSD maintains an Operations Plan with a goal to always provide adequate water supply to all customers that meets or exceeds all drinking water quality standards while efficiently managing costs through reservoir, treatment, and distribution objectives. The CSD Emergency Plan requires that under all conditions, an emergency supply is maintained in designated reservoirs to be available if a failure occurs to the imported water supply system.

If a WTP cannot treat the water to an approved health standard level for any reason, the WTP is required to shut down. The CSD will then redirect treated water to the affected service area through the distribution system served by other WTPs or SDCWA. If any emergency exists, the CSD has an internal emergency response plan for each reservoir which includes a chain of communication procedure for notification of CSD staff and CSRCB Division of Drinking Water.

As part of the WSS update, five years of water quality monitoring data from WTP effluents are compared to criteria established by the SWRCB for finished drinking water. Table includes constituents that chronically (arithmetic mean) exceed MCLs, SMCLs, or unregulated constituents with DLRs set by the SWRCB for drinking water. The summary of treated drinking water quality monitoring data for the Alvarado, Otay, and Miramar WTPs indicates the CSD is currently in full compliance with existing and pending regulatory requirements. All CSD WTPs have undergone upgrades to meet the requirements of the Stage 2 Disinfectants and Disinfectant Byproducts Rule (D/DBP) and the Long Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR) including the replacement of free chlorine as the primary disinfect; Alvarado and Miramar with ozone and Otay with chlorine dioxide.

For additional information regarding drinking water quality see the CSD Annual Drinking Water Quality Report at https://www.sandiego.gov/public-utilities/water-quality/water-quality-reports.

Summary of WTP Effluent Drinking Water Constituents with Detections Repeatedly Above Drinking Water Quality Parameters 2016 - 2020								
			Federal/California Drinking Water Standards [1]			2016 - 2020 WTP Effluent Drinking Water		
Group/Constituents	Units	CSD MDL	DLR	Primary MCL	Secondary SMCL	Alvarado Mean	Otay Mean	Miramar Mean
General Physical								
Odor Threshold @ 60 C (TON)	ODOR	1	1		3	-	1.07	-
Radiologicals								
Gross Alpha	PCI/L		3	15		-	4.68	-
Gross Beta	PCI/L		4	50 [3]		-	4.55	-
Uranium	PCI/L		1	20		1.88	-	1
Metals [2]								
Boron	UG/L	5	100			130	164	133
Inorganic Constituents								
Chlorate	UG/L		20			-	199	-
Chlorite	MG/L		0.02	1.0		-	0.346	-
Fluoride	MG/L	0.02	0.1	2		0.538	0.457	0.529
Sulfate (SO4)	MG/L	0.5	0.5		500	156	136	147
Organic Constituents, Regulated								
Bromodichloromethane	UG/L	0.4	1			6.5	9.05	12
Bromoform	UG/L	0.4	1			3.48	12.6	3.17
Chlorodibromomethane	UG/L	0.4	1			7.85	16.6	11.9
Chloroform (Trichloromethane)	UG/L	1	1			4.27	4.26	10.3
Dibromoacetic Acid (DBAA)	UG/L	1	1			1.81	5.88	2.66
Dichloroacetic Acid (DCAA)	UG/L	1	1			2.27	2.3	7.24
Trichloroacetic Acid (TCAA)	UG/L	1	1			-	-	3.46

End Notes:

Listed analytes include only analytes with Federal/California DLRs, MCLs & SMCLs. For summary of all water quality monitoring data, see appendices.

CSD MDL: City of San Diego Water Quality Laboratory minimum detection level, DLR: detection level for reporting, MCL: maximum contaminant level, SMCL: Secondary MCL

[1]DLR, MCL, SMCL are obtained from California OEHHA and SWRCB and apply to drinking water and are for reference only. California MCL and SMCL values may be more stringent than federal standards for drinking water.

[2] Trace metal values were from filtered and unfiltered samples. Differences in values were negligible.

[3] DDW considers 50 pCi/L to be the level of concern for Beta particles.

Severe infrastructure damage caused by earthquake and changes to land use within the CSD source water system are the primary threats to the local source water system. The CSD has worked with other local stakeholder agencies to mitigate potential interruptions or contamination to the source water supply due to infrastructure damage through scheduled system maintenance, system replacement, and upgrades including the Emergency Storage Program (ESP). Changes in land use within the CSD local source water system watersheds including increased land development and agriculture are a potential source of contamination in the watersheds and pose concerns for chronic water quality degradation. Wastewater discharges, particularly if the events are large, severe, or occur in sensitive areas, continue to be a potential major source of pollution.

Point Sources:

- Nutrients, pathogens, organic matter, and gross pollutants from wastewater spills from collection systems, pump stations, and wastewater treatment facilities.
- Nutrients, pathogens, and organic matter from concentrated animal facilities.
- Chemical spills at hazardous waste storage sites or along transportation corridors.

Nonpoint Sources (NPS):

- Sediment, nutrients, chemicals, and pathogens from land development.
- Nutrients and pathogens from failing, older Onsite wastewater treatment systems (OWTS).
- Sediment and nutrients from agricultural areas.
- Sediment and nutrients from burned areas.
- Sediment, nutrients, pathogens, organic matter, and gross pollutants in source water due to overall increased population and recreational usage.

The CSD owns about 7% of the total area within its local watersheds with less than 5% of the total area falling within San Diego city limits. Consequently, most of the watershed area is outside the CSD jurisdiction for land use planning, zoning, building codes, and enforcement of environmental regulations. This land ownership portfolio limits the watershed management and control practices available to the CSD in 93% of the area within its local watersheds to public outreach, monitoring land use and permitted activities, and interjurisdictional coordination with other agencies and stakeholders. In areas under the CSD jurisdiction, actions and activities with the potential to generate source water pollution are managed and controlled directly. Watershed management and control practices include public outreach, monitoring land use and permitted activities, interjurisdictional coordination with other agencies and stakeholders, ordinances, permits, implementation and maintenance of structural and non-structural Best Management Practices (BMPs), source water quality monitoring, watershed protection and restoration projects, and special studies.

Review of Recommendations from the 2015 CSD Watershed Sanitary Survey

The theme of all recommendations is protection of the watershed and source water quality.

Watershed Areas Under CSD Jurisdiction

Maintain coordination with other agencies and stakeholders on issues regarding the potential impacts to local source water quality.

The CSD is involved in interjurisdictional coordination with neighboring agencies and agencies with overlapping jurisdictions, and co-permittees through the development of source water protection policies, and participation in workgroups and watershed plan committees. Project Clean Water provides the public with information regarding area water quality and efforts to protect it while allowing for additional cooperation and coordination between San Diego Region Municipal Separate Storm Sewer Systems (MS4) co-permittees to supplement and enhance water quality outcomes (http://www.projectcleanwater.org).

Continue to screen land use and water quality permit activities.

The CSD is involved in the Integrated Regional Water Management (IRWM) which is a collaborative effort aimed at developing long-term water supply reliability, improving water quality, and protecting natural resources (https://www.sdirwmp.org).

Maintain public outreach signage installed in several transportation corridors to educate travelers and residents that they are currently within watershed boundaries and to help protect the resource.

The CSD maintains public outreach signage installed in several transportation corridors to educate travelers and residents that they are currently within watershed boundaries and to help protect the resource.

Continue stakeholder participation in the Regional Quagga Mussel Working group.

The CSD participates in the Regional Quagga Mussel Working group.

Watershed Areas Not Under CSD Jurisdiction

Continue to routinely survey, monitor, and limit the use of resources including water quality, land conditions, and land use, with emphases to meet all regulatory requirements and efficiently obtain the necessary information to make evaluations on water quality, identify trends in degradation, isolate sources of contamination, and determine effects of management practices.

The CSD monitors source water quality in El Capitan, San Vicente, Otay, and Hodges watersheds, all CSD reservoirs, and WTP influents, and surveys land use and conditions in areas under CSD jurisdiction to meet all regulatory requirements and efficiently obtain the necessary information to make evaluations on the water quality, identify trends in degradation, isolate sources of contamination, and determine effects of management practices. The CSD limits access to and use of CSD resources.

Initiate an acute event source water monitoring program for specific events (such as rain, fires, and spills) that could directly impact the CSD local source water.

The CSD monitors source water in reservoirs and watersheds during specific events that could directly impact the CSD local source water, although it does not have a formal acute event monitoring program.

Formulate a watershed land strategy to acquire parcels, conservation easements, or development rights for lands proximal to the source waters that, if preserved, would protect water quality.

The CSD does not have a formal strategy to acquire parcels, conservation easements, or development rights for lands proximal to the source waters that, if preserved, would protect water quality.
Continue public involvement and maintain established signage and public education material as to the importance of protecting the source water; ensure that it is readily available, accurate, and appropriate.

The CSD has a public education and involvement program (https://www.sandiego.gov/thinkblue) and uses signage that is accurate and appropriate in and around all recreational areas to increase the public awareness of the importance of watershed protection and protection of water quality.

Continued public outreach to promote awareness of quagga and zebra mussels, including personal prevention activities, by providing signage, pamphlets, posters and other publications supplied CDFW at infested and non-infested reservoirs.

The CSD does not provide public outreach pamphlets, posters, or other publications to promote awareness of quagga and zebra mussels. The CSD provides quagga and zebra mussel public awareness information at https://www.sandiego.gov/reservoirs-lakes and has public outreach signage at all CSD source water reservoirs.

Install additional signage at source water reservoirs to discourage the public feeding of animals.

The CSD has installed signage at Murray and Miramar reservoirs to discourage the public feeding of animals.

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CHAPTER 1
INTRODUCTION

1.1 Requirements of the Watershed Sanitary Survey (WSS)

The California Surface Water Treatment Rule (CA ADC § 64665) requires every public water system using surface water to conduct a comprehensive sanitary survey of its watersheds. The purpose of the survey is to identify actual and potential sources of contamination along with any other watershed-related factor(s) which might adversely affect the quality of water used for domestic drinking water. The initial Watershed Sanitary Survey (WSS) was completed January 1, 1996 and is to be updated every five years thereafter.

1.2 Objectives of the Watershed Sanitary Survey

The objectives of this WSS Update are to:

- Satisfy the regulatory requirement for a watershed sanitary survey.
- Provide a description of the City of San Diego (CSD) source water system.
- Provide a physical and hydrogeological description of the watersheds.
- Provide a description of activities and potential sources of contamination in the watersheds.
- Provide a summary of source water quality monitoring data.
- Provide a description of any significant changes which could affect source water quality, watershed control, and management practices, and recommendations for improvement to protect source water quality.

1.3 Conduct of the Watershed Sanitary Survey

The CSD Public Utilities Department staff produced this update of the WSS using CA ADC § 64665 and guidelines established by the American Water Works Association (AWWA). Staff reviewed various categories of information including aerial photographs, GIS data, water quality data, regulatory websites, reports, and other documents of record. This information was then supplemented with interviews, field surveys, and personal knowledge of CSD Public Utilities Department staff.

1.4 Laws and Regulations

The CSD is subject to federal, state, and local laws and regulations related to water quality. These policies are designed to develop, strengthen, and expand the protection of water quality, as well as to address existing and emerging related concerns. The Water Commission Act of 1913 established the current permit process and created the agency that evolved into the (SWRCB). The Dickey Act established nine Regional Water Pollution Control Boards which evolved into (RWQCBs) located in each of the major California watersheds. The SWRCB and the nine RWQCBs are charged with implementing provisions and have primary responsibility for protecting water quality in California. The SWRCB provides program guidance and oversight, allocates funds, and reviews RWQCB decisions. In addition, the SWRCB allocates rights to the use of surface water. The RWQCBs have primary responsibility for individual permitting, inspection, and enforcement actions within each of nine hydrogeologic regions.

Federal Water Pollution Control Act / Clean Water Act (CWA)

The Federal Water Pollution Control Act (33 U.S.C § 1251 et seq.), known as the Clean Water Act, is the principal federal statute for water quality protection. The goal is to restore and maintain the chemical, physical, and biological integrity of the nation's waters. The CWA establishes national uniform standards for regulating discharges of pollutants into the waters of the United States and water quality standards for surface waters. For point source discharges to surface water, the CWA authorizes the U.S. Environmental Protection Agency (U.S. EPA) and/or approved states (including California) to administer the National Pollutant Discharge Elimination System program (NPDES). For NPS, states are required to develop assessment reports that describe the states' NPS problems, establish management programs, and address these problems. The CWA requires the state to adopt surface water quality standards and to submit those standards for approval by the U.S. EPA. In California, the SWRCB and the nine RWQCBs implement many of the CWA's provisions.

Porter-Cologne Water Quality Control Act (California Water Code)

The Porter-Cologne Act (CA WAT § 13000 et seq.) is the principal law governing water quality regulation in California. This Act establishes a comprehensive program to protect water quality and the beneficial uses of water. The goal is to protect the quality of all the waters of the state and regulate activities and factors which may affect the quality of the waters of the state to attain the highest water quality which is reasonable. The Porter-Cologne Act applies to surface waters, wetlands, groundwater, and to both point source and nonpoint source pollution.

The Porter-Cologne Act also requires adoption of water quality control plans that contain the guiding policies of water pollution management in California. Several statewide water quality control plans have been adopted by the SWRCB. In addition, regional water quality control plans (basin plans) have been adopted by each of the RWQCBs. Portions of water quality control plans including the water quality objectives and beneficial use designations are subject to review by the U.S. EPA; when approved, they become water quality standards under the CWA.

State Water Resources Control Board Antidegradation Policy

A key policy of California's water quality program is the State's Antidegradation Policy. This policy, formally known as the Statement of Policy with Respect to Maintaining High Quality Waters in California (State Water Resources Control Board Resolution No. 68-16), restricts degradation of surface and groundwaters. This policy protects water bodies where existing quality is higher than necessary for the protection of beneficial uses. Under the Antidegradation Policy, any actions that can adversely affect water quality in all surface and groundwaters must be consistent with maximum benefit to the people of the state, not unreasonably affect present and anticipated beneficial use of the water, and not result in water quality less than that prescribed in water quality plans and policies. Furthermore, any actions that can adversely affect surface waters are also subject to the Federal Antidegradation Policy developed under the CWA.

Federal Safe Drinking Water Act (FSDWA)

The Federal Safe Drinking Water Act (42 U.S.C. § 300(f) et seq.) establishes national uniform standards for drinking water quality. The goal is to protect the quality of drinking water and its sources in the United States. The FSDWA focuses on all waters actually or potentially designed for drinking use, whether surface water or groundwater. To ensure that drinking water is safe, FSDWA sets up multiple barriers against pollution. These barriers include, but are not limited to, source water protection, treatment, distribution system integrity, and public information. The FSDWA authorizes the U.S. EPA to establish national health-based standards to protect tap water and requires all owners or operators of public water systems to comply with these primary standards. The National Primary Drinking Water Regulations set enforceable maximum contaminant levels for specific contaminants in drinking water or required ways to treat water to remove contaminants. The most direct oversight of water systems can be conducted by state drinking water programs. For the authority to implement FSDWA within their jurisdictions, states can apply to the U.S. EPA for "primacy" and must show that they will adopt standards at least as stringent as the U.S. EPA's and confirm water systems meet these standards. States acting as a primacy agent, California being one, must make sure water systems test for contaminants, review plans for water system improvements, conduct on-site inspections and sanitary surveys, provide training and technical assistance, and act against water systems not meeting standards.

California Safe Drinking Water Act (CSDWA)

California Safe Drinking Water Act (CA HSC § 116270 et seq.) requires the SWRCB to administer laws relating to drinking water standards, water quality testing programs, and permits for public water system operations. The goal is to improve laws governing drinking water quality, to improve upon the minimum requirements of the FSDWA, to establish primary drinking water standards that are at least as stringent as those established under the FSDWA, and to establish a program that is more protective of public health than the minimum federal requirements.

Federal Surface Water Treatment Rules (FSWTRs)

The purpose of the Federal Surface Water Treatment Rules (40 CFR § 141.70 et seq.) is to eliminate illnesses caused by specific pathogens in drinking water. FSWTRs apply to all public water systems using surface water or groundwater under the direct influence of surface water and requires water systems to filter and disinfect surface water sources. FSWTRs establish treatment techniques in lieu of maximum contaminant levels for turbidity and specific microbial contaminants by the means of a series of water treatment processes that provide for both removal and inactivation of waterborne pathogens.

California Surface Water Treatment Rules (CSWTRs)

The California Surface Water Treatment Rules (CA ADC § 64650) authorize the SWRCB to adopt and implement the FSWTRs and require any public water system using surface water, or groundwater under the direct influence of surface water, to provide a multiple barrier process to reliably protect users, and to comply with all requirements and performance standards.

Endangered Species Act (ESA)

The Endangered Species Act (16 U.S.C. § 1531 et. seq.) provides a program for the conservation of threatened and endangered plants and animals and the habitats in which they are found. San Diego County shelters approximately 200 imperiled plants and animals—more than in any other county in the nation. Once species are listed as threatened or endangered, this Act mandates that two basic requirements must be met: no taking of the species is allowed and any activity that could affect species requires consultation with the CDFW and the United States Fish and Wildlife Service (USFWS).

1.5 Basic Water Rights

In California, water use and supplies are controlled and managed under an intricate system of federal and state laws. These laws, court decisions, rules, regulations, contracts, and agreements all govern how water is allocated, developed, and used. All water belongs to the state; other entities may obtain rights for water use but cannot obtain ownership. The California Constitution (CA Constitution art X § 2) requires that all uses of the state's water be both reasonable and beneficial and prohibits the waste, unreasonable use, unreasonable method of use, or unreasonable method of diversion of water. These beneficial uses include municipal and industrial uses, irrigation, hydroelectric generation, livestock watering, recreational uses, and fish and wildlife protection.

Table 1.1 - Beneficial Uses assigned to City of San Diego Reservoirs/Lakes

California Regional Water Quality Control Board: Water Quality Control Plan for the San Diego Basin (9) with amendments effective on or before May 17, 2016 (Table 2-4)

	Beneficial Use												
Reservoirs & Lakes	**MUN**	**AGR**	**IND**	**PROC**	**FRSH**	**REC 1**	**REC 1***	**REC 2**	**WARM**	**COLD**	**WILD**	**RARE**	**POW**
Lake Hodges	Y	Y	Y	Y	-	(F)	Y	Y	Y	Y	Y	Y	-
Sutherland Lake	Y	Y	Y	Y	-	(F)	-	Y	Y	Y	Y	Y	-
Miramar Lake	Y	-	Y	-	-	(F)	-	Y	Y	-	Y	-	Y
Lake Murray	Y	-	Y	-	-	(F)	-	Y	Y	Y	Y	-	Y
San Vicente Reservoir	Y	Y	Y	Y	-	(F)	Y	Y	Y	Y	Y	-	-
El Capitan Reservoir	Y	Y	Y	Y	-	(F)	Y	Y	Y	Y	Y	Y	-
Lower Otay Reservoir	Y	Y	Y	Y	-	(F)	-	Y	Y	Y	Y	-	-
Upper Otay Reservoir	Y	Y	Y	Y	-	Y	-	Y	Y	Y	Y	-	-
Lake Barrett	Y	Y	Y	Y	Y	Y	-	Y	Y	Y	Y	Y	-
Morena Reservoir	Y	Y	Y	Y	Y	(F)	-	Y	Y	Y	Y	Y	-

End Notes:

MUN: Municipal and Domestic Supply, **AGR:** Agricultural Supply, **IND:** Industrial Service Supply,
PROC: Indurial Process Supply, **FRSH:** Freshwater Replenishment, **REC 1:** Contact Water Recreation (F)ishing only,
REC 1*: Limited Body Contact Recreation (permit 2018), **REC 2:** Non-contact Water Recreation,
WARM: Warm Freshwater Habitat, **COLD:** Cold Freshwater Habitat, **WILD:** Wildlife Habitat,
RARE: Rare, Threatened, or Endangered Species, **POW:** Hydropower Generation

Surface Water

California operates under a dual system of Riparian and Appropriative rights for surface water. When California entered the Union in 1850, one of the first actions taken by its lawmakers was to adopt the law of riparian rights; one year later, the Legislature recognized the appropriative rights system.

Riparian rights grant the owner of land contiguous to a stream the right to use water from the stream, including the right to divert, but not to store, a portion of water flowing by owner's land for reasonable and beneficial use subject to certain limitations. While riparian rights require no permits or licenses, they apply only to the water that would naturally flow in the stream and in general, during times of water shortages, all riparian users must reduce their diversion of water. Riparian rights remain with the property when it changes hands. Riparian rights have a higher priority than appropriative rights.

Appropriative rights grant an entity the right to divert, store, and use water on land without regard to the relationship of land to water provided the water is for reasonable and beneficial uses and is surplus to water from the same stream used by earlier appropriators. The rule of priority between appropriators is "first in time is first in rights". This practice allows for water use based on physical control and beneficial use of the water. If the land is not riparian, a permit issued by the SWRCB is required. These rights are entitlements to a specific amount of water with a definite date of priority and may also be sold or transferred. The SWRCB can temporarily grant water rights and change those already granted particularly during droughts or other emergencies. In times of drought and limited supply, the most recent (junior) right holder must be the first to discontinue use; each right's priority dates to the time the permit application was filed with the SWRCB.

The Water Commission Act, enacted in 1914, established a system of state-issued permits and licenses to appropriate water and created the agency that evolved into the SWRCB which was given the authority to administer the process. The permitting and licensing provisions do not apply to appropriative rights initiated before 1914. The CSD's water rights on the Cottonwood Creek and the Otay River are pre-1914 appropriative rights. The CSD's water rights on the San Dieguito River are post-1914 appropriative rights.

The Public Trust Doctrine establishes that certain resources are held to be the property of all citizens and subject to continuing supervision by the state. The state must balance public trust needs with the needs for other beneficial uses. California law has defined public trust uses to include recreational and ecological values such as protection of fish, wildlife, and habitat, and recreation. The California Supreme Court held that California water law is an integration of both public trust and appropriative right systems, and that all appropriations may be subject to review if changing circumstances warrant their reconsideration and reallocation.

Pueblo Water Rights are a paramount water right granted by the King of Spain when California was under Spanish rule and were affirmed by the California Supreme Court. The CSD owns paramount rights to surface and groundwater resources of the San Diego River.

Adjudicated rights supersede all others and are rights the courts have adjudicated to some watersheds and groundwater basins.

Reserved rights are for water set aside by the Federal Government when it reserves land for the public domain.

Contractual entitlements are not water rights. A contractual entitlement is created by means of a contract between the appropriative water right holder and another entity that will take delivery of water diverted by means of the water right. Much of the water used in the state is not directly authorized under water rights but under contracts between users and agencies with water rights. For example, the Helix Water District (HWD), through an agreement with the CSD, shares yield of the San Diego River.

Groundwater

Generally, entities that own land also have a right to use the groundwater underlying that land unless the basin is subject to Pueblo Rights or adjudication. Management of groundwater in California is accomplished by either judicial court decisions, adjudication of the respective rights of groundwater users and exporters, or by local management of groundwater rights authorized by statute or agreement.

1.6 Historical Background of Water Development

The period from 1835 to 1885 is best characterized by the lack of any coordinated or planned development of a water supply. From 1834 to 1872 almost all water was obtained from wells in the New Town (which is now Downtown San Diego) and from the San Diego River hauled by individual water carriers. 1873 marked the first planned development of water system with the incorporation of the San Diego Water Company (SDWC). Beginning about 1889 developers, investors, and speculators formed companies to plan and develop immense surface water conservation projects. At the turn of the last century, about 1900 to 1925, the CSD began purchasing some of the properties of the existing water companies to ensure a reliable water supply for its population. From 1926 to 1935, the CSD developed the surface supply from the San Diego River and began to look toward the Colorado River for an imported supply of water. From 1940 to 1978 the CSD developed the imported water supply from the Colorado River and Northern California. From 1989 to now the CSD focuses on upgrading water treatment infrastructure and expanding the local water supply less likely impacted by drought.

1850 California becomes a state, and the City of San Diego (CSD) is incorporated.

1873 The SDWC is formed to provide an organized water supply to serve a population of approximately 2,000. The first works of this company were artesian wells and reservoirs chiefly consisting of a well in Pound Canyon with the capability of delivering 54,000 gallons per hour and two reservoirs with a combined capacity of 170,000 gallons; these works combined with approximately 18,000 feet of distribution pipe were the first waterworks in San Diego.

1875 The SDWC piped water to San Diego from wells in the San Diego River for the first time. The project included lifting water 300 feet from wells in Mission Valley to a new reservoir in the community of University Heights.

1887 Old Town Reservoir was built to store water from 12 wells located in the San Diego River adjacent to the old Presidio near Old Town.

- Cuyamaca Dam is completed.

1889 The San Diego Flume Company completed a 35.6-mile wooden flume to transport surface water from Cuyamaca Reservoir (an artificial lake built on the side of Cuyamaca Mountain with capacity of 11,740 Acre Feet (AF) located about 50 mi. from San Diego at an elevation of about 5,000 feet). Surface water supply from local mountains is transported to San Diego for the first time.

1890 The SDWC expanded the distribution pipeline network and laid new pipes for almost the entire system which exceeded 60 mi. and included 185 fire hydrants.

1897 The Southern California Mountain Water Company (formerly the Otay Water Company) completed Lower Otay Dam and began construction of Morena Dam to develop water in the Otay River and Cottonwood Creek watersheds.

1898 Work is suspended on Morena Dam.

1901 Following a vote of the people, the CSD purchased the holdings of the SDWC that lay within the city limits creating the municipal water system.

- The Southern California Mountain Water Company completed a pipeline to transport water from Lower Otay Reservoir northward to a new reservoir at Chollas Heights with additional branch lines to supply farmers in the Otay Valley and residents of Coronado. Chollas Heights Reservoir was an artificial lake created by construction of an earth-fill dam with a steel and masonry core and held enough water to supply San Diego for two months.

1905 The CSD agreed to a new contract with the Southern California Mountain Water Company. Under the terms of the contract, the city obtained its entire supply of water from mountain reservoirs in the Otay River and Cottonwood watersheds via the Lower Otay Reservoir.

1906 The Lower Otay water supply is connected to the CSD distribution system by the Bonita Pipeline to a filtration plant located at Chollas Heights Reservoir.

1909 Construction on Morena Dam resumed.

1910 The Cuyamaca Water Company purchased the San Diego Flume Company.

1912 The CSD purchased the Otay River-Cottonwood Creek System from the Southern California Mountain Water Company including Upper and Lower Otay dams, Barrett Dam site, reservoir lands, and pipelines with service commitments to the Coronado Water Company customers. The Coronado Water Company is succeeded by California-American Water Company which serves the cities of Coronado, Imperial Beach, and the CSD South Bay service area to this day.

- Morena Dam is completed.
- The City of East San Diego is incorporated.

1914 CSD purchased Morena Dam and reservoir land.

- Otay Water Treatment Plant began operations.

1916 The Lower Otay Dam failed resulting in flooding and loss of lives downstream when heavy seasonal rainfall and corresponding runoff (referred to as the Hatfield Floods) overtopped the dam.

1917 Morena Dam is raised 5 feet.

1918 San Dieguito Mutual Water Company/Santa Fe Land Improvement Company completed Hodges and San Dieguito dams to develop water in the San Dieguito River Watershed.

- The 4-mile-long Hodges Flume is constructed to convey water from Hodges Reservoir to San Dieguito Reservoir.
- Lake Murray Dam is completed by the Cuyamaca Water Company.

1919 Lower Otay Dam (Savage Dam) reconstruction is completed.

1920 The CSD contracted for water from Hodges Reservoir to supply the La Jolla area.

1922 Barrett Dam and the Dulzura Conduit are completed to link Morena Reservoir and the Cottonwood Creek/Pine Creek watersheds with the CSD water supply system at Lower Otay Reservoir.

1923 Morena Dam is raised 10 feet.

1925 The CSD purchased the San Dieguito River Watershed System including Hodges and San Dieguito Dams, Pamo and Sutherland Dam sites, reservoir lands, and pipelines with service commitments to the San Dieguito, Rancho Santa Fe, and Del Mar areas.

1926 Voters approved a bond issue to construct a dam at the Sutherland site and a diverting dam at San Vicente.

- The CSD formally applied to the State Division of Water Resources for a right to 112,000 AF annually from the Colorado River.
- The La Mesa, Lemon Grove, and Spring Valley Irrigation District purchased Lake Murray Dam, reservoir land, and El Capitan Dam site from the Cuyamaca Water Company. The La Mesa, Lemon Grove, and Spring Valley Irrigation District subsequently becomes the Helix Irrigation District then the Helix Water District.

1927 The Mission Valley well fields, along with 19 additional wells provided water to the CSD from the Upper San Diego River in the Lakeside/Riverview area.

1928 The Metropolitan Water District of Southern California (MWD) is formed to bring Colorado River water to Southern California; the CSD is not a member.

- Construction of Sutherland Dam is halted.

1930 The U.S. Supreme Court determined the CSD has prior and paramount rights to the water of the San Diego River.

- The Secretary of Interior approved the Seven Party Agreement of 1930 which allocates Colorado River water among California users, including the CSD.
- Morena Dam is raised 4 feet.

1932 A settlement is achieved in which the La Mesa, Lemon Grove, and Spring Valley Irrigation District received rights to the first 27 cubic feet per second (CFS) flow of the San Diego River and 10,000 AF of storage capacity in the El Capitan Reservoir. The CSD received the remaining yield of the river, land for the El Capitan and Mission George dam sites, and 5,000 AF of storage capacity in Lake Murray.

1934 The CSD entered into a contract with the Secretary of Interior to provide for a 155 CFS capacity in the All-American Canal to convey its 112,000-acre feet per year (AFY) of Colorado River water allocation.

- The CSD completed construction of El Capitan Dam and the El Capitan Pipeline connecting it to the CSD water supply system. After the El Capitan Dam and Reservoir were completed, the Lakeside/Riverview well fields serve as drought reserve.

1935 University Heights Filtration Plant was expanded.

1936 The CSD decommissioned water well fields operating in Mission Valley.

1940 Voters approved funding for San Vicente Dam.

1941 Colorado River Aqueduct is completed.

1943 San Vicente Dam and pipelines are completed.

1944 The CSD along with six water districts and cities formed the San Diego County Water Authority (SDCWA). The purpose is to complete a pipeline connecting the county to the MWD water supply system and distribute the water supply regionally.

1946 SDCWA joined the MWD; the CSD merges its Colorado River water rights with MWD and is annexed to the MWD service area.

- Morena Dam spillway crest is raised 2 feet.

1947 The First San Diego Aqueduct, Pipeline 1, is completed and the first MWD water from the Colorado River Aqueduct flows into San Vicente Reservoir ending San Diego's total dependence on local sources for water.

1950 The CSD took over the operation of Murray Reservoir and commissions the Alvarado Filtration Plant adjacent to Murray Reservoir due to availability of both local and imported water provided by completion of the First San Diego Aqueduct. The water treatment plants at University Heights and Chollas Heights are decommissioned.

1954 Sutherland Dam, dormant since 1928, is completed and connected by pipeline and natural streambeds to San Vicente Reservoir.

- The First San Diego Aqueduct, Pipeline 2, connecting the Colorado River Aqueduct to San Vicente Reservoir is completed.

1956 South San Diego, Nestor, San Ysidro, and part of Otay Mesa are annexed to the CSD.

1960 The Miramar Dam is completed, and the Miramar Filtration Plant is put into commission.

- The Second San Diego Aqueduct, Pipeline 3, connecting the Colorado River Aqueduct to Miramar, Murray, and Lower Otay Reservoirs is completed.
- Lake Murray is purchased from Helix Irrigation District.

1969 The CSD sold the San Dieguito Conduit (from Lake Hodges to San Dieguito Lake), the San Dieguito Dam and Reservoir, and portions of the Lockwood Mesa-Torrey Pines Pipeline outside of San Diego city limits to the San Dieguito Water District and the Santa Fe Irrigation District.

1971 The Second San Diego Aqueduct, Pipeline 4, connecting the Colorado River Aqueduct to Miramar, Murray, and Lower Otay Reservoirs is completed.

1978 San Diego begins receiving water from Northern California through the State Water Project. The first water from the California Department of Water Resources (DWR) California Aqueduct reaches San Diego via MWD and SDCWA facilities.

1989 The Otay Water Treatment Plant is upgraded and expanded making more local water available to the CSD south and central service areas.

1997 The North City Water Reclamation Plant is completed. The plant has the capacity to process 30 million gallons per day of wastewater into reclaimed water for irrigation and industrial uses.

2002 The South Bay Water Reclamation Plant is completed. The plant has the capacity to process 15 million gallons per day of wastewater into reclaimed water for irrigation and industrial uses.

2003 The Colorado River Quantification Settlement Agreement (QSA) is signed. The QSA includes a water transfer between the Imperial Valley and San Diego for 35 years and the lining of approximately 23 mi. of All-American Canal to save 67,700 AFY of water lost through seepage in the existing earthen canal. Of the water conserved, 56,200 AF will flow annually to the SDCWA and the remaining 11,500 AF will go to the San Luis Rey Indian Settlement Parties for the next 110 years.

2007 The San Diego City Council authorized the Water Reuse Demonstration Project. The Demonstration Project consists of a one-million gallon per day advanced recycled water treatment plant at the North City Water Reclamation Plant.

2009 The CSD Water Department and Metropolitan Wastewater Department merge and became the CSD Public Utilities Department.

2010 Initial phases of the Water Treatment Plant Expansion and Improvement Projects are completed which include the conversion of the primary disinfection treatment method from free chlorine to chlorine dioxide at Otay WTP and to ozone at Alvarado WTP and Miramar WTP.

- San Vicente Reservoir is connected to the Second San Diego Aqueduct.

2012 The Hodges Reservoir is connected to the SDCWA Olivenhain Reservoir making the water available regionally.

2015 The Claude “Bud” Lewis Carlsbad Desalination Plant capable of providing 56,000 AFY of desalinated seawater is connected to the Second San Diego Aqueduct.

2016 San Vicente Dam is raised 117 feet: more than doubling the capacity of the original reservoir with new instrumentation, outlet facilities, and marina.

2017 The San Diego City Council approved forming a Groundwater Sustainability Agency and the preparation of a groundwater sustainability plan for San Pasqual Valley Groundwater and the San Diego River Valley Groundwater basins to comply with the requirements of the Sustainable Groundwater Management Act.

2018 The CSD began to receive an estimated 2,600 AFY of desalinated groundwater from the Richard A. Reynolds Groundwater Desalination Facility.

- The San Diego City Council voted to move forward with Phase 1 of the Pure Water Program. Pure Water San Diego is the CSD phased multi-year water recycling program that will provide a substantial amount of the water supply locally by the end of 2035.

2020 The RWQCB9 approves the NPDES permit to add purified water generated through the Pure Water Program to Miramar Reservoir.

- Hypolimnetic Oxygenation System is installed in Hodges Reservoir to improve water quality and reliability.

CHAPTER 2

DESCRIPTION OF THE SOURCE WATER SYSTEM

The CSD water system has evolved into a complex system. The CSD treats water from various sources including groundwater, imported water, and local surface runoff. The CSD treats water by conventional technologies using coagulation, flocculation, sedimentation, filtration, and disinfection. To ensure safe and palatable water quality, the CSD collects water samples at its reservoirs, water treatment plants, and throughout the treated water storage and distribution system.

