LAKE BERRYESSA
2018 WATERSHED SANITARY SURVEY

Final Report
October 2018

Prepared for
Napa County Flood Control Water Conservation District
and Solano County Water Agency

NAPA COUNTY FLOOD CONTROL AND WATER CONSERVATION DISTRICT
American Canyon • Calistoga • Napa
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SOLANO COUNTY WATER AGENCY

Lake Berryessa
2018 Watershed Sanitary Survey

FINAL REPORT
October 2018

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LIST OF ABBREVIATIONS

BMP – Best Management Practice

CCR – Consumer Confidence Report
CDPH – California Department of Public Health
CIWQS – California Integrated Water Quality System
CUPA – Certified Unified Program Agency
CYC – Coyote Creek

D/DBP – Disinfectants/Disinfection By-Products
DBP – Disinfection By-Product
DDW – Division of Drinking Water

E. coli – *Escherichia coli*

Gpd – gallons per day

HA – health advisory
HAA5 – Haloacetic Acids

IESWTR – Interim Enhanced Surface Water Treatment Rule
ILRP – Irrigated Lands Regulatory Program

LBBO – Lake Berryessa Boater Outreach
LBRID – Lake Berryessa Resort Improvement District
LT1ESWTR – Long Term 1 Enhanced Surface Water Treatment Rule
LT2ESWTR – Long Term 2 Enhanced Surface Water Treatment Rule

MBR – membrane bioreactor package
MCL – maximum contaminant level
µg/L - Micrograms per Liter
mgd – Million Gallons per Day
mg/L – Milligrams per Liter
MPN/100 mL – Most Probable Number per 100 milliliters
MRTS – meridian range township section

NBRID – Napa Berryessa Resort Improvement District
NOV – notice of violation
NTU – Nephelometric Turbidity Unit

OES – California Office of Emergency Services

PACl – Polyaluminum Chlorhydate
PAMP – Principal Areas of Mine Pollution
PCAs – Potential Contaminating Activities

RCD – Resource Conservation District
Regional Board – Central Valley Regional Water Quality Control Board
RIMS – Response Information Management System
RV – Recreational Vehicle

SCADA - Systems Control and Data Acquisition
SCWA – Solano County Water Agency
SDWA – Safe Drinking Water Act
SEGEP – Southeast Geyers Effluent Pipeline
SEMS – Standardized Emergency Management System
SHC – St. Helena Creek
SID – Solano Irrigation District
SOC – Synthetic Organic Compound
SSO – Sanitary Sewer Overflow
SVWQC – Sacramento Valley Water Quality Coalition
SWRCB – State Water Resources Control Board
SWTR – Surface Water Treatment Rule

TOC – Total Organic Carbon
TOMS – Topographically Occurring Mine Symbols
TTHM – Total Trihalomethanes

UPC – Upper Putah Creek
USEPA – US Environmental Protection Agency
UST – Underground Storage Tank
UV – Ultra violet

VOC – volatile organic compound

WDR – Waste Discharge Requirements
WTP – Water Treatment Plant

INTRODUCTION

Watershed Sanitary Surveys were prepared on the Lake Berryessa watershed in 1993, 2001 and 2013. The 1993 Watershed Sanitary Survey was conducted for Solano County Water Agency (SCWA) and was focused on the Solano Project. Information was provided on contaminant sources in the Lake Berryessa watershed and the significance of the contaminant sources was assessed for the SCWA facilities downstream of Lake Berryessa. The 2001 Watershed Sanitary Survey Update contains a limited amount of information on the lake water systems.

The State Water Resources Control Board Department of Drinking Water (DDW) agreed that the 2013 Update could be a simplified report that focuses on the Lake Berryessa Resort Improvement District (LBRID) and the Napa Berryessa Resort Improvement District (NBRID) water systems and describes the changes in the watershed since the 2001 Update was prepared. This 2018 Update follows the same technical approach as undertaken for the 2013 Update.

This report presents the findings of the Current Update to the Lake Berryessa Watershed Sanitary Survey. This study covers the period January 2013 through December 2017.

For assistance with abbreviations and acronyms, the reader is referred to the List of Abbreviations at the front of the report. A bibliography and list of contacts are provided in **Appendix A**.

OBJECTIVES OF THE UPDATE

A watershed sanitary survey focuses on the first barrier to contamination of the drinking water supply, namely source water protection. Evaluating source water quality and watershed contaminant sources provides key information to aid in understanding how to maintain and possibly improve the first barrier.

This Update is intended to accomplish the following objectives:

1) Fulfillment of the California Surface Water Treatment Rule (SWTR) and the Interim Enhanced Surface Water Treatment Rule (IESWTR) requirements that surface water agencies conduct a sanitary survey of the source watershed once every five years. Any significant changes within the last five years that affect source water quality are to be identified in each update. In addition, it is required to comment on the appropriate level of treatment for pathogens, specifically for *Giardia*, viruses, and *Cryptosporidium*.

2) Review and evaluation of selected constituents of interest to identify potential water quality or treatment issues for Lake Berryessa water users.

3) Review and evaluation of selected potential contaminating activities to identify impacts on source water quality. Determine whether it may be useful to conduct

additional monitoring to further assess contaminant levels in the source water or contaminants from a particular watershed source.

4) Identification of appropriate watershed management actions to protect and possibly improve source water quality. Development of recommendations for watershed management actions that are economically feasible and within the authority of the Napa County Flood Control and Water Conservation District and the SCWA to implement is critical.

CONSTITUENTS AND POTENTIAL CONTAMINATING ACTIVITIES COVERED IN THE CURRENT UPDATE

Several water quality constituents were selected for evaluation as part of the Current Update. **Table 1-1** presents a summary of the water quality constituents selected and the reason for selection.

Table 1-1
Water Quality Constituents Selected for Evaluation as Part of the Current Update

Constituent	Reason for Inclusion in Current Update
Turbidity	Turbidity is a measurement of suspended solids in water. Treated water turbidity levels are regulated in the SWTR and the IESWTR.
Total Coliform	Evaluation recommended under the SWTR to determine appropriate level of treatment for *Giardia* and viruses.
E. coli	Source water fecal coliform is a more specific surrogate for fecal contamination.
Total Organic Carbon	Total organic carbon (TOC) is a surrogate measure of disinfection by-products (DBP) precursor material in water. TOC levels in either source or treated water are used to determine treatment requirements in the Stage 1 Disinfectant/Disinfection By-Product Rule (D/DBP).

Seven potential contaminating activities were selected for review as part of the Current Update: spills, recreation, agriculture, wastewater, leaking underground storage tanks, fires, and abandoned mines. Each of these activities can contribute at least one of the constituents identified in **Table 1-1** to the source water. These activities were selected based on their presence in the watershed, and were identified as key contaminating activities.

REPORT ORGANIZATION

Section 1 – Introduction

This section describes the objectives of the Current Update, lists the main constituents and potentially contaminating activities covered, and includes a description of the basic report organization.

Section 2 - The Watershed and Supply Systems

This section is largely descriptive and provides: (1) a brief overview of the hydrologic, and land use characteristics of the watershed, (2) a description of the existing water supply system, and (3) contains a watershed map delineating the watershed and land use in the watershed. For more detailed descriptive information on watershed characteristics, the reader is referred to the 1993 Watershed Sanitary Survey.

Section 3 – Source Water Quality Review

This section provides a review of the constituents of interest, including an explanation for their selection and a summary of the data obtained for the period of study for each constituent.

Section 4 – Watershed Contaminant Sources Review

This section describes pertinent characteristics of each of the seven potential contaminating activities that were reviewed as part of this Update. If applicable, each potential contaminating activity will include a discussion on background and occurrence, seasonal patterns, water quality issues and data review, regulation and management, and source water protection activities.

Section 5 – Key Findings and Recommendations

This section consists of a discussion of key findings, update on recommendations from the 2013 watershed sanitary survey and a list of current recommendations.

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SECTION 2 – WATERSHED AND WATER SUPPLY SYSTEMS

BACKGROUND

Lake Berryessa was created by the construction of the Monticello Dam in 1958. It is located in eastern Napa County and has a watershed of 576 square miles and a storage capacity of 1.6 million acre-feet. Monticello Dam is 304 feet high. Water is released near the bottom of the dam and used to generate electricity. Water is released through the uncontrolled glory hole spillway when the lake reaches capacity.

Watershed Sanitary Surveys were prepared on the Lake Berryessa watershed in 1993, 2001 and 2013. The 1993 Watershed Sanitary Survey was conducted for Solano County Water Agency (SCWA) and was focused on the Solano Project. Information was provided on contaminant sources in the Lake Berryessa watershed and the significance of the contaminant sources was assessed for the SCWA facilities downstream of Lake Berryessa. The 2001 Watershed Sanitary Survey Update contains a limited amount of information on the lake water systems.

The State Water Resources Control Board Division of Drinking Water (DDW) agreed that the 2013 Update could be a simplified report that focuses on the Lake Berryessa Resort Improvement District (LBRID) and the Napa Berryessa Resort Improvement District (NBRID) water systems and describes the changes in the watershed since the 2001 Update was prepared. This 2018 Update follows the same technical approach as undertaken for the 2013 Update.

SCWA is a wholesale agency that provides untreated water to communities in Solano County, and is therefore responsible for preparing the watershed sanitary surveys on the Solano Project.

The Lake and Napa Berryessa Resort Improvement Districts (LBRID and NBRID or District's) are two separate Special Districts of the State of California located in Napa County on Putah Creek and Lake Berryessa respectively. Both Special Districts were formed under the Resort Improvement District Law created in 1961 and amended in 1971, and under this law, each District is allowed to provide water and sewer utility services to their respective communities. By Agreement with Napa County through its Board of Supervisors, the Napa County Public Works Department provides administrative and engineering services to each District for their water and sewer utility services. Public Works staff also administers agreements for LBRID and NBRID with third party consultants for services such as operations, maintenance, and others services that may be needed for their facilities. The Napa County Board of Supervisors also acts as each District's Board Directors through these Agreements.

WATERSHED DESCRIPTION

Land Use

The majority of the land use in the study watershed is shrub and forest. **Table 2-1** provides further information for the major land use categories, and **Figure 2-1** shows land use in the watershed. There are no incorporated cities in the watershed.

Table 2-1.
Land Use in the Lake Berryessa Watershed

Land Use	Percent of Watershed
Shrub	67%
Forest	23.1%
Other	5.4%
Developed, Open Space	2.1%
Agriculture	1.6%
Developed, low-high intensity	0.5%

Precipitation

Figure 2-2 shows monthly precipitation totals from the US Reclamation's rain gage (BER) at Monticello Dam from January 2013 to December 2017. The average annual rainfall over this five year period (by water year) was 25.3 inches at Monticello Dam. **Table 2-2** shows annual rainfall totals by water year.

Figure 2-2
Monthly Rainfall Totals at Monticello Dam, 2013-2017

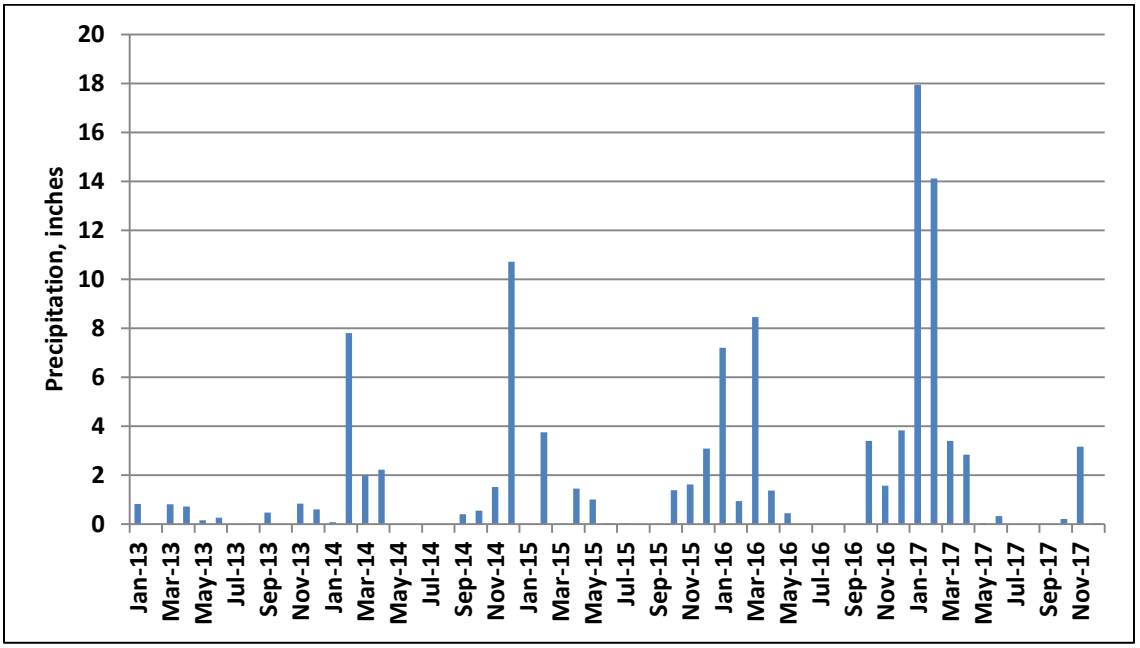
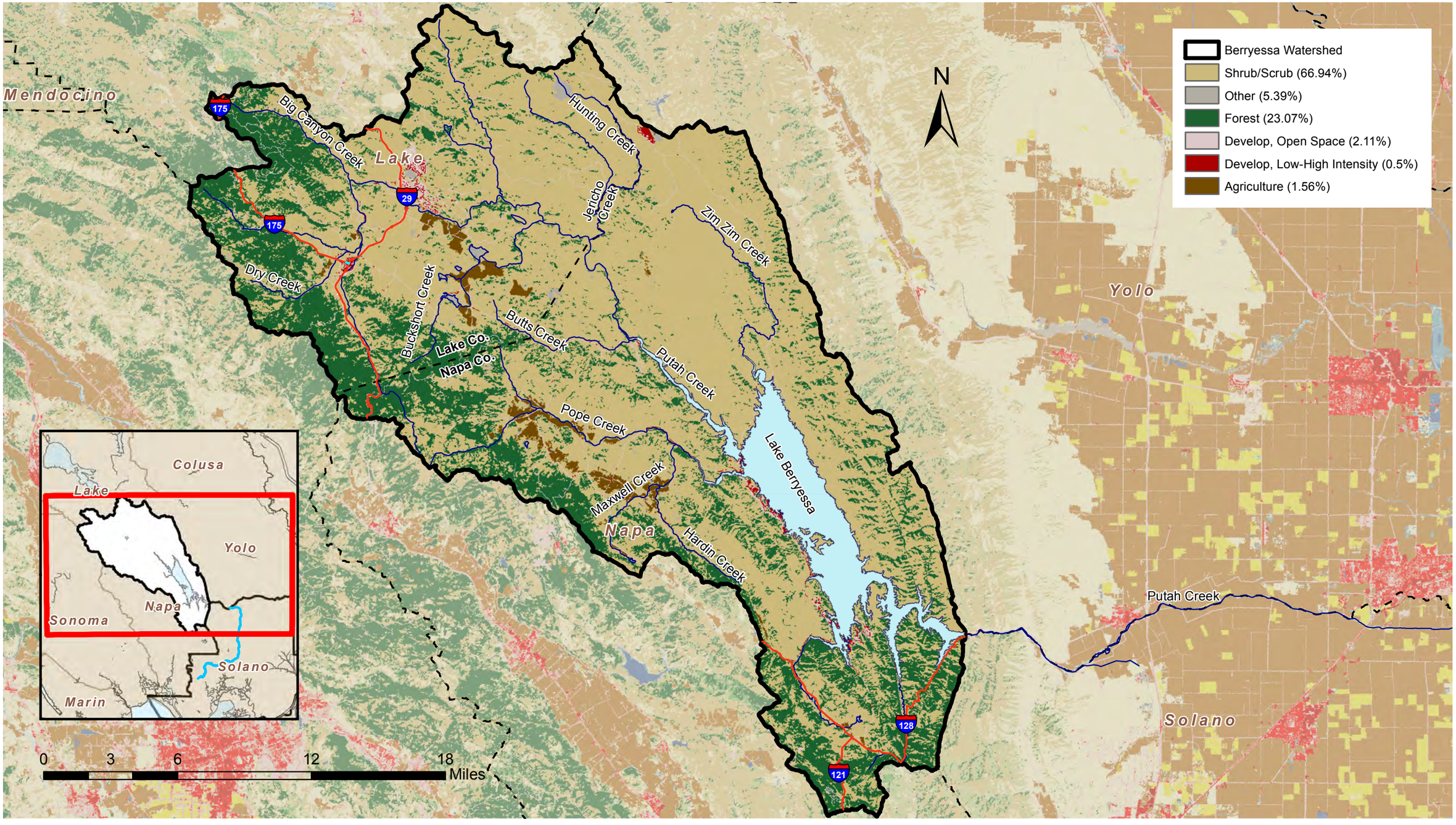


Figure 2-1. Lake Berryessa Land Use



Source: CDEC

Table 2-2.
Annual Rainfall Totals at Monticello Dam, Lake Berryessa
2013-2017

Water Year	Inches
2013	21.26
2014	13.97
2015	19.11
2016	24.53
2017	47.47

WATER TREATMENT PLANTS

There are a number of small water systems that rely on Lake Berryessa as a water source; however, this watershed sanitary survey only covers the two systems that are operated by the Napa County Department of Public Works through the service agreement described above. These two systems, the Lake Berryessa Resort Improvement District (LBRID) and the Napa Berryessa Resort Improvement District (NBRID), are shown in **Figure 2-3**. The water treatment plants (WTPs) and the systems served are described in this section.

Lake Berryessa also provides water to the SCWA and Solano Irrigation District (SID). The WTPs that receive water from SCWA and SID are described in the Watershed Sanitary Survey Update 2017 for Solano Project Below Monticello Dam. There are also other users which take water from Lake Berryessa, however, they are not covered in this report.

Lake Berryessa Resort Improvement District

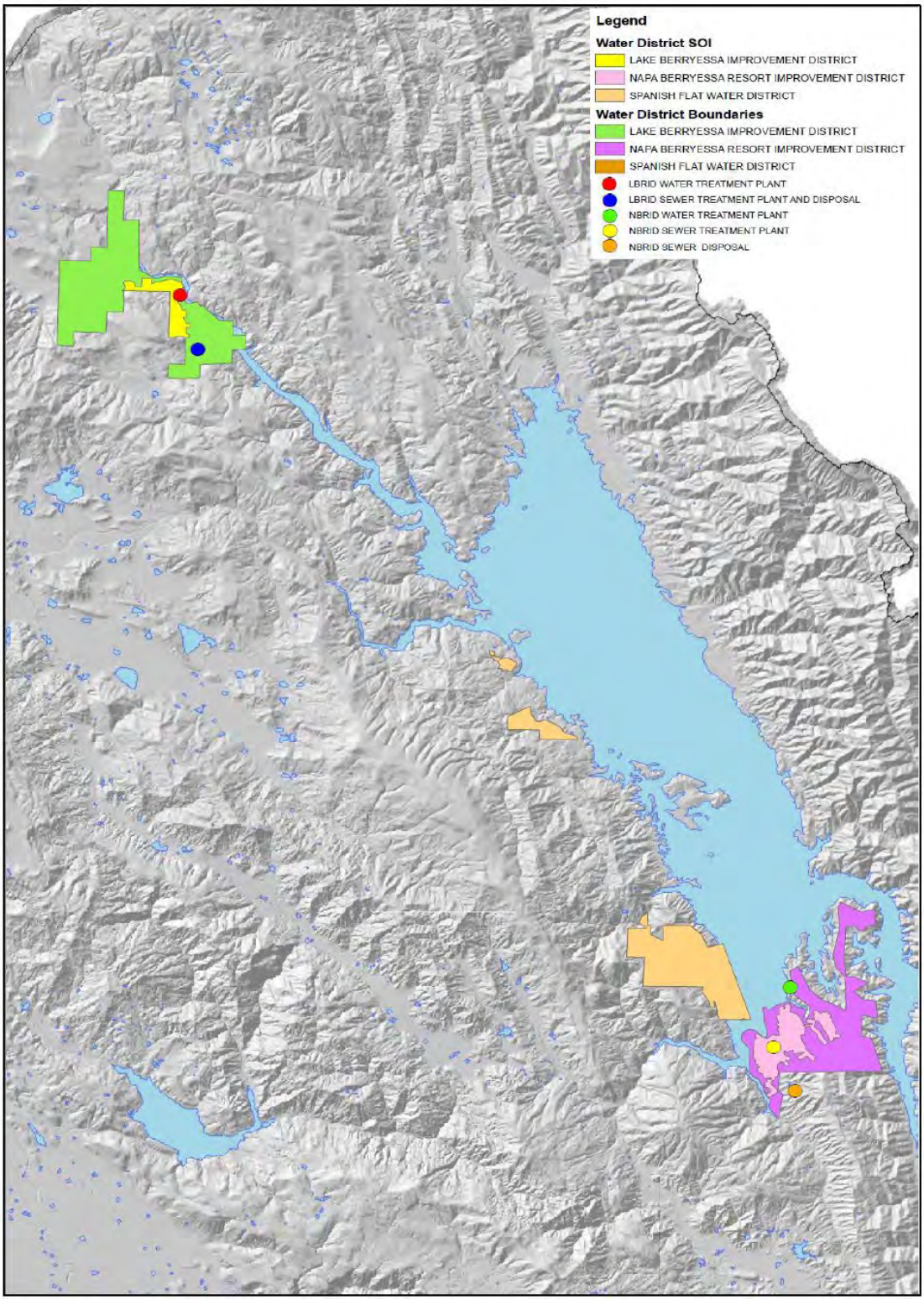
The Water Treatment Plant is a 0.3 million gallon per day (mgd) dual train immersed membrane filtration plant called the Ultrafiltration Z-Box-S12 (Z-Box), manufactured by Zenon and General Electric. The Z-Box contains 12 membranes per train and is capable of providing 4-log removal of *Giardia* and *Cryptosporidium* and 3.5-log removal of viruses. Membrane filtration is preceded by coagulation, flocculation, and pH adjust with Muriatic Acid in a 1,000 gallon tank. Sodium hypochlorite is used for disinfection. Potassium permanganate is used seasonally for iron and manganese removal prior to coagulation and flocculation. LBRID is currently in the process of replacing two existing redwood water storage tanks with bolted steel tanks, and a project to add recycling of a portion of the filter backwash wastewater is scheduled for the summer of 2018.

