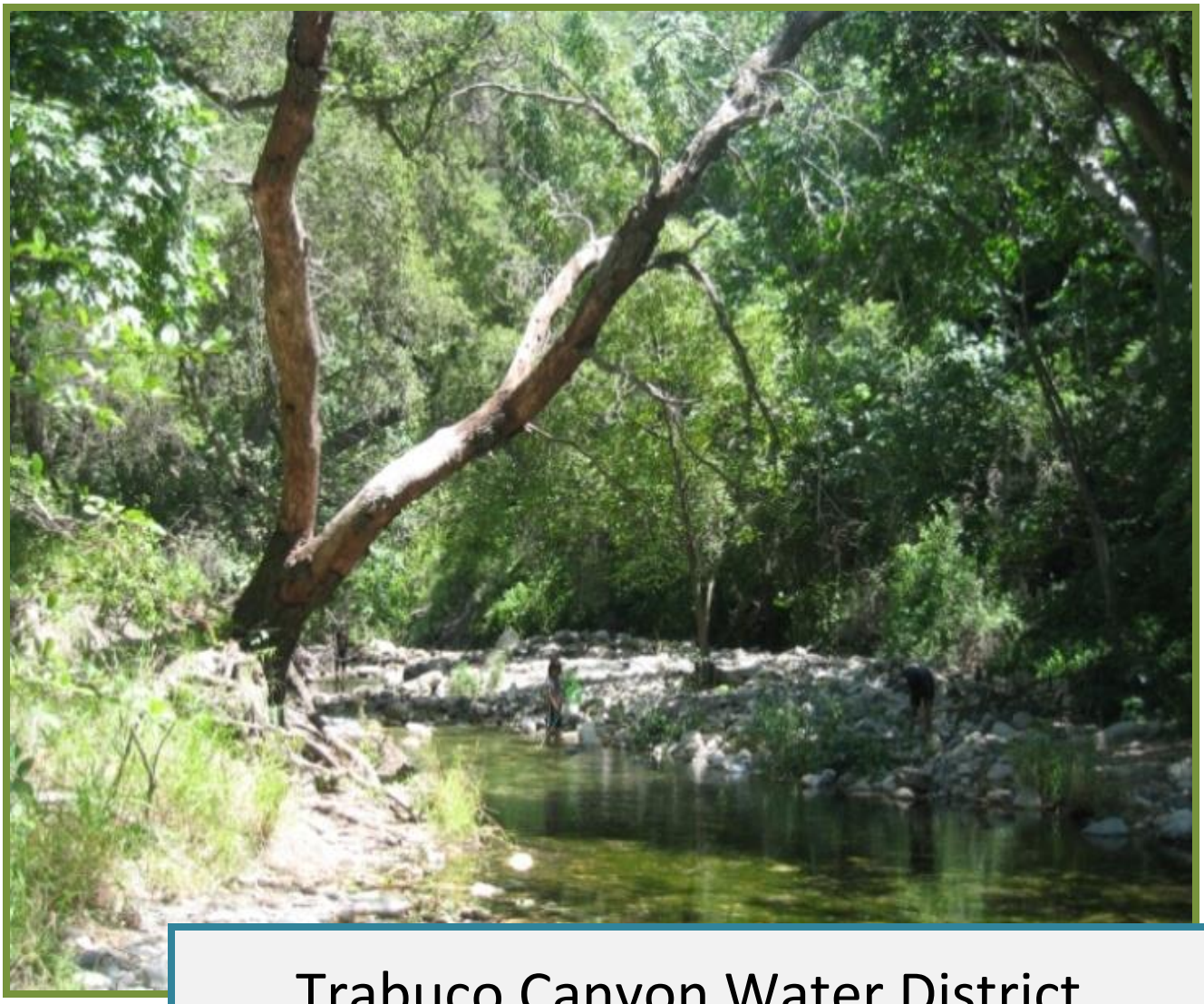


Trabuco Canyon Water District

2018 Trabuco Creek Watershed Sanitary Survey

Water Resources Planning

Water Quality & Treatment Solutions, Inc.

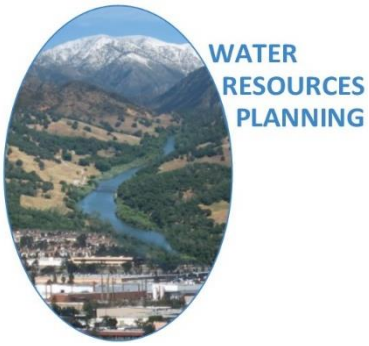
July 2018

Trabuco Canyon Water District

2018 TRABUCO CREEK WATERSHED SANITARY SURVEY

July 2018

Prepared by



WQTS
Water Quality & Treatment Solutions, Inc.
An environmental engineering and science consulting company

2018 TRABUCO CREEK
WATERSHED SANITARY SURVEY

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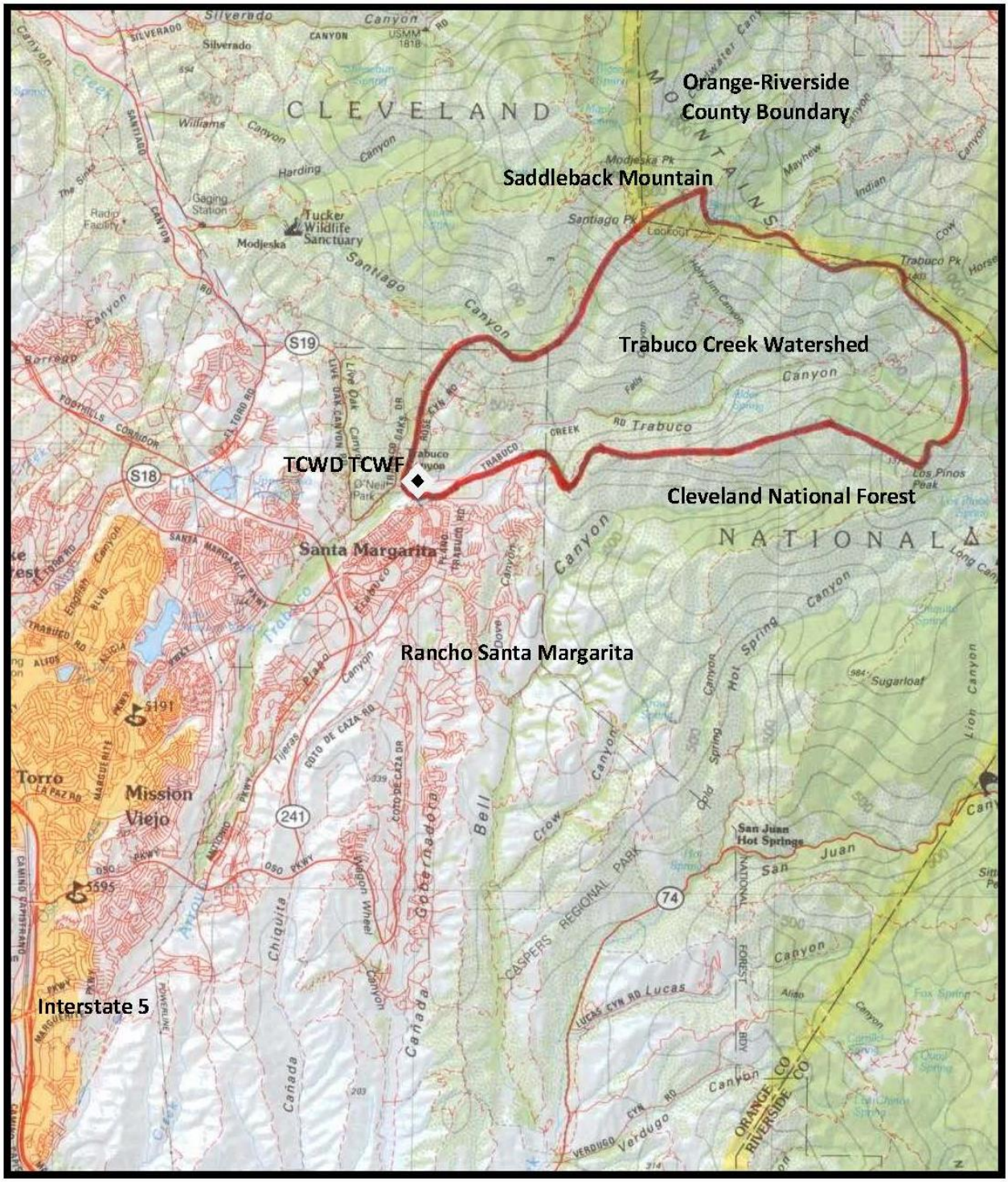
Section 1 Introduction

Study Purpose and Scope

The federal Surface Water Treatment Rule (SWTR) promulgated by the U.S. Environmental Protection Agency (EPA) in 1989 includes a recommendation for all surface water systems to prepare watershed control plans. The purpose of the SWTR was to provide a level of protection to the public by establishing treatment and performance requirements for turbidity, *Giardia*, viruses, *Legionella*, and heterotrophic plate count bacteria. As the primacy agency for the implementation of the SWTR, the California State Water Resources Control Board's (SWRCB) Division of Drinking Water (DDW) specified that all surface water systems prepare a watershed sanitary survey (WSS or survey) of their water supply watersheds by January 1, 1996 and update it every five years.

Trabuco Canyon Water District (TCWD or District) did not need a WSS for its supply sources until the development of the Groundwater Treatment Facility (GWTF), also called Trabuco Creek Wells Facility (TCWF) in the previous WSS. The GWTF is a water treatment plant (WTP) to treat water from Rose Canyon Well and Lang Well which are classified by DDW as groundwater under the influence of surface water. The watershed and location of treatment facilities is presented on Figure 1.1. This report fulfills the WSS requirements for TCWD's utilization of Trabuco Creek groundwater supplies from these two wells that are considered to be under the influence of surface water.

Title 22 of the California Code of Regulations requires that the initial WSS include a physical and hydrological description of the watershed, a summary of source water quality monitoring data, a description of activities and sources of contamination, a description of watershed control and management practices, an evaluation of the system's ability to meet requirements of Title 22 – Chapter 17: Surface Water Filtration and Disinfection Treatment, and recommendations for corrective actions. Updates are to include a description of any significant changes that have occurred since the last survey which could affect the quality of the source water. This 2018 Watershed Sanitary Survey covers the seven years of 2011 through 2017.



Trabuco Canyon Water District
2018 Trabuco Creek Watershed Sanitary Survey

Figure 1.1 ◆ Watershed Location Map

Survey Methods

The TWCD retained Water Resources Planning and Water Quality & Treatment Solutions, Inc. (WQTS) to prepare this 2018 *Trabuco Creek Watershed Sanitary Survey*. Topographic maps were reviewed along with general plan land use maps, research on existing and planned land uses and activities, water quality and quantity data from the District, and other information pertaining to the watershed. The watershed was surveyed by automobile in accessible areas, hiked a short distance on Holy Jim Trail, and by using detailed aerial photographs. Contacts were made, usually by telephone, with relevant public agencies for updated land use information, along with internet searches.

This report focuses on information relevant to a watershed sanitary survey. Water production and water quality data were compiled, summarized, reviewed, and presented for years 2011 through 2017. Existing land uses were identified and generally mapped. In addition, up-to-date general plans of each community within the watershed were reviewed for planned future land uses which have the potential for degrading water quality in the watershed.

Report Organization

This report presents the progression of the WSS from a description of the watershed to the analysis of water quality data, and discusses the nexus between land uses and water quality. Report chapters are described below. Appendices provide supporting data.

Section 1 – Introduction. This chapter presents the purpose of the survey, survey methods, report organization, abbreviations used in the report, and acknowledgment of key survey management.

Section 2 – Watershed Characteristics and Infrastructure. This chapter provides background information on the watershed study area and describes natural physical and hydrologic characteristics. An overview is provided of the Trabuco Canyon Water District and its water supplies.

Section 3 – Potential Contaminant Sources. This chapter provides a summary and update of existing potential contaminant sources by land use and their significance for the potential to impact drinking water quality. Planned changes to land uses in the watershed have been identified. A summary of agencies with watershed water quality protection responsibility is provided.

Section 4 – Water Quality Review. Current drinking water regulations are presented in this chapter, along with summarized source water quality data from Trabuco Creek watershed and the two wells used by TCWD. This chapter provides a summary of the GWTF treatment process.

Section 5 – Observations and Recommendations. This chapter provides a summary of key conclusions and a list of recommendations.

Appendices – Appendix A provides the water quality tables referred to in Chapter 4. Appendix B provides a list of references used in preparing this document.

Abbreviations and Acronyms

To conserve space and improve readability, the following standard abbreviations and acronyms were used in this report.

