TECHNICAL MEMORANDUM

Stanislaus Regional Water Authority Surface Water Supply Project
Source Water Quality Assessment TM1

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To: Stanislaus Regional Water Authority (SRWA)
Technical Advisory Committee (TAC)

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Subject: **Source Water Quality Assessment, Oct 2016 to Oct 2017**

1 INTRODUCTION

The Stanislaus Regional Water Authority (SRWA), a joint powers authority between the City of Turlock and City of Ceres (Cities), intends to implement a new surface water supply project to provide the Cities with treated water from the Tuolumne River to supplement their current groundwater supply. The project will include a new surface water treatment plant (WTP) located near the Tuolumne River near the town of Hughson. The proposed intake for the future surface WTP is an existing infiltration gallery located four to five feet below the river bottom.

As a subconsultant to West Yost Associates (West Yost), Trussell Technologies (Trussell Tech) developed a water quality sampling program titled "Source Water Characterization Sampling Plan for the SRWA Surface Water Supply Project" for SRWA during the summer of 2016. The purpose of the monitoring program was (a) to characterize the water quality of the Tuolumne River at the proposed intake location, and (b) to provide a list of monitoring parameters to assist in the design of an effective WTP capable of producing a stable supply of high-quality potable water for the Cities (Trussell, 2016a). This sampling plan was approved by the Division of

Drinking Water (DDW) in July 2016. Thereafter, additional parameters were added to the monitoring program to address the impact of local cattle and poultry operations on the source water quality and to understand the potential of algae growth in the source water (Trussell, 2016b).

This technical memorandum (TM) provides an assessment of the initial year-long monitoring program (Phase 1) for SRWA's Tuolumne River source water, covering the period of October 2016 to October 2017. The discussion includes a summary of the monitoring values and comparison with both regulatory values and historical water quality data from the nearby Tuolumne River. A long-term sampling program is planned for on-going water quality monitoring (Phase 2) through construction of the WTP. Limited on-going Phase 1 sampling related to pathogen removal requirements per the Long Term 2 Enhanced Surface Water Treatment Rule (LT2) is expected to be complete by October 2018 and will be summarized in a separate TM. Together, this source water monitoring program (Phases 1 and 2) is intended to fulfill the required Source Water Quality Analysis component of the planned domestic water supply permit application for SRWA's new WTP.

2 WATER QUALITY MONITORING PROGRAM

The initial year of the source water monitoring program (i.e., Phase 1) lasted from October 2016 to October 2017. FishBio was contracted to collect the monitoring samples and complete field testing (temperature, pH, turbidity, dissolved oxygen, conductivity) for each of the sampling events (every two weeks). Courier and analytical services were provided by Eurofins Eaton Analytical Lab (Eurofins). The purpose of Phase 1 was to characterize the water quality of the Tuolumne River, support process train selection and design criteria selection for the new WTP, and meet source water monitoring requirements for a new domestic water supply permit. The water quality characterization was based on the following constituents in the monitoring program:

- General water characterization parameters
- Title 22 contaminants (organics, inorganics, radionuclides, and DBPs)
- Microbial parameters
- Pesticides and other Synthetic Organic Chemicals (SOCs)
- Additional unregulated constituents

Monitoring for *Cryptosporidium*, *E. coli*, and turbidity will continue for a second year (through October 2018) to fulfill LT2 sampling requirements.

The year-long Phase 1 source water monitoring program is summarized in Table 1.

Table 1. SRWA Phase 1 Source Water Monitoring Program

Category	Sampling Frequency	Estimated Total Number of Samples
General Water Characteristics (Physical and Chemical)	Quarterly	4
Select Field and Other General Parameters (pH, Temperature, Dissolved Oxygen, Alkalinity, Bromide, Conductivity, Iron, Manganese, TOC, DOC)	Monthly	12
Turbidity[2]	Twice per month	48
Inorganic chemicals with DDW MCLs	Quarterly	4
Organic chemicals with DDW MCLs	Quarterly	4
Radionuclides with DDW MCLs	Quarterly	4
Microbial Parameters:		
Cryptosporidium[2], *Giardia*[3]	Monthly	24
Total Coliform[3], *E. coli*[2]	Twice per month	48
Nitrogen Compounds (NH_3, NO_2, NO_3)	Monthly	12
Select Unregulated Pesticides and SOCs	Quarterly	4
Unregulated Constituents of Interest Related to Dairy, Poultry and Ranch Operations	Quarterly	4
Unregulated Constituents of Interest Related to Algae Occurrence		
Algae Identification, Algae Enumeration, Chlorophyll A	Quarterly	4
Microcystin Screens, Cyanotoxins	2x/year	2