Table 2.1 - City of San Diego Water System Overview

CSD

U.S. Census Bureau

San Diego County Estimated Population (U.S. Census Bureau: July 1, 2019)	3,338,330
CSD Estimated Population (U.S. Census Bureau: July 1, 2019)	1,423,851
Area CSD	372.4 sq.mi.
Local Source Water System	
Area Watershed/Source Water System	921 sq.mi.
Number of Surface Water Impoundments (Reservoirs)	9
Combined Capacity of City Reservoirs	566,239 AF
Precipitation at CSD Reservoirs (Historical Annual Average)	15.6 in.
Total Runoff (Historical Average)	94,759 AFY
Evaporation Loss (Historical Average)	54.4 in.
Treatment and Distribution System	
Number of Water Treatment Plants	3
Number of Pump Stations	49
Number of Treated Water Storage Facilities	29
Pipeline	3,300 mi.
Number of Service Connections	282,027
Area Water Distribution	404 sq.mi.

The use of local and imported water by the CSD to meet water demand is affected by availability, cost, and water resource management policies. Imported water availability decreases the need to carry over local water for dry years in the CSD reservoirs. The policy of the CSD is to use local water first to reduce imported water purchases; this strategy runs the risk of increased dependence on imported water during local droughts.

2.1 Water Sources

Most water development in California has been dictated by the multi-year wet/dry weather cycles. Records indicate that extremely dry periods frequently last several years both locally and throughout California.

During wet years, excess surface runoff is impounded in surface water reservoirs. Surface runoff in dry years is generally insufficient to meet environmental requirements and riparian water rights in their natural water watersheds; therefore, during droughts all imported and local water comes from reservoir or groundwater storage. The CSD is developing major new sources of water supply less likely to be impacted by drought including desalination and PURE Water.

Groundwater

The CSD is planning or developing several groundwater basins for municipal water supply and other beneficial uses. The California Sustainable Groundwater Management Act of 2014 (SGMA) provides a framework for sustainable management of groundwater supplies by local authorities. SGMA empowers local agencies to form Groundwater Sustainability Agencies (GSAs) to manage basins sustainably and requires those GSAs to adopt Groundwater Sustainability Plans (GSPs) to avoid undesirable impacts, such as seawater intrusion, chronic depletion of groundwater, reduction of groundwater storage, degradation of water quality, depletion of surface water, or land subsidence.

The CSD has two groundwater basins that are governed by SGMA legislation: San Pasqual Valley Groundwater Basin and the San Diego River Valley Groundwater Basin.

Imported Water

Imported raw water originates either from the Colorado River or the Feather River in the Sacramento River Watershed. Precipitation on these watersheds has similar seasonal (winter/summer) and cyclical (wet/dry year) patterns to those of local watersheds. In most years, the winter snowpack in the mountain ranges of the watersheds stores a significant amount of water until early summer. This snowpack storage in combination with reservoir storage helps the CSD meet seasonal summer demand. To avoid water shortages during cyclical droughts, reservoirs are used to store water from wet years to dry years.

Imported water has historically accounted on average for 80% of the CSD's annual water use. Imported water is delivered by federal, state, and regional agencies; these agencies are the United States Bureau of Reclamation, the State of California Department of Water Resources, MWD, and SDCWA.

Local Surface Water

In their natural conditions local streams and rivers are ephemeral or intermittent. During the summer, seepage under dams and irrigation runoff are major sources of water in many streambeds. On average, 90% of the annual rainfall occurs between the months of November and April and 93% of local runoff occurs from December through May.

Table 2.2 - Climate Data for San Diego (Lindbergh Field)

National Oceanic and Atmospheric Association

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Average high (°F)	65.8	66.3	66.3	68.7	69.3	72.2	75.8	77.5	77	74	69.9	66.3	70.8
Daily mean (°F)	57.8	58.9	60	62.6	64.6	67.4	70.9	72.5	71.6	67.6	61.8	57.6	64.4
Average low (°F)	49.7	51.5	53.6	56.4	59.8	62.6	65.9	67.4	66.1	61.2	53.6	48.9	58.1
Rainfall (in)	2.28	2.04	2.26	0.75	0.2	0.09	0.03	0.09	0.21	0.44	1.07	1.31	10.77
Avg. rainy days (≥ 0.01 in)	7.2	6.6	7.2	4.1	2	1.1	0.6	0.6	1.5	2.8	4	5.2	42.9

Local surface runoff has historically accounted on average for 20% of the CSD's annual water use. Local water use varies greatly due to the variation of annual local runoff.

Table 2.3 - City of San Diego Water Use 2016 - 2020

CSD

Fiscal Year	Local Volume (AF)	Percent	Imported Volume (AF)	Percent	Total Production (AF)
2020	19,286	11%	150,577	89%	169,863
2019	21,005	12%	152,187	88%	173,191
2018	22,015	12%	155,923	88%	177,938
2017	18,547	10%	162,186	90%	180,733
2016	16,464	10%	155,329	90%	171,794
2016-2020 Total	97,317	11%	776,202	89%	873,519
2016-2020 Average	19,463	-	155,240	-	174,704
2011-2015 Total	90,181	9%	880,491	91%	970,671
2011-2015 Average	18,036	-	176,098	-	194,134

The total annual CSD water demand may be served by local water in an average of one out of 10 years. The region needs rainfall levels at about the annual average to sufficiently saturate the soils so that significant surface runoff can occur. Consequently, most of the runoff to the CSD reservoirs is produced in years with much greater than average rainfall. About one half of the total runoff into the CSD reservoirs is produced during the wettest 10% of the years. Some flooding may occur during years with average or below average rainfall levels if the annual rainfall volume is concentrated in a few intense storms. The highly variable wet and dry cycles require a large water storage capacity in comparison to the average annual water yield for conservation of surface runoff. In dry years, surface runoff from local watersheds is generally less than loss due to evaporation from local reservoirs.

Historically, about 40% of the local runoff is used for the municipal water supply. Local water use is much less than the long term average annual runoff into reservoirs due to losses which include limited reservoir capacity to conserve all local runoff during wet years resulting in loss over dams, limited pipeline capacity between reservoirs and WTPs resulting in losses due to evaporation during prolonged storage in less efficient reservoirs, and groundwater recharge when water is transferred between reservoirs via streambeds.

2.2 Source Water Reservoirs

Reservoir storage is necessary to balance seasonal and cyclical variations in the water supply volume with the variability in sources and demands. The CSD's total reservoir capacity is more than double the amount of water the CSD uses annually.

Table 2.4 - City of San Diego Reservoir Information

CSD
SDCWA
DWR-CDEC
SanGIS

Reservoir	Water source	Primary Storage Function *	Storage Capacity (AF)	Surface Area at Capacity (ac.)	Watershed Area (ac.)	Average Annual Rainfall (in)	Average Annual Runoff (AF)	Historical Average Annual Evaporation (in)
Murray	Second Aqueduct, upstream releases	E,O	4,684	168	2,298	11.74	70	48.66
San Vicente	First Aqueduct, natural runoff, upstream releases	E,I,O	249,358	1,676	47,622	15.22	7,269	57.74
El Capitan	First Aqueduct, natural runoff	E,I,O	112,807	1,562	120,335	16.1	24,922	60.69
Sutherland	Natural runoff	I	29,508	555	34,552	22.06	10,155	51.09
Otay	Second Aqueduct, natural runoff, upstream releases	E,O,I	47,067	1,035	69,117	11.36	6,431	53.14
Barrett	Natural runoff, upstream releases	I	34,806	801	83,257	16.8	11,667	51.12
Morena	Natural runoff	I	50,694	1,547	73,543	19.75	9,332	60.26
Miramar	Second Aqueduct	E,O	6,682	274	645	12.92	29	50.37
Hodges	First Aqueduct, natural runoff	E,I	30,633	1,121	158,278	14.09	24,884	56.5

Endnotes:

*E: Emergency Storage, I: Impounding Storage, O: Operational Storage

Rainfall data is collected at each reservoir by the CSD Public Utilities Department. Runoff data is calculated monthly by using the measured amount of rainfall, rain on the surface of the reservoir, evaporation, draft, storage, dam leaks, change in reservoir level, and other calculated inputs.

The conservation of local runoff with the least amount of loss requires coordinated management of CSD reservoirs involving a need to consider the following: local weather patterns, watershed characteristics, storage capacity, and the efficiency of the reservoirs. Under ideal conditions, all water storage would occur in reservoirs with the lowest probability of spillage during the winter and with the lowest evaporation loss during the summer. Ninety-three % of local runoff occurs from December through May, and 94% of the net evaporation occurs from June through December. This seasonal wet/dry cycle requires shifting priorities throughout the year between the need to maximize conservation of runoff and the need to minimize evaporative losses. To accomplish this, the CSD drafts water from its reservoirs as quickly as pipeline capacity, water quality, and demand allow until only the required emergency supply remains. While this type of operation saves no water in local reservoirs for dry years, it maximizes local water production by reducing loss due to evaporation and reservoir spills. It is not always possible to achieve this goal due to a lack of adequate transfer facilities, the need to distribute emergency supply to designated areas, and the need to access reservoirs for recreation purposes.

Average runoff produced in the watersheds is generally proportional to the relative size and elevation of the watersheds, however, rainfall and resulting runoff in a given year may vary significantly from the annual average causing unpredictable and significant variations. Consequently, optimization of the multiple reservoir system depends on whether the reservoirs are tributary or parallel; except for Morena, Barrett, and Sutherland, all CSD reservoirs are considered to be parallel.

On parallel reservoirs the storage capacity available to impound runoff is allocated among the reservoirs in proportion to the average annual runoff patterns of their respective watersheds. The amount of storage capacity allocated to each reservoir is determined by its historical percentage contribution of runoff to the system for a calendar year. This method will optimize local water production by providing the highest overall yield.

On tributary reservoirs the lower elevation reservoir may capture spills from the higher elevation reservoir, whereas spills from the lower reservoir will be a loss. Therefore, at the beginning of the rainy season most of the storage capacity available to impound runoff is allocated to the lower elevation reservoir. This practice will result in higher water yield as opposed to allocating the water storage between reservoirs in proportion to the average annual runoff patterns of their respective watersheds.

The location of storage capacity is also determined by the intended purpose. Emergency storage capacity is located as close to the point of use as possible. The purpose of emergency storage is to provide a minimum reserve of water for use during emergencies such as earthquakes, aqueduct failures, or aqueduct pump station outages. CSD Council Policy 400-4 "Emergency Storage of Water" requires the storage of 60% of the annual requirement of the CSD and its contractees as active available storage in Murray, San Vicente, El Capitan, Lower Otay, and Miramar reservoirs. Active, available storage is the portion of the water that is above the lowest usable outlet of each reservoir. Emergency storage is interpreted as a fluctuating requirement from month to month. Consequently, as water demand peaks in summer months, the volume of emergency storage increases; this results in a difference between the April high and October low. To meet this requirement, the CSD reserves up to a seven-month supply of storage capacity for emergency storage. Impounding storage capacity is used as storage to capture runoff and maximize local water yield. Operational storage capacity is located as close to the point of use as possible. Operational storage is the storage of water intended to meet the variability in daily demand of the WTP. Dry-year storage capacity, sometimes called carry-over storage, may be located anywhere along the water delivery system. Dry-year storage is the storage of surplus water in wet and normal years for use in dry years to produce a more dependable water supply. The water is stored for many years to provide water during the longest anticipated drought.

The CSD owns and operates all the reservoirs, water treatment plants, pipelines, pump stations, and associated facilities, unless otherwise noted.

Table 2.5 - City of San Diego Dam Information CSD SDCWA DWR-CDEC								
Reservoir	**Year Built**	**Construction Type**	**Current Condition**	**Total Height** (ft)	**Crest Length** (ft)	**Spillway Elevation** (ft) MSL	**Spillway Capacity** (cfs)	**Spillway Discharge Drainage**
Murray	1918	Multiple Arch	Satisfactory	117	870	536.5	2,025	San Diego River
San Vicente	1943 *2014	Concrete Gravity	Satisfactory	337	1,442	766	56,324	San Diego River
El Capitan	1934	Hydraulic Fill	Fair	242	1,170	750	170,600	San Diego River
Sutherland	1954	Multiple Arch	Satisfactory	174	1,188	2,057	41,220	Santa Ysabel Creek
Lower Otay	1919	Concrete Gravity	Fair	182	741	484	49,400	Otay River
Barrett	1922	Concrete Gravity	Fair	205	746	1,607	88,000	Tijuana River
Morena	1912	Rock Filled	Fair	181	550	3,039	25,000	Cottonwood Creek
Miramar	1960	Earth Embankment	Satisfactory	155	1,189	714	432	Los Peñasquitos Creek
Hodges	1918	Multiple Arch	Poor	157	729	315	67,440	San Dieguito River

Endnotes:
* Dam Raise

San Diego River System

The San Diego River System includes:

- Reservoirs: Murray, San Vicente, El Capitan, Sutherland owned by CSD, and Cuyamaca owned by HWD.
- Their respective watersheds.
- Interconnecting pipelines and pump stations: Sutherland-San Vicente Pipeline, San Vicente Pipelines Nos. 1 & 2, El Capitan Pipeline, El Monte Pipeline.
- San Vicente-San Diego Aqueduct 2 Pipeline, San Vicente Pump Station, and Surge Facility owned by SDCWA.
- Water treatment plants: Alvarado WTP owned by CSD, R.M. Levy Water Treatment Plant (Levy WTP) owned by HWD.

This system captures and stores runoff from the San Diego River Watershed Basin, runoff captured and transferred from the Sutherland watershed in the San Dieguito Watershed Basin, and imported water from the SDCWA Aqueduct System. The San Diego River System covers a combined estimated area of 204,807 ac. The Alvarado WTP located adjacent to Murray Reservoir is the terminus for this source water system and serves the central area of San Diego. The Alvarado WTP has a capacity of 200 MGD and is of conventional design using ozone for primary disinfection and chloramines for secondary disinfection in the distribution system. The effective volume of this system is more than half of the emergency water storage requirement for the CSD.

Murray Reservoir functions as emergency and operational storage and is located on Chaparral Canyon Stream, a tributary to Alvarado Creek and the San Diego River, impounds water transferred from San Vicente, El Capitan, and Sutherland Reservoirs via the El Monte Pipeline, and imported water from the SDCWA Aqueduct System. The reservoir is surrounded by a first-flush bypass system with a capacity of 60 cfs which diverts runoff from the surrounding 2,298 ac. Watershed, except during large storm events. The reservoir has a storage capacity of 4,684 AF and a surface area of 168 ac. at its spillway crest.

Murray Dam is a multiple arch reinforced concrete structure with a 42-foot-wide uncontrolled over pour spillway at elevation 536.5 ft Mean Sea Level (MSL). The spillway capacity is 2,025 cfs and discharges to the Pacific Ocean via the San Diego River. The dam crest has a length of 870 ft and total height is 117 ft.

The Murray Reservoir outlet structure consists of an independent wet tower with eight 30-inch saucer valves for selective level draft control. Water is released from the tower through a 48-inch outlet pipe with a maximum draft rate of 126 MGD to the Alvarado WTP.

San Vicente Reservoir functions as emergency, impounding, and operational storage and is located on San Vicente Creek a tributary to the San Diego River, impounds runoff from the surrounding 47,622 ac. watershed, water transferred from Sutherland Reservoir located in the San Dieguito watershed via the Sutherland-San Vicente Pipeline, and imported water from the SDCWA Aqueduct System. The reservoir has a storage capacity of 249,358 AF and a surface area of 1,676 ac. at its spillway crest.

San Vicente Dam is a straight concrete gravity structure with a 275-foot-wide uncontrolled over pour spillway at elevation 766 ft MSL. The spillway capacity is 56,324 cfs and discharges to the Pacific Ocean via the San Diego River. The dam crest has a length of 1,442 ft and total height is 337 ft.

The San Vicente Dam outlet structure is a wet tower integrated into the upstream face of the dam and consists of six outlets for selective level draft control. Water is released from the tower through two gates. One gate delivers water to a 90-inch pipe which connects to CWA's water system. The second gate delivers water to a 66-inch pipe that connects to both San Vicente Pipeline 1 and San Vicente Pipeline 2 with a maximum combined draft rate of 76 MGD which transfer the water to the El Monte Pipeline with a maximum draft rate of 95 MGD that delivers the water to either Murray Reservoir for storage or to the Alvarado WTP for immediate use.

El Capitan Reservoir functions as emergency, impounding, and operational storage and is located on the San Diego River, impounds runoff from the surrounding 120,335 ac. watershed, HWD water transferred from Cuyamaca Reservoir via Boulder Creek, and imported water from the SDCWA Aqueduct System. The reservoir has a storage capacity of 112,807 ac. and a surface area of 1,562 ac. at its spillway crest.

El Capitan Dam is a hydraulic fill rock embankment with an impervious clay core and a 510-foot-wide uncontrolled independent side channel spillway at elevation 750 ft MSL. The spillway capacity is 170,600 cfs and discharges to the Pacific Ocean via the San Diego River. The dam crest has a length of 1,170 ft and total height is 242 ft. An analysis of the dam, completed by the California Division of Safety of Dams (DSOD), mandated the maximum storage capacity to be lowered 20 ft to 700 ft MSL.

The El Capitan Reservoir outlet structure is an independent wet tower with six 30-inch saucer valves for selective level draft control. Water is released from the tower through two 42-inch and two 36-inch saucer valves to the El Capitan Pipeline. The El Capitan Pipeline has a 30-inch and a 48-inch blow-off and transfers water to the El Monte Pipeline; the El Capitan Pipeline has a 61 MGD draft rate to the El Monte Pipeline and a combined 345 MGD maximum draft to the El Monte Pipeline and blow-offs. The El Monte Pipeline has a maximum draft rate of 95 MGD and delivers water to either to Murray Reservoir for storage or to the Alvarado WTP for immediate use.

Cuyamaca Reservoir (owned by HWD) is a tributary stream reservoir to El Capitan Reservoir. Cuyamaca Reservoir, located on Boulder Creek, a tributary to the San Diego River, impounds runoff from the surrounding watershed. The reservoir has a storage capacity of 11,757 AF at its spillway crest.

Cuyamaca Dam is an earth-fill embankment with a 30-foot-wide rectangular spillway at elevation 4,635 ft MSL. The spillway capacity is approximately 2,935 MGD and discharges to El Capitan Reservoir via Boulder Creek. The dam crest has a length of 665 ft and total height is 40 ft.

Cuyamaca Reservoir outlet consists of a 36-inch steel pipeline extending through an outlet tunnel in the dam and a concrete channel downstream of the dam. All water discharged from Cuyamaca Reservoir to El Capitan Reservoir belongs to HWD. In addition, HWD has a separate and exclusive right to 17 MGD of runoff from the Upper San Diego River.

Sutherland Reservoir is a tributary system reservoir to San Vicente Reservoir and a tributary stream reservoir to Hodges. Although Sutherland Reservoir is in the San Dieguito watershed, for the purposes of this document it is considered part of the San Diego River System. The function of Sutherland Reservoir is to serve as impounding storage. Sutherland Reservoir is not a practical emergency or operational storage site due to its remote location, high elevation, and lack of connections to imported water aqueducts. Sutherland Reservoir captures, stores, and transfers runoff from the San Dieguito Watershed Basin to San Vicente Reservoir in the San Diego River Watershed Basin via the Sutherland-San Vicente Pipeline.

Sutherland Reservoir, located on Santa Ysabel Creek, a tributary to the San Dieguito River, impounds runoff from the surrounding 34,552 ac. watershed. The reservoir has a storage capacity of 29,508 AF and a surface area of 555 ac. at its spillway crest.

Sutherland Dam is a multiple arch reinforced concrete structure with a 168-foot-long uncontrolled over pour spillway at elevation 2,057 ft MSL. The spillway has a design capacity of 41,220 cfs and discharges to Hodges Reservoir via Santa Ysabel Creek. The dam crest has a length of 1,188 ft and total height is 174 ft.

The Sutherland Dam outlet structure is integrated into the upstream face of the dam and consists of a concrete box at 1,940 ft MSL with two 36-inch outlet pipes each controlled by a 30-inch gate valve. Each outlet discharges to the 36-inch Sutherland-San Vicente Pipeline. A 24-inch bypass pipeline with a 20-inch plug valve at the end can be used as a blow off and to control water release into the creek channel below the dam. The maximum draft rate of the Sutherland-San Vicente Pipeline is 65 MGD to San Vicente Reservoir and a combined 225 MGD maximum draft rate to the reservoir and 20-inch blow-off.

The Sutherland-San Vicente Pipeline discharges into San Vicente Creek at Daney Canyon, two miles north of the San Vicente Reservoir. Since the transfer of water from Sutherland Reservoir to San Vicente Reservoir utilizes a natural water course, the water is usually transferred to San Vicente Reservoir in the spring when the streambed is wet to minimize water loss during transport. Control of the volume and timing of the water transfer is important to minimize water loss, streambed erosion, and accommodate bass spawning (April 1 through May 15) in Sutherland Reservoir; and the federally-endangered arroyo toad (Bufo californicus) breeding (March 15 through July 1) within the streambed. In coordination with the USFWS, the CSD has agreed to conduct arroyo toad breeding activity surveys prior to, during, and after the water transfer.

The Otay-Cottonwood System

The Otay-Cottonwood System includes:

- Reservoirs: Otay, Upper Otay, Barrett, and Morena owned by CSD.
- Their respective watersheds.
- Interconnecting pipeline: Dulzura Conduit owned by CSD.
- Water treatment plant: Otay WTP owned by CSD.

This system captures and stores runoff from the Otay River Watershed Basin, runoff captured and transferred from the Cottonwood watershed in the Tijuana River Watershed Basin, and imported water from the SDCWA Aqueduct System. The Otay-Cottonwood System covers a combined estimated area of 225,917 ac. The Otay WTP, located adjacent to Lower Otay Reservoir, is the terminus for this source water system and serves the South Bay area of San Diego and the California-American Water Company. The Otay WTP has a capacity of 34 MGD and is of conventional design using chlorine dioxide for primary disinfection and chloramines for secondary disinfection in the distribution system.

Otay Reservoir functions as emergency, operational, and impounding storage and is located on the Otay River, impounds runoff from the surrounding 69,117 ac. watershed, water transferred from Morena and Barrett Reservoirs located in the Cottonwood watershed via the Dulzura Conduit, and imported water from the SDCWA Aqueduct System. The reservoir has a storage capacity of 54,043 AF at the top of the central over pour spillway flash gates, 49,848 AF at the crest of the independent spillway, and 47,067 AF at the crest of the central over pour spillway with a surface area of 1,229, 1,139, and 1,035 ac. respectively.

Lower Otay Dam is a curved concrete gravity structure with a 225-foot-wide gated over pour spillway at elevation 484 ft MSL and a 201-foot-wide gated independent spillway at elevation 487 ft MSL. The combined spillway capacity is 49,400 cfs and discharges to the Pacific Ocean via the Otay River. The dam crest has a length of 741 ft and total height is 182 ft. Spillway gates must be fully open during winter from November 1 to April 1.

Otay Reservoir outlet structure is an independent wet tower with seven 30-inch saucer valves for selective level draft control. Water is released from the tower through a 48-inch outlet pipe with a maximum draft rate of 48 MGD to the Otay WTP and a combined 225 MGD maximum draft rate to the treatment plant and blow-off.

Upper Otay Reservoir, a tributary stream reservoir to the Lower Otay Reservoir, is no longer used for storage. The reservoir, located on Proctor Valley Creek, a tributary to the Otay River, has a storage capacity of 439 AF and a surface area of 38 ac. at the 16-inch outlet invert.

The Upper Otay Reservoir Dam is a thin flat concrete arch reinforced with wire rope and steel plates with an independent uncontrolled spillway at elevation 550 ft MSL. The dam crest has a length of 350 ft and total height is 86 ft. A seismic analysis of the dam completed by DSOD mandated the maximum storage capacity be lowered. The dam was reduced in size by creating an uncontrolled central over pour spillway at elevation 535 ft MSL with a capacity of 10,500 cfs that discharges to Otay Reservoir.

The Upper Otay Dam outlet structure is integrated into the upstream face of the dam and consists of a passive 16-inch conduit at elevation 521 ft MSL with a maximum draft rate of 22 MGD that discharges to Lower Otay Reservoir.

Barrett Reservoir is a tributary system reservoir to Lower Otay Reservoir and tributary stream reservoir to the Tijuana River. Although Barrett Reservoir is in the Tijuana River watershed, for the purposes of this document, it is considered part of the Otay-Cottonwood System. The function of Barrett Reservoir is to serve as impounding storage. Barrett Reservoir is not a practical emergency or operational storage site due to its remote location, high elevation, and lack of connections to imported water aqueducts. Barrett Reservoir captures, stores, and transfers runoff from the Tijuana Watershed Basin to Otay Reservoir in the Otay River Watershed Basin via the Dulzura Conduit.

Barrett Reservoir, located on Cottonwood Creek, a tributary to the Tijuana River, impounds runoff from the surrounding 83,257 ac. watershed along with water transferred from Morena Reservoir via Cottonwood Creek. The reservoir has a storage capacity of 41,583 AF at the top of the spillway flash gates and 34,806 AF at the crest of the spillway with a surface area of 891 ac. and 801 ac. respectively.

Barrett Dam is a single curve concrete gravity structure with a 336-foot-wide gated central over pour spillway at elevation 1,607 ft MSL. The capacity of the spillway is 88,000 cfs and discharges to the Pacific Ocean via the Tijuana River. The dam crest has a length of 746 ft and total height is 205 ft. Spillway gates must be fully open during winter from November 1 to April 1.

The Barrett Reservoir outlet structure consists of an independent dry tower with three 30-inch saucer valves on the outside and 30-inch gate valves on the inside for selective level draft control. Each valve is connected to a 30-inch conduit with a maximum draft rate of 175 MGD and discharges to the Dulzura Conduit. The Dulzura Conduit can transport 31 MGD and discharges into Upper Dulzura Creek, a tributary to Jamul Creek and the Otay River. Control of the volume and timing of the water transfer is important to minimize water loss and streambed erosion.

Morena Reservoir is a tributary stream reservoir to Barrett Reservoir. Although Morena Reservoir is in the Tijuana River watershed, for the purposes of this document, it is considered part of the Otay-Cottonwood System. The function of Morena Reservoir is to serve as impounding storage. Morena Reservoir is not a practical emergency or operational storage site due to its remote location, high elevation, and lack of connections to imported water aqueducts, and is considered an inefficient reservoir due to its high evaporative losses. Morena Reservoir captures, stores, and transfers runoff to Barrett Reservoir via Cottonwood Creek.

Morena Reservoir, located on Cottonwood Creek, a tributary to the Tijuana River, impounds runoff from the surrounding 73,543 ac. watershed. The reservoir has a storage capacity of 50,694 AF and a surface area of 1,547 ac. at its spillway crest.

Morena Dam is a rock filled embankment with an impervious upstream face consisting of rubble masonry and concrete with an uncontrolled 312-foot-wide Ogee Crest spillway at elevation 3,039 ft MSL. The spillway capacity is 25,000 cfs and discharges to Barrett Reservoir via Cottonwood Creek. The dam crest has a length of 550 ft and total height is 181 ft.

The Morena Reservoir outlet structure consists of an independent dry tower with three 24-inch sluice gate valves on the outside and 24-inch gate valves on the inside for selective level draft control. Each valve is connected to a 30-inch pipe with a maximum draft rate of 194 MGD and discharges into Cottonwood Creek. Control of the volume and timing of the water transfer is important to minimize water loss and streambed erosion.

Miramar System

The Miramar System includes:

- Reservoir: Miramar owned by CSD.
- Its respective watershed.
- Water treatment plant: Miramar WTP owned by CSD.

This system stores runoff from the Los Peñasquitos Watershed Basin and imported water from the SDCWA Aqueduct System. The Miramar watershed has an estimated area of 645 ac. The Miramar WTP, located adjacent to Miramar Reservoir, is the terminus for this source water system and serves the northern section of San Diego. The Miramar WTP has a capacity of 144 MGD and is of conventional design, using ozone for primary disinfection and chloramines for secondary disinfection in the distribution system.

Miramar Reservoir functions as emergency and operational storage and is located on Big Surr Creek and impounds runoff from the surrounding 645 ac. watershed and imported water from the SDCWA Aqueduct System. The reservoir has a storage capacity of 6,682 AF and a surface area of 274 ac. at the spillway crest.

Miramar Dam is a zoned earth embankment with a 10-foot-wide uncontrolled open channel spillway at elevation 714 ft MSL. The spillway capacity is 432 cfs and discharges to the Pacific Ocean via Los Peñasquitos Creek. The dam crest has a length of 1,189 ft and total height is 155 ft.

The Miramar Reservoir outlet structure consists of an independent wet tower with seven 36-inch saucer inlet valves for selective level draft control. Water is released from the tower through a 48-inch conduit with a maximum draft rate of 100 MGD to the Miramar WTP and a total combined 178 MGD maximum draft rate to the WTP and 24-inch blow-off.

Hodges System

Hodges System includes:

- Reservoirs: Hodges owned by CSD, San Dieguito jointly owned by SDWD and SFID, Olivenhain owned by the SDCWA.
- Their respective watersheds.
- Interconnecting pipelines: Hodges Flume jointly owned by SDWD and SFID, Hodges-Olivenhain Pipeline owned by SDCWA.
- Water Treatment Plants: R.E. Badger Filtration Plant owned SDWD and SFID, David C. McCollom Water Treatment Plant owned by Olivenhain Municipal Water District.

This system captures and stores runoff from the San Dieguito River Watershed Basin and imported water from the SDCWA Aqueduct System. The Hodges System covers a combined estimated area of 158,278 ac. The CSD has no direct treatment facilities for water impounded by this system. Water from Hodges Reservoir is transferred to Olivenhain Reservoir and the SDCWA Aqueduct System via the Hodges-Olivenhain Pipeline. Water released from Hodges Dam outlet structure is transferred to San Dieguito Reservoir via the Hodges Flume.

Hodges Reservoir functions as emergency and impound storage and is located on the San Dieguito River, impounds runoff from the surrounding 158,278 ac. watershed, water that spills over Sutherland Dam via Santa Ysabel Creek, and imported water from the SDCWA Aqueduct System. The reservoir has a storage capacity of 30,633 AF and a surface area of 1,121 ac. at the spillway crest.

The Hodges Dam is a Multiple Arch Buttress Dam with a 342-foot-wide uncontrolled over pour spillway at elevation 315 ft MSL. The spillway crest consists of 202-foot-wide Ogee weir section and 140-foot-wide broad-crested weir section with a capacity of 67,440 cfs that discharges to the Pacific Ocean via the San Dieguito River. The dam crest has a length of 729 ft and total height is 157 ft. An analysis of the dam completed by DSOD, mandated the maximum storage capacity to be lowered to 295 ft MSL.

The Hodges Dam outlet structure is integrated into the upstream face of the dam and consists of four downspouts on the face of the dam for selective level draft control. The downspouts are 20-inch diameter cast iron pipes controlled by 20-inch gate valves with a maximum draft rate 117 MGD that discharge to San Dieguito Reservoir via the Hodges Flume. The Hodges Flume has a maximum draft rate of 13 MGD.

The Hodges-Olivenhain inlet/outlet structure consists of the Hodges-Olivenhain Pipeline and pump station with a maximum draft rate of 378 MGD.

CHAPTER 3
PHYSICAL AND HYDROGEOLOGICAL DESCRIPTION OF THE LOCAL WATERSHEDS

The local source water system is in southern and central San Diego County on the western slope of the Peninsular Ranges. The climate of the region is classified as semi-arid (steppe) in the west and Mediterranean hot summer in the east. The region receives precipitation below potential evapotranspiration, and the amount of surface runoff is highly variable from year to year due to wet and dry cycles. The average annual rainfall on the coastal plain is about 10 inches and exceeds 15 inches in the foothills and mountains. Mountain streams provide only a limited and extremely variable water supply. Many reservoirs have been constructed to store water for use in dry years and to provide regulation of water flow. Only a few watersheds have reliable groundwater, and their wells provide only a small percentage of the water needed.

Natural water quality can vary greatly from one area to another and is affected by many variables including: changes in seasons and climate, the types of soils and rocks through which water travels, velocity of the flow, and retention time in a location. When runoff from rain or snow travels over the surface of the land and through the ground, the water dissolves minerals in rocks and soil, percolates through organic material such as roots and leaves, and amasses algae, bacteria, and other microscopic organisms. Water may also carry plant debris, sand, silt, and clay to rivers and streams making the water appear muddy or turbid. When water evaporates from lakes and streams, dissolved minerals are more concentrated in the water that remains. Each of these natural processes changes the water quality and potentially the water use.

The most common dissolved substances in water are minerals or salts that, as a group, are referred to as dissolved solids. Dissolved solids include common constituents such as calcium, sodium, bicarbonate, and chloride; plant nutrients such as nitrogen and phosphorus; and trace elements such as selenium, chromium, and arsenic.

In general, common constituents are not considered harmful to human health, although some constituents can affect the taste, smell, or clarity of water. Plant nutrients and trace elements in water can be harmful to human health and aquatic life if they exceed standards or guidelines.

Dissolved gases such as oxygen and radon are common in natural waters. Adequate oxygen levels in water are a necessity for fish and other aquatic life. Radon gas can be a threat to human health when it exceeds drinking water standards.

San Diego County watersheds initiate in mountains of the Peninsular Ranges in the eastern portion of the county where elevations range to over 6,000 feet. Surface water generally flows to the southwest through deep canyons and large valleys surrounded by steep mountains to gently rolling hills and inland valleys of the coastal plain province.

Cottonwood watershed begins at Mount Laguna where Pine Valley and Cottonwood Creeks drain to Barrett Reservoir. Pine Valley Creek flows west to Barrett Reservoir while Cottonwood Creek flows south through Morena Reservoir then west through Hauser Canyon to Barrett Reservoir. Elevations range from approximately 1,600 to over 6,000 feet and the landscape features rough, steep, narrow canyons, large valleys, and steep mountains. Cottonwood retains an open-space character with large expanses of undeveloped land and rural communities.

Otay River watershed drains the north-facing slopes of the San Ysidro Mountains (also known as the Otay Mountains) and the southerly slopes of the Jamul Mountains. White Mountain near Dulzura forms the interior boundary. Jamul Creek drains the eastern portion of the watershed and flows west to Otay Reservoir. Otay River drains the northern portion of the watershed and flows south to Otay Reservoir. Elevations range from approximately 500 to 1,500 feet and the landscape is characterized by large valleys surrounded by steep mountains and gently rolling hills. Otay River watershed retains an open-space character with large expanses of undeveloped land, rural communities, and urban development on the western edge.