In 2014, drought conditions caused the level of Putah creek, the District's water source, to drop below the District's intake pump, causing pump failure and loss of use of the intake. The District was able to install a temporary pump in a shallow pool of water just upstream of the intake in order to continue providing water to its customers; however a new intake and pump facility was required. By November 2014, the District had a new deeper intake structure installed at the same location as the original intake that failed.

Napa Berryessa Resort Improvement District

In 2013 the original Water Treatment Plant, commissioned in 1967, was replaced with a dual train Roberts Filter style package treatment plant with a total capacity of 504,000 gallons per day (gpd) – adequate to handle average and peak potable water demands. Treated water is disinfected and sent to the District's only potable water storage tank, a 500,000 gallon welded steel tank built in the late 1960's. The water distribution system is entirely fed through gravity mains from the tank. Use of the original filter backwash wastewater pond was discontinued and one of the original sedimentation basins, not used with the new plant, is now used for storage of backwash water prior to pumping into the District's wastewater collection system.

Figure 2-3. LBRID and NBRID Water Service Areas



Source: Napa County Department of Public Works

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This section provides an overall review of the water quality data available for Lake Berryessa source water. The sources of raw water quality data include data from the Lake and Napa Berryessa Resort Improvement Districts (LBRID and NBRID or District's), as shown in **Table 3-1**. This section provides a review of the constituents of interest, including an explanation for their selection and a summary of the data obtained for the period of study, for each constituent. The period of study for this watershed sanitary survey is January 2013 through December 2017. The frequency of data collection varies by constituent.

Table 3-1
Summary of Water Quality Data Evaluated

Agency	Data Collected
Napa County Department of Public Works for Lake Berryessa Resort Improvement District WTP	Turbidity, coliforms, TOC
Napa County Department of Public Works for Napa Berryessa Resort Improvement District	Turbidity, coliforms, TOC

For assistance with abbreviations and acronyms, the reader is referred to the List of Abbreviations at the front of the Report.

SELECTED CONSTITUENT REVIEW

This section contains a general discussion of selected water quality constituents and the reasons why they were selected for further evaluation. The constituents selected for further review in this report include turbidity, microbial constituents, and total organic carbon. The constituents' general characteristics, seasonal and historical trends, and significance with respect to existing and potential future regulations are presented, along with data analysis and review

Turbidity

General Characteristics and Background

Turbidity is the measurement of light scatter in water and provides a measure of the degradation of clarity in water. Clarity is typically degraded by suspended colloids and fine suspended solids such as clay, organic particulates, and microorganisms such as *Giardia* and *Cryptosporidium,* if present. Turbidity is measured to evaluate the efficiency of the treatment process at removing these particles and also to comply with regulatory requirements.

Turbidity was selected for further evaluation since most facilities optimize treatment processes to maximize turbidity removal in order to reduce the potential for pathogens, such as *Giardia* and *Cryptosporidium,* in treated drinking water. Turbidity is monitored

throughout the treatment plant to ensure that particles are removed. Turbidity has been assumed to be an indicator constituent for the presence of *Giardia* and *Cryptosporidium*. However, turbidity alone may be a poor predictor of microbiological quality.

High turbidity levels in surface water sources are typically the result of erosion and sediment transport during precipitation and high flow events, and are undesirable because high turbidity may mask the presence of harmful particulates. The principal source of turbidity is general watershed runoff, and can also be contributed by other potential contaminating activities such as wildfires. It is common for turbidities to vary seasonally as a result of precipitation and flow.

Evaluation

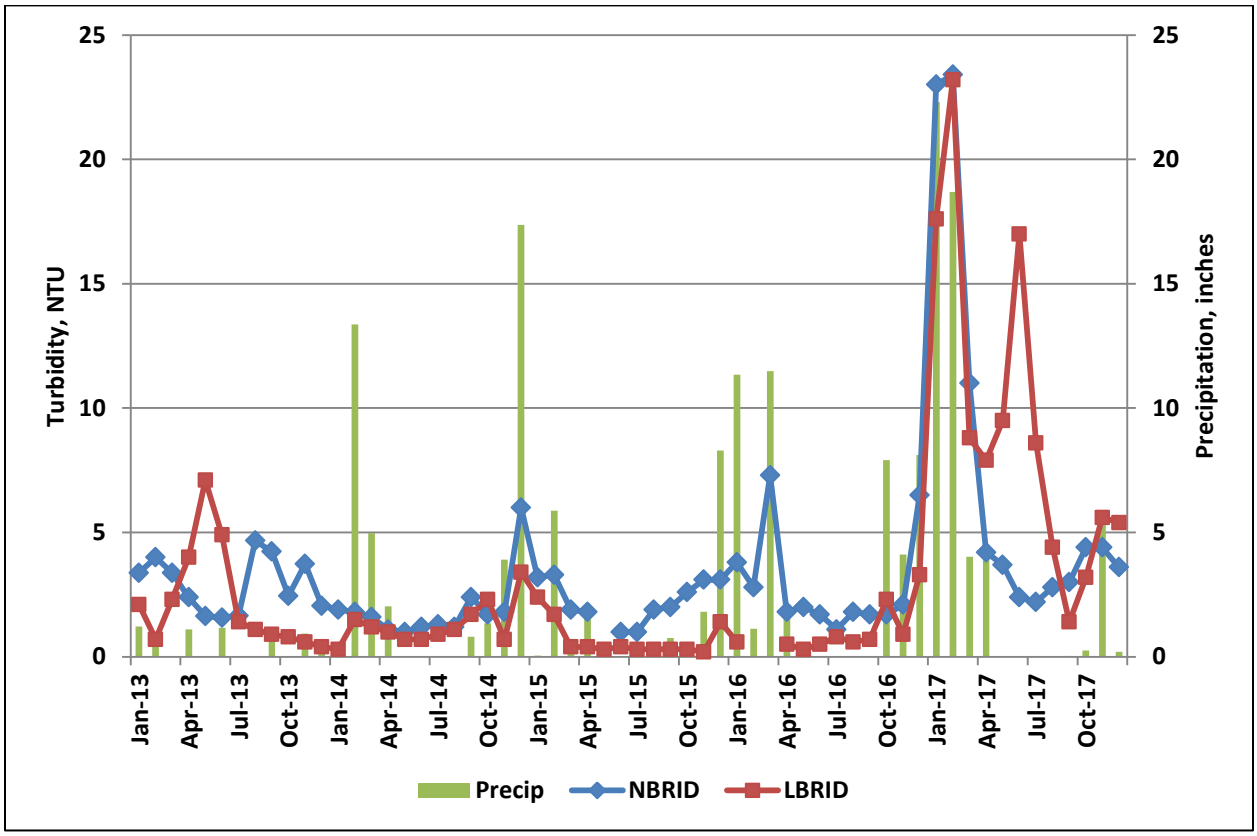
Turbidity has been selected for evaluation not only because it is a regulated constituent, but also because it is commonly used as an indicator of general water quality and overall plant performance. **Table 3-2** provides a summary of raw water turbidity data using the monthly averages of the daily medians for the water treatment plants (WTPs).

Table 3-2. Turbidity Summary Table, 2013 to 2017

WTP	Range	Average	Median	90th	Number of Samples
LBRID	0.2 – 23.2	2.98	1.1	8.1	Approx. 1800
NBRID	1– 23.4	3.5	2.4	4.9	Approx. 1800

Figure 3-1 shows raw water turbidity over time for each of the WTPs. Both of WTPs had elevated source water turbidities in January and February 2017, with daily turbidities reaching over 100 NTU due to heavy storm runoff. Please note that these daily peaks do not show in **Figure 3-1** as the figure shows a monthly average of the daily medians. The Lake Berryessa Resort Improvement District (LBRID) WTP is more susceptible to changes in water quality as the influent to the LBRID comes from beneath the gravel bed of Putah Creek, versus from Lake Berryessa, which likely has more buffering capacity for the Napa Berryessa Resort Improvement District (NBRID) WTP. Monthly precipitation data was obtained from the Angwin Pacific Union College (APU) rain gauge. Although Reclamation (or SCWA) has a rain gauge closer to the lake at Spanish Flat, it has been recording precipitation data only since March 2016.

Figure 3-1.
LBRID and NBRID WTP Influent Turbidity, NTU, 2013 to 2017



Summary of Results

- Overall, source water turbidity is normally low for both WTPs, with medians less than 3 NTU. However, there are frequent periods where levels exceed that substantially, up to 100 NTU and higher. These excursions are associated with storm water runoff caused by intense winter storms, particularly in January and February 2017.
- The LBRID WTP also had high turbidity in June 2017 due to turnover of creek water throughout the month and early growth of aquatic plants around the intake structure.
- LBRID is more susceptible to changes in water quality and peaks due to location in Putah Creek, versus lake system at NBRID.

Microbial Constituents

General Characteristics and Background

The major microbiological constituents of concern include fecal coliform, *E. coli*, *Giardia lamblia*, and *Cryptosporidium parvum*. Generally speaking, pathogenic organisms carried by mammalian species may be infectious to humans although this depends on the species of microorganism. Pathogens infecting other types of animals, such as birds and reptiles, are usually not infectious to humans. However, some types of animals, such as birds, may be vectors for human pathogens. Each of these constituents was identified for further evaluation because they are currently regulated. The presence of these constituents in the raw water governs the overall treatment requirements for the water treatment plants, though detected pathogens and pathogen indicators may not be capable of infecting humans.

Fecal coliform and *E. coli* have been used to indicate the potential presence of pathogenic microorganisms in source waters. Although coliform levels do not correlate well with pathogenic microorganisms, they continue to be used as indicators due to the lack of affordable and reliable direct analytical methods for detecting pathogens. Potential sources of coliform bacteria in the Lake Berryessa watershed include general watershed runoff, sanitary sewer overflows, and recreation.

Giardia lamblia is a species of the protozoa genus *Giardia* that infects humans and can cause the gastrointestinal disease giardiasis. *Giardia* is found in the environment as a cyst from the feces of humans and animals; both wild and domestic animals may be hosts. Sources close to waterbodies have the most potential to introduce viable cysts to the source water. Cysts may be destroyed naturally in the environment by desiccation and/or heat. The cysts are effectively inactivated using chlorine disinfection. The detectability of *Giardia* has been greatly improved with USEPA Method 1623, which is better able to establish concentrations, but still does not determine viability. *Giardia* may be carried in urban runoff and wastewater sources or may be contributed directly as a result of body-contact recreation or animal defecation, including both wild and domestic animals.

Giardia lamblia is currently regulated by the Surface Water Treatment Rule (SWTR) and the Interim Enhanced Surface Water Treatment Rule (IESWTR). Under the Surface Water Treatment Rule (SWTR), the general requirements are to provide treatment to ensure at least 3-log reduction of *Giardia lamblia* cysts and at least 4-log reduction of viruses. Surface water supplies must provide for 3-log reduction of *Giardia* through physical removal and chemical inactivation. Additional reduction may be required for impaired water supplies. The State Water Resources Control Board Division of Drinking Water (DDW) guidance provides that 3-log reduction is appropriate when monthly median levels of total coliform are less than 1,000 Most Probable Number per 100 milliliters (MPN/100 mL), fecal coliform or *E. coli* levels are less than 200 MPN/100 mL, or when directly measured confirmed *Giardia* levels are less than 0.01 cysts per liter.

Cryptosporidium parvum is a species of the protozoa genus *Cryptosporidium* that infects humans and can cause the gastrointestinal disease cryptosporidiosis. *Cryptosporidium* is found in the environment as an oocyst principally from the feces of domestic animals, although both wild and domestic animals are known to be hosts. Like *Giardia*, *Cryptosporidium* oocysts may be destroyed naturally in the environment by desiccation and/or heat. Once in the source water, however, viable oocysts are very resistant to traditional chemical inactivation using chlorine. Stronger disinfectants such as ozone or ultraviolet (UV) light are required to inactivate these pathogens. The detectability of *Cryptosporidium* has been greatly improved with USEPA Methods 1622 and 1623, which are able to establish true concentrations, but still do not determine viability. *Cryptosporidium* may be carried in urban runoff and wastewater sources or may be contributed directly as a result of body-contact recreation or animal defecation, including both wild and domestic animals.

Cryptosporidium is currently regulated through the IESWTR and the Long Term 1 ESWTR (LT1ESWTR), which require 2-log reduction, and the Long Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR) which potentially requires additional log action based on source water monitoring results for *Cryptosporidium*. Under the IESWTR (applicable to public water systems serving at least 10,000 population) and LT1ESWTR (applicable to public water systems serving fewer than 10,000 population) well-operated conventional and direct water treatment plants are granted a 2-log removal credit for *Cryptosporidium* if they meet all treated water turbidity standards. The LT2ESWTR (applicable to all public water systems) further regulates *Cryptosporidium* and requires additional action (treatment or protection) if the source water quality is determined to be impaired based on the required direct *Cryptosporidium* monitoring of the source, if running annual average presumed levels are greater than 0.075 oocysts per liter.

Evaluations

Cryptosporidium

As a small system, both the NBRID and LBRID WTPs are allowed to sample for *E. coli* every two weeks for one year, in lieu of *Cryptosporidium* monitoring. *E. coli* data for the LBRID and NBRID WTPs were submitted and it was determined that the WTPs qualified for a Bin 1 classification. A second round of source water monitoring should follow six years after the system made its initial bin determination.

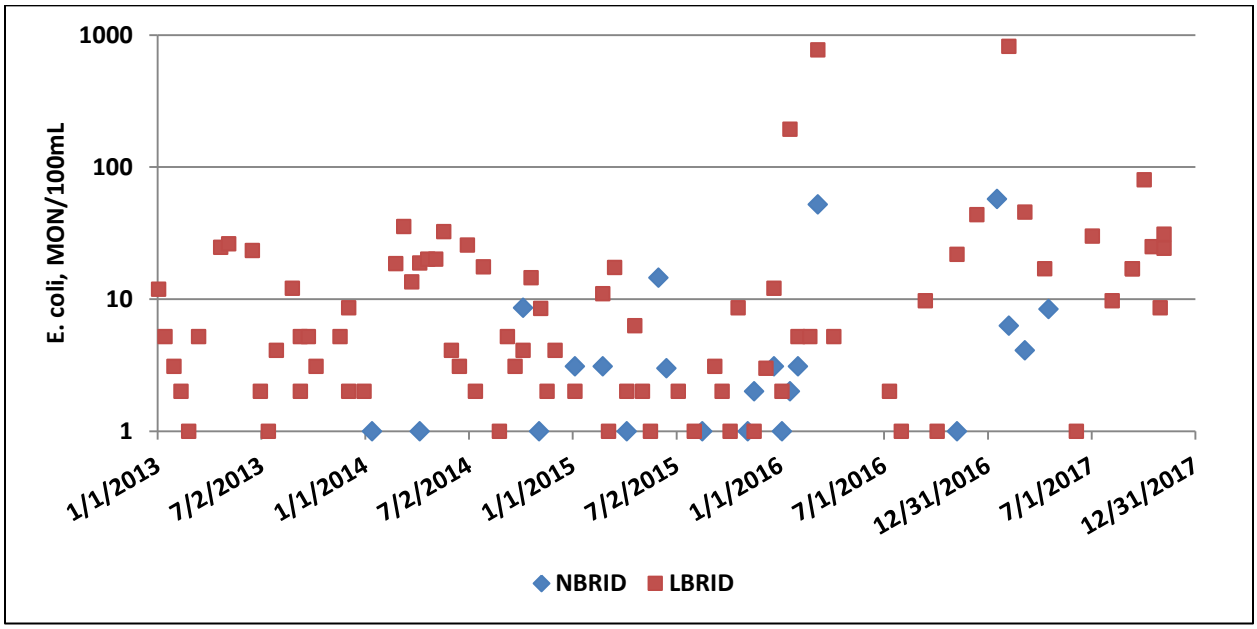
E. coli

Table 3-3 and **Figure 3-2** provides a summary of *E. coli* data. It should be noted that results that were reported as non-detectable were set to zero and those results that were reported as greater than an upper limit were set at the upper limit. Overall, the NBRID WTP has lower *E. coli* levels than the LBRID WTP.

Table 3-3. *E. coli* Summary Table, 2013 to 2017

WTP	Range	Average	Median	90th	Number of Samples
LBRID	0 – 2419	51.4	4.1	30.2	99
NBRID	0 – 57.3	2	0	3.1	89

Figure 3-2. LBRID and NBRID WTP Influent *E. coli*, 2013 to 2017



LBRID WTP

E. coli data were collected once or twice a month from 2013 through 2017. *E. coli* densities range from ND to 2,419 MPN/100mL, with an overall median of 4.1 MPN/100mL. All *E. coli* monthly medians were well below the 1,000 MPN/100 mL threshold. The elevated *E. coli* in the months of March 2016 and February 2017 were due to heavy precipitation. These data indicate that 2-log *Cryptosporidium*, 3-log *Giardia,* and 4-log virus removal and inactivation is the appropriate level of treatment.

NBRID WTP

E. coli data were collected once or twice a month from 2013 through 2017. *E. coli* densities range from ND to 57.3 MPN/100mL, with an overall median of ND MPN/100mL. The *E. coli* monthly medians were always below the 200 MPN/100 mL threshold. These data indicate that 2-log *Cryptosporidium*, 3-log *Giardia,* and 4-log virus removal and inactivation is the appropriate level of treatment.

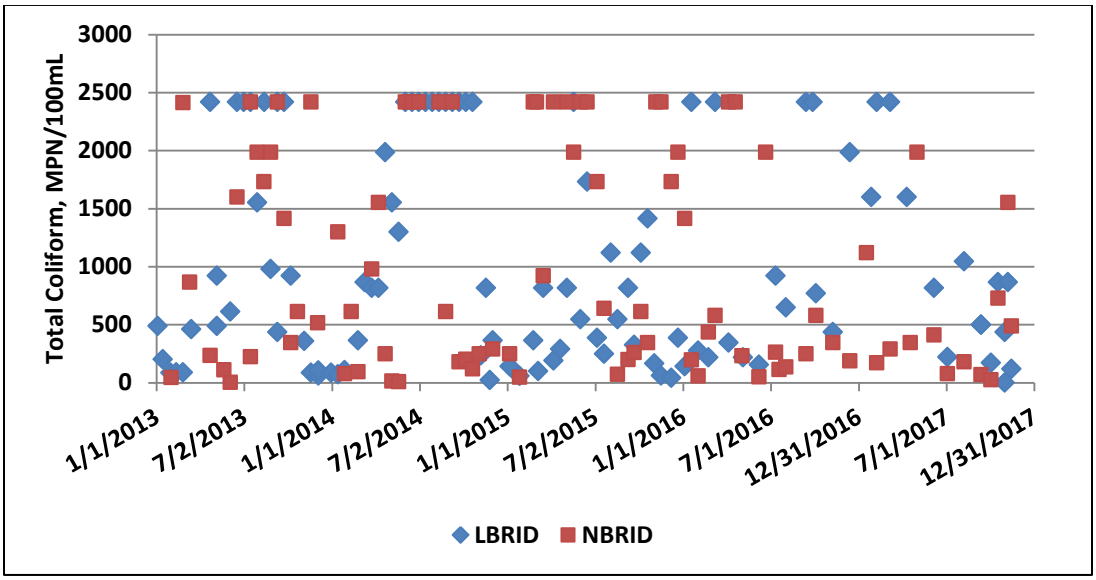
Total Coliform

Table 3-4 and **Figure 3-3** provides a summary of total coliform data. It should be noted that results that were reported as non-detectable were set to zero and those results that were reported as greater than an upper limit were set at the upper limit.

Table 3-4. Total Coliform Summary Table, 2013 to 2017

WTP	Range	Average	Median	90th	Number of Samples
LBRID	23 – 2419	1,033	816	2,419	101
NBRID	3.1 – 2419	1,002	579	2,419	90

Figure 3-3. LBRID and NBRID WTP Influent Total Coliform, 2013 to 2017



It is unclear as to why total coliform levels are high in the summer, but most likely due to algal blooms in both Putah Creek above LBRID WTP and Lake Berryessa. However, *E. coli,* fecal coliform and *Cryptosporidium* levels are very low, indicating no fecal contamination.

Summary of Results

- Source water *E. coli* levels are low, with medians less than 4 MPN/100mL.
- Overall, the NBRID WTP has lower *E. coli* levels than the LBRID WTP.
- Over the reporting period, all *E. coli* monthly medians at the LBRID WTP were well below the 1,000 MPN/100 mL threshold. The elevated *E. coli* in the months of March 2016 and February 2017 were due to heavy precipitation.
- Over the reporting period, all *E. coli* monthly medians at the NBRID WTP were well below the 200 MPN/100 mL threshold.

- Therefore, 2-log *Cryptosporidium*, 3-log *Giardia,* and 4-log virus removal and inactivation is the appropriate level of treatment for both WTPs.
- Source water total coliform are high, with medians around 1,000 MPN for both WTPs. High values are likely caused by algal blooms in the summer.

Total Organic Carbon

General Characteristics and Background

Disinfection By-Products (DBPs) are formed when disinfectants added to water react with naturally occurring organic matter or other constituents, such as bromide. The most common DBPs are total trihalomethanes (TTHMs), which are suspected carcinogens. Other DBPs, including haloacetic acids (HAA5), are suspected mutagens and teratogens. Potential sources of organic carbon are plant matter, animal matter, and soil, which can be contributed by general watershed runoff and fires,

The Stage 1 Disinfectants/Disinfection By-Products (D/DBP) Rule requires varying levels of total organic carbon (TOC) removal if the source water TOC concentrations exceed 2 milligrams per liter (mg/L) and a utility implements conventional filtration. TOC was a selected constituent for further evaluation due to its importance in the formation of DBPs and also as a general indicator of organic contamination in water. All conventional water treatment plants have the ability to remove some TOC.