ADD	average daily demand
AF	acre-feet
afy	acre-feet per year
AFT	Alternative Filtration Technology
AMP	Allen-McColloch Pipeline
CCT	chlorine contact tank
cfs	cubic feet per second
DBP	disinfection by-products
D/DBP	disinfectant/disinfection by-product
DDW	SWRCB's Division of Drinking Water
DLR	detection level for purposes of reporting
E. coli	*Escherichia coli*
EPA	U.S. Environmental Protection Agency
ESWTR	Enhanced Surface Water Treatment Rule
ETWD	El Toro Water District
GAC	granular activated carbon
gpd	gallons per day
gpm	gallons per minute
gpm/ft^2	gallons per minute per square foot
GWTF	Groundwater Treatment Facility (District WTP) also called TCWF
HA	Health Advisories
HAA	haloacetic acids
HAA5	sum of five haloacetic acids
HPC	heterotrophic plate count
ICR	Information Collection Rule
IDSE	Initial Distribution System Evaluation
IESWTR	Interim Enhanced Surface Water Treatment Rule
IOCs	inorganic constituents
IRWD	Irvine Ranch Water District
LT2ESWTR	Long-Term 2 Enhanced Surface Water Treatment Rule
MCL	maximum contaminant level – enforceable standard
MCLG	maximum contaminant level goal – health goal, non-enforceable
mgal	million gallons
mgd	million gallons per day
mg/L	milligrams per liter, equivalent to 1 part per million
msl	mean sea level
MWD	Metropolitan Water District of Southern California
MWDOC	Municipal Water District of Orange County
NPDES	National Pollutant Discharge Elimination System
NTU	Nephelometric Turbidity Unit (standard turbidity measurement)
OEL	Operational Evaluation Levels
pCi/L	picocuries per liter
PHG	Public Health Goals

RWQCB	California Regional Water Quality Control Board
SBR	sequencing batch reactor wastewater treatment process
SDWA	Safe Drinking Water Act of 1974
SMCL	Secondary Maximum Contaminant Levels
SMWD	Santa Margarita Water District
SOC	synthetic organic compounds
SWP	State Water Project
SWRCB	State Water Resources Control Board
SWTR	federal Surface Water Treatment Rule
TCR	Total Coliform Rule
TCWD	Trabuco Canyon Water District
TCWF	Trabuco Creek Wells Facility, also called GWTF
TDS	total dissolved solids
THMs	trihalomethanes
Title 22	Title 22 of the California Code of Regulations
TOC	total organic carbon
TTHM	total trihalomethanes
µg/L	nanograms per liter
USFS	U.S. Forest Service
USGS	U. S. Geological Survey
VOC	volatile organic compound
WSS	watershed sanitary survey
WTP	water treatment plant
WWTP	wastewater treatment plant

Acknowledgements

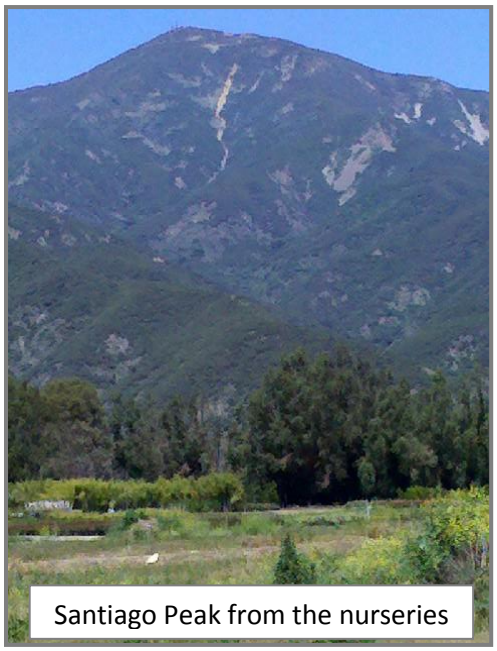
During the development of this WSS, the project team received invaluable assistance from numerous individuals and several agencies. In particular, we would like to thank the manager of this project, Michael Perea, Acting General Manager of Trabuco Canyon Water District.

Groundwater Treatment Facility

Section 2 Watershed Characteristics and Infrastructure

This section provides background information on the study area watershed's natural physical and hydrologic characteristics. In addition, an overview of the Trabuco Canyon Water District is provided, including a description of its water supplies and primary infrastructure related to conveying raw water to treatment facilities.

Watershed Study Area



Santiago Peak from the nurseries

The focus of this survey is on the upper Trabuco Creek watershed. Trabuco Creek, also called Arroyo Trabuco, is a tributary of San Juan Creek which flows from the Santa Ana Mountains to the Pacific Ocean. Trabuco Creek drains a watershed that starts at the Riverside County and Orange County border in the Cleveland National Forest between Santiago, Trabuco, and Los Piños peaks. It drains undeveloped and rural residential lands, through Trabuco Canyon, to its confluence with Rose Creek. The study area watershed ends just below this confluence, at the location of the District's Rose and Lang wells which are housed at the Groundwater Treatment Facility, also called Trabuco Creek Wells Facility (TCWF) in the previous WSS. Trabuco Creek continues to San Juan Capistrano where it joins San Juan Creek before reaching the ocean. The entire watershed is 27 miles in length draining an area of 54 square miles. The upper watershed, the subject of this survey, is approximately 10,600 acres or almost 17 square miles and is shown on Figure 1.1, Location Map.

The watershed is almost entirely within Orange County, with a few acres extending into Riverside County along the ridgeline. The watershed is located north and northeast of the City of Rancho Santa Margarita. A small portion of Rancho Santa Margarita's sphere of influence is within the watershed.

The upper reaches of the watershed are in the Trabuco District of the Cleveland National Forest. The Cleveland National Forest extends from just north of the U.S. border with Mexico, to the City of Corona and includes the Santa Ana Mountains. Most of the recreational opportunities within the Cleveland National Forest are in nearby Silverado and Modjeska Canyons in the watershed immediately north or along the Ortega Highway (State Highway 74) to the southeast. Section Three provides a summary of land uses and activities within the Trabuco Creek watershed.

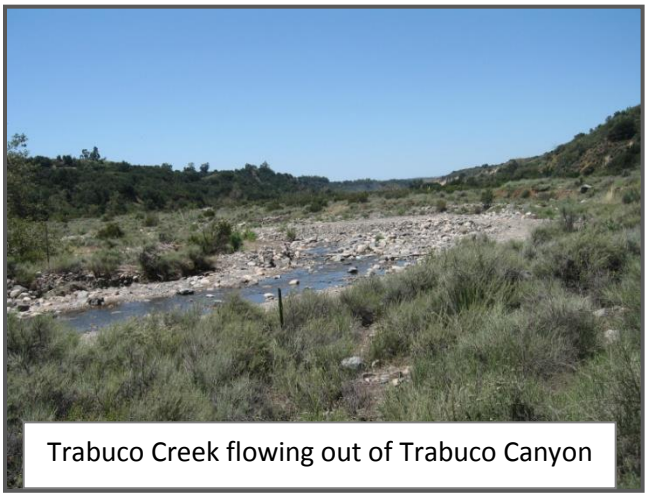
Natural Setting and Hydrology

The natural characteristics and hydrology of the Trabuco Creek watershed are summarized here.

Natural Characteristics

Elevations in the watersheds range from approximately 1,000 feet (msl) at the WTP to 5,687 feet at Santiago Peak. The watershed is located in the Santa Ana Mountains, a short peninsular mountain range that extends for approximately 35 miles along the border of Orange and Riverside counties. The Santa Ana Mountains are bounded on the northeast by a steep escarpment along the Elsinore Fault Zone, part of the San Andreas Fault System, outside of the watershed. The study area has many steep, narrow canyons that widen out at the alluvial floodplain of Trabuco Creek. Holy Jim Canyon has a stream gradient of 1,000 feet per mile.

The Santa Ana Mountains, part of the Peninsular Ranges geomorphic province, have an interesting geologic history including volcanic activity creating a batholithic-core, ocean presence leaving behind marine deposits, and canyons created by uplift and folding from past and current earthquakes and erosional processes. The exposed rocks are slightly metamorphosed volcanic from the Santiago Peak Volcanics, which have been intruded by granites, gabbros, and tonalities of Cretaceous age. Overlying these rocks are sandstones, siltstones, and conglomerates of Upper Cretaceous age. The creek flows out of these mountains through the narrow Trabuco Canyon into the "Plano Trabuco", an alluvial terrace about four to five miles long and about one mile wide. The study area watershed follows a bluff of the terrace on the south side of the creek; after the confluence of Rose Creek, the terrace drains to the creek downstream of the wells.



Trabuco Creek flowing out of Trabuco Canyon

This upper reach of Trabuco Creek serves as a sediment supply for the lower reaches of the channel with minimal obstructions within the study area watershed. Detrital materials (boulders, large cobbles, gravel, coarse sand, silt, etc.) that settled in canyon bottoms formed shallow alluvial deposits. In the vicinity of the District wells, alluvium averages 40 feet thick. Studies by the State Department of Water Resources (DWR) estimate the storage capacity of this upper reach of the Arroyo Trabuco basin to be about 1,500 acre-feet (TCWD, 1999).

This geologic activity has resulted in interesting rock outcrops and formations. Limited mining of coal, silver, lead, tin, and zinc took place historically in the Santa Ana Mountains. Sand and gravel mining has occurred in the watershed; operations were discontinued around 2004.

Habitat in low elevations includes sycamore and willow riparian habitats, oak woodland, native and non-native annual grasslands and coastal sage scrub. With increasing elevation, dense chamise and broadleaf

chaparral communities replace the coastal sage scrub except along south facing slopes. Oak woodlands and forests are found at the upper reaches of the watershed on north facing slopes and along drainages. According to the Canyon Land Conservation Fund, the major ecological communities are: foothill woodland (coast live oak woodland); cismontane chaparral and scrub (coastal sage scrub, buckwheat/white sage, northern mixed chaparral, southern mixed chaparral, chamise chaparral, scrub oak chaparral and montane chaparral), and lower montane forest (big cone Douglas fir/canyon live oak, coulter pine, canyon live oak woodland and broad leaved upland forest).

The hilly and mountainous terrain support a varied wild animal population of deer, foxes, bobcats, mountain lions, possums, raccoons, rabbits, tree and ground squirrels, badgers, waterfowl, and nesting raptors, to name a few. The Audubon Society has identified 55 species of birds in the area. Trabuco Creek once supported one of the largest steelhead habitats in Orange County.

Hydrology

Trabuco Creek within the study area is almost eight miles in length starting near Los Piños Peak and traveling west to the confluence with Rose Creek. Rainfall is variable in these upper reaches with high peak flows and high velocities due to the steepness of Trabuco Canyon and the tributaries of Trabuco Creek. Water runs off quickly into Trabuco Creek in short durations with sharp peak flows.


Trabuco Creek

As presented in Table 2.1, Watershed Precipitation, rainfall in Trabuco Creek watershed ranged from 13.64 inches per year in the lower watershed near the treatment facilities to 18.28 inches per year at Santiago Peak during the study period of 2011 through 2016. The study period included six years of drought. A review of data provided by the County of Orange indicates a significant difference in the average annual rainfall for the study period as compared with the historical average. For example, the average rainfall for Santiago Peak since 1949 is 32.28 inches compared with 18.28 inches for the study period. Not quite as dramatic, the Rancho Santa Margarita/Trabuco Canyon Road average rainfall since 1977 is 19.63 inches compared with 13.64 inches for the study period (OCWatersheds, 2018). Trabuco Creek and its tributaries generally flow in the winter and early spring, but are usually dry during summer and fall unless springs and groundwater seep into the creek.

Water Supply

Trabuco Canyon Water District is described here along with its water supplies obtained from the Trabuco Creek watershed.

Table 2.1
Watershed Precipitation
(inches)

Month	Trabuco Sta[1]	Santiago Peak[2]
January	2.66	3.45
February	2.05	3.20
March	1.90	2.25
April	0.67	0.92
May	0.61	0.91
June	0.02	0.03
July	0.30	0.48
August	0.22	0.11
September	0.37	0.49
October	0.64	1.07
November	1.08	2.03
December	3.12	3.37
Total	13.64	18.28

[1]Monthly average for January 2011 – June 2017. Station 206, Trabuco Forestry, on Trabuco Canyon Road. OCWatersheds.com
[2]Monthly average for January 2011 – June 2017. Station 208, Santiago Peak. OCWatersheds.com

TCWD Operations

The District currently serves a 2015 estimated population of 12,712. It has an estimated 3,985 water service connections within the District's service area. Within the watershed, the District serves many rural residences with potable drinking water. The District obtains its drinking water supplies from groundwater wells and from Municipal Water District of Orange County (MWDOC), which supplies its member agencies with imported water obtained from Metropolitan Water District of Southern California (MWD).

There are several interties with other agencies allowing for the transfer and sale of other supplies to the District. Through existing inter-agency agreements, there are 532 connections in the Portola Hills community that are adjacent to Irvine Ranch Water District's (IRWD) service area and receive potable water from IRWD; the District owns and reads the meters on a monthly basis and bills the customers for service; IRWD then bills the District for the supplied water per the terms of the agreement. Other interties connect the District with Santa Margarita Water District (SMWD), IRWD, and El Toro Water District (ETWD) but the interties do not provide the same service arrangement as with the Portola Hills development. Most are for emergency purposes, with the exception of a connection with SMWD for water purchases and from the Allen-McColloch Pipeline (AMP) which passes through a SMWD intertie via SMWD's South County Pump Station and Delivery System in which the District has contractual capacity.

The District also provides sewer service to 3,497 connections within the District; approximately 1,600 connections are adjacent to the IRWD service area, and approximately 200 connections are adjacent to the SMWD service area.