On the eastern boundary of the Upper San Diego River watershed is Cuyamaca Peak where elevations range to over 6,000 feet. Deep rugged river canyons drain the waters to the south and west forming the headwaters of the San Diego River and its tributaries. The steep canyons of Boulder Creek, Cedar Creek, San Vicente Creek, and the San Diego River exhibit a remote, undeveloped character. Boulder Creek and Cedar Creek drain the eastern portion of the watershed and flow west to the San Diego River which drains the northern portion of the watershed and flows south to El Capitan Reservoir. San Vicente Creek drains the western portion of the watershed and flow south to San Vicente Reservoir. Elevations range from approximately 800 to over 6,000 feet and the landscape is characterized by deep canyons and large valleys and is surrounded by steep mountains. The Upper San Diego River watershed retains an open-space character with large expanses of undeveloped land, rural communities, and urbanizing communities bordering the northwestern and southern edges.

Murray watershed is in the Lower San Diego River watershed. Cowles Mountain on the northern boundary of Murray watershed is the dominant feature. Chaparral Canyon Stream, a tributary to Alvarado Creek and the San Diego River, drains the eastern slope of Cowles Mountain and flows south to Murray Reservoir where the flow is diverted around the reservoir except for during large storm events when overflow will spill into the reservoir. Elevations range from approximately 500 to 1,500 feet. and the landscape is composed of canyons and mesa-like terraces that graduate inland into rolling hills on the western edge of the Peninsular Ranges. The northern portion of watershed retains an open-space character and the remaining watershed is urban development.

Miramar watershed is in the Los Peñasquitos watershed. Miramar Reservoir is located on Big Surr Creek a tributary to Carroll Canyon and Los Peñasquitos Creeks. Miramar watershed drains the slopes adjacent Miramar Reservoir. Elevations range from approximately 700 to 850 feet and the landscape is composed of canyons and mesa-like terraces that graduate inland into rolling hills on the western edge of the Peninsular Ranges. The portion of watershed adjacent to Miramar Reservoir retains an open-space character and the remaining watershed is urban development.

San Dieguito watershed begins at Volcan Mountain where Santa Ysabel Creek and its tributaries flow west through Sutherland Reservoir, Pamo Valley, and San Pasqual Valley to Hodges Reservoir. Elevations range from approximately 300 to 6,000 feet and the landscape features deep canyons, large valleys, steep mountains, and gently rolling hills. The eastern portion of the San Dieguito watershed above Sutherland Reservoir retains an open-space character with large expanses of undeveloped land and rural communities. Below Sutherland Reservoir the watershed is characterized by urbanizing communities and significant agriculture while the western part of the watershed is bordered by urban development to the north and south.

Figure 3.1 San Diego Hydrogeology USGS

Location of San Diego Hydrogeology study area and the five major river basins (San Dieguito, San Diego, Sweetwater, Otay, and Tijuana) and subbasins as defined in the Watershed Boundary Dataset in San Diego County, California and Baja California, Mexico. Colorized elevation model base from U.S. Geological Survey digital elevation data, 1/3 arc-second resolution.

https://ca.water.usgs.gov/projects/sandiego/resources/maps.html#wbd

Table 3.1 - Hydrologic Areas within Local Watersheds

SanGIS

Watershed	Hydrologic Area	Hydrologic Sub-Area	Hydrologic Basin Number	Acres
El Capitan	Boulder Creek	Cuyamaca	907.43	7,660
	Boulder Creek	Inaja	907.41	52,194
	Boulder Creek	Spencer	907.42	4,758
	El Capitan	Alpine	907.33	3,905
	El Capitan	Conejos Creek	907.31	51,818
Murray	Murray	Murray	907.11	2,298
San Vicente	San Vicente	Barona	907.24	10,201
	San Vicente	Fernbrook	907.21	14,077
	San Vicente	Gower	907.23	14,853
	San Vicente	Kimball	907.22	8,491
Sutherland	Santa Ysabel	Sutherland	905.53	18,511
	Santa Ysabel	Witch Creek	905.54	16,041
Barrett	Barrett Lake	Barrett Lake	911.30	59,131
	Monument	Mount Laguna	911.42	5,322
	Monument	Pine	911.41	18,804
Morena	Cameron	Cameron	911.70	30,067
	Cottonwood	Cottonwood	911.60	28,560
	Morena	Morena	911.50	14,916
Otay	Dulzura	Engineer Springs	910.37	7,092
	Dulzura	Hollenbeck	910.36	31,730
	Dulzura	Jamul	910.33	7,795
	Dulzura	Lee	910.34	2,075
	Dulzura	Lyon	910.35	2,076
	Dulzura	Proctor	910.32	8,129
	Dulzura	Savage	910.31	10,220
Miramar	Miramar Reservoir	Miramar Reservoir	906.10	640
	Poway	Poway	906.20	5
Hodges	Hodges	Bear	905.24	1,716
	Hodges	Del Dios	905.21	21,107
	Hodges	Felicita	905.23	1,820
	Hodges	Green	905.22	5,627
	San Pasqual	Guejito	905.35	12,659
	San Pasqual	Hidden	905.34	1,193
	San Pasqual	Highland	905.31	2,552
	San Pasqual	Las Lomas Muertas	905.32	23,954
	San Pasqual	Reed	905.33	1,907
	San Pasqual	Vineyard	905.36	1,796
	Santa Maria Valley	Ballena	905.45	2,494
	Santa Maria Valley	East Santa Teresa	905.46	882
	Santa Maria Valley	Lower Hatfield	905.42	2,835
	Santa Maria Valley	Ramona	905.41	25,850
	Santa Maria Valley	Upper Hatfield	905.44	1,019
	Santa Maria Valley	Wash Hollow	905.43	2,315
	Santa Maria Valley	West Santa Teresa	905.47	1,143
	Santa Ysabel	Boden	905.51	10,531
	Santa Ysabel	Pamo	905.52	36,878

3.1 Geology

The San Diego region is underlain by three principle geologic provinces. Most of the county is in the Peninsular Ranges province bounded by the coastal province to the west and the Salton Trough province to the east. This geomorphic division reflects a basic geologic difference between the three regions, with Mesozoic metavolcanic, metasedimentary, and plutonic rocks predominating in the Peninsular Ranges, and primarily Cenozoic sedimentary rocks predominating to the west and east of the central mountain range. The irregular contact between these geologic regions reflects the ancient topography of this area before it was buried by the thick sequence of Cretaceous and Tertiary sedimentary rocks deposited over the last 75 million years by ancient rivers and in ancient seas.

As the Peninsular Ranges province experienced uplifting and tilting, a series of large faults, such as the Elsinore and San Jacinto, developed along the edge of the province. The City of San Diego lies in the coastal plain province which extends from the western edge of the Peninsular Ranges and runs roughly parallel to the coastline. The province is composed of dissected, mesa-like terraces that graduate inland into rolling hills. The terrain is underlain by sedimentary rocks composed mainly of sandstone, shale, and conglomerate beds, reflecting the erosion of the Peninsular Ranges to the east.

The basement complex consists of two principal rock units. The Upper Jurassic Santiago Peak Volcanics, a succession of deformed and metamorphosed volcanic, volcaniclastic, and sedimentary rocks, and the mid-Cretaceous plutonic rocks of the Southern California Batholith, which intrude the Santiago Peak Volcanics.

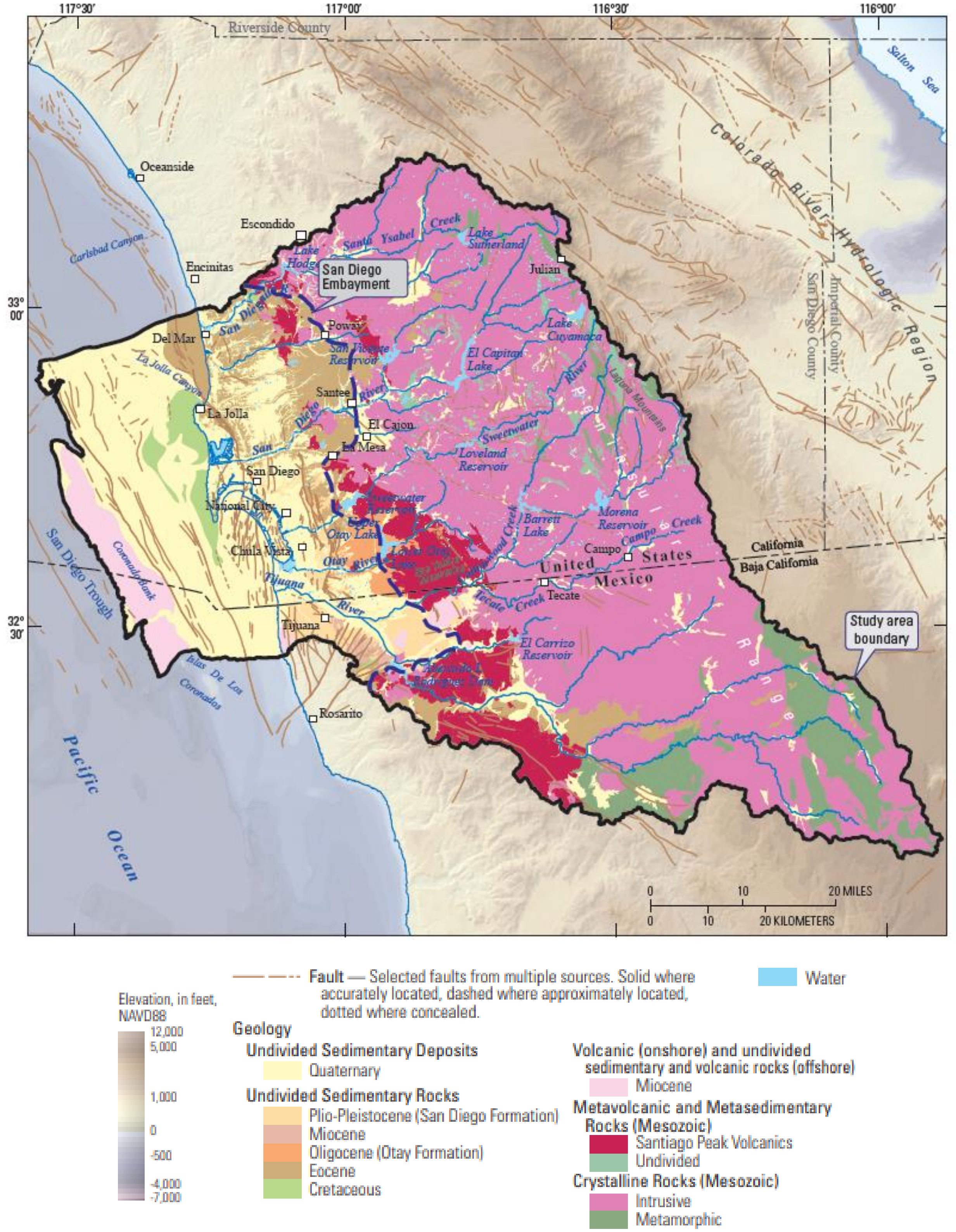
The Santiago Peak Volcanics are hard and extremely resistant to erosion and form topographic highs. Most of the volcanic rocks are dark greenish gray when fresh but weather grayish red to dark reddish brown. The soil developed on the Santiago Peak Volcanics is the color of the weathered rock and supports the growth of dense chaparral.

Plutonic rocks of the Southern California Batholith are quartz diorite and gabbro. The quartz diorite is typically coarse grained, light gray, and contains large phenocrysts of plagioclase and potassium feldspar. Hornblende and biotite are present in small amounts. The gabbro varies considerably in texture and composition but is mostly medium to coarse grained and medium to dark gray. The chief minerals are calcic feldspar and pyroxene while the accessory minerals include trace amounts of quartz and biotite. Throughout most of the area, the granitic rocks are deeply weathered.

Rocks known to occur in San Diego County:

Acmite, Albite, Allanite, Amblygonite, Andalusite, Apatite, Arsenopyrite, Azurite, Basalt, Bavenite, Bertrandite, Beryl, Biotite, Bismite, Bismuth, Bismuthinite, Bornite, Calcite (optical), Cassiterite, Celestite, Cerussite, Chalcocite, Chalcopyrite, Chrysotile, Clintonite, Cookeite, Corundum, Epidote, Erythite, Ferrimolybdite, Ferrisicklerite, Ferroaxinite, Fersmite, Fluorapatite, Francolite, Gabbro, Gahnite, Galena, Garnet, Glauconite, Gneiss, Gold, Granite, Graphite, Gypsum, Helvite, Heterosite, Heulandite, Hydromagnesite, Laumontite, Lawsonite, Leadhillite, Lepidolite, Limonite, Lithiophylite, Magnetite, Malachite, Manganite, Marcasite, Microcline, Molybdenite, Morenosite, Morinite, Muscovite, Nickel, Orthoclase, Pentlandite, Petalite, Plagioclase feldspar, Pollucite, Purpurite, Pyrite, Pyrophyllite, Pyrrhotite, Quartz, Rhodonite, Rutile, Rynersonite, Samarskite, Scheelite, Schist, Sicklerite, Silver, Sphalerite, Spinel, Spodumene, Stellerite, Stokesite, Tellurium, Tenorite, Thorogummite, Todorokite, Topaz, Tourmaline, Tremolite, Tridymite, Triphylite, Uranmicrolite, Uranophane, Violarite, Wollastonite, Zircon

Figure 3.2 San Diego Geology USGS



Surficial geology of San Diego-Tijuana area, USA and Mexico (Cromwell, unpublished). Colorized elevation model base from U.S. Geological Survey digital elevation data, 1/3 arc-second resolution.

https://ca.water.usgs.gov/projects/sandiego/resources/maps.html#wbd

Geology within the Local Source Water System

The San Diego River System dominant emplacements consist of Pre-Cenozoic granitic and metamorphic rock along with Cretaceous granitic rock of the Southern California Batholith. Lesser emplacements include Jurassic metavolcanic and metasedimentary rocks of the Santiago Peak Volcanics, Mesozoic basic intrusive rocks, Pre-Cretaceous metamorphic and metasedimentary rocks, Eocene marine sedimentary and metasedimentary rocks, Pleistocene marine and metasedimentary rocks and marine terrace deposits, Quaternary lake deposits, and Alluvium.

The Otay-Cottonwood System dominant emplacements consist of Jurassic metavocanic and metasedimentary rocks of the Santiago Peak Volcanics, and Cretaceous granitic rocks of the Southern California Batholith. Lesser emplacements include Pre-Cenozoic granitic and metamorphic rock, Mesozoic basic intrusive rock, Pleistocene marine and marine terrace deposits, Plio-Pleistocene non-marine sedimentary and metasedimenntary rocks, Quaternary non-marine terrace deposits, and Alluvium.

The Miramar System dominant emplacements consist of Eocene marine and non-marine sedimentary rocks. Lesser emplacements include Jurassic metavocanic and metasedimentary rocks of the Santiago Peak Volcanics.

The Hodges System dominant emplacements consist of Cretaceous granitic rock of the Southern California Batholith. Lesser emplacements include Jurassic metavolcanic and metasedimentary rock of the Santiago Peak Volcanics, Mesozoic basic intrusive rock, and Alluvium.

Soils and Slope

Erosion is the process of weathering and transporting of solids (sediment, soil, rock, and other particles) in the natural environment from their source to deposits elsewhere. A certain amount of erosion is natural and healthy for the ecosystem. Locally, erosion occurs due to transport by down-slope creep under the force of gravity, wind, and primarily water. In general, background erosion removes soil at roughly the same rate as soil is formed.

The rate of erosion depends on many factors. Climatic factors include the amount and intensity of precipitation, storm frequency, wind speed, average temperature, temperature range, and seasonality. Geologic factors include the sediment or rock type, porosity and permeability, slope of the land, and position of the rocks (tilted, faulted, folded, or weathered). Biological factors include the type and extent of ground cover from vegetation, and the type and density of organisms inhabiting the area including humans.

Erosion by gravity is the down-slope movement of rock and sediments, mainly due to the force of gravity. Mass movement is an important part of the erosion process, as it moves material from higher elevations to lower elevations where other eroding agents such as streams can then pick up and move the material. Mass-movement processes are occurring continuously on all slopes. Some mass-movement processes act very slowly while others occur very suddenly often with disastrous results. Any perceptible down-slope movement of rock or sediment is often referred to in general terms as a landslide.

The rate and magnitude of soil erosion by wind is controlled by the speed and duration of the wind, physical characteristics of the soil, soil moisture levels, and vegetative cover. Very fine particles can be suspended by the wind and then transported great distances, fine and medium size particles can be lifted and deposited, while coarse particles can be blown along the surface. The continual drifting of an area gradually causes a textural change in the soil. Loss of fine sand, silt, clay, and organic particles from sandy soils serves to lower the moisture holding capacity of the soil. During periods of drought, soils with low moisture levels release the particles for transport by wind creating a positive feedback system.

Soil erosion by water is the result of rain detaching and transporting vulnerable soil, either directly by means of splash erosion or indirectly by runoff erosion. The rate and magnitude of soil erosion by water is controlled by rainfall intensity along with runoff volume and velocity. The impact of raindrops on the soil surface can break down soil aggregates and disperse the aggregate material. Splash erosion is the direct detachment and airborne movement of soil particles by raindrop impact. Since soil particles are only moved a small distance, its effects are primarily on-site (at the place where the soil is detached). Although considerable quantities of soil may be moved by splash erosion, it is simply redistributed back over the surface of the soil; although on steep slopes, there will be a modest net down-slope movement of detached soil. When precipitation rates exceed soil infiltration rates, runoff occurs. Runoff may occur for two reasons: the rain arrives too quickly for it to infiltrate or the soil has already absorbed all the water it can hold. The impact of the raindrop breaks apart the soil aggregate. Particles of clay, silt and sand fill the soil pores and reduce infiltration. Once the rate of falling rain is faster than infiltration, runoff takes place. Surface runoff turbulence often causes more erosion than the initial raindrop impact. In most situations, erosion by concentrated flow is the main cause of erosion by water. It is in such channels that water erosion also operates most effectively to detach and remove soil by its kinetic energy lowering the soils surface. Lowered areas form preferential flow paths for subsequent flow creating a positive feedback system. Eventually, this positive feedback results in well-defined linear concentrations of overland flow. The effects are both on-site and off-site (where the eroded soil ends up). The amount of runoff can be increased if infiltration is reduced due to soil compaction, crusting, or freezing.

Soil erodibility is an estimate of the ability of soils to resist erosion based on the physical characteristics of each soil. Loose soils can be eroded by water or wind forces, whereas soils with high clay content are generally susceptible only to water erosion. Soil with a high sand or silt content erodes more easily than soil with highly fractured or weathered rock. Sand, sandy loam and loam textured soils tend to be less erodible than silt, very fine sand, and certain clay textured soils. For a detailed list of soil categories potentially found within the local source water system see Appendix 3.1.

Generally, soils with faster infiltration rates, higher levels of organic matter and improved soil structure have a greater resistance to erosion. Past erosion influences a soil's erodibility; many exposed subsurface soils on eroded sites tend to be more erodible than the original soils due to their poorer structure and lower organic matter.

As the slope gradient of a field increases, the amount of soil lost from erosion increases. Erosion by water increases as the slope length increases due to the greater accumulation of runoff volume and velocity. Overland flow in disturbed areas is likely to have greater velocity and volume which increases soil particle detachment and transportation. USGS estimates that 70% of soil slips originate in slopes between 20° and 36°. These soil slips have the potential to increase sedimentation in streams and reservoirs.

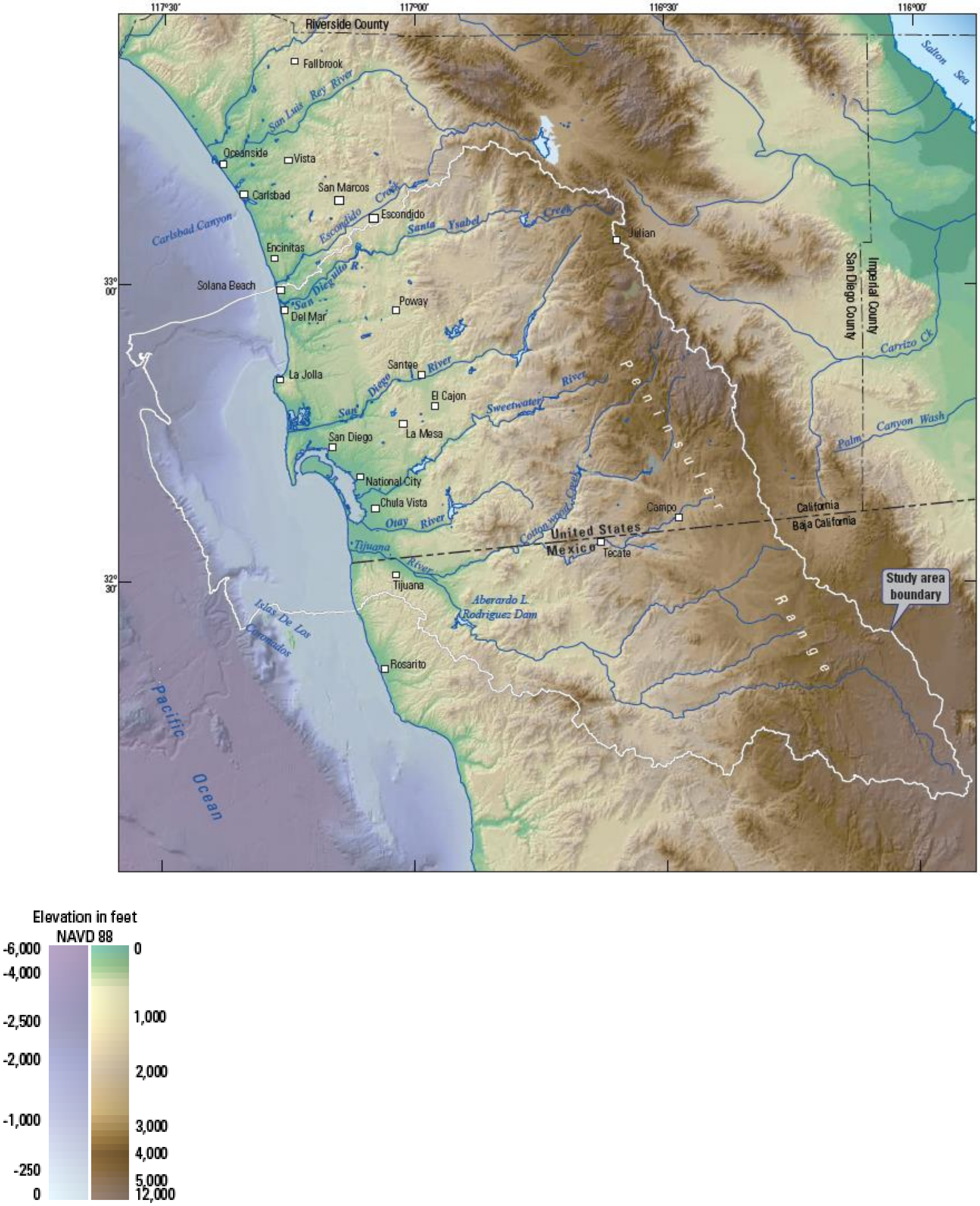
Table 3.2 - Slopes within Local Source Water System Boundaries SanGIS								
	San Diego River System		Otay-Cottonwood System		Miramar System		Hodges System	
Slope	**Acres**	**% Area**	**Acres**	**% Area**	**Acres**	**% Area**	**Acres**	**% Area**
0 < 15%	42,792	21.03	53,699	23.9	294	45.51	55,078	35.03
16% < 25%	53,758	26.41	57,642	25.66	203	31.42	40,775	25.93
26% < 50%	84,190	41.37	89,102	39.66	149	23.07	50,926	32.39
51% <	22,785	11.2	24,196	10.77	0	0	10,470	6.66

Slope failure is a perceptible movement of soil and rock material downhill to a lower elevation. Landslides are the most common naturally occurring type of slope failure in local region. The causes of classic landslides start with the preexisting condition inherent within the rock body itself that can lead to failure. Landslides in the San Diego region generally occur in sedimentary rocks such as sandstone, siltstone, mudstone, and claystone. The actuators of landslides can be both natural events such as earthquakes, rainfall, and erosion, along with human activities such as grading and filling. Earthquakes and their aftershocks can intensify or activate an unstable slope. Loosely and weakly consolidated soils, steepened slopes due to either human activities or natural causes, and saturated earth materials create a fragile situation easily affected by an earthquake. A debris flow or mudslide is a form of shallow landslide consisting of soils, rock, plants, and water and can be very destructive during periods of heavy rainfall. The local region is susceptible to mudslides due to abundant natural, hilly terrain.

A slope can be made potentially unstable by human activities involving:

- removing material from the bottom of the slope, thus, increasing the angle of the slope.
- raising the height of the slope above the previous level.
- saturating the slope with water from septic tank, gutter runoff, or diverted drainage from another part of the slope.
- adding fill to the top of the slope, creating additional weight.
- earth-moving activities reactivating an old slide.

Figure 3.3 San Diego Digital Elevation Model USGS



Sources of digital elevation models used for the San Diego Hydrogeology study. Colorized elevation model base from U.S. Geological Survey digital elevation data, 1/3 arc-second resolution.

https://ca.water.usgs.gov/projects/sandiego/resources/maps.html#wbd

Geological Hazards and Contaminants

Several earthquake fault zones and numerous faults exist in Southern California. The proximity of San Diego to large earthquake faults increases the potential of earthquake damage to structures and potentially endangers the safety of the inhabitants. Damage to structures caused by a major earthquake will depend on the distance to the epicenter, the magnitude of the event, the underlying soil, and the quality of construction.

The San Andreas Fault Zone is approximately 100 miles east of San Diego and outside the county limits. It extends a total of 650 miles from Baja California to the Northern California coast. Near the San Diego region, the San Andreas Fault follows the east side of Coachella and Imperial valleys. The nearest inhabited sections of the San Diego region are 30 miles away from this fault zone. The distance of the San Andreas Fault Zone from San Diego would indicate lesser potential for damaging impacts.

The San Jacinto Fault is the largest of the active faults in the San Diego region. The fault extends 125 miles from the Imperial Valley to San Bernardino. The southern portion has experienced displacement within the last 200 years. The fault can register an earthquake in the range of magnitude of 7.5 to 7.8 on the Richter scale. Although faults within the San Jacinto Fault Zone have greater historic and instrumental activity, their longer distances from San Diego would indicate lesser potential for damaging impacts.

The Elsinore Fault is approximately 135 miles long, located approximately 40 miles north and east of Downtown San Diego. The fault can register an earthquake in the range of magnitude 6.9 to 7.0 on the Richter scale. An event on the Elsinore Fault would potentially cause considerable damage in Northeast San Diego, but only limited damage in urban San Diego.

The Rose Canyon Fault Zone is located offshore approximately two to six miles and parallels the San Diego north county coastline before coming ashore. The fault trends through coastal San Diego before travelling offshore through San Diego Bay and parallel to the south county coastline. The Rose Canyon Fault Zone can generate an earthquake in the range of magnitude 6.2 to 7.0 on the Richter scale; potential damage resulting from the event would be especially severe in urban San Diego.

The La Nacion Fault Zone is located about five miles east of the Rose Canyon and runs parallel through central and southern San Diego County. The fault can generate an earthquake in the range of magnitude 6.2 to 6.6 on the Richter scale; potential damage resulting from the event would be especially severe in urban San Diego.

The major offshore fault zones are the San Clemente, San Diego Trough, and Coronado Bank. The San Clemente Fault Zone located 40 miles west of San Diego is the largest offshore fault zone. The fault can generate an earthquake in the range of magnitude 6.7 and 7.7. The fault is about the same distance from Downtown San Diego as the Elsinore Fault and the maximum credible event is approximated to be of the same order; however, since its historic recorded activity has been less, the San Clemente Fault does not appear to pose as significant a hazard to the San Diego area. The San Diego Trough located 25 miles west of San Diego, and the Coronado Bank located 12 miles west, can generate an earthquake in the range of magnitude 6.0 to 7.7. There is a high potential for damage in the San Diego area resulting from an event.

Accelerated erosion is the loss of soil at a much faster rate than it is formed and can result in ecosystem damage. Damage caused by excessive erosion includes loss of soil, damage to drainage networks, reduction of surface water quality, and receiving water degradation. Impacts can be both on-site and off-site.

The main on-site impact of accelerated erosion is the reduction of soil quality. Soil quality is diminished due to the loss of the nutrient-rich upper layers of soil and reduced water-holding capacity. Removal of the nutrient-rich upper horizons of the soil results in a reduction of soil suitability for vegetation and can result in the disturbance or complete removal of seeds and plants from the eroded site. Over time eroded soils become preferentially depleted of their finer fraction. The breakdown of aggregates and the removal of smaller particles or entire layers of soil or organic matter can weaken the structure and change the texture. Textural changes can affect the water-holding capacity of the soil making it more susceptible to extreme conditions such a drought.

In addition to on-site effects, soil that is detached by accelerated water or wind erosion may be transported considerable distances causing off-site effects. Eroded soil deposited down slope can inhibit or delay the emergence of seeds, bury small seedlings, and necessitate replanting in the affected areas. Sediment which reaches streams or watercourses can clog drainage ditches and stream channels resulting in flooding and local property damage, reduced downstream water quality, buried fish spawning grounds, and reservoir siltation.

Asbestos is a term used for a group of naturally occurring magnesium silicate minerals that display heat and chemical resistance, high tensile strength, and flexibility. Serpentine (chrysotile) and amphibole (tremolite) asbestos occur naturally in San Diego County most commonly in association with ultramafic rocks and along associated faults.

Because asbestos fibers are resistant to heat and most chemicals, they have been mined for use in more than 3,000 products including cement pipe used in distributing water to communities. The major sources of asbestos in drinking water are decay of asbestos cement water mains and erosion of natural deposits. Other anthropogenic sources of asbestos include building materials, manufacturing, and mining.

Asbestos is carcinogenic to humans. Inhalation of asbestos may result in the development of lung cancer or mesothelioma; ingestion increases the risk of developing benign intestinal polyps.

Mercury occurs naturally and is released into the environment by volcanic activity, weathering of rocks, and human activity. Mercury occurs in various forms and compounds in the environment some of which are not bioavailable. When mercury enters an aquatic environment by erosion, atmospheric deposition, or as the result of human activity, it may encounter conditions that cause its conversion to methyl mercury. Methyl mercury is readily taken up by aquatic organisms and concentrates as it moves up the food chain. This process is referred to as biomagnification and can result in high mercury concentrations in predatory fish, fish eating birds, and mammals. The principal route of human exposure is through consumption of contaminated fish.

Anthropogenic sources include coal combustion, waste incineration, industrial activities, and mining activities. California environmental mercury issues relate to historical mining operations in two ways. The first is mercury mining activity that occurred between 1846 and 1981 during which time about 100 million kilograms of mercury were produced within the state. The second is historic gold mining activities that took place between 1848 and the first part of the 20th century which depended upon using mercury during the gold recovery process. Significant quantities of mercury were lost to the environment during both activities.

Mercury is a human neurotoxin. Ingestion of mercury may result in neurological and behavioral disorders with developing fetuses and small children being at greatest risk.

Radon gas is a naturally occurring radioactive gas that is invisible, odorless, tasteless, and soluble in water. It forms from the radioactive decay of small amounts of uranium and thorium naturally present in rocks (Gneiss) and soils. Certain rock types, such as black shales and certain igneous rocks, can have thorium and uranium in amounts higher than is typical for the earth's crust. Increased amounts of radon will be generated in the subsurface at these locations, and because radon is a gas it can easily move through soil. Radon-222 is the isotope of most concern to public health because it has a much longer half-life (3.8 days) than other radon isotopes (radon-219 at 4 seconds and radon 220 at 55.3 seconds). The longer half-life allows radon-222 to migrate farther through the soil. The average concentration of radon in American homes is about 1.3 picocuries per liter (pCi/L) and the average concentration in outdoor air is about 0.4 pCi/L. The geologic radon potential for San Diego County is low (<2 pCi/L). Higher levels of radon tend to be found in groundwater sources than in surface water sources. Anthropogenic sources of radon release include mining and coal combustion.

Radon is carcinogenic to humans. Inhalation of elevated levels of radon gas increases the risk of developing lung cancer. To date, epidemiological studies have not found an association between consumption of drinking water containing radon and an increased risk of stomach cancer.

Arsenic occurs naturally in San Diego County (Arsenopyrite) and is widely distributed throughout the environment in the air, water, and land. It can be released into the environment through natural activities such as volcanic action, erosion of rocks, forest fires, and human activities related to agriculture and industry. When deposits of Arsenopyrite become exposed to the atmosphere, the mineral will slowly oxidize converting the arsenic into oxides that are more soluble in water. Higher levels of arsenic tend to be found in ground water sources than in surface water sources. Compared to the rest of the United States, western states have more water systems with arsenic levels greater than U.S. EPA's standard of 10 parts per billion (ppb).

Approximately 90% of industrial arsenic in the U.S. is currently used as a wood preservative; it is also used in paints, dyes, metals, drugs, soaps, and semi-conductors. Other anthropogenic sources include certain fertilizers, industrial practices involving animal feeding operations, copper smelting, mining, and coal combustion.

Arsenic is carcinogenic to humans. Ingestion of water with elevated levels of arsenic increases the risk of skin cancer.

3.2 Biology

Vegetation

Vegetation anchors the soil, protects the soil from splash erosion, slows down the movement of surface runoff, allows excess surface water to infiltrate, and provides a wind break effect. The effectiveness of vegetative covers depends on the type, extent, and quantity of cover. Trees, shrubs, and residue act as wind breaks that prevent the wind from placing soil particles into motion over greater distances which increase abrasion and soil erosion. Vegetation such as forests, shrubs, permanent grasses, and residue combinations which completely cover the soil and intercept falling raindrops at and close to the surface are the most effective at reducing splash erosion. Partially incorporated residues and residual roots are important as these provide channels that allow surface water to infiltrate into the soil. Typically, only the most severe rainfall and large hailstorm events will lead to overland flow in a well vegetated area.

In addition to providing soil stability, vegetation cover can provide other ecological services related to water quality. Wetlands and other riparian plant communities act as natural filters removing suspended sediments and contaminants. Sediments are trapped by densely growing wetland plants, and many contaminants are absorbed or chemically altered by the vegetation. For a detailed list of vegetation potentially found within the local source water system see Appendix 3.2.

Oak woodlands typically occur in the foothills and transition into mixed conifer/oak woodlands at higher elevations. Each community type can vary from open savannas in broad valleys and rolling hills, to dense woodlands in canyons and along streams. Oak woodlands are dominated by live oak tree species that include black oak, coast live oak, Engelmann oak, and canyon live oak.

Goldspotted Oak Borer (GSOB) is responsible for major oak mortality on federal, state, private, and Native American lands in Southern California. GSOB was first detected in San Diego County in 2004 by the California Department of Food and Agriculture (CDFA) during a survey for exotic woodborers. Four years later, it was found attacking three species of oak in the Cleveland National Forest in San Diego County: coast live oak, canyon live oak, and California black oak.

Oak woodlands have evolved with fire. Dense woodlands typically experience infrequent stand destroying fires. Oak trees that experience some canopy fire often survive unless the ground fire temperature is extreme enough to kill the root system. The complex of species associated with dense oak woodlands will either re-sprout or germinate from seed. Frequent or hot fires can affect the seed bank and the root system of oak woodland species resulting in degraded habitat that is susceptible to habitat conversion.