[1] First year of monitoring, except as noted for LT2 required parameters
[2] Parameters sampled monthly for 24 consecutive months, per LT2 requirements.
[3] Not a required parameter for LT2, so sampling frequency may be reduced the second year.

3 TUOLUMNE RIVER SOURCE WATER QUALITY

SRWA's new WTP will be subject to all applicable state and federal drinking water regulations. Thus, it was important to characterize the water quality of the Tuolumne River for comparison with regulatory maximum contaminant levels (MCLs) and regulatory treatment techniques (e.g., filter effluent turbidity, enhanced coagulation TOC removal). Primary MCLs (pMCLs) are enforceable limits that protect the public against the consumption of drinking water contaminants that present a risk to human health. Secondary MCLs (sMCLs) are not enforceable limits, but rather established guidelines that help manage the aesthetics (i.e., taste, color, and odor) of drinking water.

Source water quality data from samples collected during Phase 1 are summarized in this section. A complete set of data from the Phase 1 monitoring program is presented in Appendix A. Appendix B presents the various monitoring parameters for each water quality category shown in

Table 1, along with their respective analytical method, units, regulatory requirement, and collection frequency.

3.1 General Water Quality Characteristics

The general water quality characteristics for samples collected between October 2016 and October 2017 are summarized in Table 3. An important parameter under this category is total organic carbon (TOC) because it is recognized as precursor material for disinfection byproducts (DBPs), such as the regulated trihalomethanes (THMs) and haloacetic acids (HAAs). During development of the monitoring plan, historical data showed that TOC values at the water intake location (i.e., the existing infiltration gallery) were high enough that the DBP formation with free chlorine was likely to be a regulatory concern without sufficient TOC removal (Trussell, 2016a). Thus, TOC was measured monthly during the initial monitoring program to evaluate treatment techniques for TOC removal under the enhanced coagulation component of the Stage 1 Disinfectants and Disinfection Byproducts Rule (D/DBPR). The TOC removal required by the Stage 1 D/DBP Rule is based on the TOC and alkalinity of the source water, as illustrated in Table 2.

Table 2. TOC Removal Required Under the Stage 1 D/DBPR

Source Water TOC (mg/L)	Source Water Alkalinity (mg/L as $CaCO_3$)		
	0-60	>60-120	>120
Between 2.0 & 4.0	35%	25%	15%
Between 4.0 & 8.0	45%	35%	25%
>8.0	50%	40%	30%

From Table 3, the following observations about the Tuolumne River source water were made:

- In general, the source water was high quality with low total suspended solids (TSS), total dissolved solids (TDS), conductivity (specific conductance), sulfate, and chloride.
- The raw water quality, particularly the turbidity, TOC, and DOC, changed significantly between the December 2016 and January 2017 sampling events. Winter storms brought heavy rains to the area from late December through February. The Tuolumne River flows swelled from approximately 170 ft^3/s in November and early December to approximately 7,000 ft^3/s in early January and 10,000 ft^3/s from mid-February through April 2017. The high storm flows were exacerbated by releases from the upstream Don Pedro Reservoir. The 2017 flows are characterized in Figure 1, along with historical stream flows on the Tuolumne River below La Grange Dam and the City of Modesto since 1970 (when construction of Don Pedro Reservoir was completed). Figure 1 provides proper historical context to illustrate how frequently similar high flow periods might occur in the future. Figure 2 illustrates the impact of these unusual January storm events on turbidity—where the maximum turbidity measured at the infiltration gallery location was 15.43 NTU and the maximum value measured 3.5 miles upstream was 19.65 NTU. Considering the magnitude of these storms and the corresponding releases from Don Pedro Reservoir,

elevated turbidities from storm events are not expected to be a treatment challenge for a conventional treatment process, as is proposed for the new WTP. [Note: The preferred treatment train selected during Phase 1 of this project includes conventional clarification, ozonation, biologically active carbon (BAC) filtration, and free chlorine final disinfection.]