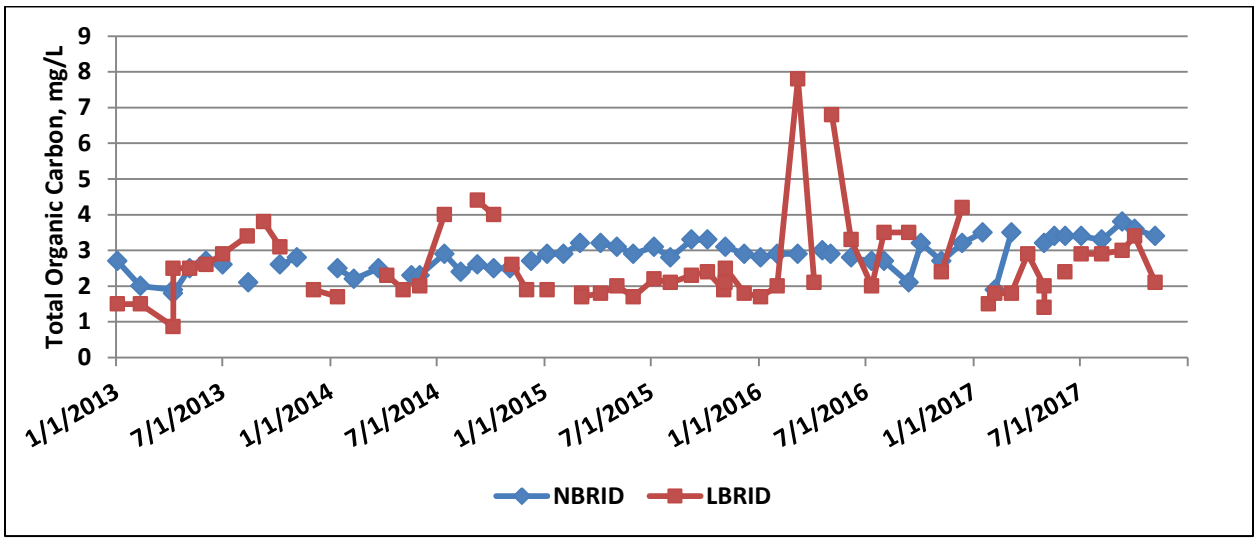
Evaluation

Table 3-5 shows the range, average, median and 90th percentile for TOC over the reporting period. Median TOC concentrations are generally between 2 and 3 mg/L. As shown in **Figure 3-4,** the LBRID WTP experienced elevated levels of TOC in March and May 2016, with values of 7.8 and 6.8 mg/L, respectively. These peaks are likely attributed to the large wildfires which occurred in summer and fall 2015. Post-fire water quality monitoring will be discussed further in Section 4. Source water TOC concentrations at the NBRID WTP did not fluctuate as much, as the highest peak was 3.8 mg/L in September 2017.

Table 3-5. TOC Summary Table, 2013 to 2017

WTP	Range	Average	Median	90th	Number of Samples
LBRID	0.87 – 7.8	2.6	2.3	3.9	60
NBRID	1.8 – 3.8	2.8	2.85	3.4	60

Figure 3-4. Raw Water TOC at NBRID AND LBRID Influent, 2013 to 2017



Enhanced coagulation is required for the WTPs that treat Lake Berryessa water because the source water TOC is routinely above 2 mg/L and they implement conventional treatment processes. Specifically, 93 percent of source water samples at the NBRID WTP were above 2 mg/L and 70 percent of the source water samples at the LBRID WTP were above 2 mg/L during the reporting period.

Summary of Results

- Median TOC concentrations are generally between 2 and 3 mg/L.
- Source water TOC peaks at the LBRID may be attributed to the large wildfires which occurred in the summer and fall of 2015, just upstream of Putah Creek.
- Enhanced coagulation is required for the plants that treat Lake Berryessa water because the source water TOC is routinely above 2 mg/L and they implement conventional treatment processes.

Cyanotoxins

General Characteristics and Background

Freshwater cyanobacteria, or "blue-green algae" can produce cyanotoxins. It is important to note that experiencing a cyanobacteria bloom does not always result in a cyanotoxin problem in the water source. This is because multiple species of cyanobacteria can exist in a single bloom, and not all species are capable of producing cyanotoxins. Furthermore, even when toxin-producing cyanobacteria are present, they may not produce toxins. The conditions that cause cyanobacteria to produce cyanotoxins are not well understood. Both non-toxic and toxic strains of the most common toxin-producing cyanobacteria species exist, and it is impossible to tell if a strain is toxic or nontoxic by looking at it. Additionally, the occurrence of unpleasant tastes and odors are not a reliable sign of a toxin-producing bloom.

Cyanobacteria are photosynthetic bacteria that share some properties with algae and are found naturally in lakes, streams, ponds and other surface waters. Similar to algae, when conditions are favorable, cyanobacteria can rapidly multiply in surface water and cause blooms. A bloom may be dominated by a single species or composed of a variety of toxic and non-toxic producing species. It may take only three to ten days for the population of cyanobacteria to double. Conditions contributing to blooms include light intensity, total sunlight duration, nutrient availability (especially phosphorus), water clarity, water temperature, pH, precipitation events, water flow (whether water is calm or fast-flowing), and water column stability. Warm, slow moving waters that are rich in nutrients can lead to algal growth.

In June 2015 the USEPA established a 10-day health advisory (HA) level for microcystin at 0.3 µg/L for children younger than school age and 1.6 µg/L for all other age groups. A 10-day HA for cylindrospermopsin was also established at 0.7 µg/L for children younger than school age and 3.0 µg/L for all other age groups. It should be noted that the HA levels for microcystin and cylindrospermopsin apply to finished or treated drinking water. Additionally, compliance with the HA levels are not based on a single sample, but calculated as a 10-day average.

Evaluation

On August 2, 2017 State Water Resources Control Board staff received report of an alleged dog death after swimming in Lake Berryessa on July 15, 2017. The suspected bloom was in the location of Spanish Flat and Oak Shores, along the west shore of Lake Berryessa. On August 23, 2017 State Water Resources Control Board staff sampled five lake locations in preparation for Labor Day weekend. As shown in **Table 3-6,** Cylindospermopsin was detected at all five locations and anatoxin-a was detected at one location. All detections were less than the 10-day health advisory for all age groups. A public notice was not issued.

Table 3-6. Detections of Cyanotoxins in Lake Berryessa

Location	Cylindospermopsin, µg/L	Anatoxin-A, µg/L
Putah Canyon Recreation Area	0.51	nd
Oak Shores	0.51	0.36
Spanish Flat	0.47	nd
Steele Canyon	0.49	nd
Pleasure Cove	0.53	nd

Summary of Results

- Cyanotoxins, specifically cylindrospermopsin and anatoxin-A were detected in Lake Berryessa in August 2017. However, all detections were less than the health advisory levels.

SECTION 4 – WATERSHED CONTAMINANT SOURCES REVIEW

This section contains an evaluation of the seven potential contaminant sources selected for review for the current Update. Seven potential contaminating activities (PCAs) were selected for review as part of the current Update: (1) spills, (2) recreation, (3) agriculture, (4) wastewater, (5) leaking underground storage tanks, (6) fires, and (7) abandoned mines. These PCAs were selected based on their presence in the watershed and their potential to impact Putah Creek and Lake Berryessa water quality.

The 1993, 2001, and 2006 watershed sanitary surveys provide a comprehensive description of the watershed and potential contaminant sources along Putah Creek above Monticello Dam and Lake Berryessa. Agreement was reached with the State Water Resources Control Board Department of Drinking Water (DDW) that the 2013 Update would focus on a few of the more significant contaminant sources, and a similar approach was taken for the 2017 Update.

SPILLS

Background

A hazardous material spill or leak into a surface water body could occur as the result of a vehicular traffic accident, pipeline leak or spill, wastewater treatment plant spill, or other incident. In the event of a leak or spill, timely notification is critical to ensure that the water treatment plant operators are provided with sufficient time and information to best respond to potential treatment concerns.

Related Constituents

The most common spills are related to oil and petroleum products or sewage. Therefore, typical constituents of concern range from volatile organic compounds (VOCs) and hydrocarbons to microbial constituents (i.e. viruses, pathogens, *Giardia, Cryptosporidium*). However, hazardous materials emergencies can involve a virtually infinite number of chemicals or chemical combinations.

Occurrence in Watershed

The main transportation route through the watershed is Highway 128.

Information on spills was queried from two sources: 1) the Office of Emergency Services (OES) Response Information Management System (RIMS) archived database, and 2) the State Water Resources Control Board's (SWRCB) California Integrated Water Quality System (CIWQS) database on sanitary sewer overflows (SSOs). Information on SSOs will be discussed in the Wastewater Section.

Excluding SSOs and other wastewater related spills, there were 21 spills occurring over the reporting time period and within the watershed, as shown in **Table 4-1. Table 4-1** shows that the majority of the spills occurred on land and were typically due to failures with pole mounted transformers, condensate water from CALPINE, or illegal dumping.

Direct spills to Lake Berryessa were caused by airplane crash, or sunken vessel in the lake.

Table 4-1. Non Wastewater Related Spills occurring in Lake Berryessa Watershed, 2013-2017

Discharger or Reporting Agency	Date	Spill Location	Type of Spill	Cause	Volume	Receiving Water
NRC	8/21/2014	18174 Hidden Valley Rd. Unincorporated	Batteries, Motor Oil, Paint, Propane	Unknown	Unknown	No
Private	7/9/2017	Spanish Flat Resort	Chemical	Partially Sunken Vessel	Unknown	Lake Berryessa
Cal Pine Corp.	1/24/2014	10350 Socrates Mine Rd. Middleton	Condensate Water	Mechanical	Unknown	Unnamed Creek
Bottlerock Power	6/8/2015	7385 High Valley Rd. Cobb	Cooling Tower Water	Human Error	200 gal	No
CHP Ukiah	11/19/2014	NB Hwy 175 @MP 18.9	Diesel	Semi-truck Collison	2 gal	No
CalPine	4/22/2015	Unit 16 Power Plant	Drilling Liquid	Broken Pipe	Unknown	No
Bottle Rock Power	2/27/2013	7385 High Valley Rd. Cobb	Fire Suppressing Water	Pipe Burst	2500 gal.	No
CalPine	2/23/2015	Big Geysers Power Plant	Geothermal Condensate	Overflow	Unknown	Lincoln Rock Creek
CalPine	10/15/2015	Socrates Mine Rd. Middleton	Geothermal Condensate	Overflow	Unknown	Lincoln Rock Creek
Lake County Env. Health	11/24/2015	12211 Mead Rd. Middletown	Kerosene	Leaking Tank	Unknown	No
Citizen	3/9/2013		Liquid Concrete?	Unknown	Unknown	Anderson Creek
PG&E	2/12/2015	11110 Hot Springs Rd Middletown	Mineral Oil	Mechanical	1 gal	Anderson Creek
PG&E	11/18/2016	16410 Golf Rd. Cobb	Mineral Oil	Transformer Failure	2 gal	No

Discharger or Reporting Agency	Date	Spill Location	Type of Spill	Cause	Volume	Receiving Water
Cal Pine Corp.	4/14/2013	Socrates Mine Rd.	Non Chlorinated Condensate	Hole in Pipe	Unknown	Anderson Creek
PG&E	7/3/2013	Golf Rd. and Hwy 175	Non PCB Mineral Oil	Car struck Pole	8 gal	No
CA-LNU ECC	10/24/2016		Oil	Vehicle	2 pints	Conn Creek?
Private	5/2/2017	Lake Berryessa, Eastside Road & Tully Canyon	Oil	Airplane Crash	23 gal	Lake Berryessa
Lake. County Fire	9/18/2013	Big Canyon Rd. North of Middleton	Paint	Tubes dumped on side of road	51.5 gals	No
Private	5/8/2017	Portuguese Canyon, between Pleasure Cove and Markley Cove	Petroleum	Airplane Crash	Unknown	Lake Berryessa
Cal Fire	2/23/2013	Hwy 175 and Cobb Rd., Cobb	Release from Vehicle	Overturned Vehicle	Unknown	Unnamed Creek
PG&E	1/17/2014	11210 Socrates Mine Rd Middleton	Transformer Oil	Forklift hit Pole	5 gal	No

The largest non-wastewater spill occurred on February 27, 2013 when 2,500 gallons of fire suppression water spilled into an unnamed creek from the Bottlerock Power facility.

Regulation and Management

When a hazardous materials spill or leak of a reportable quantity occurs, notification to an emergency response agency is required by state and federal law. A sewage spill is required to be reported if 1,000 gallons or more are released. An oil or petroleum product spill is required to be reported if 42 gallons or more are released. Any other hazardous materials spill is required to be reported if there is a reasonable belief that the release poses a significant present or potential hazard to human health and safety, property, or the environment. When a hazardous materials spill or leak occurs, it is the owner's or operator's responsibility to notify the local designated emergency response agency, which is called the Certified Unified Program Agency (CUPA), as well as the OES.

California Emergency Management Agency

OES developed the Response Information Management System (RIMS) as part of the development of the State's Standardized Emergency Management System (SEMS). The purpose of RIMS is to provide a single point for tracking the status and progress of hazardous materials spills statewide. Only registered users can input data into RIMS, but anyone can access the website to review current or archived OES cases.

The archived cases, including those from 1993 through 2017, can be accessed at:
http://www.caloes.ca.gov/FireRescueSite/Pages/Spill-Release-Reporting.aspx

Summary of Findings for Spills

- There were only two non-sewage related spills which occurred directly into Lake Berryessa.
- Most spills occurred on land, and were located far upstream of the lake.
- Although spills have potential to contaminate lake, none of significance during reporting period. Please see Wastewater section for information on sewage-related spills.

RECREATION

Background

Recreational uses along Putah Creek consist primarily of camping, picnicking, hiking, and fishing. Boating is allowed in Lake Solano, but only non-motorized boats.

The 2013 Watershed Sanitary Survey provides a historical background of recreational at Lake Berryessa from its opening in 1958 to 2013.

As stated in the 2013 Watershed Sanitary Survey, Reclamation has committed to reopening as many resorts as possible in 2013, contingent upon entering into short-term agreements with interim concession contractors. All of the recreational areas have reopened with interim concession contractors, except for Monticello Shores and Berryessa Point. Long term contracts are in place at Pleasure Cove with Forever Resorts through December 2040, and at Markley Cove with concessionaire FX10, through December 2047.

In 2018, Napa County issued a Request for Information and Interest for concessionaires at Putah Canyon, Monticello Shores, Berryessa Point, Spanish Flat and Steele Canyon. Napa County and Reclamation are currently negotiating on a Managing Partnership Agreement to allow Napa County to manage recreation at Lake Berryessa.

Additionally, in December 2017, Reclamation completed an Environmental Assessment to evaluate potential environmental consequences for redeveloping Steele Canyon, Spanish Flat, Putah Canyon, Berryessa Point .and Monticello Shores. The Environmental Assessment included infrastructure plans for water supply, wastewater treatment and disposal, stormwater management, electrical distribution and access roads. To date, these plans have not materialized.

Related Constituents

Body contact recreation in general has long been known to be a source of pathogen contamination, resulting partly from personal sanitary conduct and partly from a natural shedding process. Pathogens shed by recreationalists include bacteria, viruses, and protozoa. Moreover, because their origin is human, microorganisms shed by recreationalists are transmittable to other humans.

Occurrence in Watershed

Reclamation estimated that there were approximately 750,000 estimated visitors.to Lake Berryessa in 2017, mostly due to the lake level finally rising to full capacity. Previously, the estimated visitation was between 400,000 and 500,000 visitors. SCWA estimates that the average number of boats launching into Lake Berryessa is about 30,000 boats annually.

The current recreational facilities at Lake Berryessa are shown in **Figure 4-1** and described in this section. **Table 4-2** provides a summary of the amenities available at each of the recreational facilities.

Figure 4-1. Recreational Areas at Lake Berryessa

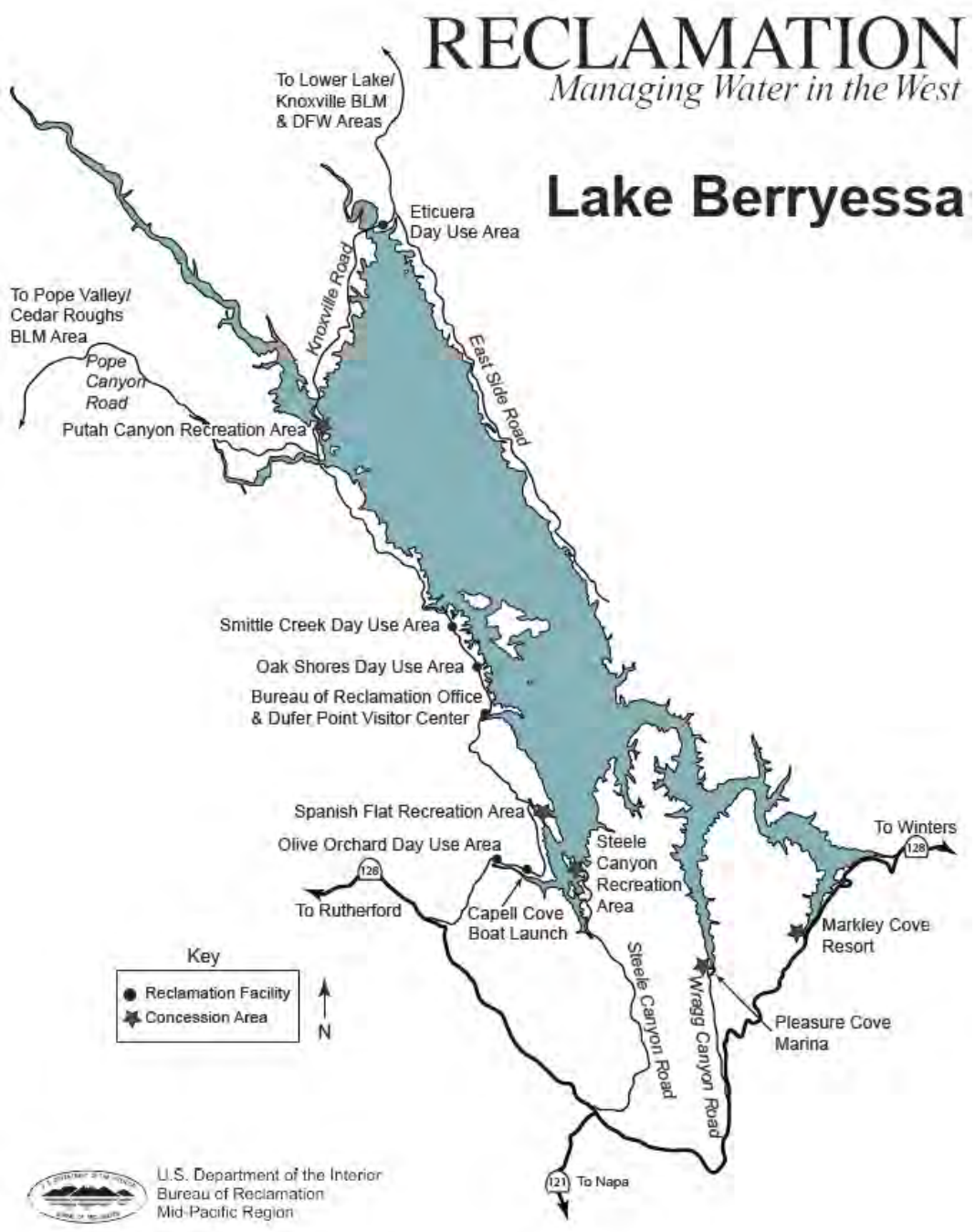


Table 4-2 Summary of Amenities at Recreation Areas

RECLAMATION
Managing Water in the West

Lake Berryessa
Visitor Services

Services	Fees Apply	Boat Launching	Hand Launch Ramp	Boat Moorage	Small Boat Rental	Houseboat Rental	Gas (For Boats Only)	Day Use Area	Hiking	Tent Camping	RV Camping	RV Hookups	RV Dump Station	Potable Water	Showers	Cabins	Store/Supplies/Bait	Contact Information (Phone/Website)
Eticuera			•					•										Operated by the Bureau of Reclamation (707) 966-2111 www.usbr.gov/mp/ccao/berryessa
Smittle Creek			•					•	•									
Oak Shores			•					•	•					•				
Capell Cove		•	•					•										
Markley Cove	•	•		•	•		•							•		•	•	(707) 966-2134 www.markleycoveresort.com
Pleasure Cove	•	•		•	•	•	•	•		•	•	•	•	•	•	•	•	(707) 966-9600 www.goberryessa.com
Steele Canyon	•	•						•		•	•		•	•				(707) 966-9179 www.goberryessa.com/campground-at-steele-canyon
Spanish Flat	•	•						•		•	•		•	•				(707) 966-0200 www.spanishflatcamping.com
Putah Canyon	•	•						•		•	•		•	•				(707) 966-9051 www.royalelkparkmanagement.com

Services may change throughout the season.
Please note that there is no vehicle gasoline available at Lake Berryessa.

Emergency Contact Information	
Napa County Sheriff Dispatch	(707) 253-4451
California Highway Patrol	(707) 551-4180
CHP Dispatch	911
Pope Valley Garage (Towing)	(707) 965-2302
Reclamation Visitor Center	(707) 966-2111 x 113

Oak Shores Day Use Area Hours	
April 1 to September 30	**7:30 am to 8:00 pm**
October 1 to March 31	**7:30 am to 5:00 pm**

Current as of: 4/6/2018

Putah Canyon Recreation Area

The Putah Canyon Recreation Area is located 29 road miles from Monticello Dam. Currently, Putah Canyon is being operated by Royal Elk Park Management through December 2018. There are 98 campground sites, both tent and RV. There is also a boat launch and RV dump station. In 2014, Reclamation installed two vault toilets, RV dump station and two spigots for potable water. In 2016, a well for potable water was installed by Reclamation. There are no showers or flush toilets. Previously in 2013, Reclamation was operating it as a free day use and boat launching area. Wastewater collection and facilities were demolished in 2011 by Reclamation.

Monticello Shores Recreation Area

The Monticello Shores Recreation Area is 27 road miles from Monticello Dam. Currently, Monticello Shores is closed to the public. Its reopening is contingent upon Napa County securing a long-term concession contract for its management and operation and upon significant improvements being made to infrastructure at the site. Wastewater collection and facilities were demolished in 2011 by Reclamation.

Berryessa Point Recreation Area

The Berryessa Point Reclamation Area is 26 road miles from Monticello Dam. Currently, the recreation area is closed to the public. Its reopening is contingent upon Napa County securing a long-term concession contract for its management and operation and upon significant improvements being made to infrastructure at the site. . Wastewater collection and facilities were demolished in 2011 by Reclamation.