Eucalyptus woodland is a non-native closed canopy community. This community is typically a monotypic stand of Eucalyptus trees with a thick mulch of Eucalyptus tree leaves.

Eucalyptus stands can be fire retardant to low intensity fires. Low intensity fires will consume the leaf litter and can be carried into the canopy where leaves are singed, or tops are burned. High intensity fires are typically stand destroying.

Table 3.3 - Vegetation Categories within Local Watersheds SanGIS			
Watershed	**Vegetation Category**	**Acres**	**% Area**
El Capitan	Scrub and Chaparral	70,446	58.54
	Disturbed or Developed Areas	5,430	4.51
	Grasslands, Vernal Pools, Meadows, and Other Herb Communities	7,024	5.84
	Bog and Marsh	108	0.09
	Riparian and Bottomland Habitat	4,913	4.08
	Forest	16,359	13.60
	Woodland	16,049	13.34
Murray	Scrub and Chaparral	499	19.40
	Disturbed or Developed Areas	1,881	73.13
	Grasslands, Vernal Pools, Meadows, and Other Herb Communities	17	0.66
	Bog and Marsh	2	0.08
	Riparian and Bottomland Habitat	173	6.73
San Vicente	Scrub and Chaparral	35,478	74.50
	Disturbed or Developed Areas	6,011	12.62
	Grasslands, Vernal Pools, Meadows, and Other Herb Communities	1,221	2.56
	Bog and Marsh	15	0.03
	Riparian and Bottomland Habitat	1,916	4.02
	Woodland	2,980	6.26
Sutherland	Scrub and Chaparral	31,157	43.62
	Disturbed or Developed Areas	1,488	2.08
	Grasslands, Vernal Pools, Meadows, and Other Herb Communities	9,178	12.85
	Bog and Marsh	463	0.65
	Riparian and Bottomland Habitat	1,442	2.02
	Forest	3,761	5.27
	Woodland	23,934	33.51
Barrett	Scrub and Chaparral	65,583	78.77
	Disturbed or Developed Areas	1,964	2.36
	Grasslands, Vernal Pools, Meadows, and Other Herb Communities	1,858	2.23
	Bog and Marsh	1	0.00
	Riparian and Bottomland Habitat	1,862	2.24
	Forest	8,225	9.88
	Woodland	3,762	4.52
Morena	Scrub and Chaparral	57,712	78.48
	Disturbed or Developed Areas	1,424	1.94
	Grasslands, Vernal Pools, Meadows, and Other Herb Communities	3,882	5.28
	Riparian and Bottomland Habitat	1,841	2.50
	Forest	4,067	5.53
	Woodland	4,615	6.28
Otay	Scrub and Chaparral	45,451	71.85
	Disturbed or Developed Areas	7,576	11.98
	Grasslands, Vernal Pools, Meadows, and Other Herb Communities	3,098	4.90
	Bog and Marsh	313	0.49
	Riparian and Bottomland Habitat	1,734	2.74
	Forest	3,183	5.03
	Woodland	1,899	3.00
Miramar	Scrub and Chaparral	243	34.71
	Disturbed or Developed Areas	300	42.86
	Grasslands, Vernal Pools, Meadows, and Other Herb Communities	10	1.43
	Riparian and Bottomland Habitat	147	21.00
Hodges	Scrub and Chaparral	50,972	41.99
	Disturbed or Developed Areas	43,920	36.18
	Grasslands, Vernal Pools, Meadows, and Other Herb Communities	12,169	10.02
	Bog and Marsh	254	0.21
	Riparian and Bottomland Habitat	4,666	3.84
	Forest	40	0.03
	Woodland	9,370	7.72

Coniferous forests occur in the lower to upper montane zone in the Peninsula Ranges. The lower montane forests typically include the Southern Interior Cypress Forest which is intermixed with oak woodlands and chaparral.

Upper montane forests include Coulter Pine Forest, Jeffery Pine Forest, and mixed Sierran Forest. They range from pure stands of a single species to mixed conifer forests intermixed with oak woodlands and chaparral.

Montane forests are typically surrounded by chaparral, or adjacent to forests subject to fire, and are therefore susceptible to fire. When fires occur more frequently than twenty-five years, Coulter pine habitat may convert to chaparral. Jeffery Pine Forests and Mixed Coniferous Forests historically experience periodic low-to-moderate intensity fires in the understory. Fuel buildup due to fire suppression can increase the risk of stand replacing crown fires.

Chaparral occurs throughout the coastal lowlands, foothills, and montane region. This community typically forms a dense almost impenetrable shrub community with no herbaceous layer. Chaparral is a highly variable plant community that includes: Chamise Chaparral, Coastal Sage-Chaparral Scrub, Mixed Chaparral, Montane Chaparral, Semi-desert Chaparral, and Scrub Oak Chaparral.

Chaparral is a fire adapted community, that stump sprouts or germinates from seed after a low-to-moderate intensity burn. Large fires often result in homogenous stands of chaparral. Frequent or hot fires can burn the root systems and surface seed banks resulting in a loss of diversity and low-density vegetative communities. For a few years after a fire, annual forbs germinate and establish on site until the woody shrubs mature.

Locally, Coastal Sage Scrub consists of low woody soft-shrubs and is classified as Diegan Coastal Sage Scrub (DCSS). DCSS is dominated by California sagebrush and/or flat-topped buckwheat and often intergrades with Chaparral communities.

DCSS species are fire adapted and quickly regenerate from seed after a fire. However, frequent fires in an area can reduce the seed bank for native shrub species and increase the presence of non-native grasses and forbs resulting in degraded habitat. Once this habitat conversion occurs, DCSS species typically do not re-colonize the area due to competition from dense populations of invasive grasses that increase the fire frequency.

Locally, Big Sagebrush Scrub is dominated by flat-topped buckwheat, broom snakeweed, deerweed, saw-toothed golden brush, and a variety of DCSS species.

The fire ecology of Big Sagebrush Scrub in eastern San Diego County is not well documented. Many of the species in this community occur in DCSS and are fire adapted. Frequent fires in the vegetative community will result in habitat conversion to non-native grasslands.

Perennial Grasslands vary among Valley Needlegrass and Valley Sacaton grasslands. Valley Needle Grassland is dominated by the tussock forming purple needlegrass, the native bunchgrasses (foothill needle grass, coast range melic), and a variety of native forbs including colar lupin, rancher's fireweed, and adobe popcorn-flower. The species' composition can vary as it transitions into the foothills and the montane zone.

Valley Sacaton Grassland is dominated by sacaton or salt grass. This community typically occurs in the areas with a high seasonal water table and is often associated with Alkali Seeps and Alkali Meadows. Non-native grasslands are dominated by Red brome, Ripgut brome, and Softchess brome. Non-native grasslands often intergrade with open oak woodlands and disturbed DCSS communities.

Grassland communities in San Diego County have evolved with and are typically maintained by fire. Fire in non-native grasslands results in a continued dominance by invasive grasses and prevents reestablishment by native shrub species.

Montane Meadows occur in the montane zone and are dense growths of sedges and perennial herbs that experience wet, cold winters. Montane Meadows are typically interspersed with montane forests.

Wildflower Field is an amorphous community of herbaceous plant species where dominance varies from site to site and year to year depending on climatic factors. Wildflower Field is typically associated with grasslands and oak woodlands in the valleys and foothills.

Wet meadows typically do not burn since the moisture content in the plants and soils retards fire advance. During drought times and in dry meadows, fire will quickly burn through these communities. Fall fires typically have little impact on local meadows since most plants are dry and have dispersed their seed.

Riparian communities vary depending on the aquatic system they are associated with and can have seral stages of community succession. Mulefat Scrub and Southern Willow Scrub are typically early seral stages for Southern Cottonwood-Willow Riparian Forest which develops into Southern Coast Live Oak Riparian Forest. In steep drainages, Mulefat Scrub and Southern Willow Scrub may be early stages for Southern Sycamore-Alder Riparian Forest or White Alder Riparian Forest.

Riparian communities often resist fire since they are not as susceptible to drought. During drought, riparian species become more vulnerable to fire. Stand destroying fires can assimilate flooding events in that they set communities back to early seral stages. Stump sprouting species can reestablish in the early successional communities. Most mature trees that experience high intensity fires will die.

Wetland communities are highly variable. Riparian and Wet Meadows are communities that can establish in areas with sufficient hydrology to be considered wetlands. Emergent wetlands occur along seeps and in shallow water and include: Alkali Seep, Freshwater Seep, and Freshwater Marsh.

Historically, fire impacts to wetlands in San Diego County are not documented. Wetlands typically do not experience fire. Many wetland species are rhizomous and will likely survive fires. Woody species in scrub and forested wetlands may recover from fire by epicormic sprouting from stems or basal sprouting from roots.

Wildlife

Diverse assemblages of wildlife species including mammals, birds, and reptiles are commonly found within the boundaries of the local source water system. Many species are common to both upland and lowland areas occurring from sea level to the mountains where suitable habitat is available. Few of the terrestrial mammals of Southern California are dependent on wetland habitats, however, some are more common along streams than in upland areas. Many birds are adapted to life on open water, and in or adjacent to wetland habitats. These include numerous species of waterfowl and wading birds. Most amphibians are also associated with temporary or permanent sources of water. The fishes associated with Southern California streams and reservoirs are primarily warm-water fishes. For a detailed list of wildlife potentially found within the local source water system see Appendix 3.3.

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CHAPTER 4

DESCRIPTION OF ACTIVITIES AND SOURCES OF CONTAMINATION WITHIN THE LOCAL WATERSHEDS

Pollution is a challenging water quality problem. The type and severity of pollutants found in water bodies are related to land use and intensity and are as varied as the types of business, industry, agricultural, and urban sources that produce them. Whether a contaminant is harmful to the aquatic environment depends on several factors including the type and concentration of the contaminant, the timing of its release, weather conditions, and the organisms living in the area.

Table 4.1 - Land Use within Local Watersheds

SanGIS

2020

Watershed	Land Use Category	Acres	% Acres
El Capitan	Total- Undeveloped	101,622	84.45
	Total - Developed	18,707	15.55
Murray	Total- Undeveloped	628	24.44
	Total - Developed	1,942	75.56
San Vicente	Total- Undeveloped	35,525	74.62
	Total - Developed	12,086	25.38
Sutherland	Total- Undeveloped	58,645	82.11
	Total - Developed	12,779	17.89
Barrett	Total- Undeveloped	77,773	93.41
	Total - Developed	5,483	6.59
Morena	Total- Undeveloped	64,834	88.16
	Total - Developed	8,707	11.84
Otay	Total- Undeveloped	51,810	81.91
	Total - Developed	11,444	18.09
Miramar	Total- Undeveloped	514	73.32
	Total - Developed	187	26.68
Hodges	Total- Undeveloped	58,335	48.06
	Total - Developed	63,055	51.94
2020 Total	Total- Undeveloped	449,686	76.99
	Total - Developed	134,390	23.01
2015 Total	Total- Undeveloped	465,280	78.92
	Total - Developed	124,290	21.08

Endnote:

For land use category details see Appendix 4.1

Point-source pollutants in surface water and groundwater are usually found in a plume that has the highest concentrations of the pollutant nearest the source with diminishing concentrations as distance from the source increases. Commercial and industrial businesses use hazardous materials in the manufacturing and maintenance process discharging various wastes from their operations in the waste stream for the facility. The raw materials and wastes may include pollutants such as solvents, petroleum products, and heavy metals. Sources of pollution from agriculture include animal feeding, cleaning, and waste storage areas, along with storage, handling, and mixing areas for pesticides, fertilizers, and petroleum. Municipal point sources include wastewater treatment plants, landfills, utility stations, motor pools, and fleet maintenance facilities. If the facility or operator does not handle, store, and dispose of the raw materials and wastes properly, these pollutants can end up in the water supply. This may occur through discharges at the end of a pipe to surface water, discharges on the ground that move through the ground with infiltrating rainwater, or direct discharges beneath the ground surface.

The most common point source pollutants in surface water are:

- High-temperature discharges
- Pathogens (bacteria, viruses, and *Giardia*)
- Nutrients (nitrogen and phosphorus)

Temperature increases and nutrients can result in excessive plant growth and subsequent depletion of dissolved oxygen levels in a waterbody resulting in increased stress and mortality of vulnerable aquatic life. Pathogens can be hazardous to human health and aquatic life. Pesticides and other toxic substances can also be hazardous to human health and aquatic life but are less commonly found in surface water because of high dilution rates.

The CWA prohibits the discharge of any pollutant to waters of the United States from a point source unless the discharge is authorized by an NPDES permit. The NPDES program is designed to track point sources and requires the implementation of the controls necessary to minimize the discharge of pollutants. Section 502(14) of the CWA defines a point source as any discernible, confined, and discrete conveyance, including but not limited to, any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, landfill leachate collection system, vessel or other floating craft from which pollutants are or may be discharged. Point sources statutorily do not include return flows from irrigated agriculture or agricultural stormwater runoff, individual homes that are connected to a municipal system, use of a septic system, or do not have a surface discharge, and conditionally excludes stormwater discharges from industrial facilities that have no exposure of industrial activities or materials to stormwater.

Initial efforts to improve water quality under the NPDES program primarily focused on reducing pollutants in industrial process wastewater and municipal sewage. As pollution control measures for industrial process wastewater and municipal sewage were implemented and refined, it became evident that more diffuse sources of water pollution were also significant causes of water quality impairment such as stormwater runoff from large surface areas including agricultural and urban land. Stormwater runoff is generated when water from rain and snowmelt flows over land or impervious surfaces. As the runoff flows over paved streets, parking lots, building rooftops, lawns, farms, and construction and industrial sites it accumulates debris, chemicals, sediment, or other pollutants that can adversely affect water quality in rivers, lakes, and coastal waters.

To address the role of stormwater in causing or contributing to water quality impairments, Section 402(p) of the FWPCA brought stormwater control into the NPDES program. Stormwater rules require NPDES permits for operators of municipal separate storm sewer systems (MS4) and construction sites larger than one acre in size. The rules also allow other sources not automatically regulated on a national basis to be designated for inclusion based on increased likelihood for localized adverse impact on water quality.

Nonpoint source pollutants are any source of water pollution that does not meet the definition of point source in section 502(14) of the CWA. NPS are diffused pollution sources which do not emanate from a discernible, confined, and discrete conveyance but generally results from land runoff, precipitation, atmospheric deposition, drainage, seepage, or hydrogeologic modification. NPS pollution is usually found spread out throughout a large area and it is often difficult to trace the exact origin of these pollutants because they result from a wide variety of human activities on the land as well as natural characteristics of the soil, climate, and topography.

NPS pollution is diffuse, widespread, and occurs continuously throughout the watersheds. NPS of pollution in urban areas include paved surfaces where runoff picks up oils, grease, salts, metals, and other toxic materials. Rainfall and irrigation runoff from landscaped and rural agricultural areas can contain sediment, salts, pesticides, and fertilizers. Rural areas with a high density of animals such as agricultural livestock are common nonpoint sources of pathogens and nutrient pollutants. These pollutants are also found in areas where there is a high density of septic systems or where the septic systems are faulty or not maintained properly.

The most common NPS pollutants in surface water are:

- Sediment
- Pathogens (bacteria, viruses, and *Giardia*)
- Nutrients (nitrogen and phosphorus)

4.1 Land Development

Land ownership and population are indicators of current and future potential levels of human disturbance within an area. These effects accumulate from a variety of outdoor human activities arising from over exploitation of a finite land resource. Human disturbance is generally in the form of development and the overuse of open spaces. Land areas with small population densities are usually rural areas with natural landscapes that trap and filter rainwater increasing infiltration into the ground. In contrast, large population densities associated with urbanized areas generally result in vegetation modification and increased impervious surface area resulting in changes to runoff volume, velocity, and pattern. Urbanization also increases the variety and amount of pollution carried into streams, rivers, and lakes. The overuse of open spaces by recreational users results in increased erosion due to vegetation removal and soil disturbance from bicycle and foot traffic, along with off-road vehicle activity.

Table 4.2 - Land Ownership within Local Watersheds

SanGIS

2015

Watershed	Ownership Category	Acres	% Watershed
El Capitan	Public Agencies	81,628	68
	Private	38,710	32
	City of San Diego	3,987	3
Murray	Public Agencies	939	41
	Private	1,359	59
	City of San Diego	592	26
San Vicente	Public Agencies	25,470	53
	Private	22,154	47
	City of San Diego	3,851	8
Sutherland	Public Agencies	17,840	52
	Private	16,713	48
	City of San Diego	1,984	6
Barrett	Public Agencies	73,585	88
	Private	9,673	12
	City of San Diego	3,905	5
Morena	Public Agencies	62,064	84
	Private	11,478	16
	City of San Diego	3,204	4
Otay	Public Agencies	33,796	46
	Private	35,317	48
	City of San Diego	4,056	6
Miramar	Public Agencies	459	71
	Private	186	29
	City of San Diego	459	71
Hodges	Public Agencies	56,980	36
	Private	101,301	64
	City of San Diego	21,093	13

Endnote:

City of San Diego land ownership included in Public Agencies figures

Table 4.3 - Population within Local Watersheds SanGIS U.S. Census Bureau 2010						
Watershed	**Location**	**Total Population**	**% Population**	**Density**	**Acres**	**% Area**
El Capitan	County of San Diego	5,938	32	<1	107,578	89
	Alpine	11,585	62	1	10,293	9
	Harbison Canyon	164	1	23	7	0
	Julian	601	3	<1	2,009	2
	San Diego Country Estates	390	2	1	444	0
Murray	El Cajon	759	3	9	82	4
	La Mesa	4,126	18	43	96	4
	San Diego	18,335	79	9	2,114	92
San Vicente	County of San Diego	4,509	31	<1	35,983	75
	Poway	0	0	0	587	1
	Ramona	455	3	1	885	2
	San Diego Country Estates	9,762	66	1	10,267	22
Sutherland	County of San Diego	857	100	<1	34,548	100
Barrett	County of San Diego	3,464	69	<1	78,591	94
	Pine Valley	1,582	31	<1	4,659	6
Morena	County of San Diego	1,351	70	<1	73,536	100
	Pine Valley	571	30	44	13	0
Otay	County of San Diego	4,898	62	<1	61,139	88
	Chula Vista	180	2	<1	1,837	3
	Jamul	2,874	36	<1	6,025	9
Miramar	San Diego	6,405	100	10	645	100
Hodges	County of San Diego	22,312	19	<1	119,041	75
	Escondido	23,211	20	4	5,632	4
	Poway	12,836	11	1	9,011	6
	Ramona	16,538	14	2	8,719	6
	San Diego	37,701	33	2	15,845	10
	San Diego Country Estates	2,258	2	87	26	0

Ecosystem Degradation

Ecosystems perform services pertinent to water quality, flood protection, water storage, and decomposition of organic wastes. The health and biodiversity of ecosystems depends on the maintenance of high-quality habitat. Habitat provides essential food, cover, migratory corridors, and breeding/nursery areas for a broad array of organisms. Ecosystems can be damaged through change or degradation in structure, function, composition, or a loss of habitat. Degradation can encourage the establishment of invasive species and alter the natural flow regimes of tributaries, increase runoff of sediments, nutrients, pathogens, and toxins causing significant effects to the water quality and distribution of living organisms in the receiving waters.

Ecosystem degradation is usually caused by over exploitation of a resource due to overpopulation, pollution, development, agriculture, industry, and recreation.

Habitat Loss

Habitat destruction involves outright loss of areas used by wild species due to removal of vegetation and erosion. Plants and other sessile organisms in these areas are usually directly destroyed. Mobile animals (especially birds and mammals) retreat into undisturbed areas of habitat.

Habitat fragmentation invariably involves some amount of habitat destruction. Fragmentation occurs when native species are squeezed onto small patches of undisturbed land surrounded by disturbed areas. Habitat fragments are rarely representative samples of the initial landscape. The remaining habitat fragments are smaller than the original habitat and lead to crowding effects and increased competition. Species that can move between fragments may use more than one fragment. Species which cannot move between fragments must survive utilizing resources available in the single fragment.

Habitat loss is generally due to the conversion of open land to commercial development and agriculture.

Nutrients

Nutrients such as nitrogen and phosphorus are necessary for growth of plants and animals and support a healthy aquatic ecosystem. In excess, eutrophication of a water body can occur resulting in an increase in biomass and abundance of phytoplankton, cyanobacteria, and other aquatic plants. When the increased mass of organic matter subsequently dies and decomposes it can release toxins (cyanotoxins) and deplete the dissolved oxygen content of the water. The oxygen level of healthy waters is in the range of 5 or 6 parts per million, when the dissolved oxygen level is less than 2 parts per million many species that rely on the waterbody are under great stress and are at greater risk of mortality. Under reduced oxygen conditions foul odors are generated, and the aesthetic quality and recreational value of the water is reduced.

Anthropogenic nutrient sources include sewage discharges, urban and agricultural stormwater runoff, erosion, pet and livestock wastes, atmospheric deposition originating from power plants or vehicles, and groundwater discharges.

Acute exposure to nitrates and nitrites through ingestion increases the risk of developing methemoglobinemia. Chronic exposure through ingestion may potentially increase the risk of developing certain cancers and birth defects.

Pathogens

Pathogens are disease-causing organisms that are typically found in animal waste. Humans, pets, livestock, and wildlife species may act as potential sources of contaminants by spreading waterborne pathogenic bacteria, viruses, and protozoa such as *Giardia* cysts and *Cryptosporidium* oocysts. Numerous species of waterfowl and wading birds may be considered a source of pathogenic bacteria contamination as they can introduce fecal matter directly into the surface waters.

Anthropogenic pathogen sources include sewage discharges, urban and agricultural stormwater runoff, erosion, and pet and livestock wastes.

Pathogens may cause diseases that range in severity from mild gastroenteritis and viral infections to potentially life-threatening ailments such as severe gastroenteritis, giardiasis, cryptosporidiosis, cholera, dysentery, and infectious hepatitis.

Toxins

Toxins can damage an aquatic ecosystem by contaminating the water and food chain. Toxic substances and compounds including metals, cyanotoxins, polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), and pesticides can alter aquatic habitat, harm animal health and reduce reproductive potential, render many fish unsuitable for human consumption, and make recreational areas unsafe and unpleasant.

Anthropogenic sources of toxins include sewage discharges, urban and agricultural stormwater runoff, industrial discharges, and atmospheric deposition originating from power plants or vehicles.

Toxins can be carcinogenic to human and cause acute and chronic illnesses as well as organ damage.

Harmful Algae Blooms

Cyanobacteria, also known as blue-green algae, naturally occur in fresh waters. Under certain environmental conditions cyanobacteria can rapidly increase in number producing a cyanobacterial bloom. Excessive nutrient loads and concentrations are a major contributing factor to the increased occurrence of cyanobacterial bloom formation in water bodies.

Many cyanobacteria species can produce toxins (cyanotoxins), which can pose health risks to humans and animals. Blooms producing toxins are often referred to as Harmful Algae Blooms (HABs). The prevalence and duration of HABs in freshwater is expanding in the United States potentially causing significant water quality, human health, and socioeconomic impacts.

Anthropogenic nutrient sources include sewage discharges, urban and agricultural stormwater runoff, erosion, pet and livestock wastes, atmospheric deposition originating from power plants or vehicles, and groundwater discharges.

Cyanotoxins can impact the liver, kidney, and nervous system functions.

Invasive Species

Invasive species are non-native organisms introduced into a habitat that are likely to hurt the environment, human health, or cause economic harm. The spread of invasive species threatens the biodiversity of native plant and wildlife in addition to the quality and quantity of water supplies. Intentional or accidental introduction of an invasive species may result in unexpected ecological and economic impacts to the environment through vegetation loss, altered water tables, modified nutrient cycles or soil fertility, increased erosion, and introduced pathogens. Invasive species can alter habitats and reduce biodiversity by causing extinctions of native plants and animals fundamentally altering of the food web in an ecosystem. Invasive species also raise the cost of maintenance for roads, public lands, and waterways.

The response to invasive species is determined by the duration, rate of spread, and extent of the invasion. Pest control measures are often controversial and include mechanical removal, application of chemical pesticides, introduction of predatory or disease-causing biocontrol organisms, genetic engineering for pest resistance, or regulatory imposition of quarantines and the requirement of pest-free certification and permits for export, import, or local transport. Preemptive surveillance and exclusion rather than reactive adaptation is considered a less costly policy.

Anthropogenic sources of invasive species include commercial land development, agriculture, and recreation.

Waterways are vulnerable to the introduction of invasive species and can result in damage to the aquatic ecosystem, water transfer system, and reduced water quality impacting source water supplies. Aquatic Invasive Species (AIS) includes both aquatic plant and aquatic animal species. Invasive aquatic plants are introduced plants that have adapted to living in, on, or next to water, and that can grow either submerged or partially submerged in water. Invasive aquatic animals require an aquatic habitat but do not necessarily have to live entirely in water.

Quagga mussel (*Dreissena bugensis*) is a freshwater mussel with the ability to rapidly colonize hard surfaces reaching extreme densities causing serious environmental and economic damage. The fast growth rate and high reproductive potential of the quagga mussel produce a major biofouling organism that can clog water intake structures such as pipes and screens resulting in a reduction of pumping capabilities for power and water treatment plants resulting in increased costs to industries, companies, and communities. Recreational industries and activities are impacted by heavy colonization of docks, break walls, buoys, boats, and beaches. The introduction of the quagga mussel to a water body is primarily through attachment to boats or conveyance in ballast water and transportation with water currents. In response to the detection of quagga mussels in Lake Mead and the Colorado Aqueduct, the CSD initiated a monitoring program for quagga mussel veligers and updated its adult monitoring program. This Response and Control Plan was prepared to satisfy the CSD obligation under Fish and Game Code 2301 and 2302.

Asian clam (*Corbicula fluminea*) is a freshwater clam with the ability to rapidly colonize causing serious environmental and economic problems. The Asian clam is a major biofouling organism that can clog water intake structures such as pipes and screens resulting in a reduction of pumping capabilities for power and water treatment plants resulting in increased costs to industries, companies, and communities. The Asian clam poses a threat to the aquatic ecosystem through competition with native species. The introduction of the Asian clam to a waterbody is primarily through attachment to boats or conveyance in ballast water, use as bait, the aquarium trade, and transportation with water currents.

Channeled apple snail (*Pomacea canaliculate*) is a freshwater snail with a voracious appetite for aquatic plants that can cause environmental damage. The fast growth rate and high reproductive potential of the channeled apple snail poses a serious threat to the aquatic ecosystem, including wetlands, through potential habitat modification and competition with native species. The introduction of the channeled apple snail to a water body is primarily through the aquarium trade.

Eurasian watermilfoil (*Myriophyllum spicatum*) is a submerged aquatic plant that can rapidly colonize a water body and cause environmental and economic damage. The fast growth rate and high reproductive potential of the Eurasian watermilfoil causes impacts to recreational industries and activities while posing a serious threat to the aquatic ecosystem by creating dense mats of vegetation that shade out other native aquatic plants, diminish habitat and food resource value for fish and birds, and water deoxygenation. The introduction of the Eurasian watermilfoil to a water body is primarily through the aquarium trade and transportation with water currents.

4.2 Regulated Facilities/Activities

Table 4.4 - Active Regulated Facilities within Local Watersheds SWRCB-GeoTracker SWRCB-CIWQS* USGS-MRDS** 2020										
Watershed	NPDES*[1]	Storm Water*[1]	WDR Program*[1]	401 CERT*[1]	Mines**[2]	ILRP[1]	CAF*[3]	Land Disposal Sites[1]	UST Sites[1]	Military UST Sites[1]
El Capitan	-	1	6	1	70	6	-	3	6	-
Murray	-	-	-	-	1	-	-	1	1	-
San Vicente	-	2	2	1	12	1	-	-	-	-
Sutherland	-	4	-	-	3	1	1	-	-	-
Barrett	-	3	2	-	50	-	-	1	1	2
Morena	-	1	3	1	31	-	-	-	3	-
Otay	-	5	3	2	12	11	-	-	-	-
Miramar	-	1	-	-	-	-	-	-	-	-
Hodges	1	22	15	10	60	255	15	6	29	-
2020 Total	1	39	31	15	239	274	16	11	40	2
2015 Total	-	-	-	-	-	-	10	-	59	-

End Notes:

[1] For details, see Appendix 4.2

[2] For details, see Table 4.7

[3] For details, see Table 4.9

NPDES Permit Program

NPDES Permit Program controls water pollution by regulating point sources that discharge pollutants into waters of the United States. Pollutants include dredged spoil, solid waste, incinerator residue, filter backwash, sewage, garbage, sewage sludge, munitions, chemical wastes, biological materials, radioactive materials (except those regulated under the Atomic Energy Act of 1954, as amended (42 U.S.C. 2011 et seq.)), heat, wrecked or discarded equipment, rock, sand, cellar dirt, and industrial, municipal, and agricultural waste discharged into water.

Stormwater Program

Stormwater is defined by U.S. EPA as the runoff generated when precipitation from rain and snowmelt events flows over land or impervious surfaces without percolating into the ground. Stormwater is often considered a nuisance because it mobilizes pollutants such as motor oil and trash. Typically storm water flows directly to water bodies through sewer systems creating a major source of pollution to rivers, lakes, and the ocean. However, stormwater may also act as a resource and recharge to groundwater when effectively managed. The Water Boards are actively involved in initiatives to improve the management of stormwater as a resource.

Stormwater discharges in California are regulated through NPDES permits. The NPDES stormwater program regulates stormwater discharges from three potential sources: municipal separate storm sewer systems, construction activities, and industrial activities.

The State and Regional Water Boards implement multiple stormwater permitting programs as follows:

Municipal Separate Storm Sewer System (MS4) Permits: Large and small municipal sewer system operators must comply with MS4 permits issued by the State Water Board or applicable Regional Water Board. MS4 permits regulate stormwater entering local municipal systems under a two-phase system.

- Phase 1 MS4 permits regulate stormwater permits for medium (serving between 100,000 and 250,000 people) and large (serving 250,000 people or more) municipalities. Phase I permits are issued by Regional Water Boards for municipalities within the corresponding region.
- The Statewide Phase II MS4 permit regulates small municipalities (population of less than 100,000 people) and non-traditional small operations such as military bases, public campuses, prisons, and hospital complexes that are not jointly regulated under a Phase I MS4 permit. The Statewide Phase II MS4 Permit is issued by the State Water Board for regulation of small municipalities statewide.

California Department of Transportation Phase I MS4 Permit: The largest municipal stormwater discharger in California is the California Department of Transportation (Caltrans). The State Water Board regulates stormwater discharges from this linear network of highways and road facilities through one statewide Phase I MS4 Permit for Caltrans.

Statewide Construction Stormwater General Permit: Stormwater from construction projects that disturb one or more acres of soil, or that disturb less than one acre but are part of a larger common plan of development, are required to obtain coverage under the statewide General Permit for Discharges of Stormwater Associated with Construction Activity.

Statewide Industrial Stormwater General Permit: Industries with stormwater from industrial activity areas are regulated by the Statewide Industrial General Permit. The Industrial General Permit requires industry owners to implement the best technology available to reduce pollutants in their stormwater discharges.

WDR Program

The California Water Code requires that anyone who discharges waste that could affect waters of the state must submit a report of waste discharge. Current practice is to issue individual waste discharge requirements (WDRs), general WDRs, or waivers of WDRs.

The WDR Program, also referred to as the Non-Chapter 15 (Non 15) Program, is a state mandated program under which WDRs are issued to regulate the discharge of municipal, industrial, commercial, and other wastes to land only. The program regulates point discharges that are exempt pursuant to Subsection 20090 of Title 27 and not subject to the FWPCA. Exemptions from Title 27 may be granted for nine categories of discharges (e.g., sewage, wastewater, etc.) that meet and continue to meet the preconditions listed for each specific exemption. The scope of the WDR Program also includes the discharge of wastes classified as inert, pursuant to section 20230 of Title 27, and from confined animal feeding operations, which the State Water Board administratively determined to not be subject to Title 27 or Chapter 15 or federal NPDES regulations.

Core regulatory programs in the WDR Program include the following:

- Agriculture - Irrigated Lands Regulatory Program
- Aquifer Storage and Recovery
- Biosolids
- Concentrated Animal Feeding Operations (CAFO)
- Discharge of treated groundwater from groundwater cleanup operations
- General Waste Discharge Requirements for Aggregate and/or Concrete Facilities (Aggregate and Concrete Order)
- General Waste Discharge Requirements for Discharges to Land with a Low Threat to Water Quality
- General Waste Discharge Requirements for Natural Gas Utility Construction, Operations, and

Maintenance Activities
- General Waste Discharge Requirements for Small Domestic Wastewater Treatment Systems
- State Water Resources Control Board Resolution No. 2014-0054
- General Waste Discharge Requirement for Small Domestic Water Treatment Systems
- Initial Study / Negative Declaration for Small Domestic Wastewater Treatment Systems
- Notice of Determination
- General Waste Discharge Requirements for Winery Process Water Treatment Systems (Winery Order)
- Onsite Wastewater Treatment Systems (OWTS)
- Recycled Water Use
- Recycled Water Policy
- Statewide General Permit for Landscape Irrigation Uses of Recycled Water
- Water Recycling Requirements for Recycled Water Use
- Sanitary Sewer Overflows
- Timber Harvest (NPS Program)

Wastewater treatment facilities provide a multi-stage process to renovate wastewater collected from a community and transported through a sanitary sewer system to the facility before reuse or reentry into the environment through a body of water or land application. The degree and method of treatment varies from facility to facility. The goal is to reduce or remove the organic matter, solids, nutrients, pathogens, and other pollutants from the wastewater to meet the Basin Plan water quality objectives of the Hydrographic Sub-area.

Table 4.5 – Permitted Wastewater Treatment Facilities within Local Watersheds

SDRWCB-CIWQS
2020

Watershed	Facility	Regulatory Measure Type	Order #	Minor/Major	TTWQ	# Enforcement Actions within 5 years	Number of Violations/5 yr.
El Capitan	Julian WPCF	Enrollee - WDR	2014-0153-DWQ	N/A	2	0	0
San Vicente	San Vicente WWTP	WDR	R9-2009-0005	N/A	1	2	10
Barrett	Pine Valley WPCF	Enrollee - WDR	2014-0153-DWQ	N/A	2	0	0
Hodges	Santa Maria WWTP	WDR	R9-2016-0154	N/A	1	2	13
	Harmony Grove WRP	WDR	R9-2012-0054	Minor	2	1	2

Endnotes:

Order No: Number assigned to the Board adopted order. This changes when a permit/WDR is revised.

Major: EPA designates certain facilities as major depending on their industrial category or by the amount of flow, generally flow greater than 1 MDG or a discharge that poses a substantial threat to water quality.

Minor: EPA designates certain facilities as minor that have smaller flows and are considered lower threat.

TTWQ: Threat to Water Quality: Value of 1, 2, or 3. The value of 1 is the the highest and the value 3 indicates low threat.

Sanitary sewers are commonly non-existent in rural areas of the country forcing rural residents to use Onsite Wastewater Treatment Systems (OWTS). OWTS have made relatively high-density residential development possible in areas where municipal wastewater treatment facilities are not available.