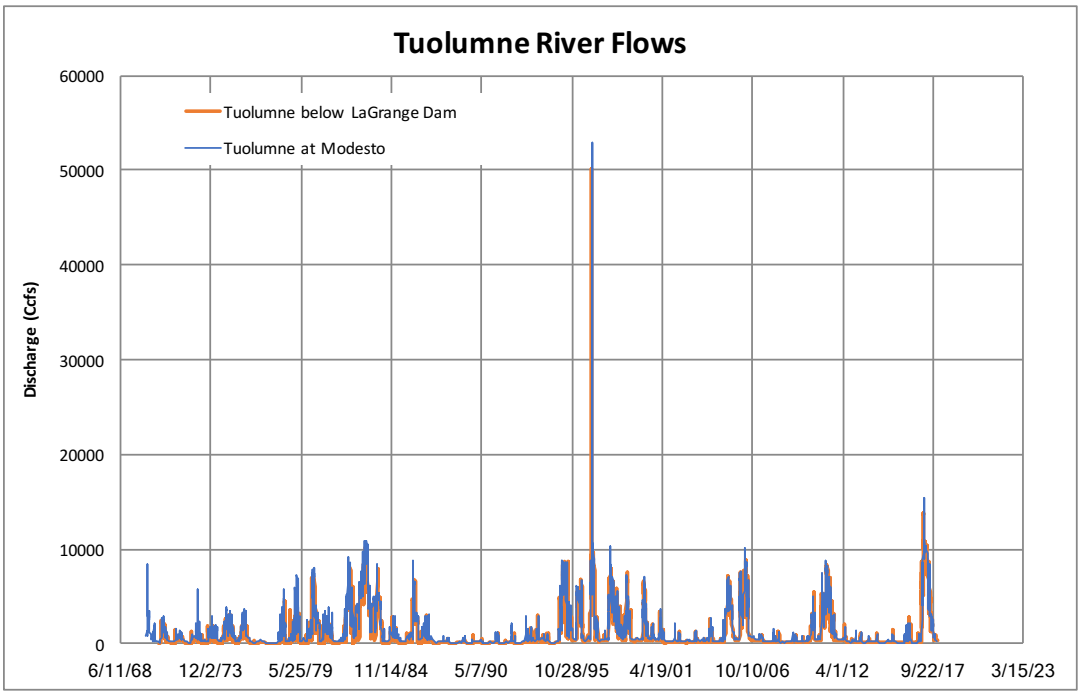

Figure 1. Historical stream flows on the Tuolumne River upstream and downstream of the Infiltration Gallery