The District provides reclaimed and recycled water service to the following users: Dove Canyon Golf Course, Dove Canyon Master Association, Trabuco Highlands Community Association, Robinson Ranch homeowners association (HOA), and two commercial nurseries. The District treats a portion of the collected wastewater in its service area at the Robinson Ranch Wastewater Treatment Plant (WWTP). The remainder is conveyed to SMWD for treatment at its Chiquita Wastewater Reclamation Plant. A major portion of the District service area remains unsewered, including the entire Trabuco Creek watershed within the study area. The recycled water supply is not currently proposed to be utilized within the study area, although it is planned to be used adjacent to the watershed if the nursery lands develop in the future.

Water Sources


Rose Canyon Creek downstream of restaurant

The District currently obtains 5 to 15 percent of its total supply from groundwater from the Arroyo Trabuco aquifer via the Rose Canyon and Lang wells. This aquifer is considered by DDW to be under the influence of surface water. The Arroyo Trabuco aquifer is a part of the San Juan Basin. Natural recharge consists of streambed percolation from Trabuco Creek, rainfall infiltration and subsequent deep percolation to the water table, and subsurface inflow from the tributary alluvial stream areas. Water supply for the wells varies year to year. During wet years there is sufficient recoverable water to allow the wells to be operated for over six months. However, during average water years, the wells may operate for up to six months before water levels drop too low to maintain pumping. In dry years, the wells are sometimes only operated for two months.

The District obtains the remaining approximately 85 to 95 percent of its supply from purchases of surface water from MWD through MWDOC. Raw water is conveyed from MWD's terminal storage reservoir, Lake Mathews, through Lower Feeder and Santiago Lateral. The Lower Feeder also provides water to MWD's Diemer WTP. Water stored in Lake Mathews is primarily Colorado River water, although it has stored limited quantities of SWP water. Imported water can be found blended with the treated Trabuco Creek groundwater supply in some areas of the distribution system.

Infrastructure

The District pumps groundwater from the Rose Canyon and Lang wells and treats the water at GWTF. Treated water is conveyed directly into the distribution system. This section describes the facilities associated with producing water from the Trabuco Creek watershed.

Wells and Conveyance Facilities

The Rose Canyon and Lang wells are housed within GWTF, approximately 120 feet from the centerline of Trabuco Creek. GWTF is located on Rose Canyon Road approximately 550 feet north of Trabuco Canyon Road. From ground level to a depth of 30 feet, the substrate is riverbed alluvium and cobbles. From 30 to 40 feet, the substrate is fine-grained siltstone.

The WTP delivers water to the Harris Grade pressure zone, the largest pressure zone in the District which encompasses most of the north and all of the central regions of the District service area, as well as to lower pressure zones. The District's primary water supply, Dimension WTP also delivers water to the Harris Grade pressure zone, blending with the GWTF supply (when in operation) within two reservoirs located in this upper pressure zone. There are several interties with other agencies in this zone, receiving or sending treated water, depending on the intertie. The Harris Grade zone supplies lower zones, such as Rose Canyon Reservoir and Joplin Reservoir, with water. These reservoirs are located within the watershed.


Rose Canyon Well

The Joplin Reservoir pressure zone is a small zone within the watershed. The District's Joplin Reservoir serves Joplin Youth Center (operated by the County of Orange). The County has its own two treated water reservoirs at the facility to augment fire fighting supplies. A dedicated pump station fills Joplin Reservoir once every few days from Rose Canyon Reservoir.

There are many pressure regulating stations in the distribution system allowing the Harris Grade zone supply to be conveyed, primarily through a network of 8-inch pipelines, to District customers. In addition to the Joplin Youth Center, District customers within the watershed are low density residential accounts located along Rose Canyon, Windy Ridge, and Flanagan roads.

Water Treatment Plant and Processes

GWTF began operation in February 2011. The treatment process consists of coagulant addition before a static mixer, followed by two-stage pressure filtration. The first stage filters employ a coarse grain garnet as the filter media, while the second stage filters employ fine grain garnet. Chlorine in the form of sodium

hypochlorite is added following the filters. A baffled chlorine contact tank provides the necessary disinfectant contact time required to meet the DDW disinfection requirements.

The EPD Filtration System is classified by DDW as a pressure filtration system. The GWTF has ten first-stage pressure filters and eight second-stage pressure filters. The filters are 36-inch diameter pressure vessels, mounted horizontally. Each vessel provides 16.5 square feet of filtration area.

The primary disinfectant at GWTF is sodium hypochlorite, which is fed to a static mixer on the upstream side of the chlorine contact tank. The chlorine contact tank is a 65-foot long, 10-foot-diameter, above-grade fiberglass tank with a total capacity of 39,000 gallons that includes a chlorine contactor volume of 33,275 gallons, and a clearwell of approximately 3,350 gallons. The tank includes 10 internal baffles.

Backwash waste from the two-stage pressure filtration system is discharged to a backwash settling tank. The clarified backwash waste is returned to the head of the plant by the backwash return pumps. Settled sludge is pumped to sludge storage tank by the sludge transfer pump. The settled sludge is periodically removed with a vactor truck and transported to the District's wastewater treatment facility for disposal.

Water Production

Total monthly water production during the planning period is provided Section 4. In dry years, such as much of the planning period for this WSS, the wells may not produce any water, while in wet years the wells may be productive almost year-round. Data indicate that total groundwater deliveries from Rose Canyon and Lang wells, treated at the GWTF, averaged 65 afy when in operation, which was only 18 months during the seven year planning period.

Section 3 Potential Contaminant Sources

The Trabuco Creek watershed is relatively small and rural, with most lands owned by the U.S. Forest Service (USFS). There is very little development within the 17 square mile watershed. Existing land uses and activities within the watershed and future potential development activities, as they relate to being potential contaminant sources, are discussed in this chapter. Agencies with water quality protection responsibility are also identified in this chapter.

Existing Potential Contaminant Sources and Significance

Figure 3.1, Existing Land Uses, presents the general location of current land uses and activities within the watershed. Activities and land uses that are not present in the watershed are not discussed here.

Concentrated Animal Facilities

Concentrated animal facilities tend to have stockpiled manure which contains pathogens and nutrients. These uses are of particular concern during heavy and/or intense precipitation events. There are several equestrian operations in the watershed. Many of these facilities offer boarding, training, and access to riding trails. In addition, there are several individual property owners with private equestrian facilities at their homes that may or may not accept boarders.

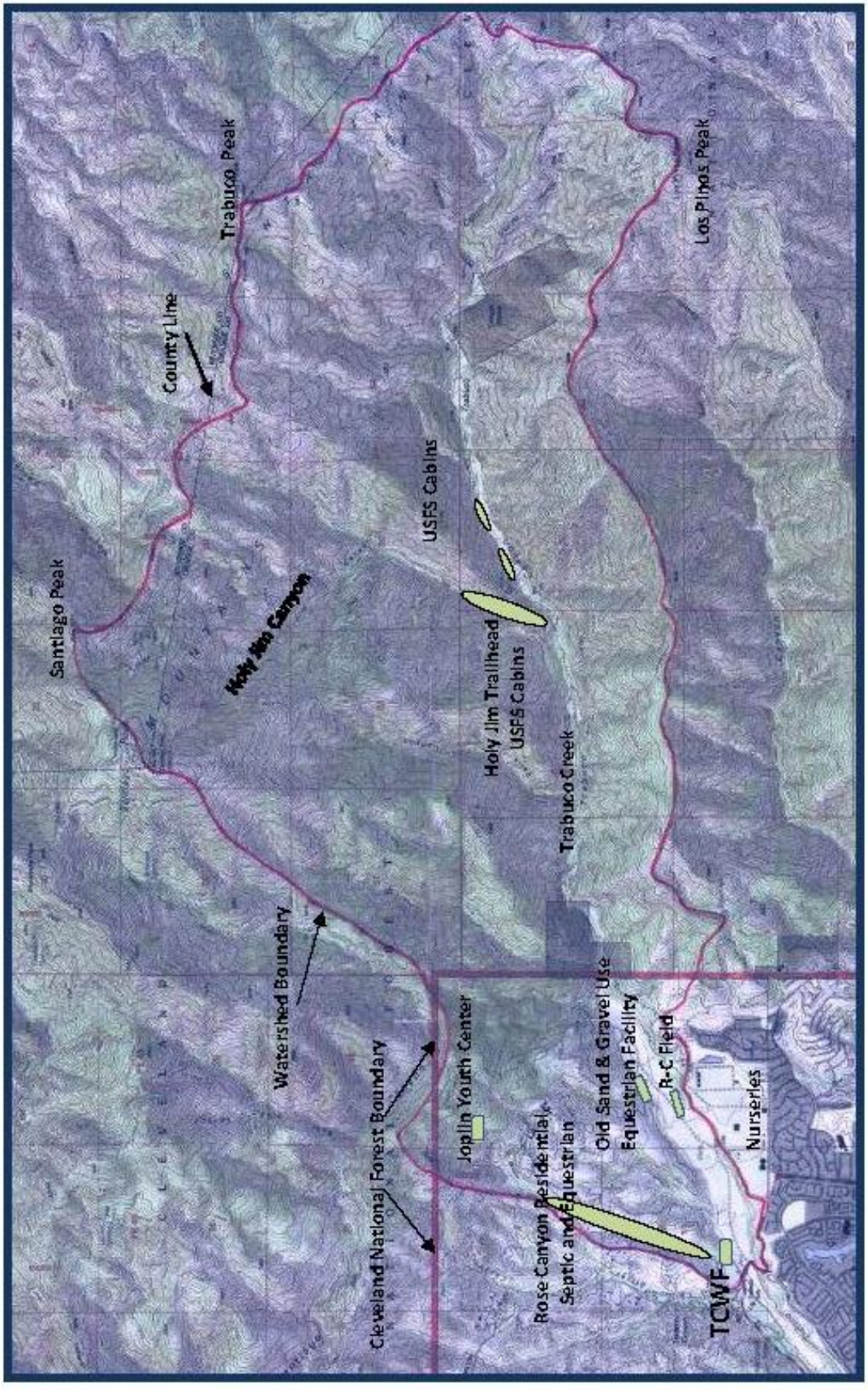
Rose Canyon equestrian manure disposal

Equestrian facilities are primarily located along Rose Canyon Road. A small equestrian facility is also located on the north side of Trabuco Creek Road on the former sand and gravel extraction property; an irrigated pasture is on the hill overlooking the facility. According to the ranch manager of one of the facilities, manure is typically disposed of in bins and hauled off-site by the solid waste management company once a week.

Geologic Hazards

The watershed is within the Santa Ana Mountains, bounded on the east just outside of the watershed by a steep escarpment along the Elsinore Fault Zone. The range is steep to very steep with narrow to rounded summits and narrow canyons. Earth movement from geologic hazards such as earthquakes, mass wasting, and fluvial erosion have the potential to contribute high loadings of suspended solids into waterbodies. High turbidity levels are associated with heavy

Trabuco Creek streambed



Trabuco Canyon Water District
Trabuco Creek Watershed Sanitary Survey
Figure 3.1 Existing Land Uses

precipitation and resulting erosion, particularly during high intensity events. Sediment loading in streams is particularly common during the first few rainy seasons following a wildfire.

For Trabuco Creek, the risk of water quality degradation associated with suspended solids loading is low because Trabuco Creek transports mainly boulders, large cobbles, gravel, and coarse sand which do not remain suspended during aqueous transport. In addition, water is filtered through the soils before being captured and pumped to the treatment plant.

Hazardous Materials and Underground Tanks

There are no known underground fuel tanks in the watershed. There is always the possibility of old unknown and unregistered fuel tanks at residences stored below ground or in the upper watershed at the USFS cabins. The USFS cabins have above ground propane tanks; the communications facilities on Santiago Peak also have propane tanks. Approximately two miles upstream from the treatment facilities and across Trabuco Creek from the radio controlled air field is a storage yard containing storage sheds, abandoned vehicles, containers, and other items.

Mining

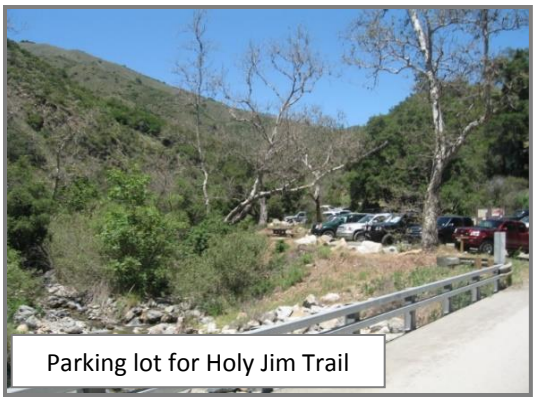
Mine drainage can cause elevated levels of metals and sediment from runoff into waterbodies. Although there are no current mining activities in the watershed, historically there were short-lived facilities extracting limited amounts of metals, including gold, from the area. According to the USFS Trabuco Ranger District, these mining activities were often exploratory and short lived because of the limited resources. There are many abandoned mines in the watershed - most not visible from a road - but none are known by the USFS to be contaminated. There is a low risk of abandoned mines degrading water quality in Trabuco Creek watershed.

Sand and gravel extraction operations have occurred in and adjacent to Trabuco Creek in an area approximately 1.5 miles upstream from the confluence with Rose Creek. This property is designated by the County General Plan for sand and gravel extraction. The most recent sand and gravel harvesting permit was obtained in 2003; this permit was considered completed and closed in 2004. The previous sand and gravel operations do not appear to be impacting water quality in the watershed.