OWTS treat and disperse relatively small volumes of wastewater from individual or small numbers of homes and commercial buildings. The most common type of onsite sewage system is the septic tank/drain field system. The main function of the tank is to remove the solids from the wastewater. The drain field is used for sub-surface disposal of the septic tank effluent.

Septic tanks remove some solids and condition the effluent for on-site subsurface disposal. Waste that is not decomposed (septage) eventually must be removed from the septic tank by a licensed company. Septage is the mixture of sludge, fatty materials, and wastewater. The concentrations of possible pollutants and pathogens in septage are high. Septage can contaminate groundwater if the septic tank is damaged and begins to leak or if the pumped septage is not disposed properly. The clarified septic tank effluent is highly odorous, contains finely divided solids, and may contain enteric pathogens. The effluent from the septic tank is disposed of through the drain field where the remaining impurities are trapped and eliminated in the soil. This process of filtration varies with the soil type, the size of the particles, soil texture, and the rate of the water flow. The major pollutants associated with septic systems are nitrates and bacteria.

Conventional OWTS systems work well for the removal of pathogens, and to a lesser extent some but not all other contaminants, when they are installed in areas with appropriate geology, soils, and hydrogeologic conditions. The amount of slope, soil permeability and texture, soil depths to impermeable soils, bedrock and groundwater, amount and frequency of rainfall, and distances from drinking water sources and surface water bodies are major factors associated with the system's associated environmental effects. Specific soil conditions, such as soil texture, soil structure, pH, salinity, temperature, oxygen, and moisture, affect the soil microorganisms that are essential for breaking down and decomposing wastewater effluent.

A common failure of a system is when the capacity of soil to absorb effluent is exceeded. Inappropriate siting or design and/or inadequate long-term maintenance are the primary causes of failure. When this happens the wastewater from the drain lines makes its way to the surface. This type of failure occurs when the soil is clogged with waste particles or other substances and it is more difficult for the water to move through the soil. When the system fails in this way and wastewater makes its way to the surface, water runoff from rain may wash the contaminants into surface waters or into inadequately sealed wells down gradient.

Many chemicals and pathogens are found in untreated or improperly treated sewage and can be a risk to public health. In the case of OWTS, this may occur where people come in direct contact with surfacing effluent or through ingestion of contaminated foods or drinking water, recreational contact, or droplet spray. Indirect contact may occur through contact with sewage-soiled clothing or tools, handling of pets that have had contact with sewage, or through vectors such as rodents or other organisms in contact with untreated sewage. Other indirect health effects may take place where vectors, such as mosquitoes, breed in surfacing effluent and may then carry diseases not related to sewage to human and animal populations.

Resolution No. 2012-0032 (23 CA ADC § 2924) Water Quality Control Policy for Siting, Design, Operation and Maintenance of Onsite Wastewater Treatment Systems (OWTS Policy) requires the RWQCBs to incorporate the standards established in the OWTS olicy, or equivalent standards that are protective of the environment and public health, into their water quality control plans. Implementation of the OWTS Policy is overseen by the SWRCB and the RWQCBs. The San Diego County Department of Environmental Health issues permits locally for both conventional and alternative OWTS according to an approved Local Agency Management Program (LAMP).

Table 4.6 - OWTS Permits within Local Watersheds 2016-2020 County of San Diego 2020					
Watershed	**Issued**	**In Process**	**New Construction**	**Repairs**	**Modifications**
El Capitan	17	120	82	51	4
Murray	-	-	-	-	-
San Vicente	1	15	12	4	-
Sutherland	2	9	7	4	-
Barrett	2	42	13	31	-
Morena	-	17	6	11	-
Otay	7	59	37	27	2
Miramar	-	-	-	-	-
Hodges	78	431	255	223	31
2020 Total	107	693	412	351	37
2015 Total	163	-	-	-	-

401 Water Quality Certification and Wetlands Program

The 401 Water Quality Certification and Wetlands Program regulates discharges of fill and dredged material under Clean Water Act Section 401 and the Porter-Cologne Water Quality Control Act. The program regulates dredge and fill activities for the protection of special-status species and regulation of hydromodification impacts in waters of the Unites States. The program protects all waters in its regulatory scope, but prioritizes wetlands, riparian areas, and headwaters due to their high resource value, vulnerability to filling, and lack of systematic protection by other programs. The program encourages basin-level analysis to protect the functions of wetlands, riparian areas, and headwater streams including pollutant removal, flood water retention, and habitat connectivity. Most projects are regulated by the RWQCBs through General Orders used to regulate multiple facilities involved in a common activity that is determined to be low threat and individual actions issued to regulate a specific discharge or discharges. The SWRCB directly regulates multi-regional projects and supports and coordinates the Program statewide.

Mines

Discharges from historic abandoned mines affect surface waters throughout the state of California. The U.S. EPA considers these discharges point sources. The SWRCB and the RWQCBs have regulatory authority over mines. Pollutants discharging from abandoned mines are generally from the chemical reaction of water and oxygen with naturally occurring residual minerals in the ore body, tailings, or waste rock. The most problematic mines discharge metals in concentrations that are predominantly toxic to aquatic life and pose a threat to human health. Remediation of mines is very costly and can take many years due to their potential large physical size, remote location, rugged steep terrain, complexity of the natural distribution of the mineralized metal bearing ore, labyrinth of underground workings, and numerous chemical reactions taking place deep underground. Therefore, large abandoned mine sites may be impossible to remediate adequately to protect aquatic life and beneficial uses or meet the water quality objectives designated for adjacent receiving waters.

Discharges often originate from a distinct mine portal, tailings pile, or waste rock disposal area. Soluble pollutants can be released into the environment when rainwater infiltrates into the subsurface where it intersects the residual ore body and underground mine workings. When this oxygenated water contacts a reactive ore body it generates sulfuric acid. The acid in turn can dissolve other elements and minerals including copper, cadmium, lead, and zinc which are especially toxic to aquatic life. The low pH mineral laden water referred to as acid mine drainage (AMD) is then collected in the mine workings and discharges from the mine portal where it can enter surface waters. The AMD is commonly toxic to aquatic life and can adversely impact the beneficial uses of the receiving waters. Discharges may also contain mercury, arsenic, and other substances which pose a threat to human health.

Table 4.7 – Mines within Local Watersheds

USGS Mineral Resources Data System (MRDS)

2020

Watershed	Development Status			Unknown
	Past or Present Producer	Prospect or Occurrence	Past or Present Producer & Prospect or Occurrence	
El Capitan	29	38	2	1
Murray	1	-	-	-
San Vicente	8	4	-	-
Sutherland	3	-	-	-
Barrett	10	33	5	2
Morena	17	12	-	2
Otay	4	8	-	-
Miramar	-	-	-	-
Hodges	38	18	2	2

Irrigated Lands Regulatory Program

The Irrigated Lands Regulatory Program (ILRP) regulates discharges from irrigated agricultural lands to prevent impairment of the waters that receive these discharges. This is done by issuing WDRs or conditional waivers of WDRs (Orders) to growers. These Orders contain conditions requiring water quality monitoring of receiving waters and corrective actions when impairments are found.

The ILRP includes all sites which discharge agricultural runoff and are regulated by ILRP at the SWRCB or one of the nine RWQCBs. Water discharges from agricultural operations include irrigation runoff, flows from tile drains, and stormwater runoff. These discharges can affect water quality by transporting pollutants, including pesticides, sediment, nutrients, salts, pathogens, and heavy metals from cultivated fields into surface waters. Many surface water bodies are impaired because of pollutants from agricultural sources. Groundwater bodies have suffered pesticide, nitrate, and salt contamination.

The impact of agriculture on water quality depends on the type of agricultural activity employed, the grade or slope of an area, and the erodibility and texture of the soil. Soil erosion and sedimentation, nutrients, pesticides, and irrigation runoff are the major agricultural concerns to nonpoint source pollution.

Intensive agriculture involves high capital investment. Typical characteristics of intensive agriculture include excessive use of chemical fertilizers, pesticides, herbicides, and hi-tech machinery, and employing a high amount of labor per unit land. The main aim of carrying out intensive agriculture is earning maximum amount of profit from a given piece of land. Extensive agriculture is an agricultural production system that uses small inputs of labor, fertilizers, and capital, relative to the land area being farmed. Orchards are an intentional planting of trees or shrubs that is maintained for commercial food production. Most temperate-zone orchards are laid out in a regular grid with a grazed or mown grass or bare soil base that makes maintenance and harvesting easy.

Soil erosion results in nutrient depletion and to a reduction of soil depth and texture all of which directly affect plant growth. Soil erosion may also lead to changes in river channels, and to sedimentation in rivers, lakes, and reservoirs. In agriculture, erosion occurs when fields are cleared of vegetation to prepare for crop planting or when vegetation is removed by grazing animals. The physical erosion potential of some soil may be exacerbated by previous agricultural practices which may have reduced the chemical fertility of the soil. The loss in fertility slows vegetative growth and leaves the soil surface exposed to wind and rain. Rates of soil erosion are usually much higher on cropland than on grassland or forest because the soil surface is exposed for at least part of the year during cultivation and the early stages of crop growth.

Application of fertilizers such as nitrogen or phosphorus can result in pollutants entering water bodies or the groundwater. Ingestion of nitrates and water with elevated levels of nitrates poses a threat to human health. Fertilizer entering surface waters can result in eutrophication of the water body causing an increase in aquatic plants, phytoplankton, cyanobacteria and related toxin levels (cyanotoxins), and dissolved oxygen depletion. Oxygen depletion in a water body can degrade water quality, cause foul odors, and adversely affect fish populations along with the aesthetic quality and recreational value of the water body.

The use of pesticides including herbicides, insecticides, and fungicides is another source of pollution originating from agricultural activity. Surface runoff from irrigation or rainfall can wash pesticides from fields into groundwater, streams, and lakes. The amount of pesticide runoff depends partly on the properties of the pesticide. Runoff ratings are based on the pesticide's ability to bind to the sediment during a runoff event. The leaching potential depends on whether the pesticide dissolves easily in water, the soil structure and texture, the amount and timing of irrigation or rainfall, the amount of adsorption to soil particles, and the persistence of the pesticide. Some pesticides can also be lost to the atmosphere, either as drift during application or through volatilization from surface of soil or plants. Once airborne, they may become available for off-site deposition on land or water.

Table 4.8 - Agriculture within Local Watersheds

SanGIS update 2020: figures calculated using ArcGIS Pro

Watershed	Landuse	Acres	% Watershed
El Capitan	Field Crops	65	0.05
	Intensive Agriculture	65	0.05
	Orchard or Vineyard	462	0.39
Murray	Field Crops	0	0.00
	Intensive Agriculture	0	0.00
	Orchard or Vineyard	0	0.00
San Vicente	Field Crops	268	0.56
	Intensive Agriculture	330	0.69
	Orchard or Vineyard	162	0.34
Sutherland	Field Crops	8,469	11.86
	Intensive Agriculture	0	0.00
	Orchard or Vineyard	25	0.04
Barrett	Field Crops	919	1.10
	Intensive Agriculture	30	0.04
	Orchard or Vineyard	0	0.00
Morena	Field Crops	1,617	2.20
	Intensive Agriculture	0	0.00
	Orchard or Vineyard	0	0.00
Otay	Field Crops	591	0.93
	Intensive Agriculture	53	0.08
	Orchard or Vineyard	32	0.05
Miramar	Field Crops	0	0.00
	Intensive Agriculture	0	0.00
	Orchard or Vineyard	0	0.00
Hodges	Field Crops	11,760	9.69
	Intensive Agriculture	3,877	3.19
	Orchard or Vineyard	4,788	3.94
2020 Total	Field Crops	23,689	4.02
	Intensive Agriculture	4,355	0.74
	Orchard or Vineyard	5,469	0.93
2015 Total	Field Crops	26,360	4.47
	Intensive Agriculture	3,775	0.64
	Orchard or Vineyard	5,929	1.01

Endnote:

Excludes home gardens and hobby farms

Confined Animal Facilities

A concentrated animal feeding operation (CAFO) is a U.S. EPA term for a large, concentrated animal feeding operation (AFO). A CAFO is an AFO with more than 1,000 animal units (an animal unit is defined as an animal equivalent of 1,000 pounds live weight and equates to 1,000 head of beef cattle, 700 dairy cows, 2,500 swine weighing more than 55 lbs., 125,000 broiler chickens, or 82,000 laying hens or pullets) confined on site for more than 45 days during the year, and feed is brought to the animals rather than the animals grazing or otherwise seeking feed in pastures, fields, or on rangeland. Any size AFO that discharges manure or wastewater into a natural or manmade ditch, stream, or other waterway is defined as a CAFO, regardless of size. CAFOs are regulated by the U.S. EPA under the Clean Water Act in both the 2003 and 2008 versions of the CAFO rule. California regulations refer to AFOs) including CAFOs, as confined animal facilities (CAFs). Each Regional Water Board develops the regulatory program it uses for CAFs. State regulations that apply to CAFs are in the California Code of Regulations, Title 27, Division 2, Chapter 7, Subchapter 2, Article 1.

CAFs congregate animals, feed, manure and urine, dead animals, and production operations on a small land area. The production area includes the animal confinement, feed and other raw materials storage areas, animal mortality facilities, manure handling containment or storage areas, and the land treatment area including any land to which manure or process wastewater is, or might be, applied for crop, hay, pasture production, or other uses.

The waste generated at a CAF is stored and removed or recycled by application on cropland and pastures. CAF discharges include manure, wastewater from animal holding and wash areas, spent bedding material, and animal mortality. Source water quality may become impaired due to increased erosion and pollution originating from regular activities such as land application of manure wastes, runoff from animal holding areas and feedlots, and rain events that overflow stored manure facilities such as waste lagoons and storage ponds. The primary pollutants associated with animal wastes are sediments, nutrients, pathogens, salts, organic matter, solids, and volatile and odorous compounds.

Dairy operations are issued wastewater discharge permits by the RWQCB9 which contain prohibitions, discharge specifications, facility designs, operation specifications, and other guidelines for complying with the Watershed Basin Plan. Dairy farms are inspected on a quarterly basis and required to submit quarterly reports to the RWQCB9 that include herd size, manure disposal, and groundwater monitoring results.

Poultry farms do not discharge a significant amount of wastewater so the RWQCB9 does not require these operations to have a permit. The San Diego County Department of Environmental Health Community Health Division regulates poultry operations for fly breeding and inspects the farms annually.

Watershed	Ranch Name	Ranch Type	Major/ Minor	Complexity	TTWQ	Cafo Population	Cafo Capacity	Enforcement Actions within 5 years	Violations within 5 years
Sutherland	Mesa Chiquita Ranch Dairy	Dairy	N/A	C	2	210	N/A	0	0
Hodges	Cloverdale Dairy	Dairy	N/A	C	2	NA	N/A	0	0
	Frank Konyn Dairy	Dairy	Minor	C	2	980	N/A	0	0
	S&S Farms	Dairy	Minor	C	3	761	N/A	0	0
	T.D Dairy	Dairy	Minor	C	2	875	N/A	1	2
	Valley View Dairy	Dairy	N/A	C	2	7	N/A	0	0
	Verger Dairy Farm	Dairy	N/A	N/A	N/A	561	N/A	0	0
	Brouwer's Poultry	Poultry	N/A	N/A	N/A	50,000	60,000	N/A	N/A
	Cebe Farms	Poultry	N/A	N/A	N/A	30,000	98,000	N/A	N/A
	Demler Bros.-Hatfield Pullet Ranch	Poultry	N/A	N/A	N/A	407,000	407,000	N/A	N/A
	Demler Bros.-Pinehill Egg Ranch	Poultry	N/A	N/A	N/A	1,500,000	2,000,000	N/A	N/A
	Eben-Haezer Poultry Ranch	Poultry	N/A	N/A	N/A	40,000	40,000	N/A	N/A
	Fluegge Egg Ranch	Poultry	N/A	N/A	N/A	175,000	175,000	0	0
	La Bahn Ranch	Poultry	N/A	N/A	N/A	10,000	16,000	N/A	N/A
	Ramona Duck Farm	Poultry	N/A	N/A	N/A	12,425	119,300	N/A	N/A
	Ramona Ranch	Poultry	N/A	N/A	N/A	85,000	90,000	N/A	N/A

Table 4.9 - CAFs within Local Watersheds

SWRCB-CIWQS

County of San Diego

2020

Endnotes:

Complexity: Value of A, B, or C. The value of A is the highest and typically indicates multiple discharge points, where C represents discharges with little or no treatment.

Major: EPA designates certain facilities as major depending on their industrial category or by the amount of flow, generally flow greater than 1 MDG or a discharge that poses a substantial threat to water quality.

Minor: EPA designates certain facilities as minor that have smaller flows and are considered lower threat.

TTWQ: Threat to Water Quality: Value of 1, 2, or 3. The value of 1 is the the highest and the value 3 indicates low threat.

Most grazing lands are considered either range or pasture, but grazing lands also include grazed forest lands, grazed croplands, hay lands, and native/naturalized pasture. Range and pasture lands are diverse types of land where the primary vegetation produced is herbaceous plants and shrubs. These lands provide forage for beef cattle, dairy cattle, sheep, goats, horses, and other types of domestic livestock.

Primary use zones are generally grasslands, either wet or dry meadows, oak woodlands, or pine forests with grassy understory. Livestock are often restricted to these primary use zones by dense vegetation boundaries formed by montane chaparral, steep slopes, or by fencing. Secondary/transitional use zones are areas of dense montane chaparral where forage may be temporarily available after fire or areas that may be used only occasionally by cattle. Transitional use zones also include isolated grassy areas that are inaccessible except after fire has cleared chaparral. These areas include all capable and suitable areas that are not primary use zones. In general, they receive only occasional use by livestock.

Many species of wildlife depend on these lands for food and cover. Wildlife values are also a major economic consideration for these lands, especially range lands. Environmental values of these lands are extensive and provide many essential ecosystem services, such as clean water, wildlife and fish habitat, and recreation opportunities.

The environmental impacts of livestock on both public and private grazing lands are the effects on soil, water quality, riparian areas, and biodiversity including invasive plant species. Livestock can affect soil quality through compaction, erosion, and changes in the plant community. Inappropriate grazing practices may accelerate erosion and sediment transport to water, alter stream flow, and disrupt aquatic habitats. Mismanagement of grazing lands can impair the capacity of riparian vegetation to filter contaminants, shade aquatic habitats, and stabilize stream banks and shorelines.

Water quality impacts of livestock on grazing lands include animal waste deposited directly into water or on land near surface waters where leaching and surface runoff can transport potential contaminants to streams, ponds, and lakes. Water quality contaminants associated with grazing are sediment, nutrients, organic matter, and pathogens.

Due to regional differences in hydrogeology, topography, climate, and land use, the SWRCB adopted a resolution directing the Regional Water Boards to work collaboratively with individual property owners, livestock grazing operators, and other interested stakeholders to establish regulatory actions and effective non-regulatory efforts for BMP implementation. The resolution directed the Regional Water Boards to consider prioritizing actions to address livestock grazing operations that cause or have the potential to cause impairment. The resolution directed that the Regional Water Boards should consider BMPs where appropriate and should consider establishing monitoring programs to evaluate the effectiveness of those BMPs. Finally, the resolution directed the Regional Water Boards to take actions they determine to be necessary to protect water quality and the beneficial uses of waters from pollution consistent with state and federal laws.

Livestock grazing within CSD watersheds largely occurs on private lands with only a small percentage occurring on public lands. No spatial data is available for grazing on private lands and the RWQCB9 does not issue waste discharge permits for livestock grazing, nor does grazing require a permit through the San Diego County Department of Planning and Land Use. It is estimated that Sutherland and Hodges watersheds host the most grazing use on private lands (CSD Staff, USFS Staff).

Table 4.10 - Permitted Grazing Allotments within Local Watersheds

BLM
USFS
2020

Watershed	Range Name	Number of Head	Total Acres	Estimated Acres Grazed	Ownership
Barrett	Corte Madera	40	6,100	470	USFS
	Guatay	20	900	300	USFS
	Hauser Mountain	11	2,952	NA	BLM
	Laguna	80	29,700	724	USFS
	Laguna Meadow	100	5,910	900	USFS
Hodges	Black Mountain	5	454	5	USFS
	Mesa Grande	30	3,535	240	USFS
2020 Total	N=7	286	49,551	2,639	
2015 Total	N=7	245	51,163	1,739	

Land Disposal Program

The State Water Board's Land Disposal Program implements statewide regulations for sites and facilities where waste is discharged to land. Requirements for siting, operation, and closure of waste disposal sites are enforced through the issuance of WDRs and compliance and enforcement efforts to ensure adequate protection of water quality. Land Disposal Sites include sites with solid and/or liquid wastes discharged to land such as landfills, mines, surface impoundments, waste piles, and land treatment facilities regulated pursuant to the California Code of Regulations Chapter 15 of Title 23, Title 27, or to the California Water Code. Land disposal sites regulated pursuant to the California Water Code include composting facilities. Wastes contained at land disposal sites are characterized as Class I (hazardous), Class II (designated), Class III (non-hazardous), or Unclassified (inert) pursuant to the California Code of Regulations, Title 22.

Permitted Underground Storage Tank (UST) Facilities

The purpose of the UST Program is to protect public health and safety and the environment from releases of petroleum and other hazardous substances from USTs. There are four program elements: leak prevention, cleanup, enforcement, and tank tester licensing.

Permitted UST facilities include facilities for which the owner or operator has been issued a permit to operate one or more USTs by the San Diego County Department of Environmental Health. A UST is a tank or combination of tanks including pipes connected thereto that is used for the storage of hazardous substances and has at least 10% of its combined volume underground. UST owners include service stations, convenience stores, fleet service operators, and local governments. Nearly all regulated USTs contain petroleum with automotive and tractor fuels making up the majority of permitted liquid hazardous storage. These fuels are stored in underground fiberglass-reinforced plastic, cathodically protected steel, or steel clad with fiberglass-reinforced plastic. The tanks are installed with a leak interception and detection system.

Military UST sites include all petroleum related sites located on existing military bases (or those which are to be transferred) and are regulated by the SWRCB and/or RWQCBs.

Recreation

The primary purpose of a CSD surface water reservoir is for domestic water supply. Recreation is a secondary use of the reservoir. The beneficial uses designated to CSD reservoirs by the RWQCB9 include contact water recreation (REC1) and non-contact water recreation (REC2). Recreational activities requiring a permit include boating, fishing, water-skiing, hunting, and camping; activities that don't require a permit include walking, running, hiking, cycling, and picnicking. Launching of private vessels (without toilets), float tubes, canoes, and kayaks are permitted except at Barrett Reservoir where no private vessels are allowed.

Facilities associated with recreation generally include parking, boat launching, docks, floats, rental boats, trash receptacles, portable toilets, and restroom facilities. Floating portable toilets are located on all reservoirs with the exceptions of Barrett and Morena. Waste is removed through a sewer system, septic system, or manually. There are no boat holding tank pump out stations or berths available at the reservoirs. Impacts associated with recreational use include unclassified trails, litter, and sanitation issues. Pollutants associated with the recreational activities include pathogens, sediment, turbidity, nutrients, toxic compounds, organic matter, and gross pollutants including plastic and paper products.

All reservoirs have a barrier demarcating a restricted access zone around the outlet facilities and dams. This area is to prevent direct recreational contact to the water immediately available for transfer or use by the WTPs.

Table 4.11 - Permitted Recreational Use (FY16 - FY20)

CSD
County of San Diego*
2020

Reservoir	Permits Issued					Rentals			Total Open Days
	Launch	Fishing	Body Contact	Hunting	Camping	Kayak	Row	Motor	
El Capitan	52,611	111,406	32,892	NA	NA	0	0	1,592	1,245
Murray	29,277	98,091	NA	NA	NA	3,849	2,168	7,530	1,751
San Vicente	60,825	126,016	71,423	NA	NA	857	0	2,337	1,200
Sutherland	2,490	11,796	NA	347	NA	0	0	0	405
Barrett	0	5,115	NA	1,028	NA	0	711	2,845	478
Morena*	1,769	18,207	NA	NA	46,933	NA	146	2,415	1,795
Otay	45,478	116,605	NA	NA	NA	3,378	242	8,736	756
Miramar	7,712	33,066	NA	NA	NA	2,886	905	2,331	1,751
Hodges	35,101	76,389	905	NA	NA	2,403	179	3,619	555
Total 2020	235,263	596,691	105,220	1,375	46,933	13,373	4,351	31,405	9,936
Total 2015	168,274	428,616	81,101	4,595	36,294	11,374	4,486	18,348	8,715

4.3 Cleanup Sites

Table 4.12 - Cleanup Sites within Local Watersheds SWRCB-GeoTracker CAL FIRE* 2020						
	Under Investigation / Remediation					
Watershed	Cleanup Program Sites [1]	Military Cleanup Sites [1]	LUST Cleanup Sites [2]	DTSC Cleanup Sites [3]	SSO[4]	Fires* [5]
El Capitan	-	-	4	1	-	-
Murray	-	-	1	-	3	-
San Vicente	-	-	-	-	2	2
Sutherland	-	-	-	-	-	1
Barrett	-	-	-	2	-	1
Morena	-	-	-	-	-	-
Otay	-	-	-	2	2	3
Miramar	-	-	-	-	-	-
Hodges	2	1	4	10	12	7
2020 Total	2	1	9	15	19	14
2015 Total	10	-	19	-	14	13

End Notes:

[1] For details, see Table 4.13
[2] For details, see Table 4.14
[3] For details, see Table 4.15
[4] For details, see Table 4.16
[5] For details, see Table 4.17

Site Cleanup Program

The Site Cleanup Program (SCP) regulates and oversees the investigation and cleanup of non-federally owned sites after the occurrence of a recent or historical unauthorized release of pollutants to the environment, including soil, groundwater, surface water, and sediment. Cleanup Program Sites include all non-federally owned sites that are regulated under the SWRCB Site Cleanup Program and/or similar programs conducted by each of the nine RWQCBs. Cleanup Program Sites are varied and include but are not limited to pesticide and fertilizer facilities, rail yards, ports, equipment supply facilities, metals facilities, industrial manufacturing and maintenance sites, dry cleaners, bulk transfer facilities, refineries, mine sites, landfills, Resource Conservation and Recovery Act / Comprehensive Environmental Response, Compensation, and Liability Act (RCRA/CERCLA) cleanups, and some brownfields. Unauthorized releases detected at Cleanup Program Sites are highly variable and include but are not limited to hydrocarbon solvents, pesticides, perchlorate, nitrate, heavy metals, and petroleum constituents.

Military Cleanup Sites include all cleanup sites that are located on existing military bases (or those which are to be transferred). Military Cleanup Sites include a wide range of discharges and are primarily regulated by the RWQCBs under RCRA/CERCLA standards.

Table 4.13 - Cleanup Program Sites under Investigation/Remediation within Local Watersheds SWRCB-GeoTracker 2020			
Watershed	**Facility Name**	**SITE / FACILITY TYPE**	**STATUS**
Hodges	CHATHAM BROTHERS BARREL YARD (FORMER)	CLEANUP PROGRAM SITE	OPEN - REMEDIATION
	RANCHO GUEJITO PROJECT SITE	CLEANUP PROGRAM SITE	OPEN - VERIFICATION MONITORING
	RAMONA BOMBING TARGET AND LANDING FIELD	MILITARY CLEANUP SITE	OPEN - SITE ASSESSMENT

Leaking Underground Storage Tank (LUST) Cleanup Sites

Leaking Underground Storage Tank Cleanup Sites include all UST sites that have had an unauthorized release of a hazardous substance and are being cleaned up. A large majority of LUST sites are a result of fuel leaks, which are regulated pursuant to Title 23 of the California Code of Regulations, Chapter 16, Article 11.

The greatest potential hazard from a LUST is that the petroleum or other hazardous substance can seep into the soil and contaminate groundwater. A LUST can present other health and environmental risks, including the potential for fire and explosion.

Table 4.14 - LUST Cleanup Sites under Investigation/Remediation within Local Watersheds SWRCB-GeoTracker 2020			
Watershed	**Facility Name**	**SITE / FACILITY TYPE**	**STATUS**
El Capitan	JULIAN CHEVRON	LUST CLEANUP SITE	OPEN - REMEDIATION
	JULIAN CIDER MILL	LUST CLEANUP SITE	OPEN - REMEDIATION
	NH COZENS, INC	LUST CLEANUP SITE	OPEN - REMEDIATION
	ROBERTA H GREEN	LUST CLEANUP SITE	OPEN - REMEDIATION
Murray	AM/PM MINI MARKET #591	LUST CLEANUP SITE	OPEN - REMEDIATION
Hodges	BLUE RIBBON INVESTMENTS INC	LUST CLEANUP SITE	OPEN - VERIFICATION MONITORING
	DONINA 2,INC/DBA RAMONA CHEVRON	LUST CLEANUP SITE	OPEN - REMEDIATION
	GASOLINE ALLEY	LUST CLEANUP SITE	OPEN - ASSESSMENT & INTERIM REMEDIAL ACTION
	RAMONA DAY & NITE MOBIL	LUST CLEANUP SITE	OPEN - REMEDIATION

Department of Toxic Substances Control (DTSC)

Department of Toxic Substances Control regulates the management of hazardous waste along with investigating and cleaning up existing contamination to restore properties affected by environmental contamination to productive use. Hazardous waste is waste with a chemical composition or other properties that make it capable of causing illness, death, or some other harm to humans and ecosystems.

The Hazardous Waste Management Program manages permitted hazardous waste facilities including former industrial properties, school sites, military bases, small businesses, and landfills, undertakes policy initiatives to reduce hazardous waste generation, and enforces the statutes and regulations relating to hazardous waste, hazardous materials, and universal wastes. It investigates complaints of illegal storage, treatment, or disposal of hazardous waste and assists local law enforcement agencies with investigations and enforcement activities.

The Site Mitigation and Restoration Program investigates sites with known or suspected contamination and, when contamination is found, ensures removal or control to reduce hazardous releases and restore these sites to productive use and manages their cleanup. The program oversees sites through enforcement orders and voluntary oversight agreements. Program staff also assists in responding to emergencies, such as wildfires, involving the release of hazardous materials.

Table 4.15 - DTSC Cleanup Sites under Investigation/Remediation within Local Watersheds DTSC-ENVIRONSTOR SWRCB-GeoTracker 2020			
Watershed	**Facility Name**	**SITE / FACILITY TYPE**	**STATUS**
El Capitan	HIGH SCHOOL NO. 12, STUDY AREA J, LAZY-A RANCH	SCHOOL CLEANUP	CERTIFIED
Barrett	MOUNT LAGUNA (GATR)	MILITARY EVALUATION	INACTIVE - NEEDS EVALUATION
	PINE VALLEY ARMY CAMP	MILITARY EVALUATION	INACTIVE - NEEDS EVALUATION
Otay	OTAY MESA INSTALLATION	MILITARY EVALUATION	INACTIVE - NEEDS EVALUATION
	OTAY MOUNTAIN AIRPORT	MILITARY EVALUATION	INACTIVE - NEEDS EVALUATION
Hodges	BROTHERTON PLAZA	EVALUATION	REFER: 1248 LOCAL AGENCY
	SAN DIEGO WILD ANIMAL PARK	EVALUATION	REFER: 1248 LOCAL AGENCY
	SANTA YSABEL	EVALUATION	REFER: RWQCB
	CAMP ESCONDIDO	MILITARY EVALUATION	INACTIVE - NEEDS EVALUATION
	CARRIER LANDING STRIP (RAMONA)	MILITARY EVALUATION	INACTIVE - NEEDS EVALUATION
	USA RESERVE DROP AREA	MILITARY EVALUATION	INACTIVE - NEEDS EVALUATION
	CHATHAM BROTHERS BARREL YARD	STATE RESPONSE	ACTIVE
	RAMONA BOMBING TARGET	STATE RESPONSE	INACTIVE - ACTION REQUIRED
	UNISYS CORP. - RANCHO BERNARDO, SAN DIEGO	TIERED PERMIT	INACTIVE - NEEDS EVALUATION
	NEW URBAN WEST/ESCONDIDO SITE	VOLUNTARY CLEANUP	CERTIFIED O&M - LAND USE RESTRICTIONS

Sanitary Sewer Overflows (SSOs)

Sanitary sewers collect and transport wastewater from a community to a wastewater treatment facility. Wastewater is water-carried wastes in either solution or suspension produced by residences, businesses, and industries. It is generally made up of 99.9% water with the remaining 0.1% dissolved and suspended material. Wastewater is characterized by its volume or rate of flow, physical condition, chemical constituents, and the bacteriological organisms it contains. Wastewater is generally either treated on site in a septic system (septage) or disposed of into a sanitary sewer system (sewage) for treatment at a public wastewater treatment facility.

Wastewater contains a range of pollutants including pathogens, sediment, turbidity, nutrients, toxic compounds, organic matter, and gross pollutants including plastic and paper products. A release of untreated wastewater can exert physical, chemical, and biological effects on the receiving environment. The overflow can result in environmental, human health, and aesthetic impacts, which can be both acute and cumulative. Such impacts are dependent on the characteristics of the wastewater and receiving environment, along with the volume and duration of the release. Environmental impacts can be minimal to a localized area if the release is detected and rectified early or significant if it is in a sensitive area or volumes are large and occur over time. Humans can be exposed through ingestion and direct contact. Human health impacts are dependent on the type and concentration of pollutants in the wastewater, and the duration and method of exposure. Sewage releases can cause unpleasant sights and odors even if their human health and environmental impacts are successfully managed. Typical consequences include polluted rivers and streams, closure of beaches and other recreational areas, and inundated properties.

A sanitary sewer overflow is any overflow, spill, release, discharge, or diversion of untreated or partially treated wastewater from a sanitary sewer system. A sanitary sewer system is defined by the SWRCB as any system of pipes, pump stations, sewer lines, or other conveyances upstream of a wastewater treatment plant and including more than one mile of pipes and sewer lines, used to collect and convey wastewater to a publicly owned treatment facility.

There is a wide range of potential causes for dry and wet weather sewer overflows including sewer blockage, pump station failure, system growth or in-growth, system age and condition, and system overload from stormwater.

Sewer blockages where pipes are completely or partly blocked are the most common cause of dry-weather overflows. Causes can be infiltration from roots, grease, construction, or vandalism. Typically, blockages develop when displaced pipe joints or cracks in pipes permit the entry of soil or tree roots to form an initial obstruction. It is common for the blockage to become worse as the obstruction in the pipes catches grease and solids from sewage.

Pump station failures may be due to factors such as equipment failure or interruptions to the power supply. System growth or in-growth can overburden sewers and sewage pumping stations that are too small to carry the increase of sewage from the newly developed subdivisions or commercial areas. Overflows are also caused by system deterioration due to age or improper maintenance.

Wet weather overflows are caused by either stormwater infiltrating the sewer system or damage to system from erosion of supporting soil. Excess water can enter through the ground into leaky sewers, illegal connections, and broken or badly connected property sewer/drains. This infiltration/inflow can significantly increase flows in sewers during wet weather far beyond the designed storm allowance made for the sewers. Exceeding the capacity of the sewers causes overflows at maintenance holes, pump stations, and sewage treatment plants. Soil erosion can cause overflows due to breakage in sewers due to disturbance in the vicinity of the pipelines and land subsidence.