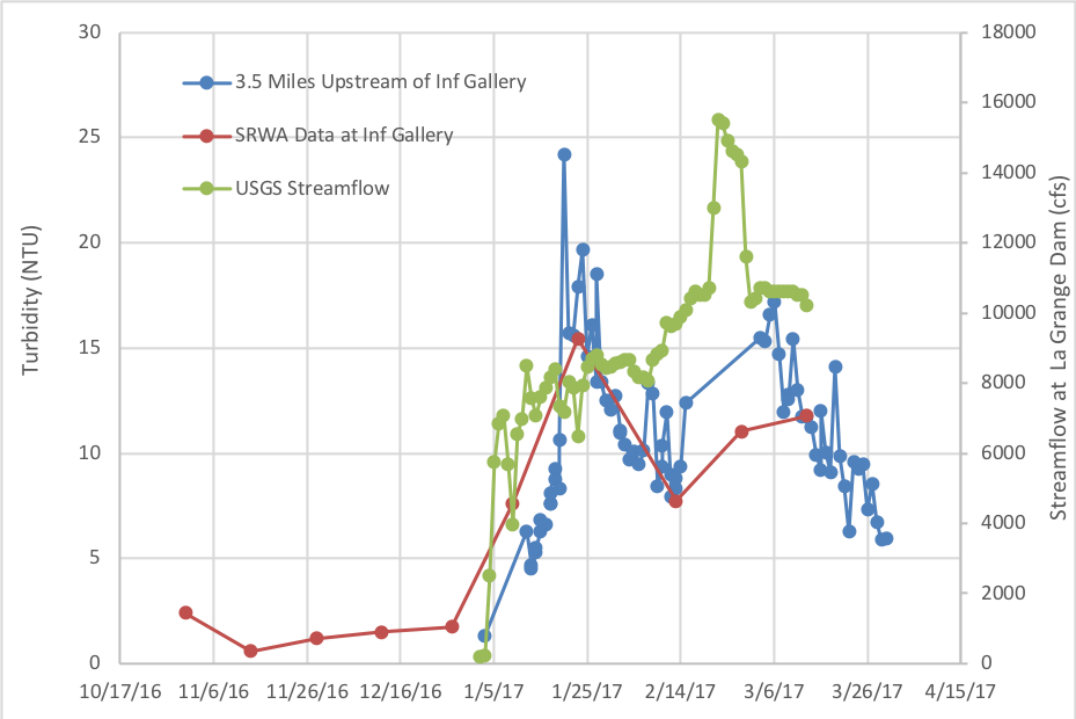

Figure 2. Turbidity measured during historic storm events in January 2017.

Selected observations of the measured results for general water quality parameters are listed below:

- Turbidity associated with each sampling event was measured twice. FishBio staff completed field measurements at the time of sample collection, and Eurofins staff completed lab measurements. The field turbidity results ranged from 0.59 to 15.4 NTU, while the lab turbidity measurements ranged from 0.58 to 12.0 NTU. Elevated turbidity measurements were during the January 2017 to April 2017 time frame, corresponding to the period of heavy rains and subsequent high flood conditions in the Tuolumne River source water. Turbidity removal will be addressed in the treatment train through clarification and filtration.
- Color measurements ranged from 5.0 to 20.0 apparent color units (ACU). Only one of the 4 samples exceeded the sMCL of 15 ACU. Color is expected to be addressed through ozonation.
- Total iron concentrations ranged from 0.032 to 0.68 mg/L, with six of the 15 samples above the sMCL of 0.3 mg/L. Dissolved iron concentrations ranged from below detection (< 0.020 mg/L) to 0.098 mg/L. Iron is generally easily removed through oxidation, clarification and filtration. In the distribution system, however, iron can cause customer complaints of "red" water.
- Total manganese concentrations ranged from 0.010 to 0.21 mg/L, with only one of the 15 samples (i.e., the maximum concentration) above the sMCL of 0.05 mg/L. Both the

maximum and average total manganese concentrations were above the level recommended by the Water Research Foundation (WRF) (Brandhuber, et al., 2013) to avoid aesthetic problems (0.015 to 0.02 mg/L), but well below the total manganese notification level (NL) based on health concerns (0.5 mg/L). Manganese currently has no pMCL.

- Dissolved manganese concentrations ranged from below detection (<0.0020 mg/L) to 0.013 mg/L. Manganese removal with ozone in the treatment train can be challenging because ozone can result in the formation of colloidal MnO2, which is able to pass through filtration. MnO2 in the distribution system can cause aesthetic issues and customer complaints of "black" or maybe "red" water (at lower MnO2 concentrations). Quarterly bench-scale tests were conducted concurrent with the Phase 1 monitoring program to evaluate the most effective means of manganese removal through the treatment train, and a separate report will be prepared summarizing the test results.
- All of the nitrogen species in the Tuolumne River were substantially below their respective pMCLs.
- Based on the median TOC value of 2.3 mg/L and median alkalinity value of 20.0 mg/L as $CaCO_3$, the Stage 1 D/DBPR requires that treatment remove at least 35% TOC. Jar testing indicated that this percentage of TOC removal is attainable (Trussell, 2017). The maximum TOC concentration measured was 7.3 mg/L (measured on 2/13/17) – which would require 45% TOC removal per the Stage 1 D/DBP Rule – however a parallel sample from the same day measured in conjunction with bench testing was 3.07 mg/L – which would require 35% TOC removal.
- Despite being included in the sampling plan, total phosphorous was not monitored during Phase 1 due to omission of the sampling bottles by the analytical laboratory (Eurofins). These missed samples will be collected with the LT2 samples during 2018. In addition, total phosphorous will be included in the Phase 2 monitoring program. High levels of phosphorus could indicate potential wastewater or fertilizer contamination, and the potential for algae blooms.