Recreational Use

Recreational uses within the watershed are primarily the extensive trail systems used by hikers, bicycle riders, and equestrians. The watershed has a very limited road network, primarily for fire and USFS access, but also for public access along Trabuco Creek Road from Trabuco Canyon Road to Holy Jim trailhead and USFS cabins. Access roads used as trails and formal and informal trails generally have the potential for contaminating waterbodies with pathogens and sediment from activities such as defecating near waterbodies, illegal fires, trash disposal, and soil disturbance from people leaving designated trails and roads and disturbing waterbodies and riparian vegetation. Vehicles driving off-road near Trabuco Creek Road have been observed at each site visit. This illegal use has resulted in the disturbance of soils and vegetation, abandoned car parts, and likely deposition of vehicle fluids and waste products.

Trails. Many of the riding, hiking, and biking trails in the watershed exist as unimproved trails on private property and in the Cleveland National Forest leading from canyons and along ridgelines connecting Santiago, Trabuco, and Los Piños peaks. Many of the hiking and biking trails in the Cleveland National Forest are very popular, such as Holy Jim Trail, with heavy use at times. Holy Jim Trail is accessed by traveling almost five miles along unpaved Trabuco Creek Road to the trailhead at the mouth of Holy Jim Canyon. Other popular trails include Santiago Truck Trail, Joplin Trail, Trabuco Canyon Trail which follows the creek to its headwaters near Los Piños Peak, and Horsethief Trail. The risk of water quality contamination associated with trail use is relatively low. The majority of equestrian, hiking, and bicycling trail users are often good stewards of the land; the terrain is steep, thus preventing off-road trail bike usage; and water flow in creeks is seasonal, thus lessoning the attraction for access to waterbodies.


Parking lot for Holy Jim Trail

Informal Recreation. Trabuco Creek Road provides access into the watershed for informal day use such as picnicking, fishing, and playing in the creek. The California Department of Fish and Game stocks Trabuco Creek from February through the end of May at a location almost five miles upstream from the beginning of Trabuco Creek Road, near the Holy Jim trailhead. Trabuco Creek had several old dams that created ponds when water flowed. These dams have been removed during the past several years to improve fish passage along the creek. The informal swimming holes were popular recreation spots; now removed, there is a reduced risk of human contamination of the creek.


Dam removed on Trabuco Creek

Cabins. There are approximately 45 cabins on USFS lands in the watershed. These cabins are owned by individuals with a 20-year special use permit allowing the structures on federal land. However, these cabin owners/lessees may not be able to rebuild if a cabin is damaged in a fire. The cabins are located along Holy Jim Creek and further upstream from the Holy Jim trailhead parking lot along Trabuco Creek. Access to the cabins is from Trabuco Creek Road, thus increasing public use of this unpaved road.

***Radio-controlled Airplanes*.** There is a radio-controlled airplane air field operated by the Trabuco Flyers Club located on the south side of Trabuco Creek less than two miles up Trabuco Creek Road from the WTP. Facilities include an asphalt runway, spectator area with picnic tables, and a facilities building. Radio-controlled flyers require small amounts of fuel which must be brought to the flying site. Waste management is discussed below.

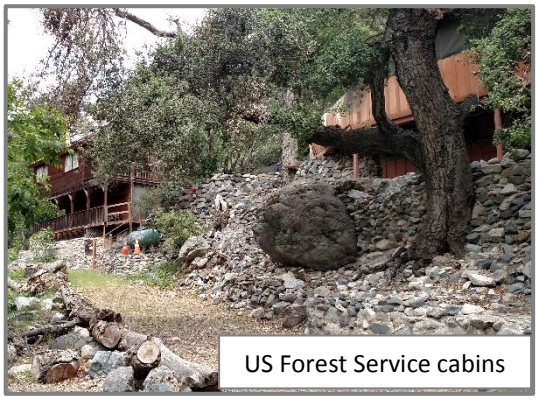
Sewage Systems

Human waste is a source of pathogenic organisms such as bacteria, parasitic cysts, and viruses. Most land uses in the watershed are on septic systems with the exception of Joplin Youth Center which has its own wastewater treatment facilities. Within the Cleveland National Forest, there are portable sanitation facilities at the trailhead for Holy Jim Trail and USFS cabins with their own facilities. There are no current plans to replace waste systems in the watershed with sewage collection service.

Septic Systems. There are fewer than 20 year-round homes in the watershed including a group home, several small home based businesses, and a restaurant, all within the most heavily populated area of the watershed along Rose Canyon Road, Flanagan Road, and Windy Ridge Road. There are a few other residences in the watershed scattered in other locations. These uses rely on individual septic tank/leachfield systems. The majority of the homes are proximate to Rose Canyon Creek which increases the risk of contamination due to failed or leaking systems. The Trabuco Flyers Club is on a septic system described under Recreational Use.

As septic systems age, they tend to fail more frequently. Older septic systems in the watershed are considered a high risk for potential contamination. Data on pathogenic microorganisms, to be collected by the District at GWTF, should continue to be reviewed carefully for the presence and any trending of pathogens which could be from leaking or failing systems, particularly following heavy rainfall events. The Orange County Planning Division indicated that it cannot pursue enforcement of septic system maintenance unless there are specific complaints. Although it has been studied, the District is not planning to sewer the northern developed areas in the vicinity of Rose Canyon.

USFS Cabins. When permits were last up for renewal, USFS required cabin owners to replace all septic systems with alternative self-contained methods of sewage disposal. The most common replacement system was on-site composting systems, although truck hauling is permissible. According to the USFS, all cabins have replaced the septic systems.



US Forest Service cabins

Portable Facility at Trailhead. The USFS has a portable sanitation facility in the parking lot at the trailhead for Holy Jim Trail. According to the USFS, vandalism in the past was a problem. Staff replaced the old facility that could be tipped over with a stronger facility. This facility is pumped out once each month by a truck that travels up Trabuco Creek Road. During the recent site visit, the facilities were full.

Radio Controlled Airplane Air Field. The radio controlled airplane air field is located less than two miles upstream of the WTP adjacent to Trabuco Creek. The club has an on-site septic system installed in the mid-1990s. According to the club president, the system operates well, has never failed, and there hasn't been a need to pump the tank. During events, the club rents portable toilets to accommodate the increase in temporary visitors.

Wastewater Treatment Plant. The Joplin Youth Center was established in 1956 and is located on the upper reach of Rose Canyon Road. The facility houses approximately 64 youths with an average staffing of 50 persons per day. The center has its own WWTP, providing secondary wastewater treatment with sequencing batch reactor (SBR) process and discharge to an on-site percolation/evaporation pond which needs periodic dredging. The capacity of the WWTP is 15,000 gallons per day (gpd).

Stormwater Runoff

Typical rural residential runoff has automobile related contaminants such as heavy metals which include copper and lead, and petroleum products; landscape fertilizers, herbicides, and pesticides associated with gardening and pest control; and pet, horse, and other animal waste contributing pathogens. Equestrian facilities at individual homes were discussed above under concentrated animal facilities. Impervious surfaces associated with developed lands increase runoff, transporting contaminants from land uses and activities to waterbodies.

Runoff from County roads typically contains herbicides from weed control and sediment from poorly constructed or maintained roadways. County roads in the watershed overall (with the exception of Trabuco Creek Road) appear to be well maintained considering their rural character and use. South of Trabuco Creek, a small area of the westernmost nursery lands appears to drain the nursery and Trabuco Road (where is curves up the bluff) to the south side of the creek. However, during heavy precipitation events, heavy flows are more likely to convey runoff to the north side of the creek near the wells.

The small, older areas of concentrated residential development within Rose Canyon have extensive areas of pervious surfaces which absorb contaminants and decrease runoff during precipitation events. Since there are minimal constructed storm drainage facilities, it is not likely that residents are dumping used motor oil on roadways.

Flooding in Trabuco Creek is difficult to predict and plan for because rainfall in the area is extremely variable. Floods are typically of short duration with high peak volumes and high velocity. When a major storm moves in, runoff collects rapidly and runs off quickly due to the rapid descent of the mountains into Trabuco Creek. Consequently, flows are of the flash flood type, generally having sharp peaks and short durations. Lands near the confluence of Rose Canyon Creek and Trabuco Creek are within the 500-year floodplain.

Traffic Accidents/Spills

The only significant public access roads through the watersheds are as follows.

- Trabuco Canyon Road at the crossing of Trabuco Creek
- Rose Canyon Road (plus minor side streets)
- Trabuco Creek Road, an unpaved road parallel to Trabuco Creek

Traffic accidents related to source water protection can result in spilled cargo content or vehicle fuel spills, ending up in waterbodies. Trabuco Canyon Road is the primary thoroughfare connecting Rancho Santa

Margarita as Plano Trabuco to O'Neill Regional Park and eventually to El Toro Road/Santiago Canyon Road as Trabuco Canyon Road. Except for septic waste hauling trucks and cargo destined for uses in the area, most traffic on this road is from private cars. However, the short section of road where Plano Trabuco becomes Trabuco Canyon Road, known as the "S" curves, has cars traveling at relatively high speeds. This is near the treatment facilities.

Rose Canyon Road conveys traffic to and from Trabuco Canyon Road through rural residential areas, including Flanagan Road and Windy Ridge Road, as far north as Joplin Youth Center.

Rose Canyon Road near Trabuco Canyon

Trabuco Creek Road is an unpaved narrow county road accessed from Trabuco Canyon Road where it crosses Trabuco Creek. It provides access to the recreational areas within the watershed including the USFS cabins, trailheads, illegal off-road vehicle access, and informal picnic and hiking locations. It is difficult for cars to travel on this road due to the underbody clearance required, so most vehicles are trucks, SUVs, and motorcycles. This road crosses Trabuco Creek numerous times. On a recent Sunday site visit, at least 50 cars were observed in either direction within several hours, some traveling about 25 miles per hour. People are injured and killed on Trabuco Creek Road in off-road accidents, typically when their truck rolls over.

Unauthorized Activity

The dumping of cars, trash, and other debris into or near waterways, and hikers and vehicles leaving trails and roadways, are common unauthorized activities in rural areas such as this watershed. These unauthorized activities could have a wide range of contaminants of concern such as hydrocarbons, heavy metals, and pathogens. Illegal cannabis farms are of concern because of the lack of control of chemicals used in illicit activities resulting in SOC's, hydrocarbons, herbicides, and pesticides making their way to waterbodies. Excessive use of these chemicals and banned rodenticides is typically found with discovered illegal farms. Illegal farms were not observed during the survey site visits.

Wildfires are often started in accessible rural areas such as this. Several USFS roads and roads providing access to communications facilities at Santiago Peak are open to the public in remote higher elevations of the watershed increasing the risk of unauthorized activities.

Vehicle driving off-road in Trabuco Creek

In the area just downstream of where Trabuco Creek leaves the canyon, vehicles were observed driving in Trabuco Creek. Abandoned automobile parts were also observed. Based on the presence of informal roads in and around the creek and posted reviews on social media,

unauthorized vehicle driving off of Trabuco Creek Road in the rough terrain is a common occurrence. This off-road vehicle use in a typical creekbed would be a source of turbidity. However, because most of the creek deposits are boulders, large cobbles, gravel, and coarse sand, disturbance of these materials does not appear to contribute materials that can be suspended during transport. As the result of an accident, however, automobile fluids could contaminate the water supply. During the development of this survey, no other apparent unauthorized or illegal activities relevant to water quality protection were observed or documented.

Wild Animal Populations

Wildlife has the potential to generate nutrients (nitrogen and phosphorous), pass along microorganisms (bacteria, viruses, and protozoa), and increase erosion of sediment from compaction and disturbance of soils. *Giardia* and *Cryptosporidium* cysts are endemic to many wild animals. Animals naturally concentrate near waterbodies which increases risk of contaminants being transported into the creeks. There is a variety of wild animals in the watershed which could contribute microorganisms directly to Trabuco Creek and its tributaries when it has water. It is not possible to manage wildlife to prevent the contribution of these contaminants of concern.

Wildfires

Wildfires result in a loss of vegetation which exposes soil to the direct impact of raindrops, which then reduces the infiltration capacity of the soils, thus increasing runoff. With the loss of vegetation, rainfall does not collect and run off along established depressions, but it dissipates rapidly as sheet flow. In addition, fires in chaparral vegetation, such as this watershed, produce hydrophobic soils. Hydrophobic soils decrease permeability of soils and increase runoff. Wildfires contribute large loadings of sediment and organic matter in surface runoff to waterbodies during the rainy seasons following the fire. Sediment is a major carrier and catalyst for pesticides, organic residues, nutrients, and pathogenic organisms.

Typically, the increase in turbidity at a treatment plant from fine particles which have not settled to the bottom of waterways during transport, results in increased treatment operational requirements (e.g., more filter backwashing, higher disinfectant dosages), increased likelihood of trihalomethanes (THMs) and other disinfectant byproducts (DBPs) generated, and a greater level of risk of pathogens slipping through the treatment process. However, because GWTF receives water that has been filtered through the soil prior to delivery to the WTP, turbidity impacts are minimized.

In addition to the Orange County Fire Authority and USFW fire response responsibilities, there is a volunteer group in the watershed called the Holy Jim Volunteer Fire Department. This group of volunteers is primarily composed of cabin owners.