SSOs include:

- Overflows or releases of untreated or partially treated wastewater that reach waters of the United States
- Overflows or releases of untreated or partially treated wastewater that do not reach waters of the United States
- Wastewater backups into buildings and on private property that are caused by blockages or flow conditions within the publicly owned portion of a sanitary sewer system.

To provide a consistent statewide regulatory approach to address SSOs, the SWRCB adopted Water Quality Order No. 2006-0003 Statewide General WDRs for Sanitary Sewer Systems. The Sanitary Sewer Systems WDR requires public agencies that own or operate sanitary sewer systems to develop and implement sewer system management plans and report all SSOs to the SWRCB.

Table 4.16 - Sanitary Sewer Overflows within Local Watersheds 2016-2020 SWRCB-CIWQS 2020							
Watershed	**Event ID**	**Event Start Date**	**Category**	**Estimated Total spill volume Reach Surface Water** (gal.)	**Estimated Total spill volume Reach Land** (gal.)	**Estimated Total spill volume Recovered** (gal.)	**Estimated Total spill volume** (gal.)
Murray	821723	1/17/2016	2	-	1,210	1,210	1,210
	833378	2/27/2017	2	-	1,562	1,532	1,562
	850662	8/27/2018	3	-	800	800	800
San Vicente	829108	10/6/2016	3	-	600	600	600
	829522	10/27/2016	3	-	30	-	30
Otay	831711	1/12/2017	1	600	50	50	650
	835813	6/12/2017	3	-	-	117	117
Hodges	822632	3/4/2016	1	100	-	50	100
	824715	5/23/2016	3	-	13	25	25
	826973	8/2/2016	3	-	100	0	100
	833488	3/5/2017	1	41,661	-	6,000	47,661
	834199	4/2/2017	3	-	45	45	45
	835005	5/4/2017	3	-	400	-	400
	840808	10/15/2017	1	54,831	-	4,500	59,331
	841267	11/1/2017	3	-	578	578	578
	845950	3/23/2018	3	-	69	136	136
	863998	1/2/2020	3	-	663	657	663
	865518	2/28/2020	3	-	320	-	320
	867625	6/21/2020	3	-	42	6	42
2020 Total	N=19						114,370
2015 Total	N=14						31,275

Endnotes:

Category 1 – Spills of any volume that reach surface water

Category 2 – Spills greater than or equal to 1,000 gallons that do not reach surface water

Category 3 – Spills less than 1,000 gallons that do not reach surface water

Fires

While many wildfires cause minimal damage to the land and pose few threats to the land or people downstream, Southern California is known for dangerous fast-moving wildland fires with a historic pattern of burning large acreages.

Fire can indiscriminately devastate certain vegetation and wildlife communities but is particularly important to the native sage scrub and chaparral communities located in Southern California. Many taxa of coastal sage scrub and chaparral plants are adapted to fire by stump sprouting, high seed production, and carryover. Burn areas will usually recover in three to five years with the soils subject to increased erosion immediately following a severe burn.

Fire alters the cycling of nutrients and the biotic, physical, moisture, and temperature characteristics of soil. Frequently the impacts of fire are minor, short-lived, and have little effect on the overall ecosystem, but the impact of a severe fire can be moderate to extreme. The degree and longevity of the effect is determined by numerous factors including fire severity, temperature, and frequency, soil type and moisture, vegetation type and amount, topography, season, and pre-/post-fire weather conditions.

Fires can volatize nutrients affecting bioavailability and, as a result, nutrient cycling. Various nutrients can become more available for primary productivity, while others may be volatilized and lost during a fire.

Volatilization is temperature dependent and most commonly affects nitrogen and to a lesser extent sulfur, phosphorus, and carbon. Even though the total amount of nitrogen on a site decreases, the amount of bioavailable nitrogen can increase or decrease.

Post-fire erosion can vary due to the extent of vegetation removal and changes in soil physical properties, altered hydrogeology, a variety of topographical factors including slope and aspect, along with climatic factors including rate and amount of precipitation. Erosion from a severe fire can transport sediments, nutrients, ash, and toxins from the burned areas to streams, lakes, and reservoirs which can cause flooding, degrade the aquatic habitat and water quality, affect water treatment procedures, and decrease reservoir storage capacity.

After some wildfires, rehabilitation and restoration activities may need to occur. Rehabilitation and restoration are long-term processes that focus on repairing infrastructure and natural resource damages caused by a fire. The priority is emergency stabilization to prevent further damage to life, property, or natural resources. The stabilization work begins immediately and may continue for up to a year. Time is critical if emergency stabilization treatments are to be effective. Generally, only a portion of the burned area receives emergency stabilization measures including severely burned areas, areas where water runoff will be excessive, or steep slopes above valuable facilities. Rehabilitation is a longer-term effort to repair damage caused by a fire and generally continues for several years. Rehabilitation focuses on the lands unlikely to recover naturally from wildland fire damage.

Forest health projects have reduced vegetation levels in some woodland areas and aid fire suppression. Vegetation and fuels projects can open areas to unauthorized off-highway vehicle use. While many fires are caused naturally or accidentally, arson along transportation corridors and illegal campfires are also primary sources of wildland fire.

The California Department of Forestry and Fire Protection (CAL FIRE) addresses large brush fires within the watersheds. CAL FIRE has an extensive fire prevention plan and provides an evaluation of burned sites and a regrowth plan to prevent erosion immediately following a fire.

Table 4.17 - Reported Fires within Local Watersheds 2016 - 2020

CAL FIRE

2020

Watershed	Fire Name	Date Started	Acres Burned
San Vicente	Rock	7/22/2016	28
	Feather	7/18/2016	100
Sutherland	Volcan	5/10/2018	12
Barrett	Valley	9/5/2020	16,390
Otay	Gate	5/20/2017	2,056
	Building	7/6/2018	10
	Otay	6/29/2019	28
Hodges	Black	6/25/2017	36
	Cloverdale	8/13/2018	100
	Rangeland	8/9/2018	250
	Casner	8/6/2018	14
	Pasqual	7/27/2018	365
	Cinnamon	7/20/2018	13
	Sawday	10/25/2019	97
2020 Total	N=14		19,499
2015 Total	N=13		1,873

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CHAPTER 5

SUMMARY OF SOURCE WATER QUALITY MONITORING DATA

Source water quality can vary greatly from source to source or within a single source. The summary of source water quality includes data collected from watersheds, CSD reservoirs, along with the CSD WTP influents and effluents. The goal of the summary is to evaluate spatial and temporal variability of the measured water quality constituents to identify significant changes.

Regulatory samples for laboratory analysis were collected daily from the CSD WTP influents and effluents. Data from Alvarado, Miramar, and Otay WTPs' influents may include water imported from SDCWA.

Water quality data from the CSD reservoirs were collected weekly from parallel primary reservoirs that deliver water directly to a WTP and monthly at serial secondary reservoirs. Regulatory samples were collected from the surface of the reservoir for laboratory analysis while samples from depth were collected to aid in treatment efficiencies. YSI EXO 2 multiparameter sonde was used to conduct water quality profiles for in-situ measurement of temperature, pH, conductivity, dissolved oxygen, oxidation reduction potential, chlorophyll, and phycocyanin concentrations.

Watershed stream samples were collected when flow was present for laboratory analysis. Hydrolab mini-sonde 4 was used for in-situ measurement of temperature, pH, conductivity, dissolved oxygen, and oxidation reduction potential.

The source water quality summary compares:

- Raw source water constituents from the watershed streams to criteria and objectives established by the RWQCB9 for inland surface waters.
- Raw source water constituents from the reservoirs to criteria and objectives established by the RWQCB9 for inland surface waters and to criteria established by the SWRCB for finished drinking water to evaluate which currently regulated constituents require treatment to achieve current and proposed regulatory standards for drinking water. Included are constituents with primary Maximum Contaminant Levels (MCLs), secondary Maximum Contaminant Levels (SMCLs), and unregulated constituents with Detection Limits for Reporting (DLRs) set by the SWRCB. Comparison of raw source water quality to drinking water standards is for reference purposes only, as the potable drinking water standards do ***NOT*** apply to raw source water.
- Raw source water constituents from the WTP influents to criteria established by the SWRCB for finished drinking water to evaluate which currently regulated constituents require treatment to achieve current and proposed regulatory standards for drinking water. Included are constituents with MCLs, SMCLs, and unregulated constituents with DLRs set by the SWRCB. Comparison of raw source water quality to drinking water standards is for reference purposes only, as the potable drinking water standards do ***NOT*** apply to raw source water.
- Finished drinking water constituents from WTP effluents to criteria established by the SWRCB for finished drinking water to verify all standards for currently regulated constituents are met.

The data in water quality assessment are structured in appendices and tables. Appendices are a summary of all source water quality monitoring data from 2016 – 2020 for all constituents and sources including streams, reservoirs, and WTP influents and effluents. Tables are a summary of source water quality monitoring data from 2016- 2020 for constituents that exceed (maximum value) SWRCB/RWQCB9 established standards, criteria, or objectives.

For additional information regarding drinking water quality see the CSD Annual Drinking Water Quality Report at https://www.sandiego.gov/public-utilities/water-quality/water-quality-reports.

Watershed	Source	Appendix	Table
Alvarado WTP	Alvarado WTP Influent	5.1	5.1
Alvarado WTP	Alvarado WTP Effluent	5.2	5.2
El Capitan	El Capitan Reservoir	5.3	5.3
El Capitan	Chocolate Creek	5.4	5.4
El Capitan	Conejos Creek	5.4	5.4
El Capitan	Puetz Creek	5.4	5.4
El Capitan	San Diego River	5.4	5.4
Murray	Murray Reservoir	5.5	5.5
San Vicente	San Vicente Reservoir	5.6	5.6
San Vicente	Barona Creek	5.7	5.7
San Vicente	Kimball Creek	5.7	5.7
San Vicente	Aqueduct Creek	5.7	5.7
San Vicente	Tollroad Creek	5.7	5.7
San Vicente	San Vicente Creek	5.7	5.7
Sutherland	Sutherland Reservoir	5.8	5.8
Otay WTP	Otay WTP Influent	5.9	5.9
Otay WTP	Otay WTP Effluent	5.10	5.10
Barrett	Barrett Reservoir	5.11	5.11
Morena	Morena Reservoir	5.12	5.12
Otay	Otay Reservoir	5.13	5.13
Otay	Jamul Creek	5.14	5.14
Otay	Proctor Valley River	5.14	5.14
Otay	Rolling Hills Ranch	5.14	5.14
Otay	Upper Otay Creek	5.14	5.14
Miramar WTP	Miramar WTP Influent	5.15	5.15
Miramar WTP	Miramar WTP Effluent	5.16	5.16
Miramar	Miramar Reservoir	5.17	5.17
Hodges	Hodges Reservoir	5.18	5.18
Hodges	Cloverdale Creek	5.19	5.19
Hodges	Del Dios Creek	5.19	5.19
Hodges	Felicita Creek	5.19	5.19
Hodges	Felicita Creek	5.19	5.19
Hodges	Green Valley Creek	5.19	5.19
Hodges	Guajuito Creek	5.19	5.19
Hodges	Kit Carson Creek	5.19	5.19
Hodges	Moonsong Creek	5.19	5.19
Hodges	Santa Maria Creek	5.19	5.19
Hodges	Santa Ysabel Creek	5.19	5.19
Hodges	Sycamore Creek	5.19	5.19

Table 5.1 - Summary of Alvarado Water Treatment Plant Influent Source Water Constituents with Detections Above Drinking Water Quality Parameters 2016 - 2020

CSD

Group/Constituents	Units	CSD MDL	Federal/California Drinking Water Standards [1] DLR	Primary MCL	Secondary SMCL	2016 - 2020 Source Water Quality No. of Samples	Min	Max	Mean
General Physical									
Odor Threshold @ 60 C (TON)	ODOR	1	1		3	66	1	2	1.44
Turbidity, Laboratory	NTU	0.07	0.1		5	1916	0.17	4.52	0.643
Microbiological									
Escherichia Coli	/100 ML	1		Present		40	< 1	27	5.15
Total Coliform	/100 ML	1		Present		2120	< 1.8	> 2400	89.2
Radiologicals									
Gross Beta	PCI/L		4	50 [3]		2	ND	4.9	2.45
Uranium	PCI/L		1	20		1	1.4	1.4	1.4
Metals [2]									
Aluminum (Al)	UG/L	5	50	1000	200	59	ND	66.1	9.13
Arsenic	UG/L	1	2	10		22	ND	2.91	1.15
Barium (Ba)	UG/L	2	100	1000		20	49.7	124	85.1
Boron	UG/L	5	100			20	95.1	165	127
Iron (Fe)	UG/L	100	100		300	60	ND	151	31
Manganese (Mn)	UG/L	0.5	20		50	59	2.71	102	19.7
Vanadium	UG/L	1	3			20	ND	3.37	1.34
Inorganic Constituents									
Bromate	UG/L	5	5	10		254	ND	6.05	ND
Fluoride	MG/L	0.2	0.1	2		60	0.131	0.401	0.242
Nitrate (as NO3)	MG/L		2	45		314	ND	2.25	0.928
Sulfate (SO4)	MG/L	0.5	0.5		500	59	68.5	237	156
Organic Constituents, Regulated									
Bromodichloromethane	UG/L	0.4	1			277	ND	16.1	3.92
Bromoform	UG/L	0.4	1			276	ND	2.93	ND
Chlorodibromomethane	UG/L	0.4	1			277	ND	14	2.74
Chloroform (Trichloromethane)	UG/L	1	1			277	ND	19.1	3.3
Dichloroacetic Acid (DCAA)	UG/L	1	1			50	ND	1.55	ND
Trichloroacetic Acid (TCAA)	UG/L	1	1			50	ND	1.36	ND

End Notes:

Listed analytes include only analytes with Federal/California DLRs, MCLs & SMCLs. For summary of all water quality monitoring data, see appendices.

CSD MDL: City of San Diego Water Quality Laboratory minimum detection level, DLR: detection level for reporting, MCL: maximum contaminant level, SMCL: Secondary MCL, ND: not detected. Calculated mean below CSD MDL reported as ND.

[1] DLR, MCL, SMCL are obtained from California OEHHA and SWRCB and apply to drinking water and are for reference only. California MCL and SMCL values may be more stringent than federal standards for drinking water.

[2] Trace metal values were from filtered and unfiltered samples. Differences in values were negligible.

[3] DDW considers 50 pCi/L to be the level of concern for Beta particles.

Table 5.2 - Summary of Alvarado Water Treatment Plant Effluent Drinking Water Constituents with Detections Above Drinking Water Quality Parameters 2016 - 2020

CSD

Group/Constituents	Units	CSD MDL	Federal/California Drinking Water Standards [1] DLR	Primary MCL	Secondary SMCL	2016 - 2020 Drinking Water Quality No. of Samples	Min	Max	Mean
General Physical									
Odor Threshold @ 60 C (TON)	ODOR	1	1		3	1779	ND	1.6	ND
Turbidity, Laboratory	NTU	0.07	0.1		5	1873	ND	0.64	0.08
Radiologicals									
Gross Alpha	PCI/L		3	15		5	ND	5.2	1.92
Gross Beta	PCI/L		4	50 [3]		5	ND	6.4	3.12
Uranium	PCI/L		1	20		5	1.2	2.3	1.88
Metals [2]									
Barium (Ba)	UG/L	2	100	1000		20	46.2	135	84
Boron	UG/L	5	100			20	101	149	130
Manganese (Mn)	UG/L	0.5	20		50	64	ND	41.1	6.32
Inorganic Constituents									
Bromate	UG/L	5	5	10		255	ND	10.2	ND
Fluoride	MG/L	0.02	0.1	2		59	0.166	0.78	0.538
Nitrite (NO2)	MG/L	0.0156	0.131	0.328		260	ND	0.278	0.018
Sulfate (SO4)	MG/L	0.5	0.5		500	58	57.7	249	156
Organic Constituents, Regulated									
Bromodichloromethane	UG/L	0.4	1			338	1.62	17.5	6.5
Bromoform	UG/L	0.4	1			337	ND	7.34	3.48
Chlorodibromomethane	UG/L	0.4	1			338	1.9	17.4	7.85
Chloroform (Trichloromethane)	UG/L	1	1			338	ND	17	4.27
Dibromoacetic Acid (DBAA)	UG/L	1	1			54	ND	3.39	1.81
Dichloroacetic Acid (DCAA)	UG/L	1	1			54	ND	4.52	2.27
Monobromoacetic Acid (MBAA)	UG/L	1	1			54	ND	1.95	ND
Trichloroacetic Acid (TCAA)	UG/L	1	1			54	ND	2.02	ND

End Notes:

Listed analytes include only analytes with Federal/California DLRs, MCLs & SMCLs. For summary of all water quality monitoring data, see appendices.

CSD MDL: City of San Diego Water Quality Laboratory minimum detection level, DLR: detection level for reporting, MCL: maximum contaminant level, SMCL: Secondary MCL, ND: not detected. Calculated mean below CSD MDL reported as ND.

[1] DLR, MCL, SMCL are obtained from California OEHHA and SWRCB and apply to drinking water and are for reference only. California MCL and SMCL values may be more stringent than federal standards for drinking water.

[2] Trace metal values were from filtered and unfiltered samples. Differences in values were negligible.

[3] DDW considers 50 pCi/L to be the level of concern for Beta particles.

Table 5.3 - Summary of El Capitan Reservoir Source Water Constituents with Detections Above Water Quality Parameters 2016 - 2020

CSD

			Federal/California Drinking Water Standards [1]			Basin Plan Inland Surface Waters Quality [2]		2016 - 2020 Source Water Quality at Surface			
Group/Constituents	Units	CSD MDL	DLR	Primary MCL	Secondary SMCL	Criteria	Objectives	No. of Samples	Min	Max	Mean
General Physical											
Color, Apparent (Unfiltered)	COLOR	1			15	20	20	19	6	28	16
Odor Threshold @ 60 C (TON)	ODOR	1	1		3		none	2	12	24	18
pH	PH					6.5-8.5 [4]		19	7.43	8.62	8.15
Total Filterable Residue @ 180 C (TDS)	MG/L	10			1000	300	300	19	278	432	354
Turbidity, Laboratory	NTU	0.07	0.1		5	20	20	20	0.73	2.22	1.41
Microbiological											
Enterococcus	/100 ML	1				60 [5]		253	< 1	240	< 1
Total Coliform	/100 ML	1		Present				253	10	> 24000	3590
Radiologicals											
Gross Beta	PCI/L		4	50 [6]				2	4.6	8.4	6.5
Metals [3]											
Aluminum (Al)	UG/L	5	50	1000	200			19	ND	54.9	33.4
Boron	UG/L	5	100			500	1000	20	48.4	114	72.4
Iron (Fe)	UG/L	100	100		300	300	300	20	ND	127	ND
Manganese (Mn)	UG/L	0.5	20		50	50	50	21	5.45	102	27.1
Inorganic Constituents											
Ammonia-N	MG/L	0.031				0.025		39	ND	0.164	ND
Fluoride	MG/L	0.02	0.1	2		1	1	20	0.155	0.308	0.211
Nitrite (NO2)	MG/L	0.0156	0.131	0.328				49	ND	0.309	ND
Phosphorus	MG/L	0.078				0.025 [7]	0.025 [7]	46	ND	0.229	ND
Sulfate (SO4)	MG/L	0.5	0.5		500	65	65	20	44.3	91.9	65.7
Total Nitrogen	MG/L	0.156					0.25 [7]	49	ND	1.34	0.505

End Notes:

Listed analytes include only analytes with Federal/California DLRs, MCLs & SMCLs and/or Basin Plan Inland Surface Water Quality Criteria or Objectives. For summary of all water quality monitoring data, see appendices

CSD MDL: City of San Diego Water Quality Laboratory minimum detection level, DLR: detection level for reporting, MCL: maximum contaminant level, SMCL: Secondary MCL, ND: not detected. Calculated mean below CSD MDL reported as ND.

[1] DLR, MCL, SMCL are obtained from California OEHHA and SWRCB and apply to drinking water and are for reference only. California MCL and SMCL values may be more stringent than federal standards for drinking water.

[2] Water Quality Control Plan for the San Diego Basin (9) with amendments effective on or before May 17, 2016. Water Quality Objectives concentrations not to be exceeded more than 10% of the time during any one year period.

[3] Trace metal values were from filtered and unfiltered samples. Differences in values were negligible.

[4] Waters designated Fresh or Warm changes in normal ambient pH levels shall not exceed 0.5 units

[5] Beach Action Values (BAV): Amendment to the Domestic Water Permit issued by SWRCB to CSD, August 27, 2018

[6] DDW considers 50 pCi/L to be the level of concern for Beta particles.

[7] P= 0.025 mg/L in any standing body of water. Nitrogen threshold determined by monitoring or if data are lacking, ratio of N:P = 10:1 is used. These values not to be exceeded more than 10% of the time.

Table 5.4 - Summary of El Capitan Watershed Source Water Constituents with Detections Above Water Quality Parameters 2016 - 2020

CSD

Group/Constituents	Units	CSD MDL	Basin Plan Inland Surface Waters Quality [1] Criteria	Basin Plan Inland Surface Waters Quality [1] Objectives	2016 - 2020 Summary of Aggregated Direct Tributaries No. of Samples	Min	Max	Mean
General Physical								
pH	PH		6.5-8.5 [2]		95	6.34	8.4	7.56
Total Filterable Residue @ 180 C (TDS)	MG/L	10		300	85	136	1230	818
Microbiological								
Enterococcus	/100 ML	1	60 [3]		91	2	2400	52.5
Escherichia Coli	/100 ML	1	190 [3]		91	< 100	2400	< 100
Inorganic Constituents								
Ammonia-N	MG/L	0.031	0.025		69	ND	0.267	ND
Chloride	MG/L	0.5	250	50	83	20.8	352	187
Nitrate (as NO3)	MG/L		5		91	ND	29.6	0.39
Phosphorus	MG/L	0.078		0.025 [4]	81	ND	0.275	0.089
Sulfate (SO4)	MG/L			65	84	19.5	267	123
Total Nitrogen	MG/L	0.156		0.25 [4]	83	ND	8.21	0.922

End Notes:

Listed analytes include only analytes with Basin Plan Inland Surface Water Quality Criteria or Objectives. For summary of all water quality monitoring data, see appendices.

Data is aggregated from all reservoir direct tributaries; for data from individual sources, see appendices

CSD MDL: City of San Diego Water Quality Laboratory minimum detection level, DLR: detection level for reporting, MCL: maximum contaminant level, SMCL: Secondary MCL, ND: not detected. Calculated mean below CSD MDL reported as ND.

[1] Water Quality Control Plan for the San Diego Basin (9) with amendments effective on or before May 17, 2016. Water Quality Objectives concentrations not to be exceeded more than 10% of the time during any one year period.

[2] Waters designated Fresh or Warm changes in normal ambient pH levels shall not exceed 0.5 units

[3] Amendment to the Domestic Water Permit issued by SWRCB to CSD, August 27, 2018

[4] P= 0.025 mg/L in any standing body of water. Nitrogen threshold determined by monitoring or if data are lacking, ratio of N:P = 10:1 is used. These values not to be exceeded more than 10% of the time.

Table 5.5 - Summary of Murray Reservoir Source Water Constituents with Detections Above Water Quality Parameters 2016 - 2020

CSD

Group/Constituents	Units	CSD MDL	Federal/California Drinking Water Standards [1] DLR	Primary MCL	Secondary SMCL	Basin Plan Inland Surface Waters Quality [2] Criteria	Objectives	2016 - 2020 Source Water Quality at Surface No. of Samples	Min	Max	Mean
General Physical											
Color, Apparent (Unfiltered)	COLOR	1			15	20	20	19	2	34	11.2
Odor Threshold @ 60 C (TON)	ODOR	1	1		3		none	2	17	17	17
pH	PH					6.5-8.5 [4]		19	7.78	9.02	8.31
Total Filterable Residue @ 180 C (TDS)	MG/L	10			1000	300	1500	19	337	657	507
Turbidity, Laboratory	NTU	0.07	0.1		5	20	20	22	0.42	3.28	1.34
Microbiological											
Enterococcus	/100 ML	1				60 [5]		255	< 1	1300	27.5
Escherichia Coli	/100 ML	1		Present		190 [5]		255	< 10	510	66.8
Total Coliform	/100 ML	1		Present				255	41	> 24000	2290
Radiologicals											
Gross Beta	PCI/L		4	50 [6]				2	ND	5.20	2.6
Uranium	PCI/L		1	20				1	1.9	1.9	1.9
Metals [3]											
Arsenic	UG/L	1	2	10				22	ND	2.02	ND
Barium (Ba)	UG/L	2	100	1000				22	49.7	126	78.6
Boron	UG/L	5	100			500	1000	21	110	172	132
Iron (Fe)	UG/L	100	100		300	300	300	20	ND	147	ND
Manganese (Mn)	UG/L	0.5	20		50	50	1000	21	7.11	57.8	19.8
Inorganic Constituents											
Ammonia-N	MG/L	0.031				0.025		43	ND	0.127	ND
Fluoride	MG/L	0.02	0.1	2		1	1	19	0.152	0.333	0.256
Nitrite (NO2)	MG/L	0.0156	0.131	0.328				49	ND	0.28	ND
Phosphorus	MG/L	0.078				0.025 [7]	0.025 [7]	48	ND	0.715	ND
Sulfate (SO4)	MG/L	0.5	0.5		500	65	500	20	87.8	235	161
Total Nitrogen	MG/L	0.156					0.25 [7]	50	ND	1.32	0.346
Organic Constituents, Regulated											
Bromodichloromethane	UG/L	0.4	1			100		20	ND	2.43	0.971
Chlorodibromomethane	UG/L	0.4	1					20	ND	2.37	1.01
Chloroform (Trichloromethane)	UG/L	1	1			100		20	ND	2.35	1.03
Trichloroacetic Acid (TCAA)	UG/L	1	1					2	ND	1.41	ND

End Notes:

Listed analytes include only analytes with Federal/California DLRs, MCLs and SMCLs and/or Basin Plan Inland Surface Water Quality Criteria or Objectives. For summary of all water quality monitoring data, see appendices

CSD MDL: City of San Diego Water Quality Laboratory minimum detection level, DLR: detection level for reporting, MCL: maximum contaminant level, SMCL: Secondary MCL, ND: not detected. Calculated mean below CSD MDL reported as ND.

[1] DLR, MCL, SMCL are obtained from California OEHHA and SWRCB and apply to drinking water and are for reference only. California MCL and SMCL values may be more stringent than federal standards for drinking water.

[2] Water Quality Control Plan for the San Diego Basin (9) with amendments effective on or before May 17, 2016. Water Quality Objectives concentrations not to be exceeded more than 10% of the time during any one year period.

[3] Trace metal values were from filtered and unfiltered samples. Differences in values were negligible.

[4] Waters designated Fresh or Warm changes in normal ambient pH levels shall not exceed 0.5 units

[5] Beach Action Values (BAV): Amendment to the Domestic Water Permit issued by SWRCB to CSD, August 27, 2018

[6] DDW considers 50 pCi/L to be the level of concern for Beta particles.

[7] P= 0.025 mg/L in any standing body of water. Nitrogen threshold determined by monitoring or if data are lacking, ratio of N:P = 10:1 is used. These values not to be exceeded more than 10% of the time.

Table 5.6 - Summary of San Vicente Reservoir Source Water Constituents with Detections Above Water Quality Parameters 2016 - 2020

CSD

Group/Constituents	Units	CSD MDL	Federal/California Drinking Water Standards [1] DLR	Primary MCL	Secondary SMCL	Basin Plan Inland Surface Waters Quality [2] Criteria	Objectives	2016 - 2020 Source Water Quality at Surface No. of Samples	Min	Max	Mean
General Physical											
Odor Threshold @ 60 C (TON)	ODOR	1	1		3		none	2	6	17	11.5
pH	PH					6.5-8.5 [4]		19	7.58	8.78	8.25
Total Filterable Residue @ 180 C (TDS)	MG/L	10			1000	300	300	57	469	623	547
Turbidity, Laboratory	NTU	0.07	0.1		5	20	20	20	0.17	0.67	0.363
Microbiological											
Escherichia Coli	/100 ML	1		Present		190 [5]		253	< 10	10	< 10
Total Coliform	/100 ML	1		Present				253	< 10	> 24000	2660
Radiologicals											
Gross Alpha	PCI/L		3	15				2	ND	3	1.5
Gross Beta	PCI/L		4	50 [6]				2	4.68	4.80	4.74
Uranium	PCI/L		1	20				1	1.9	1.9	1.9
Metals [3]											
Aluminum (Al)	UG/L	5	50	1000	200			59	ND	52.3	10.4
Arsenic	UG/L	1	2	10				20	ND	2.57	1.16
Barium (Ba)	UG/L	2	100	1000				20	71	122	97.5
Boron	UG/L	5	100			500	1000	19	125	173	138
Manganese (Mn)	UG/L	0.5	20		50	50	50	60	ND	21	4.84
Inorganic Constituents											
Ammonia-N	MG/L	0.031				0.025		55	ND	0.143	ND
Chloride	MG/L	0.5			500	250	50	58	65.5	119	97.6
Fluoride	MG/L	0.02	0.1	2		1	1	59	0.23	0.378	0.286
Phosphorus	MG/L	0.078				0.025 [7]	0.025 [7]	17	ND	0.073	ND
Sulfate (SO4)	MG/L	0.5	0.5		500	65	65	58	137	249	188
Total Nitrogen	MG/L	0.156					0.25 [7]	19	0.159	1.78	0.386

End Notes:

Listed analytes include only analytes with Federal/California DLRs, MCLs and SMCLs and/or Basin Plan Inland Surface Water Quality Criteria or Objectives. For summary of all water quality monitoring data, see appendices

CSD MDL: City of San Diego Water Quality Laboratory minimum detection level, DLR: detection level for reporting, MCL: maximum contaminant level, SMCL: Secondary MCL, ND: not detected. Calculated mean below CSD MDL reported as ND.

[1] DLR, MCL, SMCL are obtained from California OEHHA and SWRCB and apply to drinking water and are for reference only. California MCL and SMCL values may be more stringent than federal standards for drinking water.

[2] Water Quality Control Plan for the San Diego Basin (9) with amendments effective on or before May 17, 2016. Water Quality Objectives concentrations not to be exceeded more than 10% of the time during any one year period.

[3] Trace metal values were from filtered and unfiltered samples. Differences in values were negligible.

[4] Waters designated Fresh or Warm changes in normal ambient pH levels shall not exceed 0.5 units

[5] Beach Action Values (BAV): Amendment to the Domestic Water Permit issued by SWRCB to CSD, August 27, 2018

[6] DDW considers 50 pCi/L to be the level of concern for Beta particles.

[7] P= 0.025 mg/L in any standing body of water. Nitrogen threshold determined by monitoring or if data are lacking, ratio of N:P = 10:1 is used. These values not to be exceeded more than 10% of the time.

Table 5.7 - Summary of San Vicente Watershed Source Water Constituents with Detections Above Water Quality Parameters 2016 - 2020

CSD

Group/Constituents	Units	CSD MDL	Basin Plan Inland Surface Waters Quality [1] Criteria	Basin Plan Inland Surface Waters Quality [1] Objectives	2016 - 2020 Summary of Aggregated Direct Tributaries No. of Samples	Min	Max	Mean
General Physical								
pH	PH		6.5-8.5 [2]		89	6.02	8.15	7.21
Total Filterable Residue @ 180 C (TDS)	MG/L	10		300	84	140	1400	348
Microbiological								
Enterococcus	/100 ML	1	60 [3]		84	< 1	> 2400	68
Escherichia Coli	/100 ML	1	190 [3]		84	< 100	41000	< 100
Inorganic Constituents								
Ammonia-N	MG/L	0.031	0.025		75	ND	1.89	0.031
Chloride	MG/L	0.5	250	50	88	12.2	447	108
Nitrate (as NO3)	MG/L		5		91	ND	32.2	ND
Phosphorus	MG/L	0.078		0.025 [4]	76	0.014	0.315	0.095
Sulfate (SO4)	MG/L			65	88	2.58	483	39.6
Total Nitrogen	MG/L	0.156		0.25 [4]	76	ND	9.07	1.18

End Notes:

Listed analytes include only analytes with Basin Plan Inland Surface Water Quality Criteria or Objectives. For summary of all water quality monitoring data, see appendices.

Data is aggregated from all reservoir direct tributaries; for data from individual sources, see appendices

CSD MDL: City of San Diego Water Quality Laboratory minimum detection level, DLR: detection level for reporting, MCL: maximum contaminant level, SMCL: Secondary MCL, ND: not detected. Calculated mean below CSD MDL reported as ND.

[1] Water Quality Control Plan for the San Diego Basin (9) with amendments effective on or before May 17, 2016. Water Quality Objectives concentrations not to be exceeded more than 10% of the time during any one year period.

[2] Waters designated Fresh or Warm changes in normal ambient pH levels shall not exceed 0.5 units

[3] Beach Action Values (BAV): Amendment to the Domestic Water Permit issued by SWRCB to CSD, August 27, 2018

[4] P= 0.025 mg/L in any standing body of water. Nitrogen threshold determined by monitoring or if data are lacking, ratio of N:P = 10:1 is used. These values not to be exceeded more than 10% of the time.

Table 5.8 - Summary of Sutherland Reservoir Source Water Constituents with Detections Above Water Quality Parameters 2016 - 2020

CSD

Group/Constituents	Units	CSD MDL	Federal/California Drinking Water Standards [1] DLR	Primary MCL	Secondary SMCL	Basin Plan Inland Surface Waters Quality [2] Criteria	Objectives	2016 - 2020 Source Water Quality at Surface No. of Samples	Min	Max	Mean
General Physical											
Color, Apparent (Unfiltered)	COLOR	1			15	20	20	19	19	56	33.1
pH	PH					6.5-8.5 [4]		16	7.68	9.25	8.64
Total Filterable Residue @ 180 C (TDS)	MG/L	10			1000	300	500	20	199	395	286
Turbidity, Laboratory	NTU	0.07	0.1		5	20	20	20	1.17	6.09	3.78
Microbiological											
Enterococcus	/100 ML	1				60 [5]		58	< 1	86	3.95
Total Coliform	/100 ML	1		Present				58	41	> 24000	2740
Metals [3]											
Aluminum (Al)	UG/L	5	50	1000	200			19	20.9	205	75.6
Arsenic	UG/L	1	2	10				20	ND	2.39	ND
Iron (Fe)	UG/L	100	100		300	300	300	20	ND	453	133
Manganese (Mn)	UG/L	0.5	20		50	50	50	20	6.66	192	57.2
Vanadium	UG/L	1	3					20	2.87	9.67	5.75
Inorganic Constituents											
Ammonia-N	MG/L	0.031				0.025		4	ND	0.071	0.041
Fluoride	MG/L	0.02	0.1	2		1	1	20	0.151	0.346	0.226
Phosphorus	MG/L	0.078				0.025 [6]	0.025 [6]	18	0.02	0.138	ND
Sulfate (SO4)	MG/L	0.5	0.5		500	65	250	20	27.4	50.6	42.7
Total Nitrogen	MG/L	0.156					0.25 [6]	19	0.514	2.36	1.06

End Notes:

Listed analytes include only analytes with Federal/California DLRs, MCLs and SMCLs and/or Basin Plan Inland Surface Water Quality Criteria or Objectives. For summary of all water quality monitoring data, see appendices

CSD MDL: City of San Diego Water Quality Laboratory minimum detection level, DLR: detection level for reporting, MCL: maximum contaminant level, SMCL: Secondary MCL, ND: not detected. Calculated mean below CSD MDL reported as ND.