Table 3. Summary of General Water Quality Parameters Measured in the Tuolumne River from October 2016 to October 2017[1].

Parameter	Units	Regulatory List	MCL /NL	October 2016 - October 2017				
				Max	Min	Avg	Median	N
General Water Characteristics (Physical and Chemical)								
Alkalinity, total	mg/l as $CaCO_3$	-	-	26.0	11.0	18.5	20.0	15
Ammonia	mg/l as N	-	-	0.059	<0.050	0.051	<0.050	12
Bromide	mg/l	-	-	0.0089	<0.005	0.0061	<0.005	12
Calcium	mg/l	-	-	5.9	2.7	4.5	4.6	4
Chloride	mg/l	sMCL	250	2.9	<1.0	1.5	<1.0	4
Color	Color Units (ACU)	sMCL	15	20.0	5.0	10.0	7.5	4

Parameter	Units	Regulatory List	MCL /NL	October 2016 - October 2017				
				Max	Min	Avg	Median	N
Dissolved Oxygen[2] (Field Measurement)	mg/l	-	-	11.7	9.2	10.3	10.2	24
Foaming Agents (MBAS)	mg/l	sMCL	0.5	<0.10	<0.10	<0.10	<0.10	4
Iron, Dissolved	mg/l	-	-	0.098	<0.020	0.049	0.037	15
Iron, Total	mg/l	sMCL	0.3	0.68	0.032	0.33	0.24	15
Magnesium	mg/l	-	-	2.6	0.97	1.7	1.6	4
Manganese, Dissolved	mg/l	-	-	0.013	<0.0020	0.0039	<0.0020	15
Manganese, Total	mg/l	sMCL/NL	0.05/ 0.5	0.21	0.010	0.030	0.015	15
Nitrate	mg/l as N	pMCL	10	0.53	<0.10	0.22	0.13	12
Nitrite	mg/l as N	pMCL	1	<0.050	<0.050	<0.050	<0.050	12
Nitrite + Nitrate	mg/l as N	pMCL	10	0.53	<0.10	0.22	0.13	12
Odor – Threshold	Odor units	sMCL	3	2.0	2.0	2.0	2.0	4
Organic Carbon, Dissolved (DOC)	mg/l	-	-	4.4	1.8	2.4	2.1	15
Organic Carbon, Total (TOC)	mg/l	-	-	7.3	1.8	2.8	2.3	14
pH (Field Measurement)[3]	pH units	-	-	8.2	7.2	7.6	7.7	19
pH (Lab Measurement)	pH units	-	-	7.5	7.3	7.4	7.4	14
Phosphorus, Total[4]	mg/l as P	-	-					
Potassium	mg/l	-	-	1.0	<1.0	1.0	1.0	4
Sodium	mg/l	-	-	4.2	1.5	2.4	2.0	4
Specific Conductance (Field Measurement)	µS/cm	sMCL	900	68.2	20.8	46.4	44.8	24
Sulfate	mg/l	sMCL	250	3.6	1.0	2.1	2.0	4
Temperature	ºC	-	-	16.6	7.6	12.7	12.1	24
Total Dissolved Solids (TDS)	mg/l	sMCL	500	54.0	25.0	38.5	37.5	4
Total Suspended Solids (TSS)	mg/l	-	-	<10.0	<10.0	<10.0	<10.0	4
Turbidity, Field Measurement	NTU	sMCL	5	15.4	0.59	4.4	2.9	24
Turbidity, Lab Measurement	NTU	sMCL	5	12.0	0.58	2.7	1.3	24
UV-254	cm^{-1}	-	-	0.12	0.050	0.069	0.065	15

Parameter	Units	Regulatory List	MCL /NL	October 2016 - October 2017				
				Max	Min	Avg	Median	N

[1]Values presented as less than correspond to the Method Reporting Limit of each constituent.
[2]Samples collected twice a month.
[3]Initial five samples were omitted from calculation due to invalid field measurements by Fishbio.
[4]Total Phosphorous was not sampled/measured during Phase 1.