The only significant fire in the watershed during the study period was the 155 acre Holy Fire which started August 31, 2016 and lasted through September 5, 2016. This fire occurred on the south side of Trabuco Creek, four miles upstream of the WTP, contained within a subwatershed with Bell View Trail ridge as the southern boundary. Smoke Jumpers were dispatched for the first time in the Cleveland National Forest

for this fire due to steep terrain, heavy fuels, and inaccessibility. This event was followed by severe mudslides in December 2016 washing away roads and blocking access to the USFS cabins (USFS, 2018).

Significance of Potential Contaminant Sources

Table 3.1, Significance of Potential Contaminant Sources in Trabuco Creek Watershed, presents a summary of the existing potential contaminant sources discussed here. The assessments are subjective, based on information gathered from field surveys and research, and can be used to compare with future surveys to determine changed conditions.

The USFS actions to replace the approximately 45 cabin septic systems in the watershed greatly reduced the risk of pathogenic contamination of Trabuco Creek. Reducing the probable contamination from leaking septic systems most likely improved water quality in Trabuco Creek. There is still a risk of contamination from the alternative disposal systems, however, as these vacation cabins are adjacent to waterbodies and are difficult to monitor and maintain.

The remaining greatest risk to water quality is from leaking or failed septic systems near waterbodies, particularly from homes in Rose Canyon and the few along Trabuco Creek. There is also a risk of contamination from equestrian facilities and people using trails, as well as from wildlife. There is little that can be done by the District to control any of these activities since they do not own or manage the lands, activities, or sources with the greatest risks.

Planned Changes in Trabuco Creek Watershed

Land use changes anticipated and planned for within the watershed are described here. The general plans from the County of Orange and the City of Rancho Santa Margarita were reviewed to determine planned changes in land uses in the watershed.

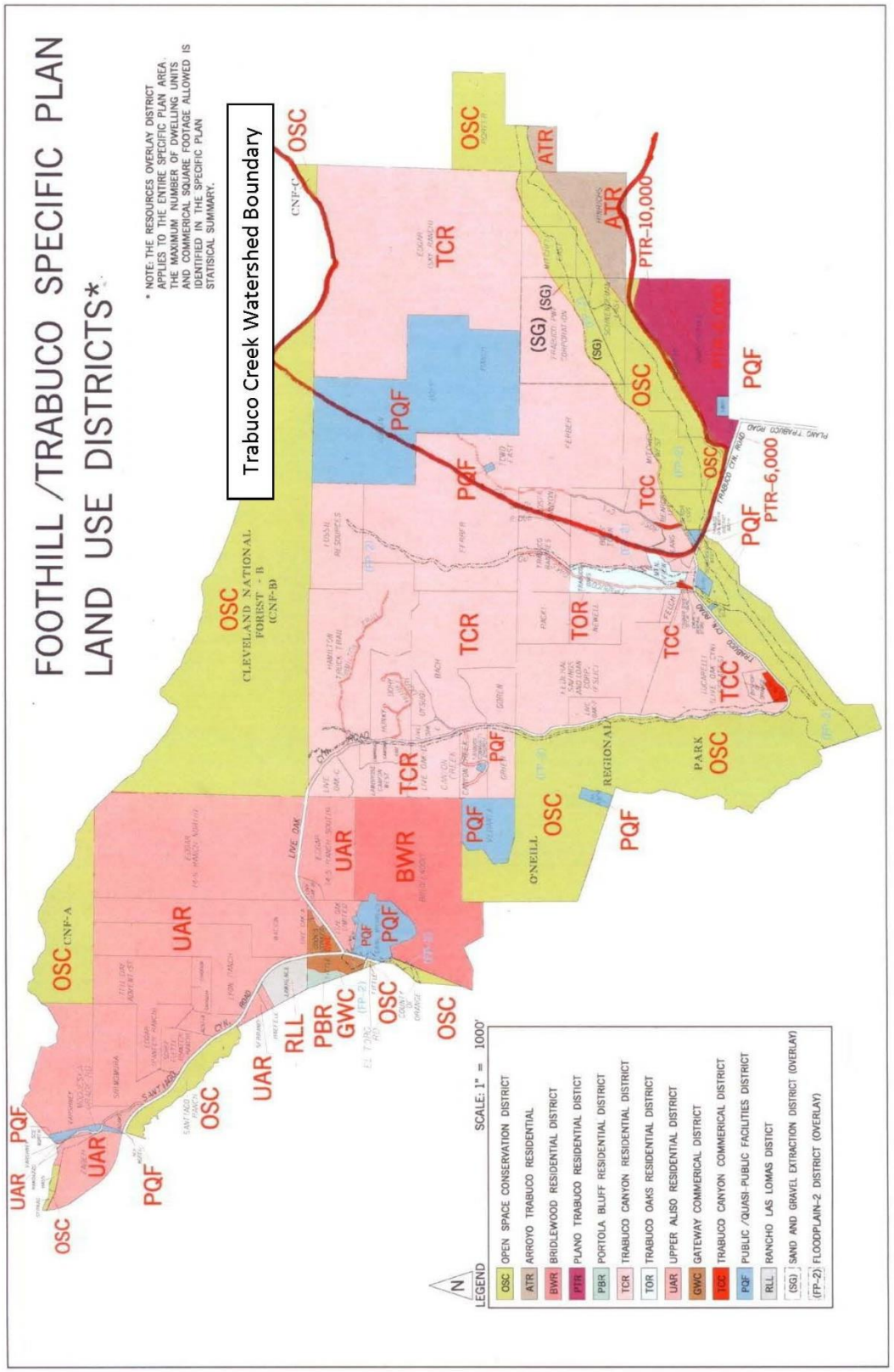
County Land Uses

The Foothill/Trabuco Specific Plan guides development of watershed lands that are outside of federal jurisdiction. As shown on Figure 3.2, County General Plan Land Uses, the Specific Plan allows for additional low density residential development on private lands north of Trabuco Creek (designated pink areas) and sand and gravel operations on one property adjacent to and with the Trabuco Creek creekbed. Land use designations shown on Figure 3.2 have not changed within the watershed since the last Watershed Sanitary Survey. The residential land use designation north of Trabuco Creek allows 0.025 to 0.5 dwelling units per acre (du/ac). The Specific Plan states that new development within the Specific Plan will be designed to maintain a buffer between urban development and the Cleveland National Forest, to be compatible with adjacent areas (OCPW, 2012).

Santiago Peak from nurseries

Table 3.1
Significance of Potential Contaminant Sources in Trabuco Creek Watershed

Potential Contaminant Source	Potential to Affect Water Quality	Comments
Concentrated Animal Facilities	Low to Medium	Equestrian facilities and extensive equestrian trails throughout watershed.
Geologic Hazards	Low	Soil and slope conditions conducive to erosion, however creekbed filled with coarse sands to boulders and water is filtered through soils before treatment.
Hazardous Materials and Underground Tanks	Low	No known abandoned underground fuel tanks. Unknown contaminants at storage yard in creekbed.
Mining	Low	Abandoned mines could be of concern following intense rainfall; sand and gravel mining no longer in operation.
Recreational Use	Low to Medium	Equestrian trail pathogens of concern. Human contact with waterbodies is of concern. Removing the old dams may have reduced the risk of contamination.
Sewage Systems	High	Septic systems near waterbodies will continue to age and increase the potential for leakage and failures. Rose Canyon systems have a high risk. USFS cabin systems have lower risk due to newer age of alternative facilities.
Traffic Accidents/Spills	Low	Potential spill hazard along Trabuco Canyon Road is highest where it crosses Trabuco Creek. There is heavy vehicle use of the unpaved Trabuco Creek Road on weekends.
Unauthorized Activity	Low	Vehicles driving in Trabuco Creek and stored cars and materials are a relatively low risk.
Urban Stormwater Runoff	Low	Runoff from low density uses. Homes and road runoff in this watershed have extensive pervious surfaces due to the rural densities.
Wild Animal Populations	Medium	Scattered wild animal populations exist but cannot be managed.
Wildfires	Low	Low because filtering of high turbidity water through creekbed materials and soils provides a barrier before treatment.



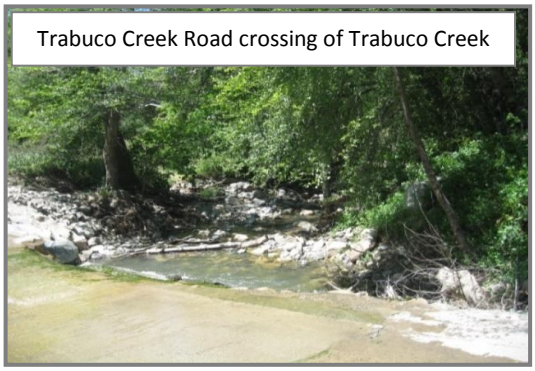
Trabuco Canyon Water District
2018 Trabuco Creek Watershed Sanitary Survey

Figure 3.2 ◆ Orange County General Plan Land Uses

South of Trabuco Creek, there are two residential districts: Plano Trabuco (indicated as PTR on figure) and Arroyo Trabuco (ATR). Plano Trabuco is outside of the watershed but along the bluff of the floodplain; it is within the sphere of influence of the City of Rancho Santa Margarita. Arroyo Trabuco is adjacent to Trabuco Creek within the watershed and is developable at 0.5 to 18 du/ac per the County Specific Plan. In addition to residential development, a linear park in the open space buffer along the bluff edge on the nursery properties for equestrian and other recreational opportunities is planned.

Based on the District's previous water master planning efforts, an estimate of up to 278 dwelling units could theoretically be developed north of the creek and 112 units south of Trabuco Creek under the allowable densities of these land use designations (TCWD, 1999). However, according to the County, requests to develop lands within the watershed are infrequent and are usually not implemented. This is because of the difficulty constructing on steep slopes, septic requirements, County requirements to dedicate 66 percent of the land to the County for open space, and onerous environmental documentation requirements. If developed, lands south of the creek should be designed to drain away from Trabuco Creek.

USFS Land Uses


Trabuco Creek Road crossing of Trabuco Creek

The only activity in the watershed planned by the USFS is associated with Trabuco Creek Road crossings of Trabuco Creek. As shown in embedded WSS photographs, the road is paved wherever it crosses the creek, thus causing an impediment to steelhead swimming upstream. The USFS is working with the Department of Fish and Game in planning to rebuild the creek crossings in the future to aid fish passage by constructing "aquatic passages". This project is associated with the larger project to remove stream barriers along Trabuco Creek and San Juan Creek. The Trabuco Creek dams have been removed since the last WSS; an example is shown in the photograph on page 3-4.

Rancho Santa Margarita Land Uses

The City of Rancho Santa Margarita city limit does not include watershed lands. The Local Agency Formation Commission (LAFCO) approved Sphere of Influence includes lands south of the Trabuco Creek in the County-designated Plano Trabuco residential district. The eastern half of the nursery lands have had development proposals in the past to develop the "Robinson Ridge" project with 200 dwelling units. If developed in the future, drainage should be connected with an existing stormdrain facility which conveys nursery land runoff eventually to Tijeras Creek. There have been no development activities on the remaining nursery lands.


Rancho Santa Margarita

The City's General Plan land use map is presented on Figure 3.3, Rancho Santa Margarita Land Use Policy Map. There are no longer any lands within the watershed designated for development. The City would like to have a future continuous recreation area along the top of the bluff, including the extension of the existing regional trails network. Plano Local Bikeway is planned to be located within the Plano Bluff Top Linear Local Park. The local bikeway will connect to the existing Trabuco Creek Regional Bikeway already in the Trabuco Creek floodplain and will be implemented in conjunction with the Bluff Top Linear Local Park when Robinson Ridge or other developments occur on the nursery lands.

As mentioned previously, most of the Plano Trabuco area is outside of the watershed - it drains to Tijeras Canyon Creek. It is mentioned in this report because of the possibility of high flows draining to a location upstream of the Trabuco Canyon Road crossing of the creek. Grading could alter drainage patterns and result in more urban runoff draining into the watershed, to Trabuco Creek proximate to the wells.

Risk to Water Quality

The risk to watershed water quality associated with full development of the lands within the watershed remains low, only because of the difficulty in fully developing the properties, particularly north of Trabuco Creek. Because of the steep slopes and proximity to Trabuco Creek, if these lands were to develop to their full potential there would be an increased risk of water quality impacts associated with runoff contaminants. The District should continue to monitor not only development activity of these properties (these lands are within the District service area simplifying the monitoring process), but also any sand and gravel harvesting or grading permits obtained through the County.

Agencies with Watershed Water Quality Protection Responsibility

Most of the watershed lands are within the County of Orange with small areas along the uppermost watershed boundary in Riverside County, as presented in Figure 1.1. Within Orange County, the lands are unincorporated. The majority of the watershed is within the Cleveland National Forest. There are numerous individually owned private properties along Rose Canyon and Windy Ridge roads.

Local, State, and federal agencies responsible for source water quality protection and their general authority are summarized in Table 3.2, Agencies with Watershed Water Quality Control Authority. Identification of these agencies within the watersheds can assist the District in the event that management practices, design standards, etc. need to be modified by these agencies to protect water quality. It is also important to maintain open lines of communication between the District and these agencies. As noted in Table 3.2, each agency has a role in protecting the source waters and their participation in doing so is important, especially considering the District does not own or manage the watershed lands (except for lands with its facilities).