Spanish Flat Recreation Area

The Spanish Flat Recreation Area is located 19 road miles from Monticello Dam. Currently, Spanish Flat is being operated by Spanish Flat Partners through December 2018. There are 55 campground sites, both tent and RV. There is also a boat launch and RV dump station. In 2015, Reclamation installed two vault toilets, RV dump station and two spigots for potable water. Previously in 2013, Reclamation was operating it as a free day use area. . Wastewater collection and facilities were demolished in 2011 by Reclamation.

Steele Canyon Recreation Area

The Steele Canyon Recreation Area is located 17 road miles from Monticello Dam. Currently, Steele Canyon is being operated by Forever Resorts through December 2018. There are 84 campground sites, both tent and RV. There is also a boat launch and RV dump station. In 2014, Reclamation installed two vault toilets, RV dump station and two spigots for potable water. Potable water comes from a water tank which is purchased from the NBRID WTP. Previously in 2013, Reclamation was operating it as a free day use area and boat launch. Wastewater collection and facilities were demolished in 2011 by Reclamation.

Pleasure Cove Marina

Pleasure Cove Marina, located at the lake shore at the end of Wragg Canyon, 9 road miles from Monticello Dam, is currently being operated under a long-term contract with Forever Resorts through December 2040. There is a full marina with gas dock and pump out for sewage. There are also houseboat rentals, boat slips, rental cabins, and 140 overnight campsites (both tent and RV). The recreational area is served by both flush and chemical toilets, with wastewater handled through septic tanks.

Markley Cove Resort

Markley Cove Resort is located 3 road miles from Monticello Dam. It is being managed by FX10 through December 2047. It has a full marina with gas dock and pump out for sewage. The resort has a general store, boat launching facilities, a boat storage area, rental cabins, boat and jet-ski rentals, boat slips, and fueling services. The marina accommodates approximately 200 boats, including 30 houseboats. Wastewater is handled by septic tanks and evaporation and percolation ponds.

Reclamation also operates 5 day use areas. The facilities are operated by Reclamation with the exception of Camp Berryessa, now renamed as EcoCamp Berryessa operated by the Napa County Regional Park and Open Space District. These facilities, all located along Berryessa Knoxville Road on the western shoreline of Lake Berryessa are described in this section.

Eticuera Day Use Area

Located on the far north shoreline of Lake Berryessa at Eticuera Creek and 33 road miles from Monticello Dam, Eticuera Day Use Area consists of a parking lot, a comfort station with pit toilets located in the lot, a trash bin, and a short walkway down to the lake shore. While picnicking and shoreline fishing can take place at Eticuera Day Use Area, there are no tables or other facilities to support these activities. While East Side Road extends further south along the lake's eastern shoreline, Eticuera Day Use Area is the recreation facility most distant from Monticello Dam developed and operated for visitors to Lake Berryessa.

Smittle Creek Day Use Area

Smittle Creek Day Use Area, located on the lake's western shore, 25 road miles from Monticello Dam is open to visitors from sunrise to sunset. The day use area consists of a parking lot, picnic tables, barbeque grills, a water fountain, a comfort station with flush toilets and a 5.2-mile out and back nature trail. Wastewater from the Smittle Creek Day Use Area is handled by the wastewater treatment plant operated by Reclamation.

Oak Shores Day Use Area

By far the largest and most-visited recreation facility operated by Reclamation at Lake Berryessa, Oak Shores Day Use Area, located on the lake's western shoreline, 23 road miles from Monticello Dam, offers day visitors a variety of recreational opportunities, including fishing, wildlife viewing, beach activities, swimming, hiking, and picnicking. Open from 7:00 am to 8:00 pm daily and spread out over eight distinct areas (from north to south: Coyote Knolls, Coyote Beach, Patwin Grove, Twin Oaks, McKenzie Ridge, Shale Point, Foxtail Flat, and Acorn Beach), Oak Shores is equipped with over 100 individual and group picnic sites equipped with barbeque grills, two hand launches for kayaks and canoes (at Foxtail Flat and Coyote Knolls), shoreline fishing areas, and protected swimming areas at Coyote Beach and Acorn Beach. A short trail leads from the southern end of Oak Shores just beyond the Acorn Beach area to the Reclamation Field Office and the Dufer Point Visitor Center.

The areas just offshore of the two beaches are off-limits to motorized boating and what areas do allow motorized boating between Oak Shores and Big Island limit boaters to a 5 mile per hour speed limit. Oak Shores provides several comfort stations with flush and pit toilets, supplemented by portable toilets, along with trash and recycling receptacles. Wastewater from the Oak Shores Day Use Area is handled by the wastewater treatment plant operated by Reclamation.

Dufer Point Visitor Center

Located 22 road miles from Monticello Dam, the Dufer Point Visitor Center offers visitors exhibits on the lake's natural resources and provides printed information and literature. The center is open to the public on Saturdays and Sundays only but several brochures are available when the center is closed at a display just outside the entry door. The center's restrooms are equipped with flush toilets. Wastewater from the visitor center is handled by the wastewater treatment plant operated by Reclamation.

Capell Cove Boat Launch

Located 18 road miles from Monticello Dam, the Capell Cove Boat Launch is a day use facility consisting of a boat launch ramp, an adjacent dock, a parking lot with a comfort station connected to a septic tank system, an oil absorbent bilge pad dispensing and receiving station and an access gate that is closed during non-operating hours.

Olive Orchard Day Use Area

Located 17 road miles from Monticello Dam, the Olive Orchard Day Use Area is a small facility with a few parking spaces, a comfort station equipped with a pit toilet and a single picnic table.

EcoCamp Berryessa

Located on 15 acres on the northern shore of Putah Cove on the lake's western shoreline and 29 road miles from Monticello Dam, Camp Berryessa is a former Boy Scout camp that closed in 2004. Camp Berryessa, now EcoCamp Berryessa, has undergone a $1.7 million transformation and opened in October 2016. A $1.5 million state Coastal Conservancy grant, a $50,000 grant from the Giles W. and Elise G. Mead Foundation of Napa and county money in the district budget brought about the $1.7 million project.

EcoCamp Berryessa is a 64-bed group environmental education camp and features solar power, showers feeding into a graywater system, environmentally friendly composting toilets, permanent tent cabins, a stone amphitheater, a canoe/kayak launch, a beach, and paths and trails. EcoCamp Berryessa is operated by the Napa County Regional Park and Open Space District and is home to the Napa Open Space District's outdoor education program.

Regulation and Management

As described in the Background section, management of recreation area is handled by Reclamation, through the use of both long and short-term concessionaire contracts. Reclamation and Napa County are currently negotiating on a Managing Partnership Agreement to allow Napa County to manage recreation at Lake Berryessa.

Source Water Protection Activities

The Lake Berryessa Boater Outreach Program (LBBO) focuses on educational outreach and invasive species prevention at Lake Berryessa. The primary goal of the LBBO program is to prevent the introduction of quagga and zebra mussels into Lake Berryessa. From mid-April to September, seven days a week, LBBO interns administered watercraft screening for invasive zebra and quagga mussels and conducted surveys and one-on-one education with boaters and recreational users. Watercraft is screened visually and the boater is asked a set of questions to determine risk of transmitting quagga and zebra mussels. Thirteen interns and three student supervisors frequented all six boat launches at Lake Berryessa.

Invasive screenings were conducted using The Bureau of Reclamation's *Invasive Mussel Self-Certification Form*, which helps identify boaters that may have launched in an infested body of water within the past 30 days. Boaters that passed the screening were given the form to display on the dashboard of their vehicle to indicate they were approved to launch; however, boaters that had launched in an infested water body within 30 days of the screening and failed a full inspection were denied entry to the lake and directed to contamination services.

Screening boats is the LBBO program's number one priority, but interns also conduct boater outreach regarding clean and safe boating practices. All boaters who completed a survey received a tote bag filled with a boater kit. Highlights of the boater kit included a bilge pad to keep oil and fuel contaminants from leaving bilge compartments, a fuel bib to eliminate spilled gasoline while refueling, and a West Marine coupon for 15% off a purchase. Also included in the kits are booklets about California boating and environmental laws as well as educational materials regarding zebra and quagga mussels. Boater kits were generously provided by the California State Parks Division of Boating and Waterways and the California Coastal Commission.

Table 4-3 summarizes the LBBO Program's totals over the past five years. A record number of 16,799 watercraft were screened in 2017.

Table 4-3. Summary of Lake Berryessa Boater Outreach Program, 2013-2017

Season Totals	2013	2014	2015	2016	2017
# of Interns & Student Supervisors	6	6	14	12	16
Total Invasive Screenings	1,547	4,301	9,197	10,860	16,799
Total Boater Surveys	1,568	1,670	1,195	1,210	1,115
Total Recreator Surveys	325	300	392	265	224
Total Bilge Pads Distributed	2,214	2,191	1,848	1,577	1,721
Total Bilge Pads Installed	478	690	589	497	372
% of Boaters to Install a Bilge Pad	51%	50%	57%	50%	41%

Summary of Findings for Recreation

- Although swimming and boating can occur in Putah Creek, all of the recreation areas are downstream of the LBRID WTP. Therefore, only the NBRID WTP is directly impacted. *E. coli* levels at the NBRID WTP are very low, with an average of 2 MPN/100mL and a median of ND from 2013 to 2017, indicating no impact from recreation.

- With new concessionaires on the horizon, the potential impact from recreation could increase in the future, although plans remain undeveloped.

- The Lake Berryessa Boater Outreach Program is a very effective program to screen for invasive mussels, but also promote clean and safe boating practices.

- There were no spills reported in regards to the gas docks or sewage pumpout located at the marinas.

AGRICULTURE

Background

Agricultural-related activities within the watershed are vineyards, crops, and nurseries.

Related Constituents

Agricultural crops can impact water quality through their use of fertilizers and pesticides. Drip irrigation is most common within the watershed for irrigation in summer and early fall. Since drip irrigated lands do not generate runoff during the growing season when most fertilizers and pesticides are applied, it is highly unlikely that pesticides or fertilizers are being transported to Putah Creek due to irrigation.

Occurrence in Watershed

Overall, there is limited agricultural use in the watershed. For the portion of the watershed which is within Napa County, 99.7 percent of the irrigated lands are wine grape vineyards, with olives as the remainder. It is important to note that wine grapes are irrigated using drip irrigation. Due to the nature of drip irrigation, drip irrigated lands do not generate runoff during the growing season when most fertilizers and pesticides are applied. Therefore, irrigation related pesticide or fertilizer transport is highly unlikely to occur in this watershed.

The Napa County Agricultural Commissioner's Office reports that the most typical pesticides used are elemental sulfur to control mildew on grapes, mineral oil to control insects, and glyphosate to control weeds. Sulfur and mineral oil is used between April and July, and glyphosate is used between November and February. However, it is not applied ahead of forecasted rainfall.

As shown in **Figure 4-2**, the Napa County Agricultural Commissioner's Office identified the top five parcels by meridian range township section (MRTS) which is approximately 1 X 1 mile for total pesticide usage (in lbs.) from 2013 to 2017. Chemical usage and crop type is summarized in **Table 4-4.**

Figure 4-2. Top Five Parcels Identified for Pesticide Usage from 2013 to 2017 in Lake Berryessa Watershed, Napa County

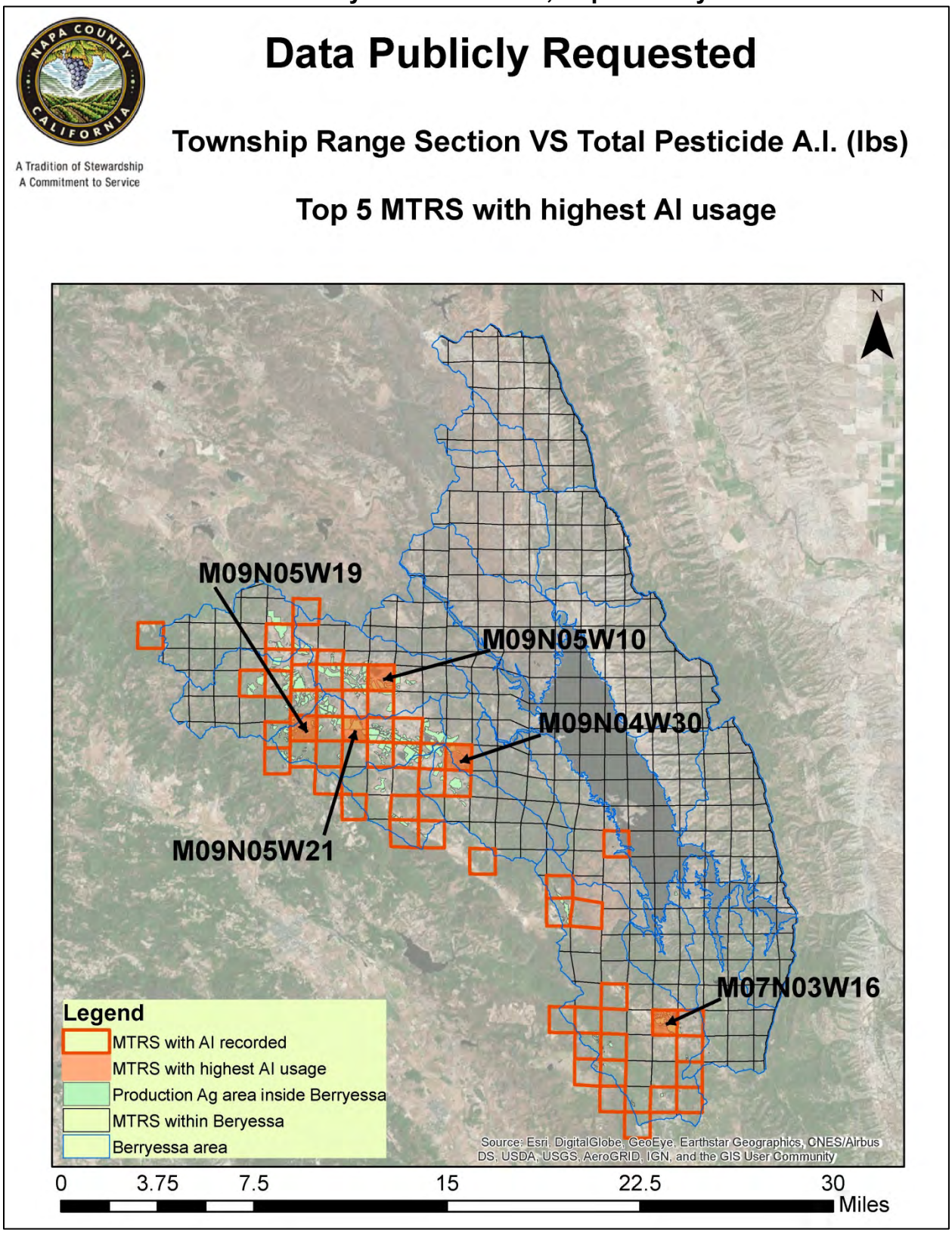


Table 4-4. Chemical Usage for Top 5 MRTS in Lake Berryessa Watershed, Napa County from 2013 to 2017

Meridian Township Range Section	Chemical Usage, lbs.	Crops Grown	Chemicals Used
M09N04W30	96,813 lbs.	Wine Grapes, Apple Pear, Stone Fruit, Olives	Glyphosate and Sulfur
M09N05W10	66,436	Wine Grapes	Sulfur, Pyraclostrobin, Myclobutanil, Flumioxazin
M09N05W21	50,327	Wine Grapes	Chloropicrin, Pyraclostrobin, Sulfur, Tebuconazole
M09N05W19	48,978	Wine Grapes	Kaolin, Sulfur
M07N03W16	28,525	Wine Grapes	Sulfur, Copper, Glyphosate

Related Water Quality Issues and Data Review

Copper and glyphosate are the only pesticides listed in **Table 4-4** for which drinking water standards has been established. No VOCs or SOCs were detected at the LBRID or NBRID intake over the reporting period. There were no detections of glyphosate at the NBRID intake over the reporting period. Glyphosate is not required to be monitored at the LBRID intake.

The United States Environmental Protection Agency (USEPA) has established human health benchmarks for various pesticides in drinking water that do not have Maximum Contaminant Levels (MCLs) to determine potential health risk. The human health benchmarks (acute and chronic) are provided in **Table 4-5** for additional information.

Table 4-5 Human Health Benchmarks for Pesticides Used in Watershed that do not have MCLs

Pesticide	Acute Benchmark (one-day), ug/L	Chronic Benchmark, ug/L
Myclobutanil	20,000	160
Pyraclostrobin	1,000	220
Flumioxazin	800	100
Tebuconazole	3,000	47

Source: https://www.epa.gov/dwstandardsregulations/human-health-benchmarks-pesticides-drinking-water

Regulation and Management

Regional Water Quality Control Board, Central Valley Region

In 2014 the Regional Board finalized and adopted the Irrigated Lands Regulatory Program (ILRP) as the long-term solution for irrigated agricultural discharges. The ILRP addresses discharge of wastes (e.g., sediments, pesticides, nitrates) from commercial irrigated lands. These wastes can harm aquatic life or make water unusable for drinking water or agricultural uses. The goal of the ILRP is to protect surface water and groundwater and to reduce impacts of irrigated agricultural discharges to waters of the State. Two orders were adopted by the Regional Board for coalitions in the Sacramento River watershed; R5-2014-0030 – Waste Discharge Requirements General Order for Growers within the Sacramento River Watershed That are Members of a Third-Party Group (Sacramento River Watershed) and R5-2014-0032 – Waste Discharge Requirements General Order for Sacramento Valley Rice Growers (Sacramento Valley Rice Growers).

The Sacramento Valley Water Quality Coalition (SVWQC) was developed to comply with the Discharges from Irrigated Lands Regulatory Program. It consisted of a monitoring program and management practices where the monitoring data indicated the need. The SVWQC covers all non-rice irrigated crops in the Sacramento Valley, including wild rice and pastureland. The Napa County Putah Creek Watershed Group was formed in response to the irrigated lands regulatory program and is a subgroup of the SVWQC. The Napa County Putah Creek Watershed Group is signatory to the SVWQC.

The SVWQC previously conducted water quality monitoring at two sites in the watershed: Capell Creek and Pope Creek. Monitoring was discontinued at Capell Creek in 2008. In lieu of water quality monitoring at Pope Creek in 2013 and 2014, the Putah Creek Watershed Group participated in a BMP pilot program.

As shown in **Table 4-6**, Pope Creek was sampled six times from 2014 to 2015. High levels of *E. coli* in December 2014, February 2015 and April 2015 are of most interest. Pope Creek was also sampled in 2016 for toxicity, pyrethroids, and chloropyrifos. Pope Creek was sampled for sediment only in 2017.

Table 4-6. Water Quality Monitoring in Pope Creek, Putah Creek Watershed Group

Date	Total Coliform MPN/100mL	*E. coli,* MPN/100mL	Nitrate/Nitrite, mg/L	TOC, mg/L	Specific Conductance, uS/cm	TSS, mg/L	Total Copper, ug/L
12/2/2014	NT	2419.6	0.12	8.2	NT	NT	NT
1/20/2015	NT		NT	NT	353.7	NT	NT
2/9/2015	2419.6	410.6	0.2	5.5	131.2	131	NT
3/18/2015	NT	44.1	0.17	2.1	436.6	6	NT
4/21/2015	2419.6	791.5	NT	2.5	568	NT	1.2
5/20/2015	NT	30.1	NT	2.3	667	NT	1

NT = sample not taken

Source Water Protection Activities

The 2014 Agricultural Orders require growers to self-inspect, implement best management practices, conduct water quality monitoring either as a group or individual, and submit farm information to either their coalition or the Central Valley Water Board, including farm evaluations and nitrogen management data

As stated above, the Putah Creek Watershed Group participated in a BMP pilot program. As part of the pilot BMP program, annual inspections were conducted for three farms. The landowner was notified and agreed to the inspection. BMPs were then recommended to the landowner such as mulching, cover crop, filter strips, integrated pest management and irrigation water management.

Summary of Findings for Agriculture

- There is limited agriculture use in the watershed, of which, 99.7 percent are wine grapes.

- As wine grapes are drip irrigated, irrigation related pesticide or fertilizer transport is highly unlikely to occur in this watershed.

- Commercial growers are required to be enrolled in the Central Valley Regional Water Quality Control Board's Irrigated Lands Program, and most growers are likely participating in the Sacramento Valley Water Quality Coalition, through the Napa County Putah Creek Watershed Group.

- Copper and glyphosate are the only pesticides used in the watershed draining to Putah Creek for which drinking water standards have been established. Monitoring data collected at the LBRID and NBRID WTPs water show low levels of copper (less than 50 µg/L) and no detections of glyphosate at the NBRID WTP.

WASTEWATER

Background

Wastewater is known to contain pathogenic microorganisms. Wastewater treatment plants remove and/or inactivate some, though not all, of these organisms through various treatment processes. Secondary treatment of domestic sewage is expected to remove 75 to 99 percent of enteric viruses[1], 85 to 99 percent of heterotrophic bacteria[2], and 92[2] percent of *Giardia* cysts.

Lake Berryessa is designated as a no discharge basin by the Central Valley Regional Water Quality Control Board (Central Valley Water Board), meaning, no direct discharges of wastewater to surface waters is allowed in the watershed.

The upper portions of the watershed are served primarily by onsite wastewater treatment systems and several small wastewater treatment facilities that discharge to ponds or to the Southeast Geysers Effluent Pipeline (SEGEP). The small communities and resorts around Lake Berryessa are served primarily by systems that discharge to evaporation and percolation ponds. Individual home owners and businesses near the lake have onsite wastewater treatment systems.

Seasonal Patterns

Sewer spills typically occur in during heavy precipitation events when infiltration occurs into the collection system. Mostly recently, this occurred in January and February of 2017 at two wastewater treatment plants in the watershed.

Related Constituents

Wastewater is a blend of sewage, washwater from showers, kitchens, etc., and any effluent from industrial facilities within the sewer collection system. Potential contaminants of concern in wastewater include microbial pathogens (such as bacteria, viruses, and protozoa), total organic carbon (TOC), volatile organic compounds (VOCs), and synthetic organic compounds (SOCs).

Occurrence in Watershed

The rural areas of the Putah Creek watershed and the small communities of Loch Lomond, Adams, and Whispering Pines are served by onsite waste treatment systems. Installation of new systems is subject to review and approval by the Lake County Environmental Health Division. Onsite systems must be designed to meet the optimal

[1] National Research Council, 1998. Issues in Potable Reuse: The Viability of Augmenting Drinking Water Supplies with Reclaimed Water. National Academy Press.