3.2 Title 22 Contaminants

SRWA's new WTP will be subject to the pMCLs and sMCLs defined in the Title 22 California Code of Regulations, which include inorganic and organic contaminants, radionuclides, and DBPs. Measured results for several Title 22 parameters were included in the general water quality summary shown in Table 3 and are not repeated in this section.

It is important to note that the Title 22 regulations are finished water standards. Therefore, the proposed treatment of the WTP will incorporate techniques to deal with all objectionable contaminants measured above their respective MCLs in the source water. At this time, the preferred treatment train for the WTP includes ozone and biologically active carbon (BAC), which is a preferred treatment approach for many of the regulated and unregulated organic contaminants.

3.2.1 Inorganic Contaminants with MCLs

The monitoring values for the inorganic contaminants sampled between October 2016 and October 2017 are summarized in Table 4. All but three of the twenty parameters included in this monitoring group were ND (below the method reporting limit) in each of the quarterly samples. The only contaminant measured above its MCL was aluminum, where only one of the three samples (i.e., the maximum concentration) was measured above the sMCL of 0.2 mg/L. The maximum aluminum concentration measured in the source water was still below the pMCL. Aluminum is expected to be removed through treatment. Both particulate and dissolved aluminum would be removed through a combination of coagulation-settling-filtration. The preferred coagulant for the full-scale WTP is an aluminum-based coagulant—either alum or polyaluminum chloride (PACl).

Table 4. Summary of Inorganic Contaminants Measured in the Tuolumne River from October 2016 to October 2017

Parameter	Units	Reg List	MCL/NL	October 2016 - October 2017				
				Max	Min	Average	Median	N
Inorganic Contaminants with a primary (p) or secondary (s) MCL (not included in general water characteristics)								
Aluminum	mg/L	pMCL/sMCL	1/0.2	0.53	0.046	0.20	0.11	4
Antimony	mg/L	pMCL	0.006	<0.0010	<0.0010	<0.0010	<0.0010	4
Arsenic	mg/L	pMCL	0.01	<0.0010	<0.0010	<0.0010	<0.0010	4

Asbestos	MFL *	pMCL	7	<5.8	<0.19	<1.6	<0.20	4
Barium	mg/L	pMCL	1	0.018	0.0078	0.013	0.014	4
Beryllium	mg/L	pMCL	0.004	<0.0010	<0.0010	<0.0010	<0.0010	4
Cadmium	mg/L	pMCL	0.005	<0.00050	<0.00050	<0.00050	<0.00050	4
Chromium, Total	mg/L	pMCL	0.05	<0.0010	<0.0010	<0.0010	<0.0010	4
Chromium, VI	mg/L	pMCL	0.01	0.000038	0.000028	0.000034	0.000035	4
Copper	mg/L	pMCL/sMCL	1.3/1.0	<0.0020	<0.0020	<0.0020	<0.0020	4
Cyanide	mg/L	pMCL	0.15	<0.025	<0.025	<0.025	<0.025	4
Fluoride	mg/L	pMCL	2	<0.050	<0.050	<0.050	<0.050	4
Lead	mg/L	pMCL	0.015	<0.00050	<0.00050	<0.00050	<0.00050	4
Mercury	mg/L	pMCL	0.002	<0.00020	<0.00020	<0.00020	<0.00020	4
Nickel	mg/L	pMCL	0.1	<0.0050	<0.0050	<0.0050	<0.0050	4
Perchlorate	mg/L	pMCL	0.006	<0.0040	<0.0040	<0.0040	<0.0040	4
Selenium	mg/L	pMCL	0.05	<0.0050	<0.0050	<0.0050	<0.0050	4
Silver	mg/L	sMCL	0.1	<0.00050	<0.00050	<0.00050	<0.00050	4
Thallium	mg/L	pMCL	0.002	<0.0010	<0.0010	<0.0010	<0.0010	4
Zinc	mg/L	sMCL	5	<0.020	<0.020	<0.020	<0.020	4
*MFL = million fibers per liter; MCL for fibers exceeding 10 µm in length								