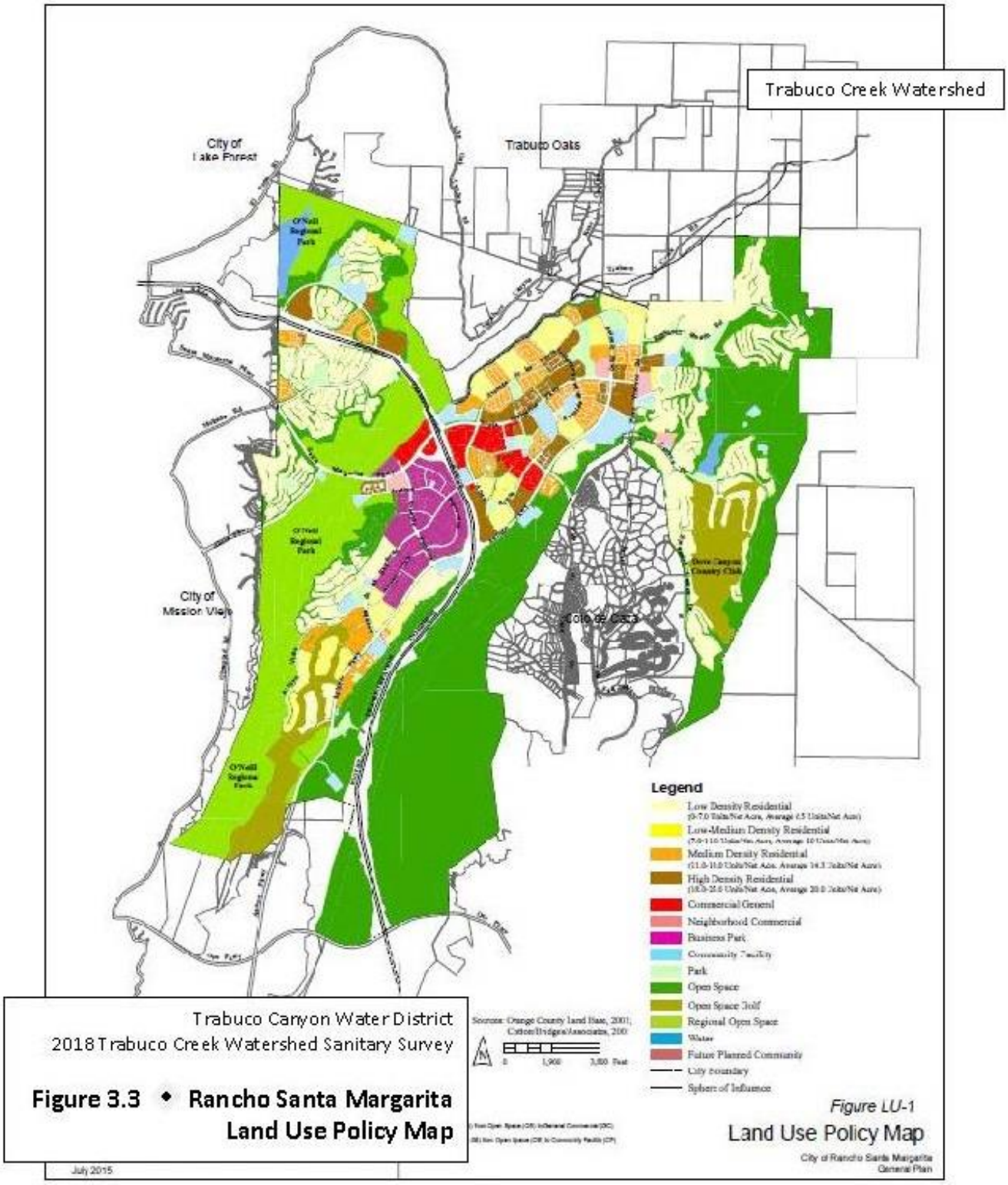

Trabuco Creek Watershed
City of Lake Forest
Trabuco Oaks
City of Mission Viejo
Colo de Caza
Legend
Low Density Residential
Low-Medium Density Residential
Medium Density Residential
High Density Residential
Commercial General
Neighborhood Commercial
Business Park
Park
Open Space
Open Space Golf
Regional Open Space
Water
Future Planned Community
City Boundary
Sphere of Influence
Trabuco Canyon Water District
2018 Trabuco Creek Watershed Sanitary Survey
Figure 3.3 • Rancho Santa Margarita Land Use Policy Map
Figure LU-1
Land Use Policy Map
City of Rancho Santa Margarita General Plan
July 2015

Table 3.2
Agencies with Watershed Water Quality Control Authority

Agency	Areas of Responsibility
Local Agencies	
City of Rancho Santa Margarita	Implement NPDES program within City; general plan and zoning land use changes; building and use permits; environmental compliance; roads, stormwater, sewage collection, and other infrastructure maintenance. Authority in the watershed pertains to potential future development within its Sphere of Influence adjacent to Trabuco Creek.
Orange County Fire Authority	Fire prevention and protection; storage of hazardous materials; emergency response
Orange County Flood Control District	Responsible for regional flood control.
Orange County Health Care Agency - Environmental Health Division	Permits and manages underground storage tank facilities. Responsible for groundwater wells.
Orange County Parks	Management of O'Neill Regional Park. Recreation Plan has numerous trails designated within the watershed.
Orange County Public Works - Agricultural Commissioner	Regulates commercial use of pesticides; weed abatement implementation.
Orange County Public Works - Engineering Department	Planning, design, and construction of road infrastructure; operation and maintenance of flood control and road infrastructure facilities.
Orange County Public Works - Planning Department	Septic system enforcement; implement NPDES program; general plan and zoning changes; building and use permits; environmental compliance; subdivisions; grading /construction activities.
San Juan Basin Authority	Joint Powers Authority established to plan and build facilities to protect water quality of San Juan Basin.
Trabuco Canyon Water District	Management of water supply, quality, treatment, and distribution; collection of water quality samples.

(Continued)

Table 3.3 (continued)
Agencies with Watershed Water Quality Control Authority

Agency	Areas of Responsibility
State Agencies	
Cal EPA - Department of Toxic Substances Control	Generation/storage of hazardous waste
Department of Conservation - California Geological Survey	Support efforts to remediate abandoned mines
Department of Fish and Game	Protection of State listed species; regulation of alterations to natural state of rivers, streams, and lakes
Office of Emergency Services	Coordination of regional emergency planning and response
SWRCB, Regional Water Quality Control Board – San Diego Region, San Juan Hydrologic Basin	Issuance of water rights permits for extraction of water from San Juan Basin.
SWRCB, Division of Drinking Water	Primacy for setting drinking water standards; protection of drinking water supplies; regulation of public water supply, treatment, and distribution systems; approval of WSS
SWRCB, Regional Water Quality Control Board	Regulation of waste discharge into surface waters; regulation of stormwater discharge
Federal Agencies	
Army Corps of Engineers	Regulation of discharge of dredged or fill materials into waters of US
Bureau of Land Management	Management and permitting of activities on federal lands
Environmental Protection Agency	Drinking water primacy given to DDW; NPDES primacy given to RWQCB
Fish and Wildlife Service	Protection of federally listed species
Forest Service - Cleveland National Forest, Trabuco Ranger District	Management of the Cleveland National Forest - Trabuco Ranger District lands including fire protection and emergency response and clean-up of soils contaminated by abandoned mines

Section 4 Water Quality Review

The first part of Section 4 presents a review of current and potential future drinking water regulations relevant to the watershed and current treatment and operation of the GWTF. The next part of the section presents a review of available water quality data for raw and treated water and an assessment of the ability of GWTF to comply with drinking water regulations.

Drinking Water Regulations

The Safe Drinking Water Act (SDWA) was enacted by the United States Congress in 1974. Through the SDWA, Congress gave the EPA the authority to set standards for contaminants in drinking water supplies. The SDWA was amended in 1986 and again in 1996. The SWRCB DDW is the primacy agency with the authority to adopt and implement drinking water regulations in California that are no less stringent than the federal regulations and to enforce those regulations.

Surface Water Treatment Rule (SWTR)

The SWTR was promulgated in 1989 to control the levels of turbidity, *Giardia lamblia*, viruses, *Legionella*, and heterotrophic plate count (HPC) bacteria. The SWTR applies to surface water systems and systems determined to be groundwater under the direct influence of surface water. Compliance with the SWTR is demonstrated by meeting specific turbidity and disinfection performance requirements. Surface water treatment plants are required to achieve 3-log (99.9%) reduction of *Giardia* and 4-log (99.99%) reduction of viruses. Compliance with the disinfection requirements is demonstrated by monitoring CT where C is the concentration of disinfectant and T is the contact time for the disinfectant.

Interim Enhanced Surface Water Treatment Rule (IESWTR)

EPA promulgated the IESWTR in 1998 (effective in California in January 2008). The IESWTR modified several aspects of the 1989 SWTR including the following: (1) added a requirement that utilities achieve a 2-log removal of *Cryptosporidium*, with compliance demonstrated by meeting the turbidity performance requirement, (2) added requirements for disinfection profiling and benchmarking, and (3) added a requirement that all new finished water storage facilities be covered.

Long-Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR)

The LT2ESWTR was promulgated in 2006 and was effective in California in July 2013. The LT2ESWTR required two years of monthly source water monitoring for *Cryptosporidium*. Depending upon the concentration of *Cryptosporidium*, utilities were placed into one of four risk levels (referred to as Bins). Table 4.1 presents the various Bin classifications adopted in the LT2ESWTR. If the monitoring results indicated placement in Bin 1, no additional treatment for *Cryptosporidium* was required. Placement in Bins 2 through 4 required increasing levels of *Cryptosporidium* reduction. For systems using a DDW

approved Alternative Filtration Technology (AFT) and assigned to Bins 2, 3 or 4, the additional required *Cryptosporidium* reduction depends upon the amount of credit assigned to the AFT[1].

Table 4.1
LT2ESWTR *Cryptosporidium* Bin Classification

***Cryptosporidium* Concentration (oocysts/L)**	**Bin Classification**	**Additional Treatment Required for AFT***
<0.075	1	No additional treatment
>0.075 and <1.0	2	DDW Determination*
>1.0 and <3.0	3	DDW Determination*
>3.0	4	DDW Determination*

*Additional required treatment depends upon *Cryptosporidium* reduction credit assigned to the AFT, but total *Cryptosporidium* reduction for systems in Bins 2, 3 and 4 must be 4.0, 5.0 and 5.5 logs, respectively.

The LT2ESWTR requires that utilities conduct a second round of source water monitoring six years after completing the initial monitoring.

Disinfection By-Products (DBPs)

DBPs have been regulated since the adoption of the 1979 trihalomethane (THM) standard. In 1998, EPA promulgated the Stage 1 Disinfectants/Disinfection By-Products (D/DBP) Rule, which lowered the MCL for THMs from 0.10 mg/L to 0.080 mg/L, and established new MCLs for haloacetic acids (HAA5) at 0.060 mg/L, bromate at 0.010 mg/L (for systems using ozone), and chlorite at 1.0 mg/L (for systems using chlorine dioxide). The Stage 1 D/DBP Rule also established Maximum Residual Disinfectant Levels for disinfectants including chlorine, chloramines, and chlorine dioxide, and included requirements for "enhanced coagulation" for the removal of natural organic matter in surface water filtration plants that use conventional treatment (not applicable to GWTF).

On January 4, 2006, EPA promulgated the Stage 2 D/DBP Rule. The Stage 2 D/DBP Rule did not change the MCLs, MRDLs, or the enhanced coagulation requirements from the Stage 1 Rule. However, it did change how compliance with the MCLs for THMs and HAA5 is determined, requiring compliance at each sample location rather than averaging results across the entire distribution system. The Stage 2 Rule added a new requirement for water systems to conduct an Initial Distribution System Evaluation to identify sample locations anticipated to produce higher levels of DBPs. The Stage 2 Rule also established Operational Evaluation Levels (OEL) for THMs and HAA5 that if exceeded would trigger an assessment of the cause (but would not be considered a violation).

Additional Drinking Water Regulations

In addition to the regulations described above, EPA and DDW have established health-based regulations for microbiological constituents (total coliform, *E. coli*), inorganic chemicals (metals, minerals), organic

[1] As discussed later in this section, the AFT installed at the GWTF is granted 2-logs credit for physical removal of *Cryptosporidium*.

chemicals (volatile and synthetic organic chemicals), radionuclides (man-made and naturally occurring), and non-health based secondary standards for constituents that can impact the taste, odor, and/or color of drinking water.

Six-Year Review of National Primary Drinking Water Regulations

Under the SDWA as amended in 1996, EPA is required to conduct a review of drinking water regulations every six years, and if appropriate, revise specific regulations. Previous six-year reviews were concluded in 2003 and in 2010.

In December 2016, EPA announced the completion of its third review of existing drinking water regulations. Based on EPA's review of 76 regulations, EPA determined that 68 do not need to be revised and that eight NPDWRs are candidates for regulatory revision. The eight regulations are chlorite, *Cryptosporidium*, *Giardia lamblia*, HAA5, HPC, *Legionella*, THMs, and viruses.