[2] Chauret, C. et al., 1999. Fate of *Cryptosporidum oocysts*, *Giardia cysts*, and microbial indicators during wastewater treatment and anaerobic sludge digestion. Canadian Journal of Microbiology, 45: 257-262.

carrying capacity of the individual site's soils, slopes, and water table conditions. While lots with site conditions that are inadequate to support septic systems previously were undevelopable, relatively new technology and regulations permit installation of engineered systems that are self-contained and not reliant on site conditions. Many previously undevelopable lots can now be developed using these systems (Lake County Community Development Department, 2010).

The community of Anderson Springs surrounds Anderson Creek, a small stream that flows into Putah Creek. The Anderson Springs subdivision has had numerous septic system failures, largely due to inadequate and/or aging systems. Water samples taken within and downstream of Anderson Springs showed elevated fecal coliform levels. The Valley Fire of 2015 destroyed 193 of the 212 homes in Anderson Springs. Due to more stringent requirements associated with the siting and construction of new septic tanks, over half the homes cannot be rebuilt unless a sewer system is installed. A $7.4 million grant was received from the State Water Resources Control Board through the Clean Water State Revolving Fund in January 2018. Plans are now moving forward to install a sewer system, to be completed by December 2019.

Two spills also occurred from the Cal Pine facility in Middletown. On August 2, 2014 25,000 gallons of tertiary treated sewage entered Anderson Creek, which is a tributary to Bear Canyon Creek, which is a tributary to Putah Creek. *E. coli* levels in the LBRID plant influent on August 11, 2014, August 25, 2014 and September 8, 2014 ranged from ND to 5.2 Most Probable Number per 100 milliliters (MPN/100mL), indicating no impact from the spill. There was also a smaller spill of 270 gallons of secondary treated recycled water on June 28, 2017 due to a cracked pipe.

Middletown

LACOSAN provides wastewater collection and treatment to 492 connections (pre-Valley Fire) in the community of Middletown and the Harbin Springs Resort. The Middletown WWTF operates under Waste Discharge Requirement (WDR) Order 97-249, issued by the Central Valley Water Board. The WWTF was constructed in 1992 and has an average dry weather flow of 0.15 million gallons per day (mgd) and a peak wet weather flow of 0.5 mgd. The WWTF consists of a facultative pond system consisting of a primary pond, three secondary ponds, a sodium hypochlorite feed system and contact basin, an effluent storage reservoir, an effluent pump station, and a spray irrigation system that may be used as a back-up disposal. The influent flows are measured using magnetic flow meters, which are all calibrated on an annual basis. The ponds are all lined. The facility discharges to SEGEP, where it is injected into the Geysers steamfield for power production. The back-up disposal system consists of a 240 acre-foot storage pond. Water from the storage pond is used to spray irrigate fodder crops. The plant was last inspected on July 30th, 2015. The inspection report noted that BOD and pH in the effluent, which is discharged to the effluent storage reservoir, exceeded permit levels. However, this does not affect water quality to Lake Berryessa.

Although discharge to surface waters is not allowed, any spills from the collection system or WWTF would flow into Putah Creek. As shown in **Table 4-7**, there were three spills over the reporting period. It is important to note that these did not reach surface waters.

Table 4-7. Sanitary Sewer Overflows from Middletown WWTF or Collection System

Discharger or Reporting Agency	Date	Spill Location	Type of Spill	Cause	Volume	Receiving Water
Lake County Special Districts	4/26/2014	21450 Valley Oak Dr. Middleton	Sewage	Blockage	200 gals	No
Middletown Regional Waste Disposal CS	11/9/2016	21425 Valley Oak Dr. Middletown	Sewage	Grease Blockage	30 gal.	No
Middletown Regional Waste Disposal CS	10/7/2014	21713 South Hwy 29 Middletown	Sewage	Grease Blockage	300 gal.	No

Hidden Valley Lake Community Services District

The Hidden Valley Lake Community Services District provides wastewater collection and wastewater treatment services to 1,400 connections in the community of Hidden Valley Lake and some commercial parcels in the Coyote Valley. A number of residences in the Hidden Valley Lake community are on engineered onsite wastewater treatment facilities.

The wastewater collection system consists of eight sewage booster pump stations. The Hidden Valley Lake Water Reclamation Facility operates under Waste Discharge Order R5-00-019, issued by the Central Valley Water Board. The facility became operational in 1996 and includes an activated sludge-extended aeration plant with an average dry weather flow of 0.350 mgd and a peak wet weather flow of 0.894 mgd. The facility processes include primary screening, secondary treatment through an activated sludge and clarification process, direct tertiary filtration, chlorination, six sludge drying beds, a

concrete-lined equalization basin and an effluent storage basin. The sludge from the plant is pumped into Geotube@ bags for dewatering, and then transported to Keller Canyon landfill in Contra Costa County for disposal. Treated effluent is stored in the 412 acre-feet, clay-lined, effluent storage basin, and is then pumped into two irrigation ponds located on the Hidden Valley Lake golf course. Treated effluent is used to spray irrigate the Hidden Valley Lake golf course. The plant was last inspected on February 8, 2017. The inspection report noted that total coliform and pH in the effluent exceeded permit levels. However, this does not directly affect water quality to Lake Berryessa.

Although discharge to surface waters is not allowed, any spills from the collection system or plant would flow into Crazy Creek and then into Putah Creek. As shown in **Table 4-8,** there were three spills, with one spill reaching Hidden Valley Lake. As a precautionary measure, Hidden Valley was temporarily closed to the public for recreation use.

Table 4-8. Sanitary Sewer Overflows from Hidden Valley Lake Water Reclamation Facility or Collection System

Discharger or Reporting Agency	Date	Spill Location	Cause	Volume (gallons)	Receiving Water
Hidden Valley Lake CSD	1/10/2017	Manhole located at 18805 North Shore Drive	I & I (rainfall)	1,500 gallons	No
Hidden Valley Lake CSD	01/08/2017	Overflowing Manholes located at the corner of 18550 Brookfield Road and North Shore Drive	I & I (rainfall)	9,775	Hidden Valley Lake
Hidden Valley Lake CSD	01/08/2017	19666 and 19683 Mountain Meadow South	I & I (rainfall)	39,900 gallons	No

Lake Berryessa Resort Improvement District, Lake Berryessa Estates

LBRID was established in 1965 to provide potable water and sewer services to the Lake Berryessa Estates Unit 2 subdivision, an unincorporated community located along Putah Creek. The LBRID WWTF currently serves 180 single-family residences. At full build-out, LBRID will provide water and wastewater services to 339 lots.

The disposal of wastewater is allowed under WDR Order R5-2013-0114, issued by the Central Valley Water Board. The order allows LBRID to treat and dispose of an average dry weather flow of 42,000 gallons of treated water per day with a peak flow of 123,000 gallons per day.

Wastewater from the community flows via gravity to three lift stations where it is pumped to a 91,000 gallon aboveground holding tank. From the tank, wastewater is pumped approximately 1.2 miles into a manhole. From the manhole, wastewater gravity flows to facultative treatment ponds. LBRID completed repairs to the sewage collection system in the fall of 2011 to reduce infiltration and inflow to the system.

Between 2014 and 2016, the capacity of the LBRID treatment, storage and disposal area was increased. The LBRID treatment system now contains eight ponds, where there were seven before: four are considered treatment ponds, and the other four are storage ponds. Wastewater flows via gravity through the four treatment ponds that are connected in series. From the fourth pond, wastewater can either gravity flow into pond 5, or be pumped to ponds 7 or 8. Wastewater from pond 7 and 8 can gravity flow into pond 6 as needed, and wastewater from pond 6 can be released back into pond 4 for pumping back into pond 7 for storage or disposal.

The wastewater in pond 7 is disinfected with sodium hypochlorite, pumped through a chlorine contact basin, and then applied via spray irrigation to four separate land application areas totaling approximately 15.5 acres. The acreage for the land application area was increased as part of the 2014 to 2016 project from two areas totaling 5.3 acres, to four totaling 15.5 acres. Runoff from the spray fields is collected within a tail water collection ditch which flows via gravity or is pumped back into the pond system for reapplication.

As shown in **Table 4-9**, there have been 20 spills from the LBRID system, of which 9 spills reached a surface water, either Stone Corral Creek or Butts Creek. The largest spill was a controlled wastewater discharge from pond 7 to the land application area without collection of tail water runoff. This controlled discharge began on February 20, 2017 and the total volume was 4.5 million gallons. The controlled discharge was implemented to prevent overtopping of the pond berms. The District has stated that a combination of direct rainfall, local runoff, and groundwater seepage into the storage ponds exceeded the 100-year design capacity of the ponds. Another large spill occurred due to a broken pipe leading from pond 3 to pond 4. A total of 2.5 million gallons was spilled.

Table 4-9. Sanitary Sewer Overflows from LBRID Facility or Collection System

Discharger or Reporting Agency	Date	Spill Location	Type of Spill	Cause	Volume	Receiving Water
Berryessa Estates	11/17/2014	2356 Stagecoach	Sewage	Blockage	30 gal	No
Phillips and Associates	8/22/2014	1465 Stagecoach Canyon Rd. Pope Valley	Sewage	Mechanical	75 gal	No
Phillips and Associates	4/23/2015	2337 Stage Coach Canyon Rd Pope Valley	Sewage	Blockage	100 gal	No
Napa County Public Works	1/18/2016	2535 Wagon Wheel Dr.	Sewage	Power Failure	100-150 gal	Unknown
Napa County Public Works	2/5/2016	2212 Stage Coach Canyon Pope Valley	Sewage	Blockage	30 gal	No
LBRID	2/21/2017	2446 Stage Coach Canyon Road. Pope Valley	Sewage	Storm Surge	110,000 gal	Stone Corral Creek
LBRID	3/30/2014	2535 Wagon Wheel Drive	Sewage	Root Intrusion	600 gal.	Yes (200 gal), Stone Corral Creek
LBRID	9/20/2017	1500' from LBRID facility at 2446 Stagecoach Canyon Rd	Sewage	Pipe Failure	1,000 gal.	Putah Creek
LBRID	2/3/2017	Main Collection Tank for LBRID WWTP	Sewage	Pump Station Failure	5,000 gal.	2,500 gal to Putah Creek
LBRID	1/31/2015	2218 Stagecoach Canyon Rd	Sewage	Root Intrusion	3,000 gal.	2,000 gal. to Butts Creek, then Putah Creek
LBRID	2/20/2017	LBRID Spray Fields - 1.5 miles south of 2446 Stagecoach	Treated wastewater and storm water	Capacity of Storage Ponds exceeded	4.5 MG	4,514 gal to Stone Corral Creek , then Putah Creek

Discharger or Reporting Agency	Date	Spill Location	Type of Spill	Cause	Volume	Receiving Water
LBRID	1/8/2017	LBRID Spray Fields - 1.5 miles south of 2446 Stagecoach Canyon Rd.	Treated wastewater and storm water	Pipe break due to excessive storm water runoff beneath pipe during heavy storms in January 2017.	2.5 MG	Stone Corral Creek, then Putah Creek
LBRID	3/11/2014	2390 Harness Dr	Sewage	Grease Blockage	20 gal.	No
LBRID	1/25/2016	113 Mustang Ct.	Sewage	Debris Blockage	30 gal.	No
LBRID	11/26/2013	2451 Harness Dr.	Sewage	Root Intrusion	10 gal.	No
LBRID	10/30/2016	Manhole A-2.1	Sewage	Debris Blockage	350 gal.	No
LBRID	1/4/2013	119 Mustang Ct.	Sewage	Pipe Failure	100 gal.	No
LBRID	3/12/2015	Easement next to 119 Mustang Ct	Sewage	Root Intrusion	100 gal.	No
LBRID	12/7/2015	114 Sage Ct	Sewage	Root Intrusion	50 gal.	No
LBRID	1/13/2017	Main Sewer Collection Tank	Sewage	Pump at Lift Station Failed	5,000 gal.	Putah Creek
LBRID	1/8/2017	Main Sewer Collection Tank	Sewage	Pipe Failure	51,000 gals	Putah Creek

The LBRID WWTP was last inspected on April 21, 2016. The inspection report noted that some of the reporting requirements were incomplete, as well as a few months where the pond pH was greater than 10, or the total coliform (prior to discharge to land) was above 240 MPN/100mL.

Spanish Flat Water District, Berryessa Pines

The Spanish Flat Water District provides water and sewer services to the Berryessa Pines subdivision. The WWTF serves approximately 73 homes.

Sewage from most of the subdivision flows to a pump station at the east end of the site. Sewage from a small portion of the subdivision flows by gravity to the WWTF. The disposal of wastewater is allowed under WDR Order R5-2000-200, issued by the Central Valley Water Board. The wastewater is treated at an 14,000 gallons per day extended aeration package plant. Effluent from the plant is discharged to an evaporation and percolation pond. There is a second pond that is used in emergencies.

The plant was last inspected on May 24, 2012. The inspection report did not note any water quality related issues, but noted the monitoring reports have not been submitted on time. CIWQS does not contain any reports of sanitary sewer overflows from the collection system.

Spanish Flat Water District

The Spanish Flat Water District provides water and sewer services to approximately 50 mobile homes in the Spanish Flat Mobile Villa, and 60 homes in the Spanish Flat Woodlands Subdivision. The Spanish Flat Water District owns the Spanish Flat WWTF and Napa County owns the land on which the treatment plant and main storage/disposal ponds have been constructed.

The disposal of wastewater is allowed under WDR Order 93-236, issued by the Central Valley Water Board. The WDRs allow the discharge of a monthly average dry weather flow of 25,000 gallons per day, with peak daily flows up to 53,000 gallons per day. The WWTF was constructed in 1993 and consists of an extended aeration package treatment plant with an aeration tank, a clarifier, and a chlorine contact chamber. Wastewater is stored and disposed of in an unlined 4.2 million gallon percolation/evaporation pond. During the summer, wastewater is also spray-irrigated on a 2.5 acre disposal field and at the 3.7 acre Monticello Cemetery. In 2006, the Central Valley Water Board adopted a new Monitoring and Reporting Program (Order No. R5-2006-0095) requiring the installation of groundwater monitoring wells.

The plant was last inspected on May 24, 2012. The inspection report did not note any water quality related issues, but noted the monitoring reports have not been submitted on time. CIWQS does not contain any reports of sanitary sewer overflows from the collection system, or any violations.

Napa Berryessa Resort Improvement District, Berryessa Highlands

NBRID was created in 1965 for the purpose of providing water and wastewater service to residential customers and the Steele Park Resort. The WWTF is located on land

owned by Reclamation under a permanent easement to NBRID. The WWTF currently serves only the Berryessa Highlands subdivision.

Wastewater is conveyed to the WWTF by gravity sewers, lift stations, and force mains. The disposal of wastewater from the NBRID WWTF is currently allowed under WDR Order R5-2013-0065, adopted by the Central Valley Water Board on May 31, 2013. The current order allows NBRID to treat and dispose of a monthly average flow of 50,000 gallons of treated water per day to four sprayfields. The new plant, constructed in November 2013, is a membrane bioreactor package (MBR) treatment plant system. Wastewater from the MBR system is disinfected using a sodium hypochlorite and one of the effluent storage ponds as the chlorine contact basin. The disinfected wastewater is then pumped to a 50,000 gallon above ground storage tank prior to being discharged to one of four land application areas, totaling 60 acres. Wastewater runoff from each of the sprayfields is collected and returned to the above ground tank. Sludge is dewatered and disposed of in a landfill.

As shown in **Table 4-10**, there have been six spills from the NBRID system, with one spill reaching Lake Berryessa.

Table 4-10. Sanitary Sewer Overflows from NBRID Facility or Collection System

Discharger or Reporting Agency	Date	Spill Location	Type of Spill	Cause	Volume	Receiving Water
Napa County	5/3/2014	Steele Canyon Rd.	Treated wastewater	Mechanical - Tank Overflow	600-1,000 gal	Lake Berryessa
NBRID	9/19/2013	100' from NBIRD WTP	Backwash water	Broken Valve	80 gal.	No
NBRID	5/17/2016	NBRID Lift Station	Sewage	Pipe Failure	150 gal.	No
NBRID	3/25/2013	1458 Steele Canyon Road Manhole	Sewage	Root Intrusion	300 gal.	No
NBRID	7/17/2013	342 Black Oak Lane	Sewage	Root Intrusion	100 gal.	No

Discharger or Reporting Agency	Date	Spill Location	Type of Spill	Cause	Volume	Receiving Water
NBRID	9/13/2015	1013 Arroyo Grande	Sewage	Debris Blockage	200 gal.	No

The plant was last inspected on April 21, 2016. The inspection report noted that some of the reporting requirements were incomplete, as well as a few months where the total coliform was above 2.2 MPN/100mL in groundwater monitoring wells.

Turtle Rock Motel and Boat Storage WWTF

The Turtle Rock WWTF is a privately owned facility that serves 15 connections, which includes the motel/storage facility and the restaurant/bar located across Highway 128, near the intersection of Highway 28 and Berryessa Knoxville Road.

The disposal of wastewater from the facility is allowed under Water Quality Order 97-010-DWQ, General Waste Discharge Requirements for Discharges to Land by Small Domestic Wastewater Treatment Systems. The facilities consist of two septic tanks and then to a percolation/evaporation pond with a monthly average dry weather flow of 2,500 gallons. The last inspection for this plant was on April 21, 2016. The inspection report did not note any water quality related violations.

Although discharge of wastewater is not allowed, any spills from the WWTF would flow into Soda Creek, a tributary of Capell Creek and Lake Berryessa. No spills were reported from this facility from either the OES database or the State Water Board SSO database.

Capell Valley Mobile Home Park

The Capell Valley Mobile Home Park WWTF is privately owned and serves approximately 59 sewer connections, which include the Capell Valley Mobile Home Park, a few commercial establishments, and domestic wastewater from Moss Creek Winery. The mobile home park is located near the intersection of Highways 128 and 121.

In 1994, the Central Valley Water Board adopted WDRs Order 94-099 to regulate discharges from the Capell Valley Mobile Home Park WWTF. Approximately 9,600 gallons per day of septic tank effluent is discharged to three evaporation/percolation ponds and one emergency overflow pond. In 2006, the Central Valley Water Board adopted a new Monitoring and Reporting Program, requiring the installation of groundwater monitoring wells. All of the ponds have sprinkler aeration systems. The Last inspection for this plant was on April 21, 2016. The inspection report did not note

any water quality related violations, but it did note that some of the reporting requirements were incomplete.

Although discharge to surface waters is not allowed, any spills from the collection system or wastewater ponds would flow into Oak Moss Creek, a tributary of Capell Creek and Lake Berryessa. No spills were reported from this facility from either the OES database or the State Water Board SSO database.

Central Valley Water Board issued a notice of violation (NOV) citing problems with not maintaining adequate freeboard in the ponds and requiring the discharger to submit a short-term contingency plan and a water balance plan. The plans were submitted and Central Valley Water Board staff concurred with the recommendations and required the work to be completed by October 2012. The discharger was unable to complete the work by October 2012 and failed to submit a work plan and schedule. In July 2012, the Central Valley Water Board issued Cleanup and Abatement Order R5-2012-0711. The Cleanup and Abatement Order requires the discharger to submit plans for improvements to correct the pond capacity problem and requires a number of plans and improvements to the monitoring program. According to the Regional Board, the discharger met the requirement of the Cleanup and Abatement Order by enlarging the ponds and the Order was rescinded in June 2014. The April 2016 inspection report noted that there were no freeboard staff gauges in the three evaporation/percolation ponds and one emergency overflow pond.

Circle Oaks County Water District

The Circle Oaks County Water District serves the Circle Oaks subdivision, located three miles south of the junction of Highways 128 and 121. The WWTF currently serves approximately 300 to 350 homes.

In 1994, the Central Valley Water Board adopted WDRs Order 94-097 to regulate discharges from the Circle Oaks County WWTF. The WWTF consists of three stabilization ponds with the capacity to treat a monthly average dry weather flow of 72,000 gallons per day with disposal by evaporation and percolation. The last inspection for this plant was on April 21, 2016. The inspection report noted that total coliform levels in the five groundwater monitoring wells have been consistently reported at concentrations up to 1,600 MPN/100mL.

Although discharge to surface waters is not allowed, any spills from the collection system or WWTF would flow into Capell Creek. As shown in **Table 4-11**, there were two spills over the reporting period, with one spill reaching Capell Creek.

Table 4-11. Sanitary Sewer Overflows from Circle Oaks WWTF or Collection System

Discharger or Reporting Agency	Date	Spill Location	Type of Spill	Cause	Volume	Receiving Water
Circle Oaks WD	11/9/2014	21 Beachwood Dr. Circle Oaks	Sewage	Overflow	150-200 gals	No
Circle Oaks WD	12/1/2014	310 Country Club Dr. Circle Oaks	Sewage	Mechanical	200 gals	Capell Creek

Reclamation Administrative Center and Day Use Areas

The Eticuera and Olive Orchard Day Use Areas have pit toilets and the Capell Cove Boat Launch has restrooms connected to a septic tank. The Reclamation Administrative Center, Dufer Point Visitor Center, Oak Shores Day Use Area, and Smittle Creek Day Use Area are located on the west shore of Lake Berryessa near the community of Spanish Flat. Reclamation operates its own wastewater collection, treatment, and disposal system.

The discharge of wastewater is authorized by General Waste Discharge Requirements for Small Domestic Wastewater Treatment Systems, Order WQ 2014-0153. Wastewater is collected from the Administration Center and eight public restrooms in nine septic tanks located near the facilities at each site. Nine lift stations pump the wastewater to two concrete lined oxidation-evaporation ponds. The ponds receive up to 3,000 gallons per day (average dry weather flow) of wastewater. Backwash from a water treatment plant is discharged to a third unlined evaporation/percolation pond. Graywater from the administrative center (except the dormitory) and sinks in the recreation area is discharged to subsurface leachfields.

CIWQS does not contain any information on sanitary sewer overflows or spills of treated wastewater from the system. The last inspection for this plant was in June 2012. The inspection report did not note any water quality related violations.

Pleasure Cove Marina

Pleasure Cove Marina, located on Wragg Canyon, is operated by a private corporation, Forever Resorts, on land owned by Reclamation.