[1] DLR, MCL, SMCL are obtained from California OEHHA and SWRCB and apply to drinking water and are for reference only. California MCL and SMCL values may be more stringent than federal standards for drinking water.

[2] Water Quality Control Plan for the San Diego Basin (9) with amendments effective on or before May 17, 2016. Water Quality Objectives concentrations not to be exceeded more than 10% of the time during any one year period.

[3] Trace metal values were from filtered and unfiltered samples. Differences in values were negligible.

[4] Waters designated Fresh or Warm changes in normal ambient pH levels shall not exceed 0.5 units

[5] Beach Action Values (BAV): Amendment to the Domestic Water Permit issued by SWRCB to CSD, August 27, 2018

[6] P= 0.025 mg/L in any standing body of water. Nitrogen threshold determined by monitoring or if data are lacking, ratio of N:P = 10:1 is used. These values not to be exceeded more than 10% of the time.

Table 5.9 - Summary of Otay Water Treatment Plant Influent Source Water Constituents with Detections Above Drinking Water Quality Parameters 2016 - 2020

CSD

Group/Constituents	Units	CSD MDL	Federal/California Drinking Water Standards [1] DLR	Primary MCL	Secondary SMCL	2016 - 2020 Source Water Quality No. of Samples	Min	Max	Mean
General Physical									
Odor Threshold @ 60 C (TON)	ODOR	1	1		3	1	1	1	1
Turbidity, Laboratory	NTU	0.07	0.1		5	1914	0.22	5.63	0.874
Microbiological									
Escherichia Coli	/100 ML	1		Present		40	< 1	50	6.35
Total Coliform	/100 ML	1		Present		1723	< 1	> 2400	43.6
Total Crypto Oocyst Count	/ L	0.1		1		42	ND	6.0	ND
Total Giardia Cyst Count	/ L	0.1		1		42	ND	6.5	ND
Radiologicals									
Gross Alpha	PCI/L		3	15		2	ND	4.79	2.40
Gross Beta	PCI/L		4	50 [3]		2	ND	4.36	4.08
Metals [2]									
Aluminum (Al)	UG/L	5	50	1000	200	59	ND	454	21.3
Arsenic	UG/L	1	2	10		21	ND	2.84	1.29
Barium (Ba)	UG/L	2	100	1000		20	48.9	139	83.4
Boron	UG/L	5	100			20	118	231	166
Iron (Fe)	UG/L	100	100		300	59	ND	231	37.7
Manganese (Mn)	UG/L	0.5	20		50	59	2.34	288	33.1
Nickel	UG/L	1	10	100		20	ND	24	1.2
Vanadium	UG/L	1	3			20	ND	3.48	1.61
Inorganic Constituents									
Chlorate	UG/L		20			5	120	194	139
Chlorite	MG/L		0.02	1.0		3	0.95	1.16	1.06
Fluoride	MG/L	0.02	0.1	2		57	0.158	0.516	0.333
Nitrate (as NO3)	MG/L		2	45		281	ND	3.61	ND
Nitrite (NO2)	MG/L	0.0156	0.131	0.328		228	ND	0.386	ND
Sulfate (SO4)	MG/L	0.5	0.5		500	56	55.9	245	135
Organic Constituents, Regulated									
Bromodichloromethane	UG/L	0.4	1			245	ND	18.5	5.14
Bromoform	UG/L	0.4	1			245	ND	5.43	1.22
Chlorodibromomethane	UG/L	0.4	1			245	ND	14.4	4.43
Chloroform (Trichloromethane)	UG/L	1	1			245	ND	34	4.28
Dibromoacetic Acid (DBAA)	UG/L	1	1			49	ND	2.87	ND
Dichloroacetic Acid (DCAA)	UG/L	1	1			49	ND	2.93	ND
Trichloroacetic Acid (TCAA)	UG/L	1	1			49	ND	1.82	ND

End Notes:

Listed analytes include only analytes with Federal/California DLRs, MCLs & SMCLs. For summary of all water quality monitoring data, see appendices.

CSD MDL: City of San Diego Water Quality Laboratory minimum detection level, DLR: detection level for reporting, MCL: maximum contaminant level, SMCL: Secondary MCL, ND: not detected. Calculated mean below CSD MDL reported as ND.

[1] DLR, MCL, SMCL are obtained from California OEHHA and SWRCB and apply to drinking water and are for reference only. California MCL and SMCL values may be more stringent than federal standards for drinking water.

[2] Trace metal values were from filtered and unfiltered samples. Differences in values were negligible.

[3] DDW considers 50 pCi/L to be the level of concern for Beta particles.

Table 5.10 - Summary of Otay Water Treatment Plant Effluent Drinking Water Constituents with Detections Above Drinking Water Quality Parameters 2016 - 2020

CSD

Group/Constituents	Units	CSD MDL	Federal/California Drinking Water Standards [1] DLR	Primary MCL	Secondary SMCL	2016 - 2020 Drinking Water Quality No. of Samples	Min	Max	Mean
General Physical									
Odor Threshold @ 60 C (TON)	ODOR	1	1		3	1814	1	2	1.07
Turbidity, Laboratory	NTU	0.07	0.1		5	1874	ND	0.3	ND
Microbiological									
Total Coliform	/100 ML	1		Present		1190	A	P	A
Radiologicals									
Gross Alpha	PCI/L		3	15		2	3.40	5.96	4.68
Gross Beta	PCI/L		4	50 [3]		2	4.09	5.00	4.55
Metals [2]									
Barium (Ba)	UG/L	2	100	1000		20	35.2	136	71.4
Boron	UG/L	5	100			20	51.7	211	164
Manganese (Mn)	UG/L	0.5	20		50	63	ND	41	1.81
Inorganic Constituents									
Chlorate	UG/L		20			1430	ND	393	199
Chlorite	MG/L		0.02	1.0		1.416	ND	1.04	0.346
Fluoride	MG/L	0.02	0.1	2		58	0.239	0.633	0.457
Nitrate (as NO3)	MG/L		2	45		295	ND	3.81	ND
Nitrite (NO2)	MG/L	0.0156	0.131	0.328		240	ND	0.17	0.011
Sulfate (SO4)	MG/L	0.5	0.5		500	57	75.2	242	136
Organic Constituents, Regulated									
Bromodichloromethane	UG/L	0.4	1			313	4.38	20.7	9.05
Bromoform	UG/L	0.4	1			313	ND	33	12.6
Chlorodibromomethane	UG/L	0.4	1			313	6.26	38.8	16.6
Chloroform (Trichloromethane)	UG/L	1	1			313	1.09	17.8	4.26
Dibromoacetic Acid (DBAA)	UG/L	1	1			53	ND	14.3	5.88
Dichloroacetic Acid (DCAA)	UG/L	1	1			53	ND	5.24	2.3
Monobromoacetic Acid (MBAA)	UG/L	1	1			53	ND	1.74	ND
Trichloroacetic Acid (TCAA)	UG/L	1	1			53	ND	1.64	ND

End Notes:

Listed analytes include only analytes with Federal/California DLRs, MCLs & SMCLs. For summary of all water quality monitoring data, see appendices.

CSD MDL: City of San Diego Water Quality Laboratory minimum detection level, DLR: detection level for reporting, MCL: maximum contaminant level, SMCL: Secondary MCL, ND: not detected. Calculated mean below CSD MDL reported as ND.

[1] DLR, MCL, SMCL are obtained from California OEHHA and SWRCB and apply to drinking water and are for reference only. California MCL and SMCL values may be more stringent than federal standards for drinking water.

[2] Trace metal values were from filtered and unfiltered samples. Differences in values were negligible.

[3] DDW considers 50 pCi/L to be the level of concern for Beta particles.

Table 5.11 - Summary of Barrett Reservoir Source Water Constituents with Detections Above Water Quality Parameters 2016 - 2020

CSD

Group/Constituents	Units	CSD MDL	Federal/California Drinking Water Standards [1] DLR	Primary MCL	Secondary SMCL	Basin Plan Inland Surface Waters Quality [2] Criteria	Objectives	2016 - 2020 Source Water Quality at Surface No. of Samples	Min	Max	Mean
General Physical											
Color, Apparent (Unfiltered)	COLOR	1			15	20	20	19	23	84	40.9
pH	PH					6.5-8.5 [4]		13	7.46	9.05	8.27
Total Filterable Residue @ 180 C (TDS)	MG/L	10			1000	300	500	20	295	815	477
Turbidity, Laboratory	NTU	0.07	0.1		5	20	20	20	1.14	23.1	5.44
Microbiological											
Total Coliform	/100 ML	1		Present				21	31	> 24000	8760
Metals [3]											
Manganese (Mn)	UG/L	0.5	20		50	50	50	4	32	209	83.2
Vanadium	UG/L	1	3					4	ND	3.49	2.35
Inorganic Constituents											
Ammonia-N	MG/L	0.031				0.025		5	0	0.563	0.129
Fluoride	MG/L	0.02	0.1	2		1	1	20	0.206	0.504	0.329
Nitrate (as NO3)	MG/L		2	45		5		19	ND	3.23	0.178
Phosphorus	MG/L	0.078				0.025 [5]	0.025 [5]	17	ND	0.226	0.11
Sulfate (SO4)	MG/L	0.5	0.5		500	65	250	20	43.1	145	69.6
Total Nitrogen	MG/L	0.156					0.25 [5]	19	0.685	3.46	1.33

End Notes:

Listed analytes include only analytes with Federal/California DLRs, MCLs & SMCLs and/or Basin Plan Inland Surface Water Quality Criteria or Objectives. For summary of all water quality monitoring data, see appendices

CSD MDL: City of San Diego Water Quality Laboratory minimum detection level, DLR: detection level for reporting, MCL: maximum contaminant level, SMCL: Secondary MCL, ND: not detected. Calculated mean below CSD MDL reported as ND.

[1] DLR, MCL, SMCL are obtained from California OEHHA and SWRCB and apply to drinking water and are for reference only. California MCL and SMCL values may be more stringent than federal standards for drinking water.

[2] Water Quality Control Plan for the San Diego Basin (9) with amendments effective on or before May 17, 2016. Water Quality Objectives concentrations not to be exceeded more than 10% of the time during any one year period.

[3] Trace metal values were from filtered and unfiltered samples. Differences in values were negligible.

[4] Waters designated Fresh or Warm changes in normal ambient pH levels shall not exceed 0.5 units

[5] P= 0.025 mg/L in any standing body of water. Nitrogen threshold determined by monitoring or if data are lacking, ratio of N:P = 10:1 is used. These values not to be exceeded more than 10% of the time.

Table 5.12 - Summary of Morena Reservoir Source Water Constituents with Detections Above Water Quality Parameters 2016 - 2020

CSD

Group/Constituents	Units	CSD MDL	Federal/California Drinking Water Standards [1] DLR	Primary MCL	Secondary SMCL	Basin Plan Inland Surface Waters Quality [2] Criteria	Objectives	2016 - 2020 Source Water Quality at Surface No. of Samples	Min	Max	Mean
General Physical											
Color, Apparent (Unfiltered)	COLOR	1			15	20	20	18	36	120	59.1
pH	PH					6.5-8.5 [4]		15	8.18	8.78	8.57
Specific Conductance (E.C.)	UMHO/CM				1600			19	876	1940	1200
Total Filterable Residue @ 180 C (TDS)	MG/L	10			1000	300	500	19	582	1200	765
Turbidity, Laboratory	NTU	0.07	0.1		5	20	20	20	5.24	27.6	16.2
Microbiological											
Total Coliform	/100 ML	1		Present				21	< 10	> 24000	5370
Metals [3]											
Aluminum (Al)	UG/L	5	50	1000	200			19	76.7	1120	379
Arsenic	UG/L	1	2	10				20	3.59	8.25	6.25
Barium (Ba)	UG/L	2	100	1000				20	64.5	175	96.2
Boron	UG/L	5	100			500	1000	20	118	362	205
Iron (Fe)	UG/L	100	100		300	300	300	19	ND	845	240
Manganese (Mn)	UG/L	0.5	20		50	50	50	20	46.1	224	85.7
Vanadium	UG/L	1	3					20	12.7	37.9	20.1
Inorganic Constituents											
Ammonia-N	MG/L	0.031				0.025		16	ND	0.462	0.098
Fluoride	MG/L	0.02	0.1	2		1	1	20	0.359	0.783	0.526
Nitrate (as NO3)	MG/L		2	45		5		21	ND	2.44	0.406
Nitrite (NO2)	MG/L	0.0156	0.131	0.328				20	ND	0.593	0.072
Phosphorus	MG/L	0.078				0.025 [5]	0.025 [5]	17	0.054	0.455	0.195
Sulfate (SO4)	MG/L	0.5	0.5		500	65	250	20	86.8	237	162
Total Nitrogen	MG/L	0.156					0.25 [5]	19	0.988	3.12	1.73

End Notes:

Listed analytes include only analytes with Federal/California DLRs, MCLs & SMCLs and/or Basin Plan Inland Surface Water Quality Criteria or Objectives. For summary of all water quality monitoring data, see appendices

CSD MDL: City of San Diego Water Quality Laboratory minimum detection level, DLR: detection level for reporting, MCL: maximum contaminant level, SMCL: Secondary MCL, ND: not detected. Calculated mean below CSD MDL reported as ND.

[1] DLR, MCL, SMCL are obtained from California OEHHA and SWRCB and apply to drinking water and are for reference only. California MCL and SMCL values may be more stringent than federal standards for drinking water.

[2] Water Quality Control Plan for the San Diego Basin (9) with amendments effective on or before May 17, 2016. Water Quality Objectives concentrations not to be exceeded more than 10% of the time during any one year period.

[3] Trace metal values were from filtered and unfiltered samples. Differences in values were negligible.

[4] Waters designated Fresh or Warm changes in normal ambient pH levels shall not exceed 0.5 units

[5] P= 0.025 mg/L in any standing body of water. Nitrogen threshold determined by monitoring or if data are lacking, ratio of N:P = 10:1 is used. These values not to be exceeded more than 10% of the time.

Table 5.13 - Summary of Otay Reservoir Source Water Constituents with Detections Above Water Quality Parameters 2016 - 2020

CSD

Group/Constituents	Units	CSD MDL	Federal/California Drinking Water Standards [1] DLR	Primary MCL	Secondary SMCL	Basin Plan Inland Surface Waters Quality [2] Criteria	Objectives	2016 - 2020 Source Water Quality at Surface No. of Samples	Min	Max	Mean
General Physical											
Color, Apparent (Unfiltered)	COLOR	1			15	20	20	19	4	19	10.9
MBAS (Foaming Agents)	MG/L	0.05		0.5		0.5	0.5	5	ND	0.66	0.15
Odor Threshold @ 60 C (TON)	ODOR	1	1		3		none	2	17	24	20.5
pH	PH					6.5-8.5 [4]		19	7.38	8.64	8.00
Total Filterable Residue @ 180 C (TDS)	MG/L	10			1000	300	500	20	520	643	579
Turbidity, Laboratory	NTU	0.07	0.1		5	20	20	20	0.29	6.83	1.2
Microbiological											
Enterococcus	/100 ML	1				60 [5]		511	< 1	2400	25.2
Escherichia Coli	/100 ML	1		Present		190 [5]		512	< 10	1200	35
Total Coliform	/100 ML	1		Present				512	< 10	> 24000	2940
Radiologicals											
Gross Beta	PCI/L		4	50 [6]				2	4.3	4.61	4.46
Metals [3]											
Arsenic	UG/L	1	2	10				20	ND	2.13	ND
Boron	UG/L	5	100			500	750	20	158	244	206
Manganese (Mn)	UG/L	0.5	20		50	50	50	20	3.61	83.1	18.1
Inorganic Constituents											
Ammonia-N	MG/L	0.031				0.025		17	ND	0.368	0.092
Fluoride	MG/L	0.02	0.1	2		1	1	21	0.385	0.6	0.491
Phosphorus	MG/L	0.078				0.025 [7]	0.025 [7]	48	ND	0.268	ND
Sulfate (SO4)	MG/L	0.5	0.5		500	65	250	21	81.6	150	113
Total Nitrogen	MG/L	0.156					0.25 [7]	48	ND	1.55	0.61
Organic Constituents, Regulated											
Chloroform (Trichloromethane)	UG/L	1	1			100		21	ND	1.15	ND

End Notes:

Listed analytes include only analytes with Federal/California DLRs, MCLs & SMCLs and/or Basin Plan Inland Surface Water Quality Criteria or Objectives. For summary of all water quality monitoring data, see appendices

CSD MDL: City of San Diego Water Quality Laboratory minimum detection level, DLR: detection level for reporting, MCL: maximum contaminant level, SMCL: Secondary MCL, ND: not detected. Calculated mean below CSD MDL reported as ND.

[1] DLR, MCL, SMCL are obtained from California OEHHA and SWRCB and apply to drinking water and are for reference only. California MCL and SMCL values may be more stringent than federal standards for drinking water.

[2] Water Quality Control Plan for the San Diego Basin (9) with amendments effective on or before May 17, 2016. Water Quality Objectives concentrations not to be exceeded more than 10% of the time during any one year period.

[3] Trace metal values were from filtered and unfiltered samples. Differences in values were negligible.

[4] Waters designated Fresh or Warm changes in normal ambient pH levels shall not exceed 0.5 units

[5] Beach Action Values (BAV): Amendment to the Domestic Water Permit issued by SWRCB to CSD, August 27, 2018

[6] DDW considers 50 pCi/L to be the level of concern for Beta particles.

[7] P= 0.025 mg/L in any standing body of water. Nitrogen threshold determined by monitoring or if data are lacking, ratio of N:P = 10:1 is used. These values not to be exceeded more than 10% of the time.

Table 5.14 - Summary of Otay Watershed Source Water Constituents with Detections Above Water Quality Parameters 2016 - 2020

CSD

Group/Constituents	Units	CSD MDL	Basin Plan Inland Surface Waters Quality [1] Criteria	Basin Plan Inland Surface Waters Quality [1] Objectives	2016 - 2020 Summary of Aggregated Direct Tributaries No. of Samples	Min	Max	Mean
General Physical								
pH	PH		6.5-8.5 [2]		133	5.76	8.22	7.49
Total Filterable Residue @ 180 C (TDS)	MG/L	10	300	500	129	168	6970	3260
Microbiological								
Enterococcus	/100 ML	1	60 [3]		137	3	> 2400	610
Escherichia Coli	/100 ML	1	190 [3]		137	< 100	19000	< 100
Inorganic Constituents								
Ammonia-N	MG/L	0.031	0.025		117	ND	0.466	ND
Chloride	MG/L	0.5	250	250	122	48.6	6410	1520
Fluoride	MG/L	0.02	1	1	126	ND	2.92	1.74
Nitrate (as NO3)	MG/L		5		137	ND	65.2	15.5
Phosphorus	MG/L	0.078		0.025 [4]	114	ND	0.25	0.116
Sulfate (SO4)	MG/L		65	250	127	11.6	414	268
Total Nitrogen	MG/L	0.156		0.25 [4]	114	ND	15.3	4.6

End Notes:

Listed analytes include only analytes with Basin Plan Inland Surface Water Quality Criteria or Objectives. For summary of all water quality monitoring data, see appendices.

Data is aggregated from all reservoir direct tributaries; for data from individual sources, see appendices

CSD MDL: City of San Diego Water Quality Laboratory minimum detection level, DLR: detection level for reporting, MCL: maximum contaminant level, SMCL: Secondary MCL, ND: not detected. Calculated mean below CSD MDL reported as ND.

[1] Water Quality Control Plan for the San Diego Basin (9) with amendments effective on or before May 17, 2016. Water Quality Objectives concentrations not to be exceeded more than 10% of the time during any one year period.

[2] Waters designated Fresh or Warm changes in normal ambient pH levels shall not exceed 0.5 units

[3] Beach Action Values (BAV): Amendment to the Domestic Water Permit issued by SWRCB to CSD, August 27, 2018

[4] P= 0.025 mg/L in any standing body of water. Nitrogen threshold determined by monitoring or if data are lacking, ratio of N:P = 10:1 is used. These values not to be exceeded more than 10% of the time.

Table 5.15 - Summary of Miramar Water Treatment Plant Influent Source Water Constituents with Detections Above Drinking Water Quality Parameters 2016 - 2020

CSD

Group/Constituents	Units	CSD MDL	Federal/California Drinking Water Standards [1] DLR	Primary MCL	Secondary SMCL	2016 - 2020 Source Water Quality No. of Samples	Min	Max	Mean
General Physical									
Color, Apparent (Unfiltered)	COLOR	1			15	56	ND	17	4.6
Odor Threshold @ 60 C (TON)	ODOR	1	1		3	67	1.27	2	1.47
Turbidity, Laboratory	NTU	0.07	0.1		5	1913	0.08	4.45	0.713
Microbiological									
Escherichia Coli	/100 ML	1		Present		41	< 1	36	< 1
Total Coliform	/100 ML	1		Present		1785	< 1	> 2400	6.8
Radiologicals									
Gross Beta	PCI/L		4	50 [3]		2	ND	4.7	2.35
Uranium	PCI/L		1	20		1	1.2	1.2	1.2
Metals [2]									
Aluminum (Al)	UG/L	5	50	1000	200	60	ND	120	19.7
Arsenic	UG/L	1	2	10		22	ND	2.83	1.51
Barium (Ba)	UG/L	2	100	1000		20	48.3	146	89.9
Boron	UG/L	5	100			20	113	150	130
Iron (Fe)	UG/L	100	100		300	60	ND	133	15.7
Manganese (Mn)	UG/L	0.5	20		50	60	3.91	101	13.9
Vanadium	UG/L	1	3			20	ND	3.29	1.89
Inorganic Constituents									
Fluoride	MG/L	0.02	0.1	2		59	0.113	0.445	0.227
Sulfate (SO4)	MG/L	0.5	0.5		500	58	64.1	287	152
Organic Constituents, Regulated									
Bromodichloromethane	UG/L	0.4	1			262	0.7	19.3	7.21
Bromoform	UG/L	0.4	1			262	ND	8.06	1.93
Chlorodibromomethane	UG/L	0.4	1			262	0.58	21.6	6.97
Chloroform (Trichloromethane)	UG/L	1	1			262	ND	37.1	5.85
Dalapon	UG/L	2	10	200		46	ND	24	ND
Dibromoacetic Acid (DBAA)	UG/L	1	1			47	ND	1.75	ND
Dichloroacetic Acid (DCAA)	UG/L	1	1			47	ND	2.76	1.04
trans-1,2-Dichloroethylene (t-1,2-DCE)	UG/L	0.4	0.5	10		17	ND	3.24	1.58

End Notes:

Listed analytes include only analytes with Federal/California DLRs, MCLs & SMCLs. For summary of all water quality monitoring data, see appendices.

CSD MDL: City of San Diego Water Quality Laboratory minimum detection level, DLR: detection level for reporting, MCL: maximum contaminant level, SMCL: Secondary MCL, ND: not detected. Calculated mean below CSD MDL reported as ND.

[1] DLR, MCL, SMCL are obtained from California OEHHA and SWRCB and apply to drinking water and are for reference only. California MCL and SMCL values may be more stringent than federal standards for drinking water.

[2] Trace metal values were from filtered and unfiltered samples. Differences in values were negligible.

[3] DDW considers 50 pCi/L to be the level of concern for Beta particles.

Table 5.16 - Summary of Miramar Water Treatment Plant Effluent Drinking Water Constituents with Detections Above Drinking Water Quality Parameters 2016 - 2020

CSD

Group/Constituents	Units	CSD MDL	Federal/California Drinking Water Standards [1] DLR	Primary MCL	Secondary SMCL	2016 - 2020 Drinking Water Quality No. of Samples	Min	Max	Mean
General Physical									
Odor Threshold @ 60 C (TON)	ODOR	1	1		3	1812	ND	1	ND
Turbidity, Laboratory	NTU	0.07	0.1		5	1868	ND	0.45	ND
Microbiological									
Escherichia Coli	/100 ML	1		Present		1181	A	P	A
Total Coliform	/100 ML	1		Present		1181	A	P	A
Radiologicals									
Gross Alpha	PCI/L		3	15		3	ND	3.40	2.23
Gross Beta	PCI/L		4	50 [3]		3	ND	5.73	3.44
Uranium	PCI/L		1	20		1	1	1	1
Metals [2]									
Barium (Ba)	UG/L	2	100	1000		13	47.9	138	88.7
Boron	UG/L	5	100			13	119	158	133
Inorganic Constituents									
Fluoride	MG/L	0.02	0.1	2		57	0.122	0.718	0.529
Sulfate (SO4)	MG/L	0.5	0.5		500	56	68.5	313	147
Organic Constituents, Regulated									
Bromodichloromethane	UG/L	0.4	1			315	3.4	32.9	12
Bromoform	UG/L	0.4	1			314	ND	9.71	3.17
Chlorodibromomethane	UG/L	0.4	1			315	3.96	26.4	11.9
Chloroform (Trichloromethane)	UG/L	1	1			315	2.03	50.3	10.3
Dibromoacetic Acid (DBAA)	UG/L	1	1			48	1.52	5.9	2.66
Dichloroacetic Acid (DCAA)	UG/L	1	1			48	3.41	23.6	7.24
Monobromoacetic Acid (MBAA)	UG/L	1	1			48	ND	3.9	ND
Trichloroacetic Acid (TCAA)	UG/L	1	1			48	1.56	11.6	3.46

End Notes:

Listed analytes include only analytes with Federal/California DLRs, MCLs & SMCLs. For summary of all water quality monitoring data, see appendices.

CSD MDL: City of San Diego Water Quality Laboratory minimum detection level, DLR: detection level for reporting, MCL: maximum contaminant level, SMCL: Secondary MCL, ND: not detected. Calculated mean below CSD MDL reported as ND.

[1] DLR, MCL, SMCL are obtained from California OEHHA and SWRCB and apply to drinking water and are for reference only. California MCL and SMCL values may be more stringent than federal standards for drinking water.

[2] Trace metal values were from filtered and unfiltered samples. Differences in values were negligible.

[3] DDW considers 50 pCi/L to be the level of concern for Beta particles.

Table 5.17 - Summary of Miramar Reservoir Source Water Constituents with Detections Above Water Quality Parameters 2016 - 2020

CSD

Group/Constituents	Units	CSD MDL	Federal/California Drinking Water Standards [1]			Basin Plan Inland Surface Waters Quality [2]		2016 - 2020 Source Water Quality at Surface			
			DLR	Primary MCL	Secondary SMCL	Criteria	Objectives	No. of Samples	Min	Max	Mean
General Physical											
Odor Threshold @ 60 C (TON)	ODOR	1	1		3		none	2	4	17	10.5
Total Filterable Residue @ 180 C (TDS)	MG/L	10			1000	300	500	20	340	661	489
Turbidity, Laboratory	NTU	0.07	0.1		5	20	20	20	0.2	3.79	0.551
Microbiological											
Enterococcus	/100 ML	1				60 [4]		252	< 1	730	15
Escherichia Coli	/100 ML	1		Present		190 [4]		252	< 10	170	32
Total Coliform	/100 ML	1		Present				252	10	24000	757
Radiologicals											
Gross Beta	PCI/L		4	50 [5]				2	ND	4.30	2.15
Uranium	PCI/L		1	20				1	1.3	1.3	1.3
Metals [3]											
Barium (Ba)	UG/L	2	100	1000				20	59.6	129	88.3
Boron	UG/L	5	100			500	750	20	106	184	139
Manganese (Mn)	UG/L	0.5	20		50	50	50	20	4.34	42.8	10.4
Inorganic Constituents											
Ammonia-N	MG/L	0.031				0.025		38	ND	0.171	ND
Fluoride	MG/L	0.02	0.1	2		1	1	20	0.152	0.826	0.272
Phosphorus	MG/L	0.078				0.025 [6]	0.025 [6]	46	ND	0.211	ND
Sulfate (SO4)	MG/L	0.5	0.5		500	65	250	20	90.3	273	158
Total Nitrogen	MG/L	0.156					0.25 [6]	49	ND	1.08	0.278
Organic Constituents, Regulated											
Bromodichloromethane	UG/L	0.4	1			100		20	0.99	2.83	1.62
Chlorodibromomethane	UG/L	0.4	1					20	1.16	2.7	1.8
Chloroform (Trichloromethane)	UG/L	1	1			100		20	ND	4.75	1.34
Trichloroacetic Acid (TCAA)	UG/L	1	1					2	ND	1.18	ND

End Notes:

Listed analytes include only analytes with Federal/California DLRs, MCLs & SMCLs and/or Basin Plan Inland Surface Water Quality Criteria or Objectives. For summary of all water quality monitoring data, see appendices

CSD MDL: City of San Diego Water Quality Laboratory minimum detection level, DLR: detection level for reporting, MCL: maximum contaminant level, SMCL: Secondary MCL, ND: not detected. Calculated mean below CSD MDL reported as ND.

[1] DLR, MCL, SMCL are obtained from California OEHHA and SWRCB and apply to drinking water and are for reference only. California MCL and SMCL values may be more stringent than federal standards for drinking water.

[2] Water Quality Control Plan for the San Diego Basin (9) with amendments effective on or before May 17, 2016. Water Quality Objectives concentrations not to be exceeded more than 10% of the time during any one year period.

[3] Trace metal values were from filtered and unfiltered samples. Differences in values were negligible.

[4] Beach Action Values (BAV): Amendment to the Domestic Water Permit issued by SWRCB to CSD, August 27, 2018

[5] DDW considers 50 pCi/L to be the level of concern for Beta particles.

[6] P= 0.025 mg/L in any standing body of water. Nitrogen threshold determined by monitoring or if data are lacking, ratio of N:P = 10:1 is used. These values not to be exceeded more than 10% of the time.

Table 5.18 - Summary of Hodges Reservoir Source Water Constituents with Detections Above Water Quality Parameters 2016 - 2020

CSD

			Federal/California Drinking Water Standards [1]			Basin Plan Inland Surface Waters Quality [2]		2016 - 2020 Source Water Quality at Surface			
Group/Constituents	Units	CSD MDL	DLR	Primary MCL	Secondary SMCL	Criteria	Objectives	No. of Samples	Min	Max	Mean
General Physical											
Color, Apparent (Unfiltered)	COLOR	1			15	20	20	19	24	99	42.8
Odor Threshold @ 60 C (TON)	ODOR	1	1		3		none	2	> 24	> 24	> 24
pH	PH					6.5-8.5 [4]		18	7.36	9.32	8.43
Total Filterable Residue @ 180 C (TDS)	MG/L	10			1000	300	500	22	507	808	690
Turbidity, Laboratory	NTU	0.07	0.1		5	20	20	62	1.55	37.8	6.13
Microbiological											
Enterococcus	/100 ML	1				60 [5]		253	< 1	> 2400	6.69
Escherichia Coli	/100 ML	1		Present		190 [5]		253	< 10	160	12.8
Total Coliform	/100 ML	1		Present				253	< 10	> 24000	7160
Radiologicals											
Gross Beta	PCI/L		4	50 [6]				1	6.9	6.9	6.9
Metals [3]											
Aluminum (Al)	UG/L	5	50	1000	200			82	ND	1670	81.6
Arsenic	UG/L	1	2	10				20	ND	2.8	1.6
Boron	UG/L	5	100			500	750	20	50.7	220	165
Iron (Fe)	UG/L	100	100		300	300	300	60	ND	378	ND
Manganese (Mn)	UG/L	0.5	20		50	50	50	85	11.5	219	64.8
Inorganic Constituents											
Ammonia-N	MG/L	0.031				0.025		218	ND	0.714	0.078
Fluoride	MG/L	0.02	0.1	2		1	1	20	0.231	0.319	0.277
Nitrate (as NO3)	MG/L		2	45		5		269	ND	2.97	0.474
Nitrite (NO2)	MG/L	0.0156	0.131	0.328				246	ND	0.999	0.062
Phosphorus	MG/L	0.078				0.025 [7]	0.025 [7]	112	ND	0.291	0.107
Sulfate (SO4)	MG/L	0.5	0.5		500	65	250	76	143	249	198
Total Nitrogen	MG/L	0.156					0.25 [7]	116	0.623	2.63	1.14

End Notes:

Listed analytes include only analytes with Federal/California DLRs, MCLs & SMCLs and/or Basin Plan Inland Surface Water Quality Criteria or Objectives. For summary of all water quality monitoring data, see appendices

CSD MDL: City of San Diego Water Quality Laboratory minimum detection level, DLR: detection level for reporting, MCL: maximum contaminant level, SMCL: Secondary MCL, ND: not detected. Calculated mean below CSD MDL reported as ND.

[1] DLR, MCL, SMCL are obtained from California OEHHA and SWRCB and apply to drinking water and are for reference only. California MCL and SMCL values may be more stringent than federal standards for drinking water.

[2] Water Quality Control Plan for the San Diego Basin (9) with amendments effective on or before May 17, 2016. Water Quality Objectives concentrations not to be exceeded more than 10% of the time during any one year period.

[3] Trace metal values were from filtered and unfiltered samples. Differences in values were negligible.

[4] Waters designated Fresh or Warm changes in normal ambient pH levels shall not exceed 0.5 units

[5] Beach Action Values (BAV): Amendment to the Domestic Water Permit issued by SWRCB to CSD, August 27, 2018

[6] DDW considers 50 pCi/L to be the level of concern for Beta particles.

[7] P= 0.025 mg/L in any standing body of water. Nitrogen threshold determined by monitoring or if data are lacking, ratio of N:P = 10:1 is used. These values not to be exceeded more than 10% of the time.

Table 5.19 - Summary of Hodges Watershed Source Water Constituents with Detections Above Water Quality Parameters 2016 - 2020

CSD

Group/Constituents	Units	CSD MDL	Basin Plan Inland Surface Waters Quality [1] Criteria	Basin Plan Inland Surface Waters Quality [1] Objectives	2016 - 2020 Summary of Aggregated Direct Tributaries No. of Samples	Min	Max	Mean
General Physical								
pH	PH		6.5-8.5 [2]		236	6.32	8.15	7.23
Total Filterable Residue @ 180 C (TDS)	MG/L	10		500	234	168	3250	1620
Microbiological								
Enterococcus	/100 ML		60 [3]		215	1	2400	140
Escherichia Coli	/100 ML	1	190 [3]		215	< 100	27000	100
Inorganic Constituents								
Ammonia-N	MG/L	0.031	0.025		325	ND	1.97	0.039
Chloride	MG/L	0.5	250	250	345	10.6	832	301
Nitrate (as NO3)	MG/L		5		377	ND	153	ND
Phosphorus	MG/L	0.078		0.025 [4]	350	0.022	3.18	0.188
Sulfate (SO4)	MG/L		65	250	345	9.49	1030	311
Total Nitrogen	MG/L	0.156		0.25 [4]	349	0.18	36.9	1.56

End Notes:

Listed analytes include only analytes with Basin Plan Inland Surface Water Quality Criteria or Objectives. For summary of all water quality monitoring data, see appendices.