Cyanobacteria[2]

Cyanobacteria (also known as blue green algae) occur throughout the world. Some species of cyanobacteria can produce toxins. Factors that affect cyanobacteria blooms include light intensity, sunlight duration, nutrient availability, water temperature, pH, and water stability.

In June 2015 EPA released 10-day Health Advisories (HA) for two cyanotoxins: microcystin and cylindrospermopsin. The 10-day HAs are presented in Table 4.2.

Table 4.2
EPA 10-day HA Values (µg/L)

Algal Toxin	10-Day HA <6 years of Age	10-Day HA >6 Years of Age	Health Effect
Microcystin	0.3	1.6	Liver Toxicity
Cylindrospermopsin	0.7	3	Liver & Kidney Toxicity

Groundwater Treatment Facility (GWTF)

The GWTF treatment system is a two-stage EPD filtration system. A coagulant is added to the raw water, which is then filtered through the first-stage filters, followed by the second-stage filters. A schematic of the GWTF is presented in Figure 4.1.

The filters are 36-inch diameter vessels, mounted horizontally. Each vessel provides 16.5 square feet of filtration area. The system uses a water-only backwash scheme, with a backwash rate of 350 gpm. A coagulant is fed to a static mixer on the upstream side of the filtration system to improve filter performance. The EPD Filtration System can operate at a loading rate of up to 12 gallons per minute per

[2] While cyanotoxins are an important regulatory topic presently, they are not anticipated to occur in the GWTF raw water supply.

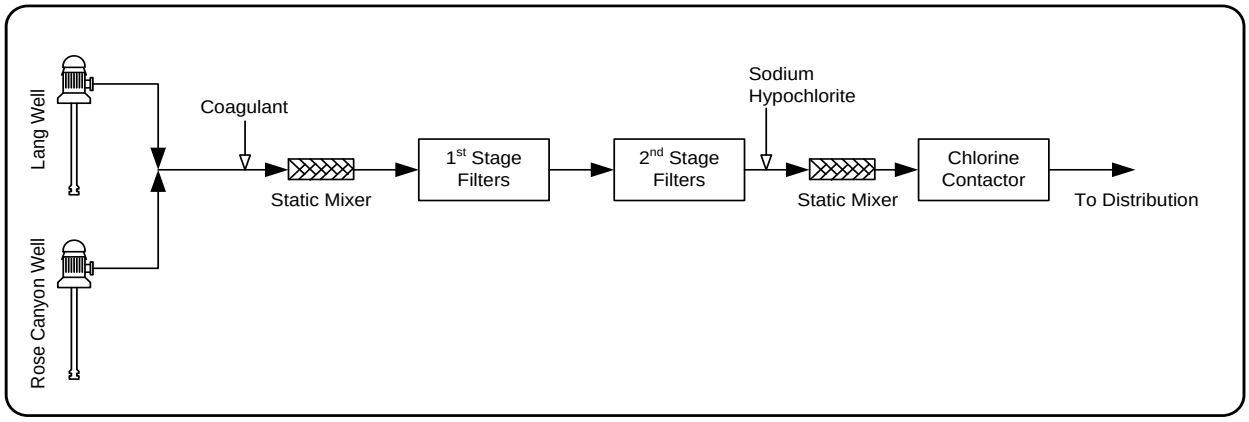


Figure 4.1 GWTF Schematic

square foot (gpm/ft²) if the influent turbidity is less than or equal to 6 NTU, and up to 5 gpm/ft² if the influent turbidity is between 6 and 20 NTU.

The primary disinfectant at the GWTF is sodium hypochlorite, which is fed to a static mixer located downstream of the 2nd stage filters and upstream of the chlorine contact tank (CCT). The CCT is an above-grade fiberglass tank with a total volume capacity of 39,000 gallons, which include a chlorine contactor volume of 33,275 gallons, and a clearwell of approximately 3,350 gallons. The tank includes 10 internal baffles that result in a serpentine flow pattern in the contactor.

GWTF Assigned SWTR Treatment Credit

The EPD filters are an approved AFT for surface water treatment regulations and are assigned one log credit for virus removal, 2-logs credit for *Giardia* removal and 2-logs credit for *Cryptosporidium* removal. That means that the GWTF must achieve 3-logs inactivation of virus and 1-log inactivation of *Giardia* through disinfection. No additional treatment is required for *Cryptosporidium*.

GWTF Production

The GWTF is only operated seasonally during wet years. During the period of this assessment (2011 through 2017) the GWTF was operated a total of 18 months. Table 4.3 presents the months during each year that the GWTF was operated.

Table 4.3
Months GWTF Operated (2011 through 2017)

Year	Months Operated (# of Months)
2011	February to August (7)
2012	February to June (5)
2013	March to April (2)
2014	Not Operated
2015	Not Operated
2016	Not Operated
2017	March to June (4)

Figure 4.2 presents GWTF production for each month during 2011 through 2017. For those months when GWTF was operated, the production ranged from 13 acre-feet (AF)[3] (February 2012) to 123 AF (May 2011), and averaged approximately 65 afy.

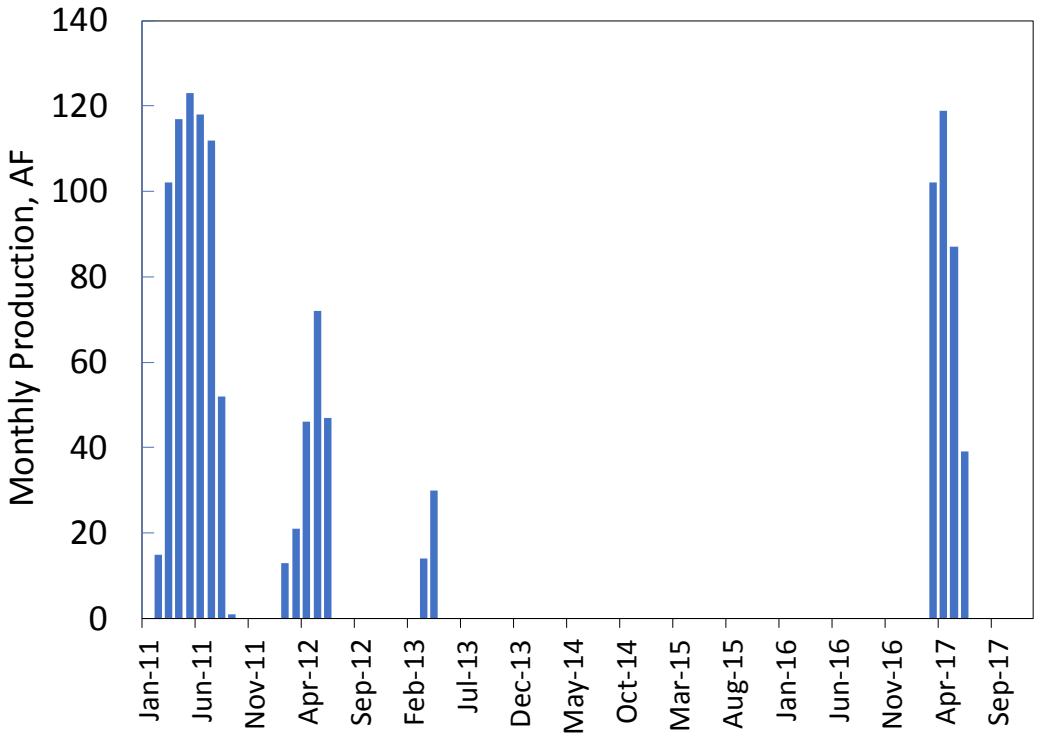


Figure 4.2 GWTF Monthly Production (2011 through 2017)

GWTF Water Quality Data

The following sections present available raw and treated water quality data for the GWTF during the study period (2011 through 2017).

Raw Water Turbidity

Raw water turbidity ranged from ND to 0.09 NTU, with an average of 0.007 NTU during the study period.

Raw Water Microbiological

When the TCWF is online, the District collects monthly raw water coliform and fecal coliform samples. During the months of operation in 2011, 2012, and 2013 there was one sample with a coliform result of 2 MPN/100 mL (collected in February 2011 from the Lang well). All other monthly total coliform sample results were not-detected (ND) for both the Rose and Lang wells. All fecal coliform samples were ND

[3] This minimum production is ignoring 1 AF recorded in September 2011.

during 2011, 2012, and 2013 for both wells. In March 2017 one raw water sample was positive for total coliforms (1 MPN/100 mL). The other monthly coliform results were ND.

Between March 2017 and June 2017, bi-weekly raw water samples were collected and tested for the presence of *Cryptosporidium* and *Giardia* (during the second round of LT2ESWTR source water monitoring). All results were ND. In that same period, the District collected bi-weekly raw water *E. coli* samples. In April 2017 a raw water sample was recorded as positive for *E. coli* (result of 1 MPN/100 mL). All other *E. coli* results were ND. In October 2017, the District submitted a "bin" classification letter to DDW indicating that no additional treatment for *Cryptosporidium* was required.

Filtered Water Turbidity

Monthly log sheets with the recorded filter effluent turbidity for 2011, 2012, 2013 and 2017 were reviewed for preparation of the 2018 WSS. The TCWF achieved the required turbidity performance standards.

Giardia Inactivation Compliance

Under the SWTR, disinfection at the GWTF must be sufficient to achieve at least 1-log inactivation of *Giardia*. The daily *Giardia* log inactivation included in TCWD's monthly DDW reports were reviewed. The following table presents information on the daily log inactivation of Giardia achieved during months when the GWTF was operated. As indicated in Table 4.4, the daily recorded log inactivation was never less than 1.0.

Table 4.4
Daily GWTF Log Inactivation of *Giardia* (2011 through 2017)

Month	Minimum	Maximum	Average
March 2011	1.7	2.4	1.8
April 2011	1.5	1.8	1.7
May 2011	1.6	1.9	1.7
June 2011	1.7	2.0	1.9
July 2011	1.4	2.7	2.1
August 2011	2.6	3.4	3.0
February 2012	2.3	3.4	2.9
March 2012	2.0	3.4	3.0
April 2012	2.8	3.5	3.1
May 2012	2.5	3.2	2.9
June 2012	2.5	3.3	2.9
April 2013	2.0	3.1	2.9
March 2017	1.7	3.2	2.0
April 2017	1.8	2.4	2.1
May 2017	1.9	3.5	2.9
June 2017	3.0	4.4	3.7

Title 22 Monitoring Results

Raw and treated water samples are collected and tested for Title 22 constituents with primary (health based) and secondary (aesthetics) MCLs. Tables with raw and treated water quality results are presented in Appendix A. The following presents brief descriptions of these monitoring results for the GWTF.

Regulated Inorganic Constituents (IOCs). As presented in Appendix A, Table A.1, low levels of aluminum, arsenic, barium, fluoride, nitrate and selenium were detected in raw water samples well below their respective MCLs. No other IOCs were detected in raw water. In treated water, Table A.2, low levels of fluoride, nitrate and selenium were detected (well below their respective MCLs). No other IOCs were detected in the plant effluent.

Regulated Organic Constituents. As indicated in Appendix A, Table A.3, no VOCs were detected in the raw water. Samples were also collected in the treated water and the results for all VOCs in the plant effluent were ND (a table with treated water VOC results is not presented in Appendix A). Table A.4 presents the raw water results for regulated SOCs. As presented in Table A.4, no SOCs were detected in raw water. Samples for SOCs were also collected in the plant effluent and no SOCs were detected in treated water (a table with treated water SOC results is not presented in Appendix A).

Regulated Radionuclides. Table A.5 presents raw water results for radionuclides. Low levels of gross alpha and uranium were recorded; however, all results were less than DDW's detection level for purposes of reporting (DLR). Therefore, these results would be considered ND. Similarly, in the plant effluent, low levels of gross alpha, radium 226/228 and uranium were detected, below their respective DLRs. The plant effluent results, therefore, would also be considered ND. A table with plant effluent radionuclide results is not included in Appendix A.

Regulated DBPs. Three THM results (samples collected in 2011, 2012 and 2013) were available for the GWTF effluent. The results ranged from 3 µg/L to 15 µg/L. Two sample results (samples collected in 2011 and 2012) for HAA5 at the effluent of the GWTF were available from 2011 and 2012. Both sample results were ND. The District began Stage 2 D/DBP Rule monitoring at four sample locations in the distribution system in June 2012. During the period covered in this WSS, the District experienced THM results in the distribution system that exceeded the Operational Evaluation Level (OEL). In the District's OEL reports, issues with increased precipitation and organics were believed to be associated with the elevated THMs produced by the District's Dimension Water Treatment Plant.

Regulated Secondary MCLs. Tables A.6 and A.7 present raw and treated water results for constituents with secondary MCLs. Treated water alkalinity ranged from 154 mg/L as $CaCO_3$ to 186 mg/L, with an average of 169 mg/L as $CaCO_3$, pH ranged from 6.7 to 7.1, with an average of 6.9, total dissolved solids ranged from 370 mg/L to 575 mg/L with an average of 452 mg/L, chloride ranged from 12 mg/L to 22 mg/L with an average of 17 mg/L and sulfate ranged from 120 mg/L to 231 mg/L, with an average of 167 mg/L. From data presented in annual Consumer Confidence Reports, the hardness ranged from 270 mg/L to 310 mg/L as $CaCO_3$.