The Central Valley Water Board adopted WDRs Order 98-086 to permit the discharge of up to 25,000 gallons per day of domestic wastewater into four percolation/evaporation ponds. The ponds receive wastewater from 23 cabins, 14 RV spaces, 5 modular homes, RV dump station, houseboat dump station, campground restrooms and

showers. There are also 23 portable toilets at the site which are removed by Berryessa Sanitation.

Effluent from the septic tanks is discharged to four stabilization ponds at three separate sites. Pond 1 has a capacity of 105,000 gallons. Ponds 2 and 3, near the mid-point of the resort, have a combined capacity of 70,000 gallons. Pond 4, near the north end of the resort, has a capacity of 25,000 gallons. Up to 25,000 gallons per day of wastewater is collected in the ponds, and disposed of by sprayfield irrigation.

CIWQS does not contain any information on sanitary sewer overflows or spills of treated wastewater from the system. The last inspection for this plant was in May 2012. The inspection report did not note any water quality related violations.

Markley Cove Resort

Markley Cove Resort, on Highway 28 about 3 miles west of Monticello Dam, is one of the few resorts that stayed open. The resort is operated by a private concessionaire FX 10 on land owned by Reclamation.

The Central Valley Water Board adopted WDRs Order No. 98-084 in 1998 authorizing the collection and treatment of up to 11,500 gallons per day (average dry weather flow) of septic tank, houseboat pump out, and domestic wastewater effluent. Wastewater is discharged to septic tanks and then to two evaporation/percolation ponds.

CIWQS does not contain any information on sanitary sewer overflows or spills of treated wastewater from the system. The last inspection for this plant was in September 2013. The inspection report did not note any water quality related violations.

Other Recreation Areas

The wastewater collection and disposal facilities for the Putah Creek Resort, Monticello Shores, Berryessa Point, and Spanish Flat were all demolished by Reclamation prior to 2011. Currently, there are only WWTPs at Markley Cove, Pleasure Cove and the Oak Shores Day Use Area.

Regulation and Management

Septic Systems

State Water Resources Control Board

Onsite wastewater treatment systems are governed by the SWRCB Onsite Wastewater Treatment Systems Policy (Order 2012-0032) and by local agencies. In Napa County, the Environmental Health Division of the Planning, Building & Environmental Services Department oversees the permitting and inspection of onsite wastewater treatment systems. In Lake County, these services are overseen by the Environmental Health

Division of the Health Services Department. The community and resort wastewater systems are governed by the Central Valley Water Board through WDRs issued to each facility.

Wastewater Treatment Plants

The discharge of treated wastewater is regulated by the individual permits for each wastewater treatment plant, as indicated in the write-up for each plant.

Spills from sanitary sewer collection systems are governed by the State Water Board under Order No. 2006-0003-DWQ, Statewide General Waste Discharge Requirements for Sanitary Sewer Systems. The State Water Board defines Category 1 spills as discharges of sewage that equal or exceed 1,000 gallons, or result in a discharge to a drainage channel and/or surface water, or discharge to a storm drain that was not fully captured and returned to the sanitary sewer system. Category 2 spills are defined as other discharges of sewage and are generally small discharges that do not reach surface waters. Discharges from wastewater treatment facilities are governed by the individual WDRs issued to the facilities. Spill information was obtained from the State Water Board's CIWQS database and from Central Valley Water Board records. Operators of sanitary sewers in the Lake Berryessa watershed were required to start reporting spills to CIWQS in November 2007.

Source Water Protection Activities

LBRID will be conducting flow monitoring in the sewer collection system in the winter of 2018/2019 to identify areas, if any, that are susceptible to inflow/infiltration either due to age, condition, or installation. Additionally, LBRID has two capital improvement projects underway that will reduce flow of wastewater to the District's treatment/storage ponds. The first project is in the construction phase and focuses on replacing 3,000 ft of sewer force main leading to the wastewater pond system and installing a filter backwash wastewater recovery system at the LBRID WTP. LBRID currently sends all backwash wastewater to the pond system, and installation of the backwash recovery system will allow the District to recycle approximately one million gallons of backwash wastewater throughout the year.

The second project in progress is called the wastewater Ponds Groundwater Inflow Mitigation Project, and is mandated by the Central Valley Water Board through a Time Schedule Order in response to the discharges during the January to March 2017 storm events. The order requires the District to increase capacity in the treatment/storage ponds to accommodate a 100-year precipitation return period. The project, currently in the design phase, will provide the means to prevent the inflow of groundwater into the pond system.

Finally, in response to the bank failures near the main wastewater tank that caused pipe supports to fail and ultimately spills into Putah Creek, the District recently completed a

Slope Stabilization project to stabilize the bank and replace the pipes and supports that failed during the storms.

Summary of Findings for Wastewater

- The NBRID and LBRID WWTP were the only facilities which had major changes/improvements to their facility.
- Out of all the wastewater facilities, the LBRID WWTP experienced the most number of SSOs entering a waterbody, all due to excessive rain in January and February 2017.
- The LBRID WWTP has a number of projects currently underway to address the occurrence of SSOs.
- Hidden Valley WWTP, Circle Oaks WWTP and NBRID WWTP had only one SSO that reached a waterbody.

LEAKING UNDERGROUND STORAGE TANKS

Background

Leaking underground storage tanks (USTs) can be a significant source of petroleum-based products to groundwater and may pose the following potential threats to health and safety:

- Exposure from contaminated soil and/or groundwater;
- Contamination of drinking water aquifers;
- Contamination of public or private drinking water wells;
- Inhalation of vapors.

Although leakage from underground storage tanks primarily affects groundwater, there is potential for surface water contamination if the contaminated groundwater is hydrogeologically connected to surface water. The potential for a leaking underground storage tank to impact surface water is also dependent on the magnitude of the spill, proximity of the spill to a waterway, and fate and transport characteristics of the contaminant.

Related Constituents

Contaminants of concern in underground storage tanks likely include hydrocarbons from gasoline and other petroleum-based products. Benzene is a major concern due to carcinogenic health effects.

Occurrence in Watershed

According to the Regional Board's Geotracker database, there were two leaking UST sites within the watershed at the following locations.

- Former Putah Creek Resort
- Spanish Flat Yard

The leaking underground tank at the former Putah Creek Resort is located at 7600 Knoxville Road and was a former fueling station and convenience store at Putah Creek Resort. Petroleum hydrocarbons impacted the soil and groundwater beneath the site. From 2002 to 2012, various remedial technologies were implemented, but nothing was effective as a long-term remedy. In 2016, pilot testing for soil vapor extraction and air sparging indicated it would be viable for the remaining contamination. As part of the remedial action plan, 33 new remediation wells are proposed. The remedial action plan has been approved and is awaiting implementation pending funding. (Email communication, Vera Fischer, July 2018).

The leaking underground tank at Spanish Flat Yard is located at 4300 Spanish Flat Loop Road and is currently being used by the Napa County Public Works for vehicle and equipment maintenance. Two underground storage tanks were removed in 1991. Petroleum hydrocarbons impacted the soil and groundwater beneath the site. The remedial system was shut down in January 2018. Post-remedial verification monitoring is ongoing.

Related Water Quality Issues and Data Review

There were no detects of hydrocarbons, MTBE, benzene, or other VOCs in the NBRID influent over the reporting period related to leaking underground storage tanks.

Regulation and Management

The Regional Board's Underground Storage Tank Section directs environmental cleanup activities at leaking UST sites. Such sites include active and inactive gasoline stations, agricultural sites, brownfield redevelopment sites, airports, bulk petrochemical storage terminals, pipeline facilities, and various chemical and industrial facilities. Local agencies manage the majority of leaking UST sites in the region. The local agencies work cooperatively with the Regional Board to manage cases in their jurisdiction. Normally, the local agency handles the majority of leaking sites. The Regional Board typically handles the sites where groundwater has been impacted, or if the responsible party is recalcitrant.

Source Water Protection Activities

This contaminating activity has the potential to impact source water quality, but no data exists to show that Lake Berryessa is currently impacted by any of the leaking underground storage tank sites. Therefore, no source water protection activities are recommended at this time.

Summary of Findings for Leaking Underground Storage Tanks

- The latest remedial action plan for the former Putah Creek Resort has been approved and is awaiting implementation pending funding. The remedial system at Spanish Flat Yard was shut down in January 2018 and post-remedial verification monitoring is ongoing.

- There were no detects of hydrocarbons, MTBE, benzene, or other VOCs in the NBRID influent over the reporting period related to leaking underground storage tanks.

FIRES

Background

The aftermath of a wildfire or prescribed burn can alter source water quality. In general, the load of dissolved substances to streams will increase following a wildfire, due to increased runoff. Increased runoff can occur following a fire because the formation of a hydrophobic organic layer in the soil increases the water repellency of soils (DeBano, 2000). A 2004 USGS study revealed that measurable effects of fires on streamwater quality are most likely to occur if the fire was severe enough to burn large amounts of organic matter, if windy conditions were present during the fire, if heavy rain occurred following the fire, and if the fire occurred in a watershed with steep slopes and soils with little cation-exchange capacity (USGS, 2004).

Related Constituents

The magnitude of the effects of fire on water quality is dependent on how fire characteristics (frequency, intensity, duration, and spatial extent of burning) interact with watershed characteristics (weather, slope, soil type, geology, land use, timing of regrowth of vegetation, and burn history). This interaction is complex and highly variable so that even fires in the same watershed can burn with different characteristics and produce variable effects on water quality. Typically, storm water runoff from burned forested areas contains high concentrations of phosphorus, nitrogen, dissolved organic carbon, sediment, and metals such as mercury, lead, and arsenic.

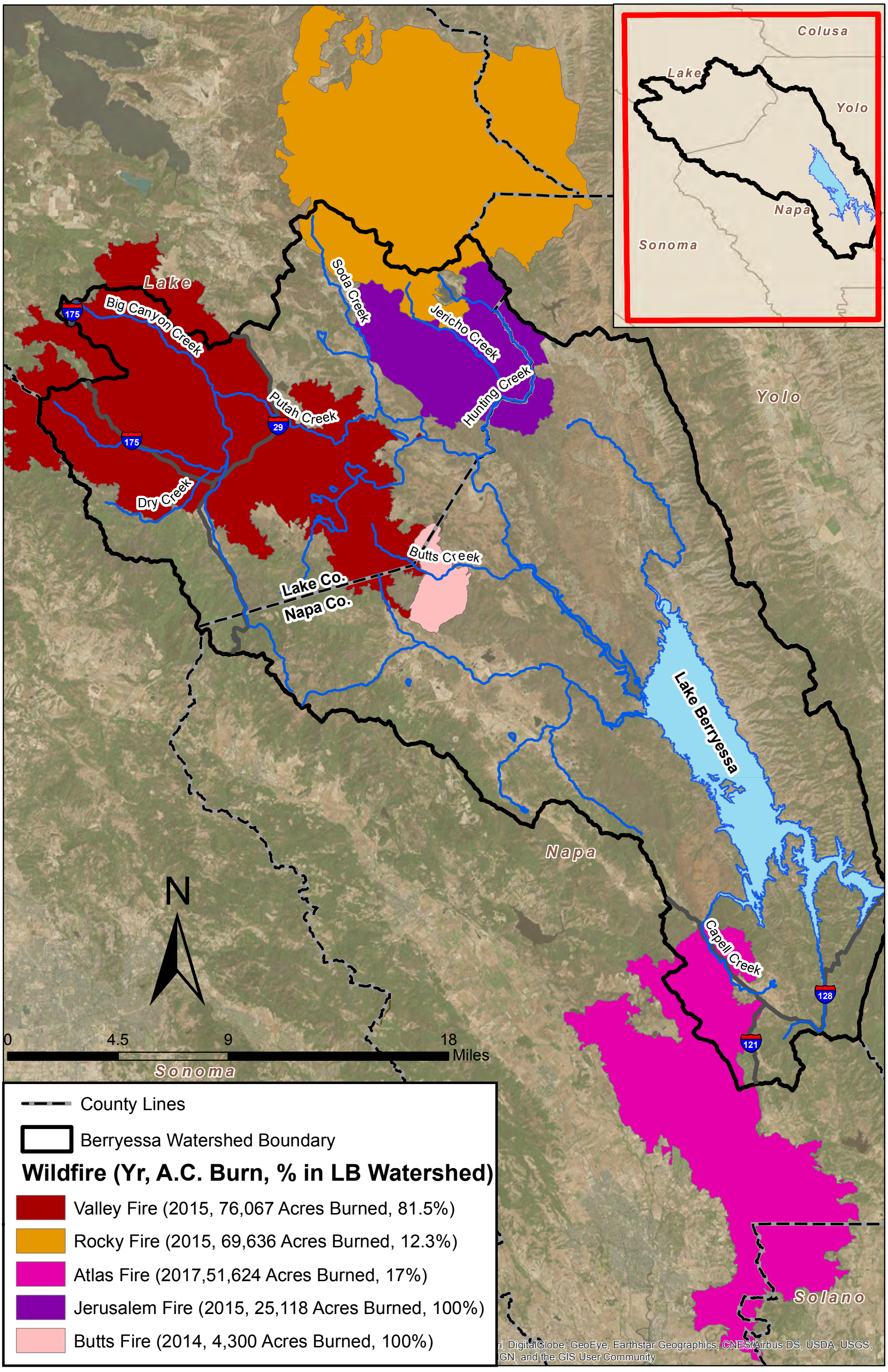
Occurrence in Watershed

There were six wildfires in the watershed over the reporting period. **Table 4-12** contains information about these fires and **Figures 4-3** show the fire burn areas for each fire. SCWA was particularly concerned about the water quality impacts after the Valley Fire, and therefore decided to conduct post-fire water quality monitoring in January and March 2016, as discussed below. It should be noted that the location of the 2017 Atlas Fire would not have affected the LBRID WTP.

Table 4-12. Wildfires in the Lake Berryessa Watershed, 2013 to 2017

Fire Name	Dates or Date Started	Acres Burned
Butts	July 2014	4,300
Rocky	July 2015	69,636
Jerusalem	August 2015	25,118
Valley	September 2015	76,067
Rumsey	2015	Unknown
Atlas	October 2017	52,499

Figure 4-3. Burn Areas



Related Water Quality Issues and Data Review

After a fire has occurred, the natural vegetation on hillsides is denuded, and therefore increased erosion of soils is expected to occur during the first rains immediately following a fire. Additionally, a fire can cause the soils to become hydrophobic.

As shown in **Figure 4-4**, samples were collected at St. Helena Creek (SHC), Coyote Creek (CYC), Upper Putah Creek (UPC), and Putah Creek at LBRID during three storm conditions on January 6, March 7 and March 11, 2016. Samples were collected for Title 22 minerals and metals, as well as TOC and physical parameters. **Figures 4-5** through **4-10** show that the Cold Canyon Creek site, downstream of Lake Berryessa, had the worst water quality of all the sites, particularly for sediment. However, the Upper Putah Creek site was the second highest sampling site for sediment, with TSS at 470 mg/L in January 2016 and also had levels of aluminum well above the primary MCL of 1 mg/l and levels above the secondary MCLs for manganese and iron. This may have contributed to exceedances of the secondary MCL for iron and manganese at the LBRID WTP, as reported in the 2017 Consumer Confidence Report (CCR). St. Helena Creek, Coyote Creek and Putah Creek at LBRID showed elevated levels of TOC, all above 5 mg/L in January 2016. Interestingly, specific conductance was also higher at the sampling sites downstream of Lake Berryessa compared to the creeks monitoring sites above Lake Berryessa.

According to Napa County, higher than normal turbidities were experienced at both the LBRID and NBRID WTPs due to the post-fire ash and debris flow in Putah Creek which eventually flowed into Lake Berryessa. Post-fire related impacts were experienced in both winters of 2016 and 2017, but more impacts were experienced in winter 2017 due to heavier precipitation. For the LBRID WTP, grit from the ash and debris flow overwhelmed the in-line strainers located prior to the filters, which caused damage to one of the immersed membrane treatment units. The membrane cartridges were unable to be repaired, and replacement cartridges had to be purchased and installed in 2018. Post-fire impacts to the NBRID WTP required the operators to adjust plant processes to handle higher turbidities.

Figure 4-4. Water Quality Sampling Locations in Lake Berryessa Watershed, January and March 2016 for Post-Fire Assessment