Data is aggregated from all reservoir direct tributaries; for data from individual sources, see appendices

CSD MDL: City of San Diego Water Quality Laboratory minimum detection level, DLR: detection level for reporting, MCL: maximum contaminant level, SMCL: Secondary MCL, ND: not detected. Calculated mean below CSD MDL reported as ND.

[1] Water Quality Control Plan for the San Diego Basin (9) with amendments effective on or before May 17, 2016. Water Quality Objectives concentrations not to be exceeded more than 10% of the time during any one year period.

[2] Waters designated Fresh or Warm changes in normal ambient pH levels shall not exceed 0.5 units

[3] Beach Action Values (BAV): Amendment to the Domestic Water Permit issued by SWRCB to CSD, August 27, 2018

[4] P= 0.025 mg/L in any standing body of water. Nitrogen threshold determined by monitoring or if data are lacking, ratio of N:P = 10:1 is used.
These values not to be exceeded more than 10% of the time.

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CHAPTER 6
CONCLUSIONS AND RECOMMENDATIONS

Local source water quality is critical to the CSD efforts in the treatment of raw source water to meet required finished drinking water standards as efficiently as possible. Protection of the watersheds and reservoirs is the first barrier to source water quality degradation. Strengthening the first barrier reduces potential impacts on the water treatment process.

6.1 Description of Significant Changes Which Could Affect Source Water Quality

Significant changes which could affect source water quality can be acute or chronic. Acute changes have impacts to source water quality that are severe and can be measured immediately, while chronic changes have impacts that are trends measured over time.

Acute changes to source water quality can involve point source pollution, extreme events, or source water system modification. Most of the events are likely to occur infrequently or at identifiable locations.

- Failure of source water system infrastructure from earthquake damage due to several earthquake faults that exist in Southern California combined with the age of the system infrastructure.
- Increase to the levels of nutrients, pathogens, organic matter, and gross pollutants in source water due to wastewater discharges from collection systems, pump stations, and treatment facilities primarily in the Hodges and San Vicente watersheds particularly if the events are large, severe, or occur in sensitive areas.
- Increase to the levels of nutrients, pathogens, and organic matter in source water due to wastewater or recycled water discharges into Miramar Reservoir from the CSD Indirect Potable Reuse Reservoir Augmentation Project.
- Increase to the levels of nutrients, pathogens, and organic matter in source water due to discharges and runoff from animal husbandry operations primarily in the Hodges watershed.
- Increase to the levels of hazardous waste in source water due to discharges from storage sites or along transportation corridors adjacent to the reservoirs in the El Capitan, San Vicente, Murray, Otay, and Hodges watersheds.
- Changes to characteristics of WTP influents due to the addition of desalinated water as source water from the Claude "Bud" Lewis Carlsbad Desalination Plant and the Richard A. Reynolds Groundwater Desalination Facility.
- Changes to characteristics of WTP influents due to the variability of imported water sources between the Colorado River and state water.

Chronic changes can involve nonpoint source pollution, activities, extreme events, and watershed management and control practices.

- Increase to the levels of sediment, nutrients, chemicals, gross pollutants, and pathogens in source water due to runoff from land development primarily in the Murray and Hodges watersheds, increased development throughout the entire source water system, primarily in Sutherland and El Capitan watersheds, and potential development of private land in the Hodges watershed.
- Increase to the levels of nutrients and pathogens in source water due to discharges of partially treated sewage from failing septic systems throughout the entire source water system, primarily in the Hodges watershed.

- Increase to the levels of sediment and nutrients in source water due to runoff from agricultural crop and grazing areas, primarily in the Hodges and Sutherland watersheds.
- Increase to the levels of sediment, nutrients, and chemicals in source water due to runoff from burned areas throughout the entire source water system and primarily in the Barrett watershed. Changes may be acute particularly if the fire events are large, severe, or occur in sensitive areas.
- Increase to the levels of sediment, nutrients, pathogens, organic matter, and gross pollutants in source water due to overall increased population and recreational usage.
- Degradation to aquatic ecosystems in the source water reservoirs due to accelerated eutrophication caused by climate change.
- Increase to the levels of cyanotoxins and taste and odor compounds in source water from increases in Harmful Algal Bloom (HAB) frequency, duration, and intensity in source water reservoirs.
- Aquatic ecosystem changes in the source water reservoirs and increased cost of water conveyance infrastructure maintenance due to the aquatic invasive species *Dreissena bugensis* in El Capitan, Murray, San Vicente, Otay, and Miramar Reservoirs.
- Improvement to the aquatic ecosystem in Hodges Reservoir due to reduction in levels of dissolved metals and nutrients resulting from the installation of a Hypolimnetic Oxygenation System (HOS).
- Aquatic ecosystem changes in Miramar Reservoir due to the introduction of source water from the Indirect Potable Reuse Reservoir Augmentation Project.

6.2 Watershed Management and Control Practices

The CSD owns about 7% of the total area within its local watersheds with less than 5% of the total area falling within San Diego city limits. Consequently, most of the watershed area is outside the CSD jurisdiction for land use planning, zoning, building codes, and enforcement of environmental regulations. This land ownership portfolio limits the watershed management and control practices available to the CSD in 93% of the area within its local watersheds to public outreach, monitoring land use and permitted activities, and interjurisdictional coordination with other agencies and stakeholders. In areas under the CSD jurisdiction, actions and activities with the potential to generate source water pollution are managed and controlled directly.

Preventing pollutants from entering a waterway is less expensive than restoring a waterway after it has been polluted. Therefore, programs focus on preventing pollution before it happens. Source water pollution is impacted by the actions and activities of individuals and the public. It is important the public be aware that their actions can either protect or pollute our waterways. Public education on the pollution potential of common activities can increase awareness of the direct links between land activities, rainfall runoff, storm drains, and local water resources encouraging the public to change their behavior, properly dispose of materials, and control pollution.

Encouraging community participation, forming partnerships, and combining efforts with other groups helps ensure progress on shared goals. Public involvement helps build community capital of interested individuals and groups to prevent water pollution, undertake group activities that highlight water pollution, and contribute volunteer community actions to restore and protect local water resources. Public involvement includes creating volunteer programs along with opportunities for direct action.

To prevent pollution and flooding, stormwater free from contaminants and debris needs to be able to flow freely into storm drain inlets and through the storm water network. Think Blue is the CSD stormwater pollution prevention campaign to help educate residents, businesses, and industry leaders about the effects of stormwater pollution, ways to prevent that pollution from harming the environment, and steps everyone can take to protect the environment. Think Blue works with community-based organizations and other government agencies to promote stormwater pollution prevention. These partnerships have built programs that educate and inform the public throughout the region. Think Blue is the education and outreach arm of the CSD Transportation & Stormwater Department (https://www.sandiego.gov/thinkblue).

Think Blue provides standards-based classroom watershed presentations for middle and high school students within San Diego with collaboration from I Love A Clean San Diego. The watershed presentations emphasize the importance of water quality protection and identify everyday actions that can be taken to keep the local watershed healthy. Students discuss watersheds, urban runoff, the water cycle, food webs, biomagnification, eutrophication, and marine debris. The Think Blue Brigade is a middle and high school environmental club established in San Diego dedicated to the protection of beaches, bays, and waterways through participation in pollution prevention events and projects while earning community service hours. Project SWELL (Stewardship: Water Education for Lifelong Leadership) is a standards-based elementary school science curriculum about the importance of the regional recreational waterways developed through a partnership between the CSD, the San Diego Unified School District, and San Diego Coastkeeper. Think Blue coordinates Environmental Awareness Day during each session of the Junior Lifeguard summer camp program in collaboration with the CSD Lifeguard Services. Environmental Awareness Day builds on the Junior Lifeguard goal of "Skills for Life" by teaching participants the importance of water quality protection in San Diego. Junior Lifeguards visit several distinct learning stations focused on such topics as watershed and marine life protection, water conservation, water quality monitoring, recycling, and litter prevention. Additional partners include the CSD Public Utilities and Environmental Services departments, San Diego Coastkeeper, and I Love A Clean San Diego.

Think Blue attends several community events each month to help educate businesses and property owners about pollution prevention, water quality improvement and steps everyone can take to protect the environment. Information regarding sustainable landscapes that apply water conservation design techniques to reduce outdoor water use, decrease the need for yard chemicals, and minimize the amount of urban runoff that enters the storm drain system. Design techniques include converting to native landscaping, applying rainwater harvesting methods, and installing efficient irrigation systems. Related rebate programs are available for both residential and commercial properties.

The educational messaging of Think Blue includes the following:

- Promotes Integrated Pest Management that uses good bugs and plant selection to avoid the use of pesticides and aids residents to plan a strategy that reduces pollution to the environment by providing tip cards to identify the good and the bad bugs.
- Encourages the public to sweep regularly and pick-up trash, leaves, grass clippings, and debris that collects around the storm drains and curb gutters clogging the storm drains and increasing the potential for flooding.
- Ensure all outdoor garbage cans are tightly covered to prevent trash and debris from leaving the property clogging storm drains and polluting receiving water bodies.
- Store and contain outdoor materials to prevent trash, fluids, and debris from leaving the property clogging storm drains and polluting receiving water bodies.
- Pick-up after pets to prevent stormwater washing pet waste into the storm drains causing bacterial contamination to receiving water bodies.
- Keep automobiles in good repair to prevent automotive fluids leaking onto the streets; a leading cause of pollution in receiving water bodies.

The CSD is involved in interjurisdictional coordination with neighboring agencies and agencies with overlapping jurisdictions, and co-permittees for the development of source water protection policies, and participation in workgroups and watershed plan committees such as the IRWM. IRWM is a collaborative effort aimed at developing long-term water supply reliability, improving water quality, and protecting natural resources. The statewide IRWM Program is supported by bond funding provided by the DWR to fund competitive grants for projects that improve water resources management (https://www.sdirwmp.org). Other groups in which the CSD actively engages include:

- The San Dieguito River Park Joint Powers of Authority whose mission is "To preserve and restore land within the Focused Planning Area of the San Dieguito River Park as a regional open space greenway and park system that protects the natural waterways and the natural and cultural resources and sensitive lands and provides compatible recreational opportunities, including water related uses, that do not damage sensitive lands."
- The San Diego River Watershed working group involving representatives of public agencies and non-governmental organizations to guide and shape a watershed management plan.
- The Joint Habitat Restoration and Research Project at Hodges Reservoir with Urban Corps of San Diego County, California Conservation Corps, Del Dios Habitat Protection League, USDA Natural Resources Conservation Services, and The Friends of Los Peñasquitos Canyon Preserve.
- The Joint Exercise of Powers Agreement (JEPA) with the County of San Diego, City of Chula Vista, and City of Imperial Beach to produce a watershed management plan for the Otay River Watershed.
- The CSD coordinates in HAB monitoring with the RWQCB9 and the County of San Diego.
- The CSD participates in the Regional Quagga Mussel Working Group.
- The CSD has worked with other agencies to identify and purchase lands proximate to water bodies for conservation purposes in coordination with other agencies.
- The County of San Diego hosts a regional hotline where residents from across the county can report illegal discharges into the storm drain system: 888-Think Blue (888-844-6525).

The San Diego Water Board regulates discharges from Phase I municipal separate storm sewer systems in the San Diego region under the Regional Municipal Separate Storm Sewer System (MS4) Permit (Order No. R9-2013-0001, as amended by Order Nos. R9-2015-0001 and R9-2015-0100). The Regional MS4 Permit covers 39 municipal, county government, and special district entities (referred to jointly as co-permittees) located in San Diego County, southern Orange County, and southwestern Riverside County who own and operate large MS4s which discharge stormwater runoff and non-stormwater runoff to surface waters throughout the San Diego Region. San Diego County is made up of 21 co-permittees and below are some of the highlights of the CSD and co-permittees actions:

- Project Clean Water is a regional clearinghouse required by the MS4 Permit order. The regional clearinghouse provides the public with information regarding area water quality and efforts to protect it while allowing for additional cooperation and coordination between co-permittees to supplement and enhance water quality outcomes (http://www.projectcleanwater.org).
- The San Diego Regional Stormwater Management Committee (RMC) is made up of representatives of the 21 co-permittees to the San Diego Municipal Stormwater Permit which develops and oversees regional urban runoff management programs in San Diego County. It serves as a forum for the coordination of urban runoff management activities across jurisdictions, and provides a framework for establishing consistency between regional, watershed, and jurisdictional programs.
- The Program Planning Subcommittee (PPS) serves as an intermediary between the RMC and other co-permittee working bodies and provides regional coordination of urban runoff management activities, develops and implements regional general programs, and directs and coordinates the activities of Regional, Watershed, or Other General Programs. It consists of nine members, each representing a watershed outlined in the Municipal Permit, Order No. R9-2013-0001 (as amended by order Nos. R9-2015-0001 and R9-2015-0100).

- The Land Development Workgroup is made up of the 21 co-permittees and serves to develop and implement regional land development plans and programs. Primary responsibilities consist of the development and update of the Regional Model BMP Design Manual as well as maintenance of the Standard Urban Stormwater Management Plan (SUSMP) and Hydromodification Management Plan (HMP). The Land Development Workgroup supplies the Co-permittee Management Committee with land development resources and recommendations necessary to support the requirements of the Municipal Stormwater Permit.

Watershed Areas Under CSD Jurisdiction

In areas under the CSD jurisdiction, actions and activities with the potential to generate source water pollution are managed and controlled directly. Watershed management and control practices include public outreach, monitoring land use and permitted activities, interjurisdictional coordination with other agencies and stakeholders, ordinances, permits, implementation and maintenance of structural and non-structural BMPs, source water quality monitoring, watershed protection and restoration projects, and special studies.

The CSD has passed ordinances regulating behaviors and activities that contribute to water pollution such as:

- littering
- disposing of trash and recyclables
- disposing of pet waste
- disposing of leftover paint and household chemicals
- changing and disposing of motor oil
- washing cars
- over-irrigation.

The City performs additional activities to limit stormwater pollution, including:

- Marking storm drains with a pollution prevention message to notify the public not to allow liquids or other pollutants into the storm drain system.
- Issuing fines related to the illegal discharge of pollutants into the storm drain system.
- Conducting inspections of industrial and commercial facilities and treatment control BMPs within CSD limits.
- Requiring the proper use and maintenance of BMPs at all construction sites in San Diego city limits to protect water quality and minimize pollution.
- Creating and managing reports from the Get It Done mobile application, used by citizens to report illegal discharges and dumping, trash and recycle collection schedules, storm drain issues and maintenance
- Staffing a CSD Pollution Prevention Hotline: 619-235-1000.

On CSD owned properties, including source water reservoirs and their associated facilities, the CSD developed public education material for trail and reservoir usage. Information is posted on CSD reservoirs and lakes website (https://www.sandiego.gov/reservoirs-lakes). Public awareness signage providing information on actions the public can take to help improve water quality has been installed around source water reservoirs, associated facilities, and in several transportation corridors.

Educational signage also exists to inform the public of the following:

- Reservoirs are a source for municipal drinking water.
- Help protect water quality using toilets and litter receptacles.
- Leash and clean up after pets and to maintain a minimum of 50 feet from water.
- Prohibit swimming, wading, consumption of alcohol, smoking, use of glass containers disposal of waste in the water or along the shoreline, and feeding or harassment of wildlife.
- Inform reservoirs users of presence of quagga mussels in the water body and to prevent their movement to other water bodies.
- Storm drain stenciling warning of pollution prevention to the receiving water body.
- Signage posted on major traffic corridors to inform commuters they are entering a CSD watershed.

The CSD encourages cleanup efforts at CSD reservoirs and watersheds by environmentally conscious volunteer organizations including the Friends of the Otay Valley Regional Park, Friends of Lake Murray, and I Love a Clean San Diego, and promotes volunteer programs such as tree planting days, volunteer monitoring programs, storm drain marking, and watershed clean-up programs. The CSD supports cleanup efforts by providing resources such as CSD staff assistance, dumpsters for trash removal to landfill, and supplies including trash bags, litter pickers, and gloves.

The CSD uses ordinances, leases, barriers, signage, and staff to control public access and activities. The CSD generally prohibits water contact activities on CSD source water reservoirs except for on designated days. During periods of permitted public access, CSD staff is on duty to ensure compliance with applicable regulations. CSD restricts public access to critical areas using fencing, has posted no trespassing signage, and installed buoy systems around dams and outlet towers to keep users at a distance. CSD works in partnership with local, state, and federal law enforcement agencies to enforce laws and ordinances on CSD-owned reservoirs. CSD also manages property upstream from reservoirs leased for agricultural and other uses through lease agreements that specify location of use/non-use areas along with other restrictions on activities.

The CSD established a Jurisdictional Runoff Management Plan (JRMP) for CSD facilities. The JRMP is the CSD stormwater compliance plan applicable to all CSD facilities connected to a MS4 Permit. The JRMP is a CSD ordinance requiring implementation, inspection, and maintenance of BMPs for preventing stormwater pollution at all CSD facilities along with prevention, response, and reporting of Non-Stormwater Discharges (NSWDs).

Municipal facilities and activities can be a source of pollutants if controls are not in place to contain spills, erosion, manage trash, and prevent NSWDs. At CSD reservoirs and associated facilities, the CSD utilizes controls for the reduction or elimination of pollutant discharges from areas such as roads, parking lots, maintenance and storage yards.

BMPs conducted by CSD at its reservoirs include:

- Providing and maintaining an adequate number of waste facilities including covered litter/recycle receptacles, toilets, and plastic trash bag dispensers for collection of trash and animal waste around the reservoirs. Reservoir staff empties the receptacles daily or as needed. “PACK IT IN / PACK IT OUT” trash bags are available for public use. Toilets are sufficient in number, conveniently located, readily accessible to the public, and always maintained in a clean, sanitary fashion.
- Routinely sweeping parking areas and roadways including removal of weeds, litter, and debris.
- Inspecting, cleaning, and maintaining storm drain catch basins.

- Using low-emission motors on CSD owned vessels including the rental fleet.
- Minimizing the on-site use and storage of hazardous materials.
- Performing routine inspections of on-site hazardous material/waste containers, and storage sites.
- Performing routine inspections of on-site spill-kits which contain 300 feet of spill containment boom.
- Installing stormwater catchment basins in parking lots at the El Capitan, Murray, Otay, and San Vicente Reservoirs.
- Installing detention ponds and bioswales to collect and confine stormwater during construction of the San Vicente Reservoir marina area.
- Conducting routine area surveys to appraise the condition of fencing, gates, locks, signs, evidence of illegal off-road activity, dumping, excessive erosion, or other obvious contamination of source water streams.

To measure source water quality, the CSD has a well-established watershed source water monitoring program. The source water monitoring program enables the CSD to complete the requirements of the Watershed Sanitary Survey, determine source water quality and water treatment efficiencies, identify impacts and sources of source water degradation, and meet permit regulatory requirements for the WTPs and body contact programs. The CSD conducts routine and seasonal source water quality monitoring in CSD watersheds to measure flow, general physical, microbiological, and inorganic constituents at streams that flow directly into CSD reservoirs. Source water quality is routinely monitored to measure general physical, microbiological, radiological, metal, and inorganic and organic constituents at CSD reservoirs. CSD source water reservoirs are routinely monitored for protozoans, quagga mussels, and HABs including HAB event response to provide visual observations and measure chlorophyll, phycocyanin, and cyanotoxin levels.

The CSD has been involved in many watershed protection and restoration projects to limit unlawful access to and restore critical watershed areas such as:

- The installation of steel pipe barrier along 3.4 miles of Proctor Valley Road to exclude off-road vehicles, prevent accelerated erosion, and provide source water protection. Partial funding was provided through TransNet administered by the San Diego Association of Governments (SANDAG).
- The closure of illegal/volunteer trails at Hodges Reservoir. The project was conducted by the Institute for Conservation Research.
- The installation of boulders along Lake Drive to prevent illegal access to Hodges Reservoir.
- The placement of large boulders along Santa Ysabel Creek crossing in San Pasqual Valley (Hodges Watershed) to prevent off-road vehicle activity, habitat destruction in the stream bed, and provide source water protection. This project was conducted by the Institute for Conservation Research.
- The installation of fencing at Sutherland Reservoir on CSD land where livestock access was identified. The fencing will reduce ecosystem degradation in the reservoir buffer which can adversely affect water quality.
- The installation of boulders and fencing to prevent illegal off-road vehicle activity and habitat destruction in the Cottonwood Creek streambed and along the north shore of Morena Reservoir. This project was conducted by County of San Diego Parks and Recreation Department staff.
- The acquisition of a five-acre parcel in Proctor Valley for restoration to coastal sage habitat, providing additional source water protection by reducing impacts associated with development, livestock disturbance, grading, and soil compaction. The project conducted by the CSD.
- The restoration and enhancement of six acres of vernal pools and sensitive upland watershed habitat in Proctor Valley. The project will benefit the CSD Multiple Species Conservation Program Cornerstone Land and improve habitat value while providing source water protection.

- The restoration along five small urban streams and in the main drainage to Upper Otay Reservoir totaling nearly 6,900 linear feet of streambed over 101 acres including the removal of invasive plants and the establishment of riparian and upland plant communities creating high quality habitat while providing source water protection. The drainage restoration will attenuate urban runoff flows and remove pollutants helping to protect water quality. The project was conducted by the CSD and River Partners. Funding was provided through the Urban Streams Restoration Program under California Proposition 84 administered by SWRCB, Environmental Enhancement and Mitigation Program administered by the California Transportation Commission, and San Diego Foundation.
- The restoration of a 55-acre site located north of SR 94, east of Honey Springs Road, west of Dulzura including the removal of invasive and non-native plants along with the development of a native plant design and site management providing source water protection. This project was conducted by the CSD and River Partners. Funding was provided through TransNet administered by SANDAG.
- The restoration of approximately 20 acres between four sites affected by the 2007 wildfires at Hodges Reservoir to coastal sage habitat providing source water protection. The project was conducted by the Institute for Conservation Research.
- The restoration of a 90-acre project area around Hodges Reservoir through the removal of eucalyptus trees and other invasive and non-native plants to restore drainages around the reservoir attenuating urban runoff flows and removing pollutants to protect source water quality. The project was conducted by the CSD, Del Dios Habitat Protection League, and Friends of Los Peñasquitos Canyon. The funding was provided through the Natural Resources Conservation Service.
- The development of an Integrated Weed Management Plan for the San Pasqual Valley to remove invasive and non-native plants and provide source water protection in Santa Maria Creek. This project was conducted by the CSD. The funding was provided through TransNet administered by SANDAG.
- The restoration of the aquatic ecosystem in Hodges Reservoir through the installation of a HOS. The HOS is designed to prevent low oxygen conditions from occurring and consequently improve water quality by reducing levels of dissolved metals and nutrients, thereby controlling excessive algal productivity and the likelihood of HABs. The funding was provided through California Proposition 84 administered by the Integrated Regional Water Management Program of the Department of Water Resources.
- Restoration of Morena Lake County Park adjacent to Morena Reservoir through the planting and maintenance of approximately 400 native trees including oak, cedar, sycamore, cottonwood, and pine. This project was conducted by the County of San Diego Parks and Recreation Department.

The CSD has been involved in many studies to model reservoirs and enhance ecosystems including field tracer studies at San Vicente, Otay, and Miramar Reservoirs in support of the CSD indirect potable reuse reservoir augmentation projects. The tracer study results validate the performance of a three-dimensional hydrodynamic model to assess retention, blending, and dilution of purified water in the reservoir.

Another study was a field study of the efficacy of using resident fish including the planktivorous bluegill sunfish and the carnivorous redear sunfish as biocontrol agents for managing quagga mussels in water bodies that serve as drinking water sources. The study was conducted by the CSD and the University of California, Santa Barbara. Funding was provided through California Sea Grant administered by the Scripps Institution of Oceanography at the University of California, San Diego.

A field study at Hodges Reservoir was conducted to quantify oxygen demand through model development in pre-deployment support of a HOS conducted by the CSD and Brown and Caldwell.

A six-year monitoring study to evaluate the performance of the HOS pre- and post-installation is an ongoing study conducted by the CSD as a requirement of the related Prop 84 grant agreement with the DWR. The study is focused on evaluating concentrations of oxygen, nutrients (phosphate, nitrate, ammonia) and redox-sensitive metals (iron and manganese) as well as any increases in water supply availability because of improved water quality and increased operational flexibility of the Hodges-Olivenhain reservoir system.

The Hodges Reservoir Nutrient Source Investigation Monitoring Plan is a two-year special study required by the RWQCB as part of the San Dieguito Water Quality Improvement Plan (WQIP). The study goal is to fill in data gaps related to the nutrient loading coming into Hodges Reservoir and provide an understanding of biological factors impacting nutrient processes to ultimately develop a functional model of the complete subwatershed system including its internal drainage pathways (e.g., tributaries, MS4, etc.) to the reservoir. The study is a joint effort between MS4 co-permittees, the CSD, City of Poway, City of Escondido, and the County of San Diego.

6.3 Evaluation of System Ability to Meet Regulatory Requirements

The summary of source water and treated water quality monitoring data for the Alvarado, Otay, and Miramar WTPs indicates the CSD is currently in full compliance with existing and pending regulatory requirements. All CSD WTPs have undergone upgrades to meet the requirements of the Stage 2 Disinfectants and Disinfectant Byproducts Rule (D/DBP) and the Long Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR) including the replacement of free chlorine as the primary disinfectant; Alvarado and Miramar now use ozone, and Otay uses chlorine dioxide as primary disinfectants.

Table 6.1 - Summary of Compliance Status for Alvarado, Otay, and Miramar WTPs to Existing and Future Regulatory Requirements

	Compliance Status		
Regulations	**Alvarado WTP**	**Otay WTP**	**Miramar WTP**
Surface Water Treatment Rule	Influent Data requires 0.5-log reduction for *Giardia* and 2-log reduction for viruses. All disinfection and turbidity removal requirements met.	Influent Data requires 0.5-log reduction for *Giardia* and 2-log reduction for viruses. All disinfection and turbidity removal requirements met.	Influent Data requires 0.5-log reduction for *Giardia* and 2-log reduction for viruses. All disinfection and turbidity removal requirements met.
Interim Enhanced Surface Water Treatment Rule (IESWTR)	Influent Data requires 2-log reduction credit for *Cryptosporidium.* All turbidity standards and filter performance requirements met.	Influent Data requires 2-log reduction credit for *Cryptosporidium.* All turbidity standards and filter performance requirements met.	Influent Data requires 2-log reduction credit for *Cryptosporidium.* All turbidity standards and filter performance requirements met.
Stage 1 Disinfectants/Disinfectants Byproducts Rule	TTHM/HAA5 RAAs in distribution system currently comply with drinking water standards.	TTHM/HAA5 RAAs in distribution system currently comply with drinking water standards.	TTHM/HAA5 RAAs in distribution system currently comply with drinking water standards.
Phase I, II and V SOC/IOC Regulations	No MCL's exceeded.	No MCL's exceeded.	No MCL's exceeded.
Long Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR)	*Cryptosporidium* data placed Alvarado WTP in bin 1; no additional treatment required.	*Cryptosporidium* data placed Otay WTP in bin 1; no additional treatment required.	*Cryptosporidium* data placed Miramar WTP in bin 1; no additional treatment required.
Stage 2 Disinfectants/Disinfectants Byproducts Rule	Plant upgrade to ozone replacing free chlorine as primary disinfectant, compliance to Stage 2 D/DBP Rule expected.	Plant upgrade to chlorine dioxide replacing free chlorine as primary disinfectant, compliance to Stage 2 D/DBP Rule expected.	Plant upgrade to ozone replacing free chlorine as primary disinfectant, compliance to Stage 2 D/DBP Rule expected.
Perchlorate	All WTP effluent data non-detects (< 4 µg/L), under the MCL of 6 µg/L; future regulations pending	All WTP effluent data non-detects (< 4 µg/L), under the MCL of 6 µg/L; future regulations pending	All WTP effluent data non-detects (< 4 µg/L), under the MCL of 6 µg/L; future regulations pending
Lead and Copper Rule	Continued compliance expected.	Continued compliance expected.	Continued compliance expected.
Radionuclides	All raw water and WTP data below MCL's; continued compliance expected.	All raw water and WTP data below MCL's; continued compliance expected.	All raw water and WTP data below MCL's; continued compliance expected.
Arsenic	All WTP effluent data non-detects (< 2 µg/L) , under the MCL of 10 µg/L; future compliance expected	All WTP effluent data non-detects (< 2 µg/L) , under the MCL of 10 µg/L; future compliance expected	All WTP effluent data non-detects (< 2 µg/L) , under the MCL of 10 µg/L; future compliance expected
Ground Water Rule	Continued compliance expected.	Continued compliance expected.	Continued compliance expected.

6.4 Water Operations Plan

Goal

Always provide adequate water supply to all customers that meets or exceeds all drinking water quality standards while efficiently managing costs.

Reservoir Operations Objectives

- Maximize use of local water while insuring emergency storage requirements per Council Policy 400-4.
- Distribute surplus water storage among reservoirs to maximize conservation of local runoff in wet seasons and minimize evaporation and transport losses in dry seasons.

Treatment Operations Objectives

- Adjust source water treatment process to always meet or exceed all drinking water quality standards.
- Keep clear wells within target levels.
- Follow reservoir operations plan for local water use.
- Minimize WTP chemical and energy use.
- Minimize water purchases and pumping.
- Maximize pumping of treated water to SDCWA aqueduct at Miramar WTP.
- Efficiently manage infrastructure maintenance, improvements, and expansion.
- Minimize service interruptions due to equipment failures.

Distribution Operations Objectives

- Ensure treated water quality always meets or exceeds all drinking water quality standards throughout entire distribution system.
- Keep line pressures and treated water storage levels within targets.
- Maintain water circulation through treated water storage facilities and dead-end mains.
- Adjust service areas as needed to meet objectives.
- Minimize imported treated water purchases and pumping.
- Maximize use of available treatment capacity and local water.
- Efficiently manage infrastructure maintenance, improvements, and expansion.
- Minimize service interruptions due to equipment failures.

6.5 Emergency Plans

Typically, the CSD manages its water supply system to restrict the purchase of imported water and to regulate the reservoir levels to maximize the use of local water. Under all conditions, an emergency supply is maintained in designated reservoirs to be available if a failure occurs to the source water supply system.

The CSD has two understood policies if an emergency occurs relating to water quality. If a WTP cannot treat the water to an approved health standard level for any reason, the WTP is required to shut down. The CSD will then re-direct treated water to the affected service area through the distribution system served by other WTPs or SDCWA. For non-water quality emergencies, the CSD has an internal emergency response plan for each reservoir which includes a chain of communication procedure for notification of CSD staff and SWRCB Division of Drinking Water.

6.6 Recommendations

The purpose of all recommendations is protection of the watershed and source water quality.

Watershed Areas Outside of CSD Jurisdiction

Public commitment and involvement are critical to any watershed protection program. The CSD should continue the source water public awareness program at CSD reservoirs and associated facilities. The CSD should further develop public awareness programs that reach out to communities within the watershed and encourage community participation in watershed protection by emphasizing the benefits and identifying what actions individuals can take to help. The CSD should centralize, strengthen, and expand CSD relationships and networks within the CSD and with other agencies and jurisdictions in the watersheds, continue participation in workgroups, and determine if additional workgroups are beneficial.

Additional recommendations for these areas include:

- Maintain established public awareness signage installed in several transportation corridors to educate commuters that they are currently within watershed boundaries and to help protect the resource.
- Continue to provide source water protection educational material at https://www.sandiego.gov/reservoirs-lakes informing the public of the significance of their actions. Ensure the availability, accuracy, and appropriateness of the materials for people using the resource.
- Develop a watershed protection communication strategy utilizing social media platforms targeting community groups, landowners, businesses, residents, and recreational users within watersheds identifying common individual behaviors and activities that have the potential to generate source water pollution.
- Work with landowners and lease owners to reduce the potential negative impact of cattle grazing and other agricultural practices.
- Continue Think Blue stormwater pollution prevention campaign, engagement in the San Diego IRWM, and Project Clean Water.
- Establish new lines of communication and coordination with neighboring agencies and overlapping jurisdictions including the U.S. Forest Service, the Bureau of Land Management, and Native American governments.

Watershed Areas Under CSD Jurisdiction

Control and understanding of the resource is key to watershed protection. Land uses such as agriculture, recreation, and development throughout the entire source water system continue to pose potential concerns for chronic water quality degradation. The CSD should continue to monitor and assess current watershed land use and permit activities while reviewing new land uses and development within watersheds to identify potential impacts and sources of degradation to source water. The CSD should continue to implement projects and programs to improve land management and water quality of source waters. The source water monitoring program should place emphasis on obtaining information necessary to ensure all regulatory requirements are met and obtaining the necessary information to make evaluations on source water quality, identify trends in degradation, isolate sources of contamination, and determine effects of management practices. Watershed monitoring should include land use and land conditions. Other recommendations include:

- Continue to use ordinances, barriers, signage, and staff to control public access and activities.
- Continue public involvement through environmentally conscious volunteer organizations.
- Maintain established source water protection signage at CSD reservoirs and associated facilities and periodically review it for accuracy and appropriateness.
- Continue to conduct routine area surveys to appraise the condition of fencing, gates, locks, signs, evidence of illegal off-road activity, dumping, excessive erosion, or other obvious contamination of source water streams.
- Formulate a watershed land strategy to acquire parcels, conservation easements, or development rights for lands proximal to the source waters that, if preserved, would protect water quality.
- Encourage the use of low impact development/green infrastructure principles and practices that mimic natural hydrologic processes to treat and control stormwater in land development and re-development projects.
- Continue to reduce the impacts from cattle grazing by restraining cattle from riparian corridors, reducing cattle density, and reviewing grazing leases on CSD properties.
- Ensure lease agreements, upon renewal or creation, include language requiring stormwater BMPs and enrollment in the Agricultural Order, if applicable.
- Continue to seek grant funding to implement watershed improvement projects, programs, and public education and outreach initiatives.
- Continually evaluate the source water monitoring program for reservoirs and watersheds to ensure the program is appropriate, complete, and consistent, and the necessary data is effectively and efficiently being obtained.
- Continually evaluate the data to provide guidance on actions necessary to protect the watersheds and source water quality.
- Assure the results and conclusions from monitoring are effectively and efficiently distributed to all interested parties.
- Initiate an acute event source water monitoring program for specific events such as storms, fires, and discharges that could directly impact source water quality.
- Expand the source water monitoring program to track external sources of reservoir degradation through focused monitoring of significant direct tributaries and subsequent tracking of contaminants to locate potential upstream sources.
- Finalize the plan for monitoring and responding to HABs at reservoirs including monitoring frequency and thresholds for posting and closures. To increase efficiency and reduce cost, the CSD should investigate performing associated cyanotoxin analyses. Continue coordination in HAB monitoring with the RWQCB9 and the County of San Diego.

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