Compliance Assessment

As described in this report, GWTF was operated for limited periods of time during 2011 through 2017. The AFT is assigned 1-log virus removal credit, 2-logs *Giardia* removal credit and 2-logs *Cryptosporidium* removal credit. Disinfection is sufficient to meet inactivation requirements. The TCWF met the turbidity performance requirements. LT2ESWTR source water monitoring indicates no additional treatment for *Cryptosporidium* is required.

Low levels of a few IOCs were detected in raw and treated water. No VOCs or SOCs were detected in raw or treated water. Levels of radionuclides were all less than their respective DLRs. The water is moderately hard with moderate level of alkalinity. During the period of this assessment (2011 through 2017) GWTF provided sufficient disinfection to meet inactivation requirements.

Section 5: Observations and Recommendations

This section summarizes the primary conclusions of the 2018 Trabuco Creek Watershed Sanitary Survey analysis and provides practical recommendations for the District.

Observations

Strengthening the first barrier to water quality degradation by protecting source watersheds is one of DDW's reasons for requiring a WSS. The second barrier, treatment of surface water has been designed by the District to remove an array of water quality parameters to meet the changing drinking water quality regulations. The following conclusions are based on the 2018 WSS analysis.

- All water quality parameters monitored in raw and treated water for the GWTF are within acceptable drinking water levels, and therefore, no special treatment is required at the GWTF other than the currently implemented filtration and disinfection processes.
- No VOCs or SOCs were detected in raw or treated water. Low levels of a few IOCs were detected in raw and treated water, however they were well below their respective MCLs.
- TCWD conducted bi-weekly monitoring for *Giardia* cysts and *Cryptosporidium* oocysts in raw water from March through June 2017. All results were ND. No additional treatment for *Cryptosporidium* is required. The greatest current threat to water quality is still aging septic systems within the Rose Canyon watershed that may leak or fail in the future. However, there are very few homes currently in the watershed and most are less than 50 years old.
- The watershed is small, has relatively few land uses and activities that are potential contaminant sources, and land use changes and activities on non-federal lands are limited. There have been very few changes in the watershed since the last WSS.

Recommendations

As the drinking water industry's knowledge increases regarding analytical tools and techniques for evaluating health effects, source controls become more important. However, the District is constrained by the lack of ownership of watershed lands, thus relying on further potential changes to existing water treatment processes and operations for GWTF.

The following recommendations reflect areas where TCWD has some ability to control treatment operations and source water quality within the watershed.

- If the nursery lands are developed in the future, site design should redirect the runoff to the downstream side of Trabuco Road where it crosses the creek or preferably away from the creek.

- Attention should be paid to water quality data for the presences of pathogens. These may be associated with failing or leaking septic systems as they age, particularly in Rose Canyon due to the proximity of systems to Rose Canyon Creek, or from the USFS cabin sanitation systems. Meet with the County of Orange Environmental Management or the USFS regarding any potential indications of failures and push for investigations, if warranted. Request additional monitoring and oversight of systems by the County of Orange and the USFS, if monitoring data detect the presence of pathogens or nitrates.

- While no detections of *Giardia* and *Cryptosporidium* were reported and monitoring for Title 22 constituents did not indicate any issues of concern, TCWD should continue to be vigilant about maintaining optimum operation of its filtration and disinfection systems. Given the long periods when the GWTF is off-line, TCWD staff should continue to sample regularly and closely follow and implement the GWTF start-up plan.

- Ensure that any missed water quality samples that could not be collected due to the periods when the GFTF was off-line are scheduled to be collected when the facility is back on-line.

- DDW adopted a new MCL for 1,2,3-trichloropropane (1,2,3-TCP) in 2017 and initial monitoring was required in 2018. In the State's online water quality database there are annual samples for 1,2,3-TCP in 2011, 2012, and 2013 (all results were ND). Before the GWTF is started up again, confirm with DDW if TCWD should conduct monitoring for 1,2,3-TCP during the next period of operation.

- Monitor the status of County and Rancho Santa Margarita project developments, to ensure that water quality mitigations and monitoring are implemented and runoff is directed away from Trabuco Creek where possible. These lands are within the District service area simplifying the monitoring process.

- The District should monitor any sand and gravel harvesting/grading permits requested or obtained through the County.

- Staff should periodically inspect the watershed, in particular along Trabuco Creek Road, for dumping of debris or unauthorized activities.

Appendix A Water Quality Data Tables

Table A.1
GWTF Raw Water Monitoring Results for Regulated IOCs (2011 – 2017)

Constituent	Count	Units	Min	Max	Average	MCL
Aluminum	4	µg/L	ND	39	18	1000
Antimony	4	µg/L	ND	ND	ND	6
Arsenic	4	µg/L	ND	1.03	0.51	10
Asbestos	2	MFL*	ND	ND	ND	7
Barium	4	µg/L	23	37	30	1000
Beryllium	4	µg/L	ND	ND	ND	4
Cadmium	4	µg/L	ND	ND	ND	5
Chromium	4	µg/L	ND	ND	ND	50
Cyanide, Total	2	mg/L	ND	ND	ND	0.15
Fluoride	4	mg/L	ND	0.16	0.10	2.0
Mercury	4	µg/L	ND	ND	ND	2
Nickel	4	µg/L	ND	ND	ND	100
Nitrate as N	15	mg/L	ND	1.6	0.29	10
Nitrite as N	2	mg/L	ND	ND	ND	1
Perchlorate	4	µg/L	ND	ND	ND	6
Selenium	4	µg/L	2	5.5	2.9	50
Thallium	4	µg/L	ND	ND	ND	2

* MFL = million fibers per liter, greater than 10 µ

Table A.2
Treated Water Monitoring Results for Regulated IOCs (2011 – 2017)

Constituent	Count	Units	Min	Max	Average	MCL
Aluminum	4	µg/L	ND	ND	ND	1000
Antimony	4	µg/L	ND	ND	ND	6
Arsenic	4	µg/L	ND	ND	ND	10
Asbestos	2	MFL	ND	ND	ND	7
Barium	4	µg/L	ND	ND	ND	1000
Beryllium	4	µg/L	ND	ND	ND	4
Cadmium	4	µg/L	ND	ND	ND	5
Chromium	4	µg/L	ND	ND	ND	50
Cyanide, Total	1	µg/L	ND	ND	ND	150
Fluoride	4	mg/L	ND	0.16	0.1	2
Mercury	4	mg/L	ND	ND	ND	0.002
Nickel	4	µg/L	ND	ND	ND	100
Nitrate as N	20	mg/L	ND	2.5	0.5	10
Nitrite as N	1	mg/L	ND	ND	ND	1
Perchlorate	6	mg/L	ND	ND	ND	0.006
Selenium	4	µg/L	ND	5.5	1.4	50
Thallium	4	µg/L	ND	ND	ND	0.002

* MFL = million fibers per liter, greater than 10 µ

Table A.3
GWTF Raw Water Monitoring Results for Regulated VOCs (2017)

Constituent	Count	Unit	Min	Max	Average
1,1,1-Trichloroethane	1	µg/L	ND	ND	ND
1,1,2,2-Tetrachloroethane	1	µg/L	ND	ND	ND
1,1,2-Trichloroethane	1	µg/L	ND	ND	ND
1,1,2-Trichlorotrifluoroethane	1	µg/L	ND	ND	ND
1,1-Dichloroethane	1	µg/L	ND	ND	ND
1,1-Dichloroethene	1	µg/L	ND	ND	ND
1,2,4-Trichlorobenzene	1	µg/L	ND	ND	ND
1,2-Dichlorobenzene	1	µg/L	ND	ND	ND
1,2-Dichloroethane	1	µg/L	ND	ND	ND
1,2-Dichloropropane	1	µg/L	ND	ND	ND
1,4-Dichlorobenzene	2	µg/L	ND	ND	ND
Benzene	1	µg/L	ND	ND	ND
Carbon Tetrachloride	1	µg/L	ND	ND	ND
Chlorobenzene	1	µg/L	ND	ND	ND
cis-1,2-Dichloroethene	1	µg/L	ND	ND	ND
cis-1,3-Dichloropropene	1	µg/L	ND	ND	ND
Ethylbenzene	1	µg/L	ND	ND	ND
m,p-Xylene	1	µg/L	ND	ND	ND
Methyl tert-Butyl Ether	1	µg/L	ND	ND	ND
Methylene chloride	1	µg/L	ND	ND	ND
Methylene chloride (dichloromethane)	1	µg/L	ND	ND	ND
o-Xylene	1	µg/L	ND	ND	ND
Styrene	1	µg/L	ND	ND	ND
Tetrachloroethene	1	µg/L	ND	ND	ND
Toluene	1	µg/L	ND	ND	ND
trans-1,2-Dichloroethene	1	µg/L	ND	ND	ND
trans-1,3-Dichloropropene	1	µg/L	ND	ND	ND
Trichloroethene	1	µg/L	ND	ND	ND
Trichlorofluoromethane	1	µg/L	ND	ND	ND
Vinyl Chloride	1	µg/L	ND	ND	ND

Table A.4
GWTF Raw Water Monitoring Results for Regulated SOCs (2017)

Constituent	Count	Unit	Min	Max	Average
1,2-Dibromo-3-chloropropane	1	µg/L	ND	ND	ND
1,2-Dibromoethane	2	µg/L	ND	ND	ND
2,3,7,8-TCDD (Dioxin)	1	pg/L	ND	ND	ND
2,4,5-TP	1	µg/L	ND	ND	ND
2,4-D	1	µg/L	ND	ND	ND
Alachlor	1	µg/L	ND	ND	ND
Atrazine	1	µg/L	ND	ND	ND
Bentazon	1	µg/L	ND	ND	ND
Benzo (a) pyrene	1	µg/L	ND	ND	ND
Bis (2-ethylhexyl) adipate	1	µg/L	ND	ND	ND
Bis (2-ethylhexyl) phthalate	1	µg/L	ND	ND	ND
Carbofuran	1	µg/L	ND	ND	ND
Chlordane	1	µg/L	ND	ND	ND
Dalapon	1	µg/L	ND	ND	ND
Dinoseb	1	µg/L	ND	ND	ND
Diquat	1	µg/L	ND	ND	ND
Endothall	1	µg/L	ND	ND	ND
Endrin	1	µg/L	ND	ND	ND
Lindane	1	µg/L	ND	ND	ND
Glyphosate	1	µg/L	ND	ND	ND
Heptachlor	1	µg/L	ND	ND	ND
Heptachlor epoxide	1	µg/L	ND	ND	ND
Hexachlorobenzene	1	µg/L	ND	ND	ND
Hexachlorocyclopentadiene	1	µg/L	ND	ND	ND
Methoxychlor	1	µg/L	ND	ND	ND
Molinate	1	µg/L	ND	ND	ND
Oxamyl	1	µg/L	ND	ND	ND
PCBs (Total)	1	µg/L	ND	ND	ND
Pentachlorophenol	1	µg/L	ND	ND	ND
Picloram	1	µg/L	ND	ND	ND
Thiobencarb	1	µg/L	ND	ND	ND

Table A.5
GWTF Raw Water Monitoring Results for Regulated Radionuclides (2011, 2017)

Constituent	Count	Unit	Min	Max	Average	MCL
Gross Alpha	2	pCi/L	ND	2.4	1.2	15
Radium 226/228	1	pCi/L	ND	ND	ND	5
Uranium	2	pCi/L	ND	0.6	0.3	20

Table A.6
GWTF Raw Water Monitoring Results for Constituents Regulated with Secondary MCLs (2011 through 2017)

Constituent	Count	Unit	Min	Max	Average
Aluminum	4	µg/L	ND	39	18
Chloride	4	mg/L	12	22	17
Color	4	CU	ND	ND	ND
Copper	4	µg/L	ND	9.0	4.3
Iron	4	mg/L	ND	ND	ND
Manganese	4	µg/L	ND	1.0	0.50
MBAS	4	mg/L	ND	ND	ND
Methyl tert-Butyl Ether	1	µg/L	ND	ND	ND
Odor	4	TON	ND	ND	ND
Silver	4	µg/L	ND	1.5	0.38
Specific Conductivity	4	µmho/cm	557	821	666
Sulfate	4	mg/L	120	231	167
Thiobencarb	1	µg/L	ND	ND	ND
Total Dissolved Solids	4	mg/L	370	575	452
Turbidity	13	NTU	ND	0.09	0.007
Zinc	4	mg/L	0.01	0.02	0.02

Table A.7
GWTF Treated Water Monitoring Results for Constituents Regulated with Secondary MCLs (2011 through 2017)

Constituent	Count	Units	Min	Max	Average
Alkalinity	4	mg/L as $CaCO_3$	154	186	169
Color	4	CU	ND	ND	ND
Copper	4	µg/L	ND	ND	ND
Foaming Agents (MBAS)	4	mg/L	ND	ND	ND
Iron	4	mg/L	ND	ND	ND
Manganese	4	mg/L	ND	ND	ND
Odor—Threshold	4	Units	ND	ND	ND
pH	4	Units	ND	7.1	6.9
Silver	4	mg/L	ND	ND	ND
Turbidity	4	NTU	ND	0.09	0.02
Zinc	4	mg/L	ND	ND	ND
Total Dissolved Solids	4	mg/L	370	575	452
Specific Conductance	4	µmho/cm	557	821	666
Chloride	4	mg/L	666	22	17
Sulfate	4	mg/L	120	231	167

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