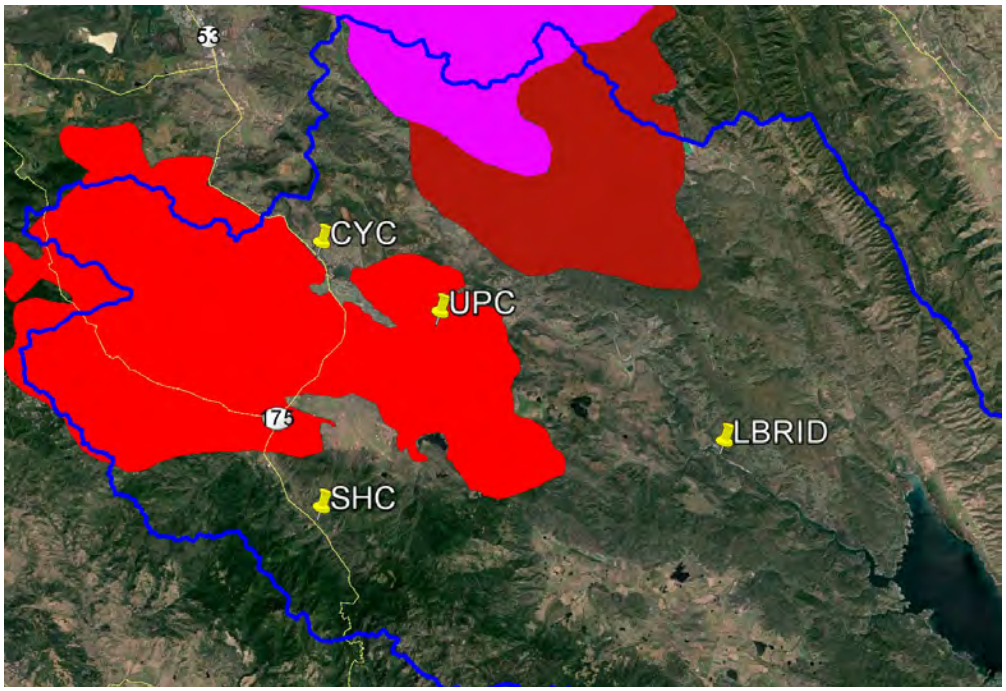


Figure 4-5. Post-Fire Water Quality Sampling Results for TSS

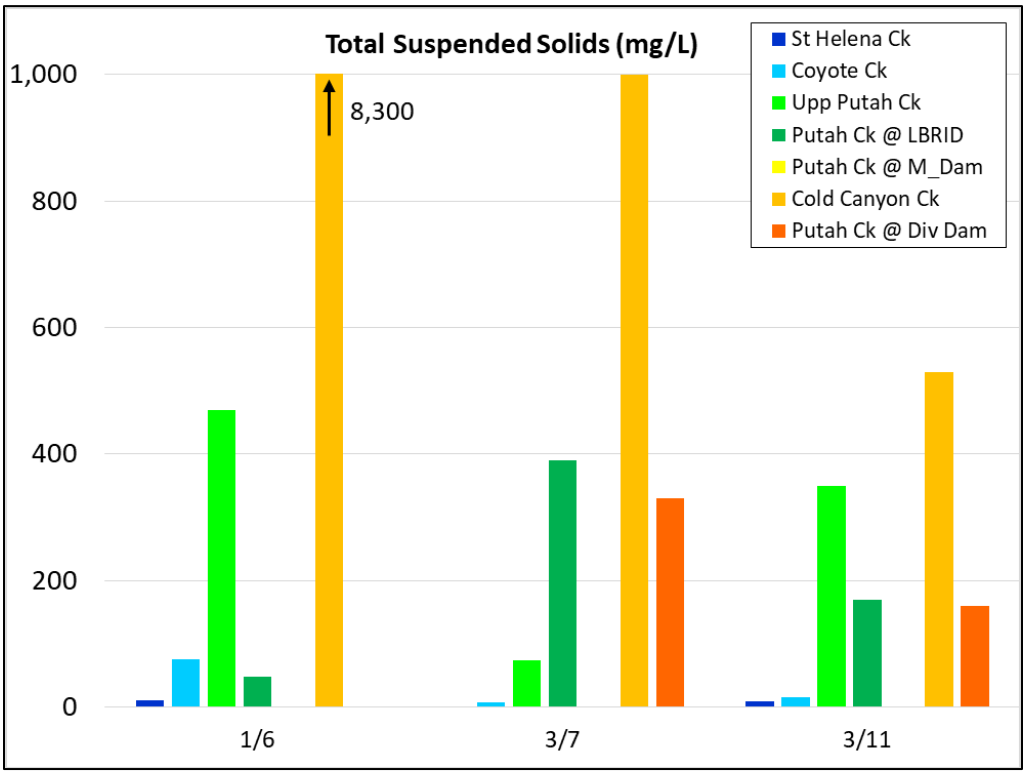


Figure 4-6. Post-Fire Water Quality Sampling Results for TOC

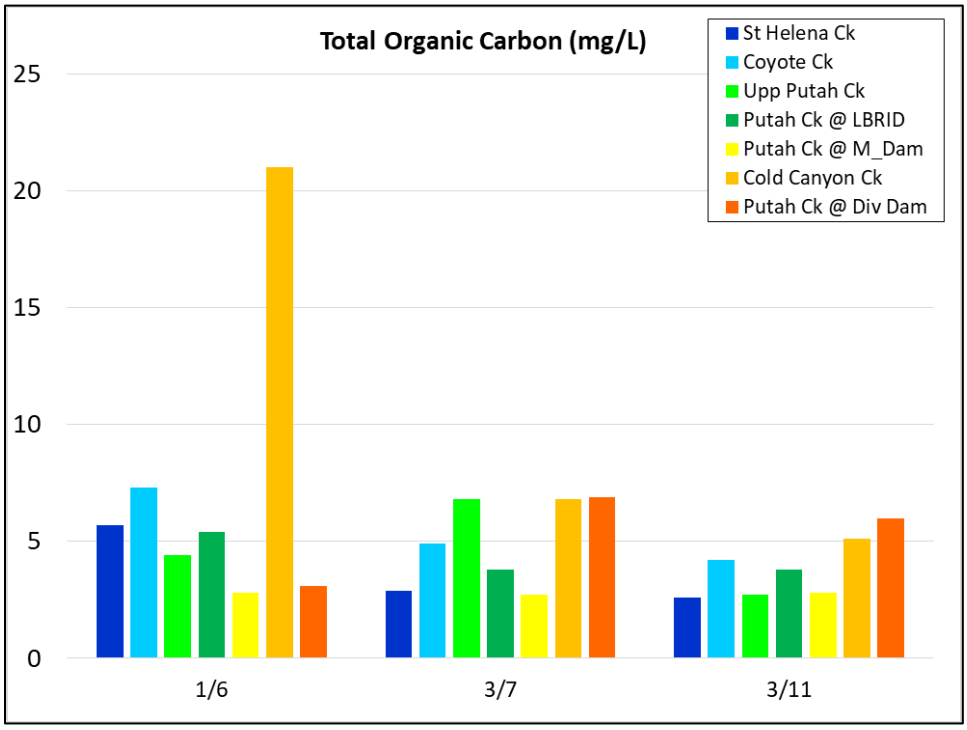


Figure 4-7. Post-Fire Water Quality Sampling Results for Specific Conductance

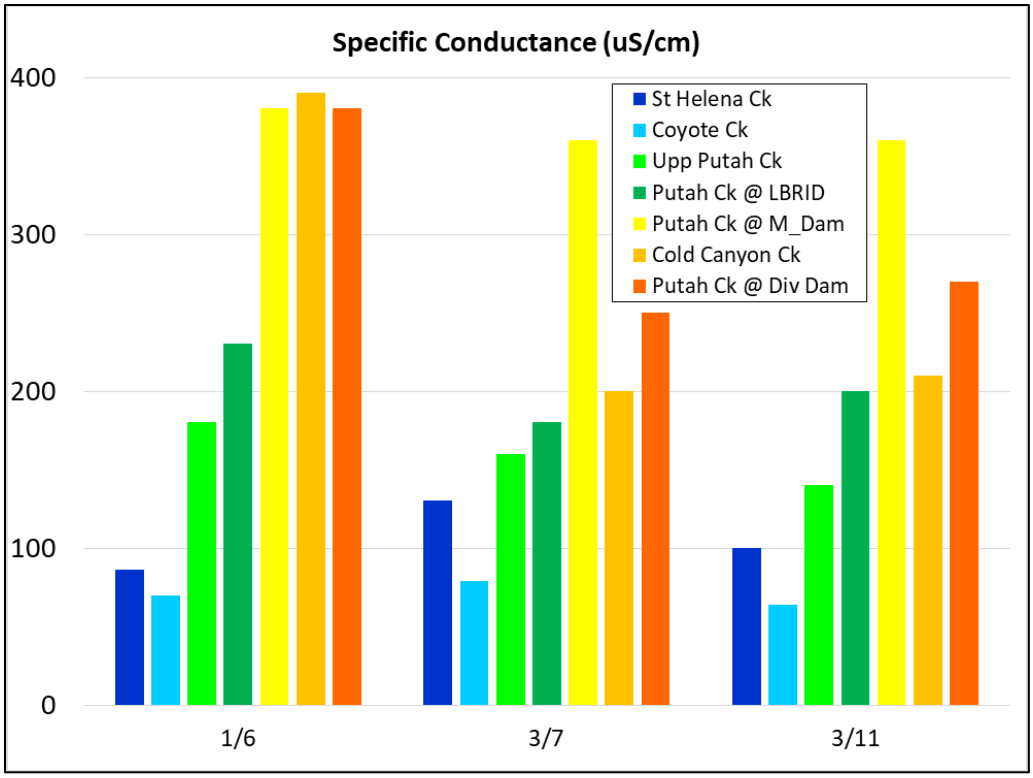


Figure 4-8. Post-Fire Water Quality Sampling Results for Aluminum

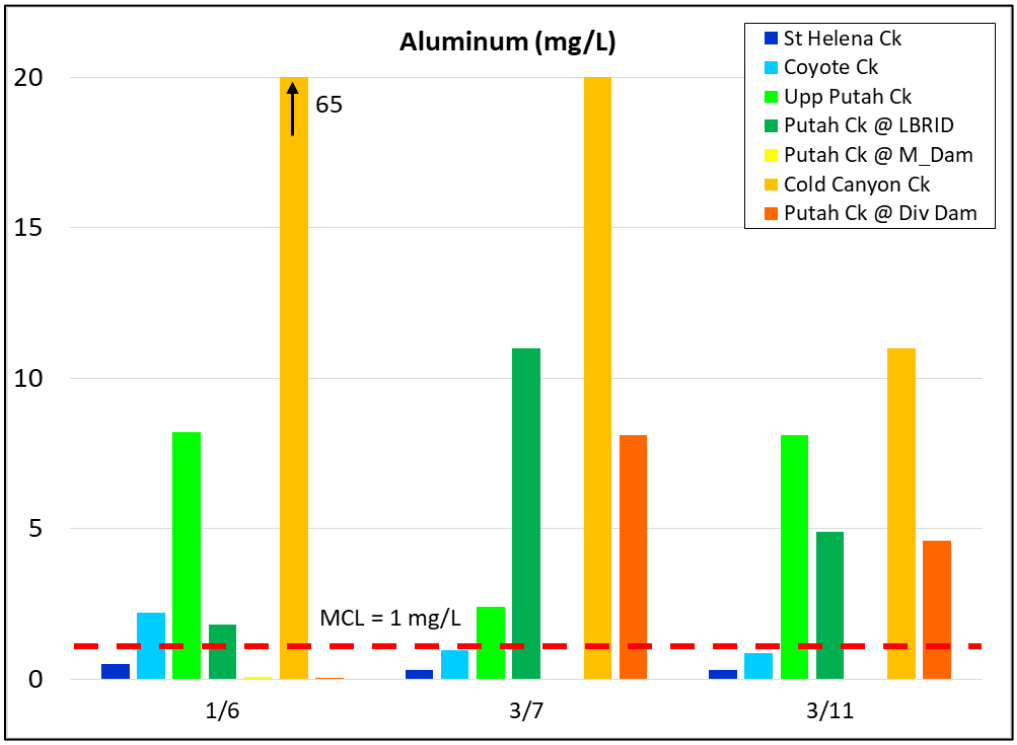


Figure 4-9. Post-Fire Water Quality Sampling Results for Iron

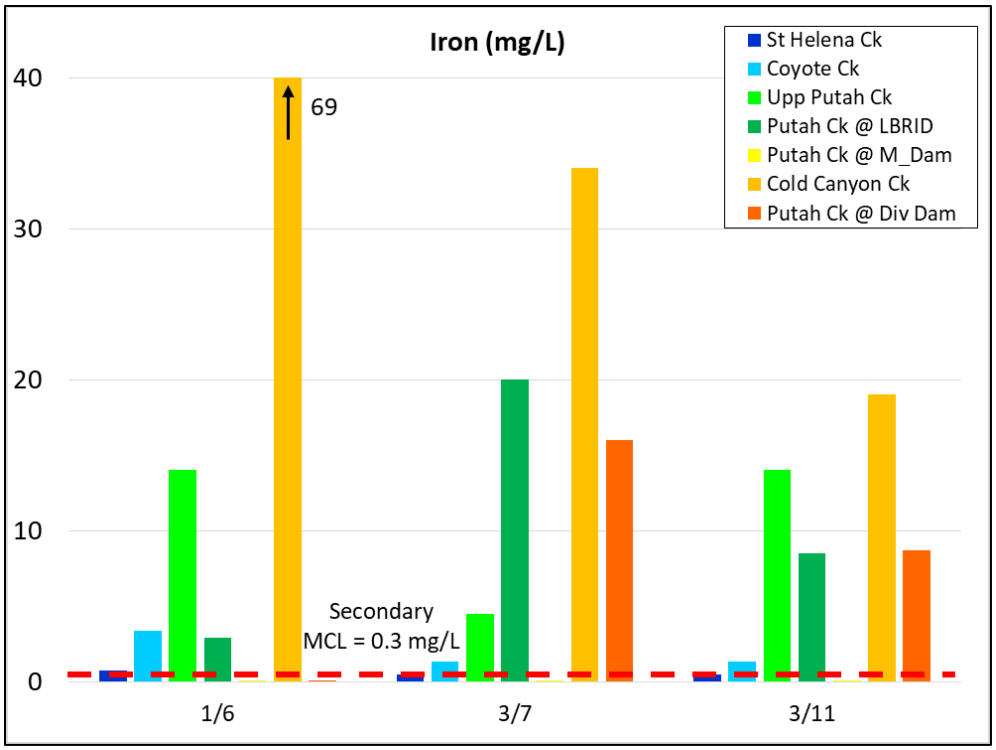
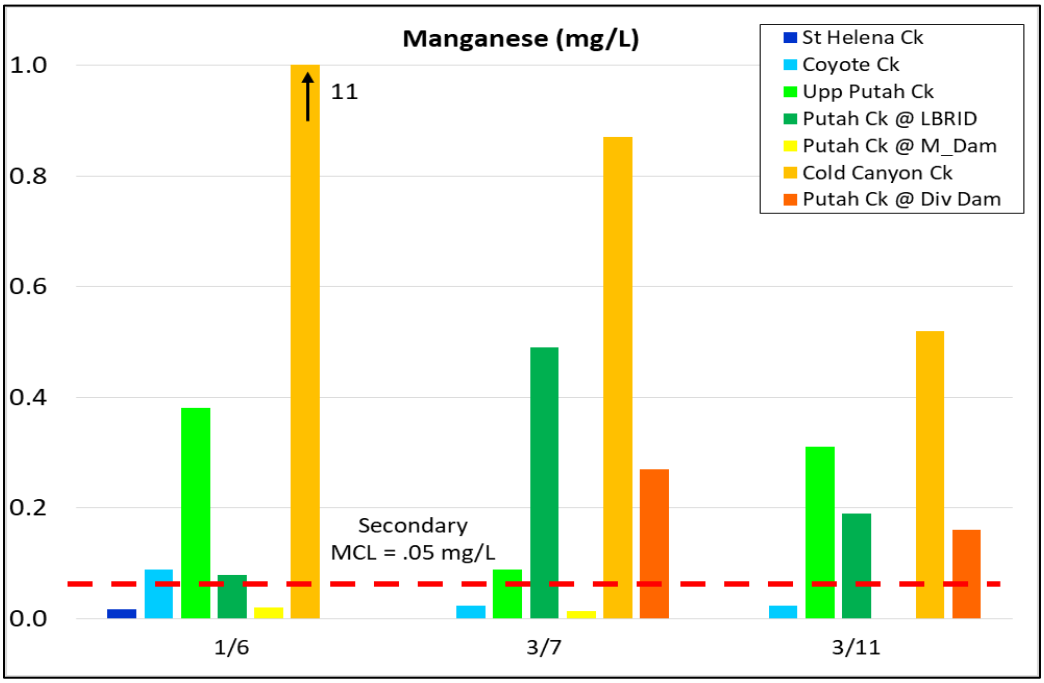


Figure 4-10. Post-Fire Water Quality Sampling Results for Manganese



Summary of Findings for Fires

- Post-fire water quality monitoring showed that the Cold Creek site, downstream of Lake Berryessa had the worst water quality of all sites, particularly for sediment. However, the Upper Putah Creek site also showed elevated levels of TSS in January 2016, and also had levels of aluminum well above the primary MCL of 1 mg/l and levels above the secondary MCLs for manganese and iron. This may have contributed to exceedances of the secondary MCL for iron and manganese at the LBRID, as reported in the 2017 CCR.

- Both the LBRID and NBRID WTPs were impacted after the 2015 wildfires with elevated turbidities, which necessitated the operators to adjust plant processes. Additionally, replacement cartridges had to be purchased and installed in 2018 for the LBRID WTP.

ABANDONDED MINES

Background

Mining has occurred in the upper regions of the Putah Creek watershed since the 1850s. To date, the vast majority of mines in this region for mercury, gravel and other materials are abandoned.

Related Constituents

Water draining from abandoned mines can be highly acidic. Acidic mine drainage can contain metals such as nickel and mercury. Mercury is toxic after it transforms and magnifies its concentration in fish.

Occurrence in Watershed

The Westside Brownfields Coalition Assessment Project is currently working on creating an interactive database of mine sites, assess prioritized mine-scarred sites in the area, evaluate sites for potential cleanup, and create an overall brownfields cleanup plan for the region. Brownfields are properties that are difficult sites for expansion, redevelopment, and reuse due to contaminants such as hazardous materials, pollutants, petroleum or mine waste.

In 2016, the project completed a number of maps to eventually identify Brownfield priority sites. These maps are included to give a sense of the locations of historical mines.

The site inventory began with an assessment of identified mines and mine features, such as tailings piles, waste process materials (calcines) and mine related structures. Mine and mine feature information came from the following State and Federal sources:

- Topographically Occurring Mine Symbols (TOMS). TOMS originated by digitizing mining features from scanned USGS topographic quadrangles. Each of the 7.5-minute USGS topographic quadrangles was examined and all mining features were digitized and annotated with information derived from the map. (*Total 414 mines*). Source: California Department of Conservation, Office of Mine Reclamation, 2001.
- Principal Areas of Mine Pollution (PAMP). The PAMP data set is a compilation of 2,422 mining operations and their potential water-quality problems. This information was originally compiled in 1972 by the Division of Mines and Geology for the State Water Resources Control Board. It was published in a series of volumes of tabular data. The data set includes operations where production exceeded $100,000 or where other factors indicated a high potential for pollution. (*Total 74 Mines*). Source: California Department of Conservation, Office of Mine Reclamation, 1972,

With this inventory, the project then conducted a risk ranking evaluation of the sites.

The implied risks are to waterbodies or wetlands from runoff, erosion, landslide, inundation, and other transport mechanisms from the mine features to the environment. Figure **4-11** shows the three focus areas in the Lake Berryessa watershed which are Middletown Area, Upper Putah Creek Complex and Quicksilver Complex. **Figures 4-12** through **4-14** present zoomed in maps showing areas with mines having a ranked impact value greater than 20.

A separate suite of criteria was used to prioritize individual sites for assessment which were:

- **Category 1: Economic Development Potential Factors**. How well the cleaned up site would support local economic development. These questions include gauging if there is local support to complete a project regardless of the physical conditions.
- **Category 2: Reuse Readiness Factors**. How readily the site could be reclaimed and reused.
- **Category 3: Brownfields Factors.** These factors allow an assessment of how readily the site might be cleaned up or identifies if it is technically complex
- **Category 4: Community Benefit Factors.** How well the cleaned up site would address local values.
- **Category 5: Environmental Benefit Factors.** How well the cleaned up site would provide ecological benefits.

To date, the sites shown in **Figure 4-15** are prioritized Brownfield sites. The closest sites to the lake are Whitney and Pope Creek Placers Site.

Related Water Quality Issues and Data Review

Methyl Mercury sources come from legacy gold mining activity, atmospheric deposition, and natural geology. SCWA has not collected water quality samples for mercury at Lake Berryessa in the past, but only at downstream locations from Monticello Dam. The issue of mercury is not a drinking water concern due to the detection levels being drastically low in comparison to drinking water MCLs.

Summary of Findings for Abandoned Mines

- The ongoing Westside Brownfields Coalition Assessment Project provides information on location of historical mines in the watershed. The project is also evaluating a number of sites for potential cleanup and redevelopment. To date, the Whitney and Pope Creek Placers sites are the closest to the lake.

- The issue of mercury is related to fish consumption as it can accumulate in fish tissue. It is not a drinking water concern due to the detection levels being drastically low in comparison to drinking water MCLs.

Figure 4-11. Mercury Related Mines Ranked Focus Areas

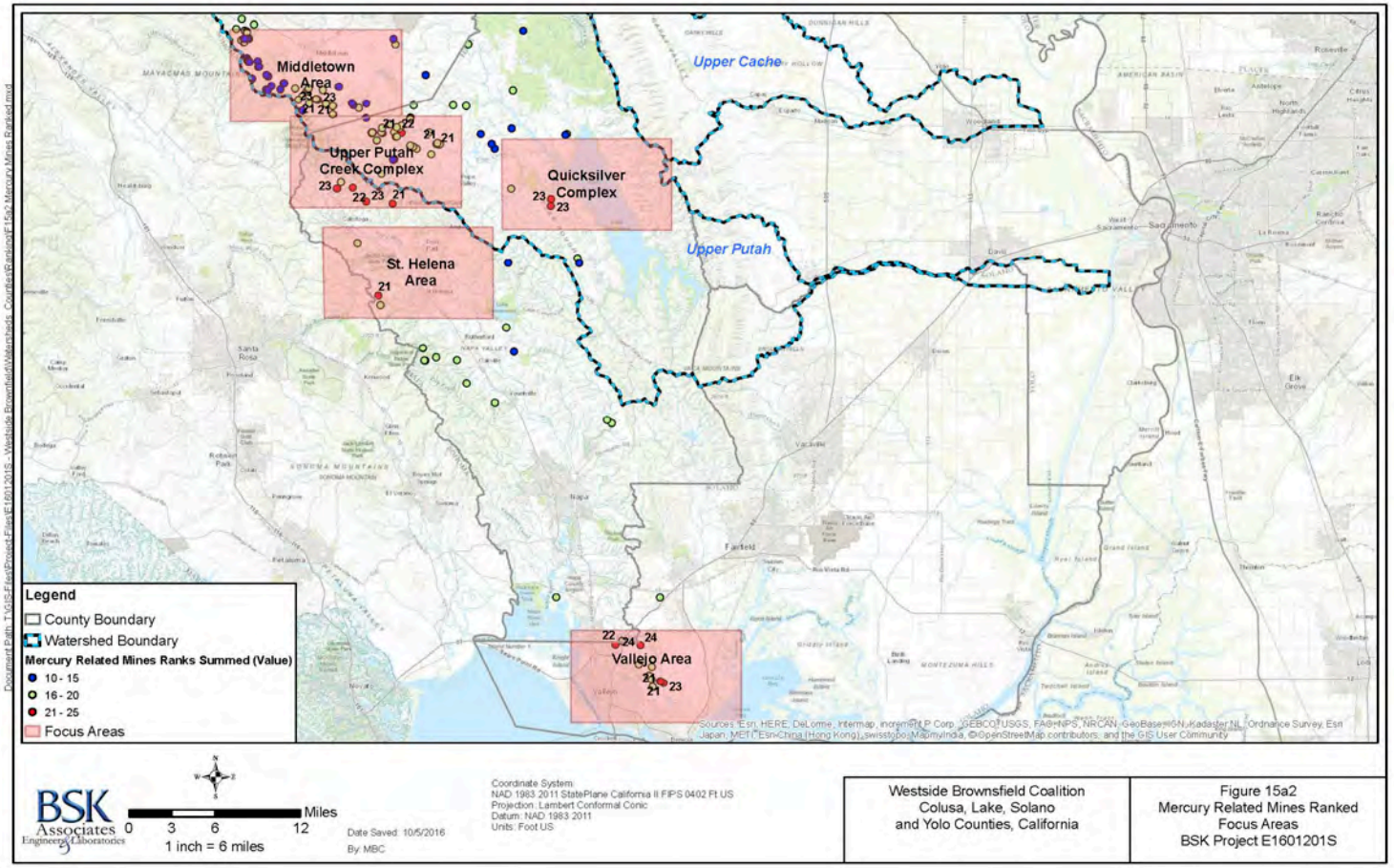


Figure 4-12. Mercury Related Mines Ranked in Upper Putah Creek Complex

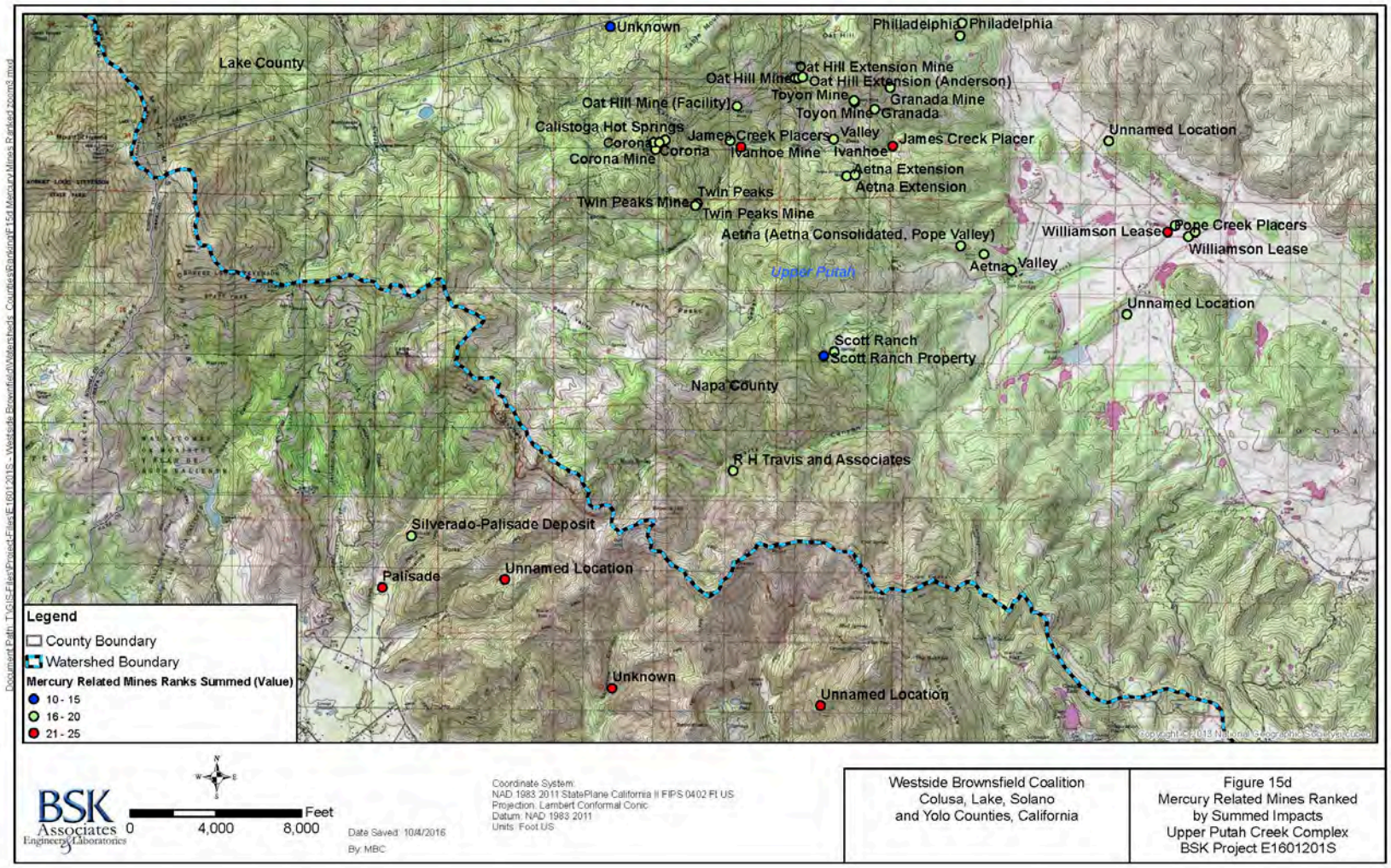


Figure 4-13. Mercury Related Mines Ranked in Middletown Area

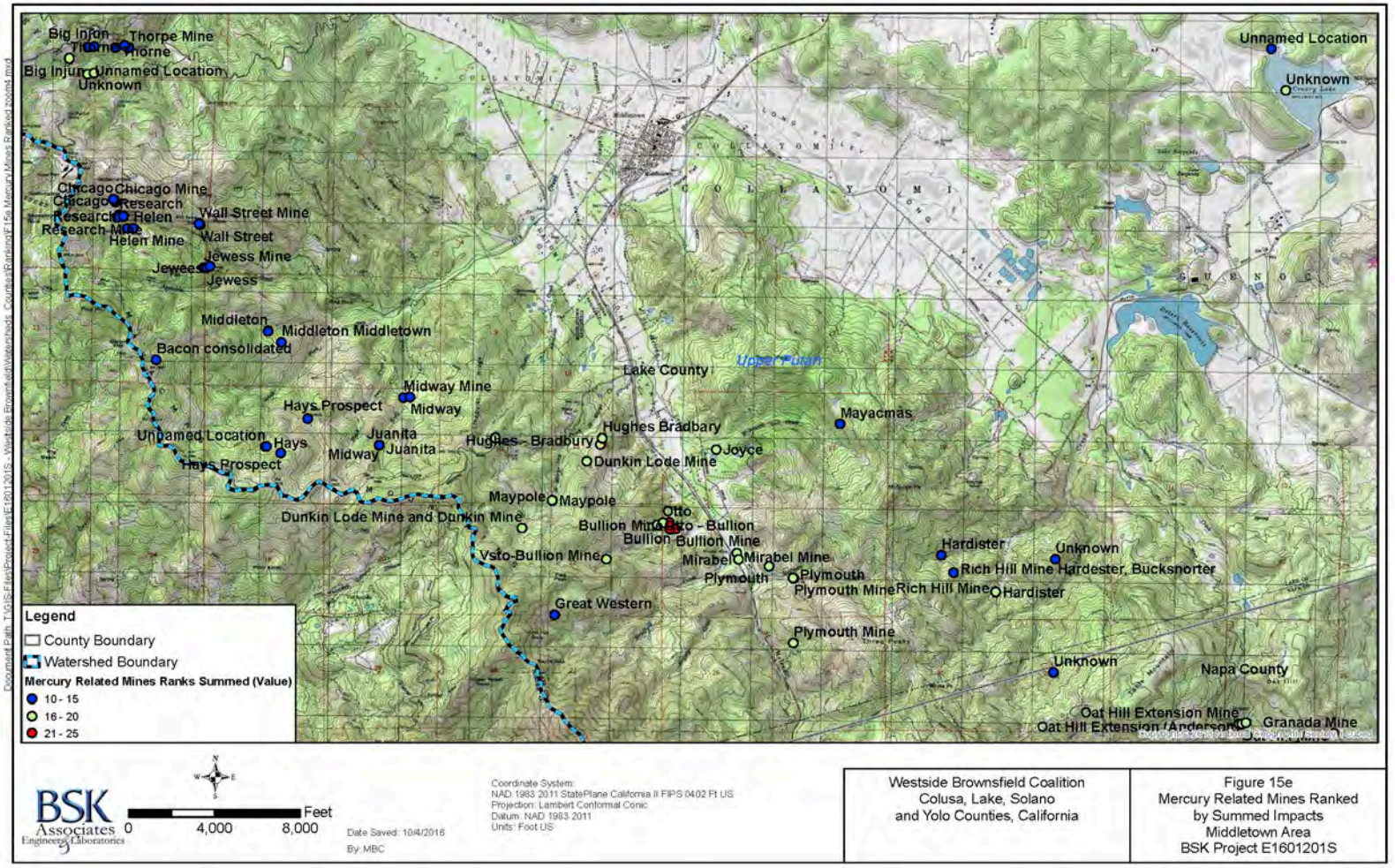


Figure 4-14. Mercury Related Mines Ranked in Quicksilver Complex

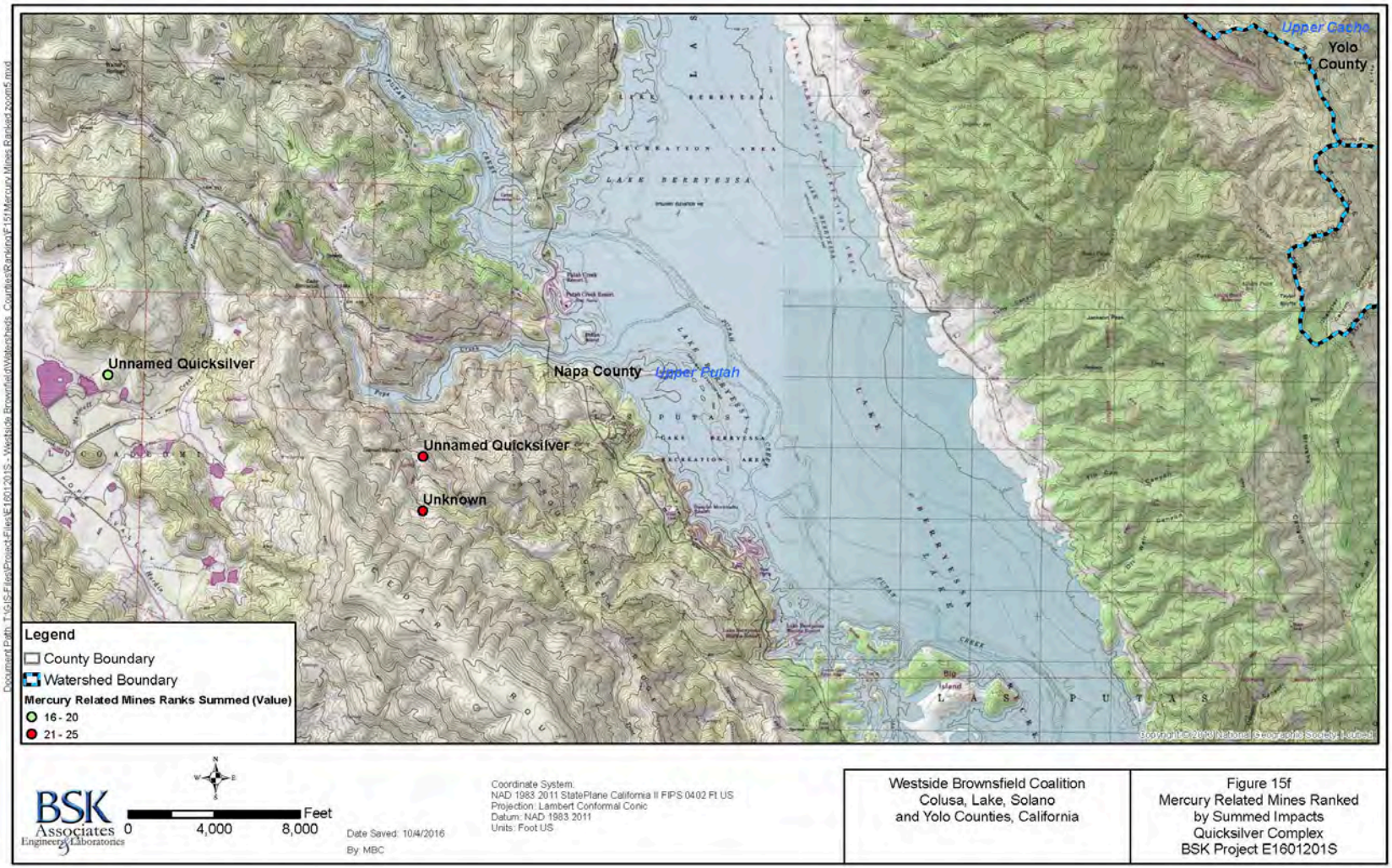
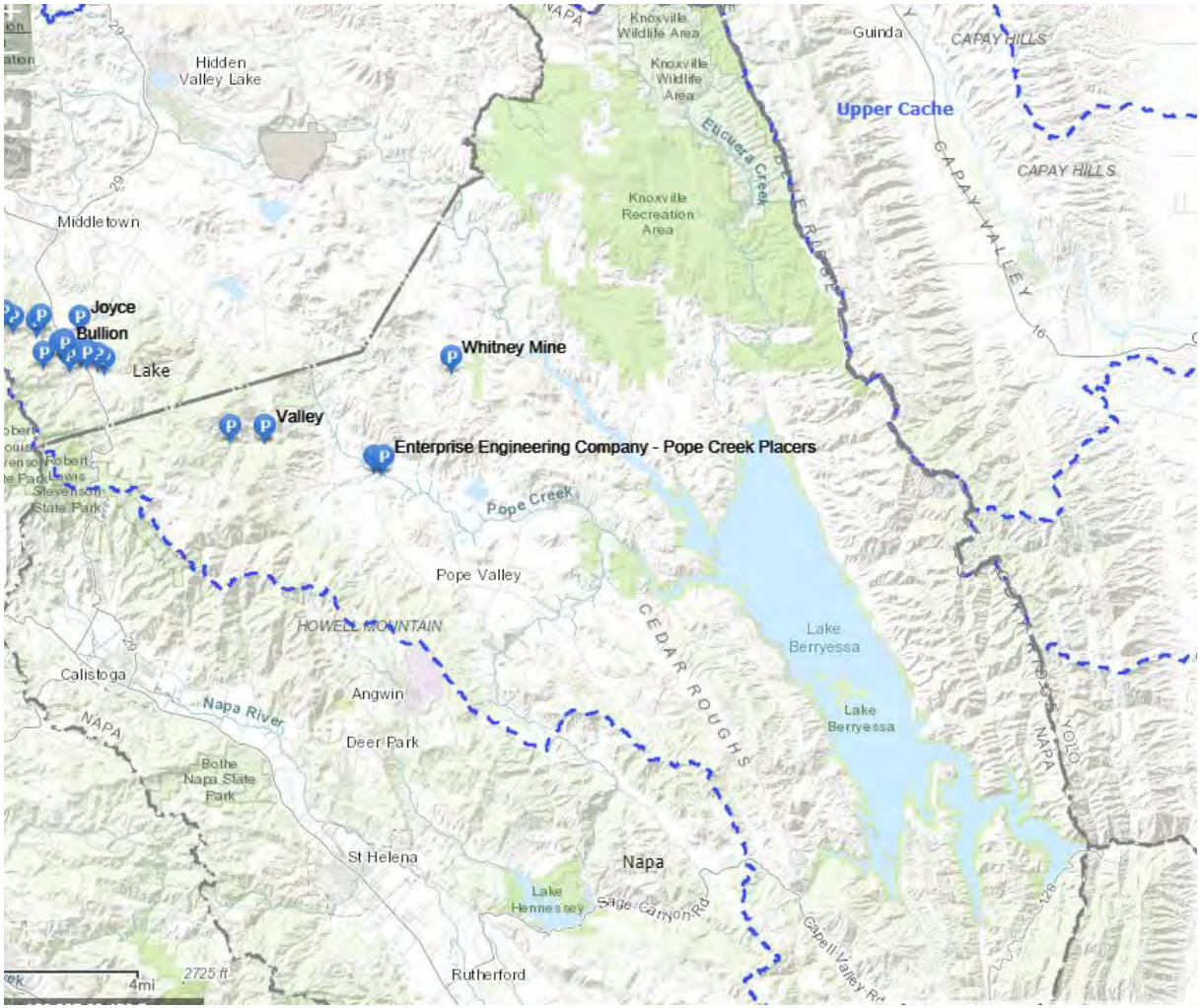


Figure 4-15. Prioritized Brownfield Sites



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SECTION 5 – KEY FINDINGS AND RECOMMENDATIONS

This section consists of a discussion of key findings, update on recommendations from the 2013 watershed sanitary survey and a list of current recommendations.

KEY FINDINGS

It is important to understand that the intakes to the LBRID and NBRID WTPs are different as the LBRID WTP intake is located beneath the gravel bed of Putah Creek and the NBRID intake is located in Lake Berryessa. As creek water quality is more susceptible to changes, especially after fires and during/after storms, the LBRID WTP experiences wider variations in water quality.

Additionally, the different geographical locations of the LBRID and NBRID WTPs may mean that certain potential contaminating activities are less relevant. For example, the leaking underground storage tanks at the former Putah Creek Resort and Spanish Flat yard are downstream of the LBRID WTP and will not affect the source water quality of the LBRID WTP. Additionally, although swimming and boating may occur in Putah Creek, all campgrounds and resorts are located downstream of the LBRID WTP, indicating less impact on the LBRID WTP from recreational activities. However, all seven potential contaminating activities discussed in this report are relevant for the NBRID WTP.

Water Quality

Turbidity

- Overall, source water turbidity is normally low for both WTPs, with medians less than 3 NTU. However, there are frequent periods where levels exceed that substantially, up to 100 NTU and higher. These excursions are associated with storm water runoff caused by intense winter storms, particularly in January and February 2017.
- The LBRID WTP also had high turbidity in June 2017 due to turnover of creek water throughout the month and early growth of aquatic plants around the intake structure.
- LBRID is more susceptible to changes in water quality and peaks due to location in Putah Creek, versus lake system at NBRID.

Microbial Constituents

- Source water *E. coli* levels are low, with medians less than 4 MPN/100mL.
- Overall, the NBRID WTP has lower *E. coli* levels than the LBRID WTP.
- Over the reporting period, all *E. coli* monthly medians at the LBRID WTP were well below the 1,000 MPN/100 mL threshold. The elevated *E. coli* in the months of March 2016 and February 2017 were due to heavy precipitation.
- Over the reporting period, all *E. coli* monthly medians at the NBRID WTP were well below the 200 MPN/100 mL threshold.

Total Organic Carbon

- Median TOC concentrations are generally between 2 and 3 mg/L.

- Source water TOC peaks at the LBRID may be attributed to the large wildfires which occurred in the summer and fall of 2015, just upstream of Putah Creek.
- Enhanced coagulation is required for the plants that treat Lake Berryessa water because the source water TOC is routinely above 2 mg/L and they implement conventional treatment processes.

Potential Contaminant Sources

Spills

- There were only two non-sewage related spills that occurred directly into Lake Berryessa.
- Most spills occurred on land, and were located far upstream of the lake.
- Although spills have potential to contaminate lake, none of significance during reporting period. Please see Wastewater section for information on sewage-related spills.

Recreation

- Although swimming and boating can occur in Putah Creek, all of the recreation areas are downstream of the LBRID WTP. Therefore, only the NBRID WTP is directly impacted. *E. coli* levels at the NBRID WTP are very low, with an average of 2 MPN/100mL and a median of ND from 2013 to 2017, indicating no impact from recreation.
- With new concessionaires on the horizon, the potential impact from recreation could increase in the future, although plans remain undeveloped.
- The Lake Berryessa Boater Outreach Program is a very effective program to screen for invasive mussels, but also promote clean and safe boating practices.
- There were no spills reported in regards to the gas docks or sewage pumpout located at the marinas.

Agriculture

- There is limited agriculture use in the watershed, of which, 99.7 percent are wine grapes.
- As wine grapes are drip irrigated, irrigation related pesticide or fertilizer transport is highly unlikely to occur in this watershed.
- Commercial growers are required to be enrolled in the Central Valley Regional Water Quality Control Board's Irrigated Lands Program, and most growers are likely participating in the Sacramento Valley Water Quality Coalition, through the Napa County Putah Creek Watershed Group.
- Copper and glyphosate are the only pesticides used in the watershed for which drinking water standards have been established. Monitoring data collected at the LBRID and NBRID WTPs water show low levels of copper (less than 50 µg/L) and no detections of glyphosate at the NBRID WTP.

Wastewater

- The NBRID and LBRID WWTP were the only facilities that had major changes/improvements to their facility.

- Out of all the wastewater facilities, the LBRID WWTP experienced the most number of SSOs entering a waterbody, all due to excessive rain in January and February 2017. The LBRID WWTP has a number of projects currently underway to address the occurrence of SSOs.
- Hidden Valley WWTP, Circle Oaks WWTP and NBRID WWTP had only one SSO which reached a waterbody.

Leaking Underground Storage Tanks

- The latest remedial action plan for the former Putah Creek Resort has been approved and is awaiting implementation pending funding. The remedial system at Spanish Flat Yard was shut down in January 2018 and post-remedial verification monitoring is ongoing.
- There were no detects of hydrocarbons, MTBE, benzene, or other VOCs in the NBRID influent over the reporting period related to leaking underground storage tanks.

Fires

- Post-fire water quality monitoring showed that the Cold Creek site, downstream of Lake Berryessa had the worst water quality of all sites, particularly for sediment. However, the Upper Putah Creek site also showed elevated levels of TSS in January 2016, and also had levels of aluminum well above the primary MCL of 1 mg/l and levels above the secondary MCLs for manganese and iron. This may have contributed to exceedances of the secondary MCL for iron and manganese at the LBRID, as reported in the 2017 Consumer Confidence Report.
- Both the LBRID and NBRID WTPs were impacted after the 2015 wildfires with elevated turbidities, which necessitated the operators to adjust plant processes. Additionally, replacement cartridges had to be purchased and installed in 2018 for the LBRID WTP.

Abandoned Mines

- The ongoing Westside Brownfields Coalition Assessment Project provides information on location of historical mines in the watershed. The project is also evaluating a number of sites for potential cleanup and redevelopment. To date, the Whitney and Pope Creek Placers sites are the closest to the lake.
- The issue of mercury is related to fish consumption as it can accumulate in fish tissue. It is not a drinking water concern due to the detection levels being drastically low in comparison to drinking water MCLs.

UPDATE ON 2013 RECOMMENDATIONS

The 2013 Update recommended several actions that Napa County Flood Control and Water Conservation District and SCWA should take to protect source water quality. These recommendations and the agencies' responses are discussed in **Table 5-1.**

Table 5-1. Recommendations from 2013 Watershed Sanitary Survey

2013 Update Recommendation	Summary of Actions Taken b
SCWA and Napa County should continue to track recreational development activities at Lake Berryessa through participation in the Lake Berryessa Community Coordinating Team. SCWA and Napa County should work with this group and Reclamation to ensure that protection of water quality is considered as plans are developed for the recreation areas.	As of 2018, Napa County and Reclamation are currently negotiating on a Managing Partnership Agreement to allow Napa County to manage recreation at Lake Berryessa. SCWA participated on the Lake Berryessa Community Coordinating Team from 2015 to 2017. As of 2018, the Lake Berryessa Community Coordinating Team is no longer active.
SCWA and Napa County should continue to support and participate in the Lake Berryessa Partnership.	Over the reporting period, SCWA provided student interns to conduct vessel inspection, recreation surveys and public education during the summer season.
SCWA should work with Napa County to determine if funding can be obtained to support a more formal inspection program at Lake Berryessa.	SCWA remains fully committed to the inspection program and inspections have increased from 2013 to 2017. A record of 16,799 boats was inspected in 2017. Also, when student interns are not on shift, the concessionaires will screen vessels, and park rangers will screen vessels at the Capell boat launch.
Napa County and SCWA should review plans for new facilities to ensure that adequate pond capacity is provided and that the ponds are located as far from Lake Berryessa as possible.	Recommendation will continue for 2018 recommendations.

RECOMMENDATIONS

Table 5-2 presents the recommendations developed for this Fourth Update, listed by subject area and not by priority. Development of recommendations for watershed management actions that are economically feasible and within the authority of Napa County and SCWA is critical. Recommendations will be implemented as resources are available.

Table 5-2
Recommendations for 2018 Watershed Sanitary Survey

Recommendation	Basis for Recommendation
1) Continue to optimize treatment during periods of reduced or changing source water quality.	Certain source water risk periods such as storm events and post-fire events require special attention to turbidity reduction and disinfection.
2) Continue to provide 3/4/2-log reduction for *Giardia*/virus/*Cryptosporidium.*	Coliform concentrations in Putah Creek and Lake Berryessa support this level of reduction.
3) Napa County to begin submitting *E. coli* data for Round 2 Long Term 2 Enhanced Surface Water Treatment Rule.	Round 2 should begin 6 years after Round 1 sampling.
4) Napa County and SCWA should review plans for new wastewater facilities associated with new or redeveloped recreation areas to ensure that adequate pond capacity is provided and that the ponds are located as far from Lake Berryessa as possible.	SSOs can impact Lake Berryessa during heavy storms if ponds overflow.
5) SCWA and Napa County should continue to support and participate in the Lake Berryessa Partnership.	Boater education and vessel inspection are very important to protect source water quality.

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APPENDIX A
BIBLIOGRAPHY AND LIST OF CONTACTS

BIBLIOGRAPHY AND LIST OF CONTACTS

Email Communication, Vera Fischer, Central Valley Water Quality Control Board, (916)464-4792, Vera.Fischer@waterboards.ca.gov (Leaking Underground Storage Tanks)

Email Communication, Nathan Kyle, US Bureau of Reclamation, Concessions Manager, (707)966-2111 X10

Email Communication, Guy Childs, Central Valley Water Quality Control Board, (916)464-4648, Guy.Childs@waterboards.ca.gov

Email and Personal Communication, Andre Napolitano, County of Napa Agriculture Commissioners Office, (707) 253-4357, andre.napolitano@countyofnapa.org

Lake Berryessa Boater Outreach Program Report, Summer 2017, prepaed by 2017 Lake Berryessa Boater Outreach Interns

Lake Berryessa Request for Information and Interest, RFII No. CEO091701, Issued by Napa County Executive Office, September 2017.

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