3.2.2 Organic Contaminants with MCLs

A summary table is not provided for the organic contaminants listed in the Title 22 drinking water regulations because only simazine was measured above its detection limit. Simazine was detected in two of the four quarterly samples, and the highest measured concentration (0.00069 mg/L) was well below the pMCL of 0.004 mg/L.

3.2.3 Disinfection Byproducts (DBPs) with MCLs

No DBPs were detected in any of the samples collected from October 2016 to October 2017. Regulated DBPs include THMs, HAAs, bromate, and chlorite. These chemicals are typically formed through reaction with oxidants (e.g., during the disinfection process), and are not expected to be present in the source water unless discharged from a disinfected water source upstream.

3.2.4 Radionuclides with MCLs

No radionuclides were detected in any of the samples collected between October 2016 and October 2017. Regulated radionuclides include those naturally present in the environment (i.e., combined radium-226 and radium-228, gross alpha particle activity, and uranium), as well as those of anthropogenic origin (i.e., beta/photon emitters, strontium-90, tritium). Each drinking water supply must comply with the pMCLs of these contaminants to protect public health.

3.3 Microbial Parameters

In addition to MCLs, treatment techniques have been legislated to regulate microbial removal through filtration and microbial inactivation through disinfection. Per the Surface Water Treatment Rule (SWTR) promulgated in 1989, all surface WTPs must provide 3-log *Giardia* removal/inactivation and 4-log virus removal/inactivation. LT2, promulgated in 2006, requires monthly monitoring of *Cryptosporidium*, *E. coli*, and turbidity over a 24-month period. The maximum running annual average *Cryptosporidium* concentration places the source water in a "Bin" that dictates the level of treatment required to achieve the necessary log removal/inactivation, as shown in Table 5. If the source water is placed in Bin 1, no additional treatment beyond the 2-log removal required under the Interim Enhanced Surface Water Treatment Rule (IESWTR) is necessary.

Table 5. Bin classification for filtered public water systems indicating the *Cryptosporidium* removal required under LT2

Bin	*Cryptosporidium* Concentration (oocysts/L)	Treatment Requirements for Conventional Filtration	Treatment Requirements for Direct Filtration
1	<0.075	No additional treatment	No additional treatment
2	0.075 to <1.0	1-log	1.5-log
3	1.0 to <3.0	2-log	2.5-log
4	≥3.0	2.5-log	2-log

The source water microbial data sampled from October 2016 to October 2017 are summarized in Table 6. SRWA will need to submit the *Cryptosporidium* results from the full 24-month LT2 monitoring campaign to DDW for review and approval before establishing Bin classification for the new WTP. Results through October 2017, though, put the source water in Bin 1.

Table 6. Summary of Microbiological Parameters Measured in the Tuolumne River from October 2016 to October 2017

Parameter	Units	Reg List	MCL/ NL	October 2016 - October 2017				
				Max	Min	Average	Median	N
Microbiological Parameters								
Cryptosporidium	oocysts/L	-	-	0.10	0	0.0083	0	12
E. coli	MPN/100mL	-	-	460	6.3	73.4	40	24
Giardia	cysts/L	-	-	0.4	0	0.075	0	12
Total Coliform	MPN/100mL	-	-	>2,420	380	1,953	2,400	24

Total coliform and *Giardi*a were included in the monitoring program pursuant to the DDW SWTR guidance document[1] for determination of the log treatment requirements for *Giardia* and viruses.

Total coliform (monthly median)

- If <1000 /100 mL, then 3-log or 4-log treatment for *Giardia* and viruses
- If >1000 – 10,000 /100 mL, then 4-log or 5-log treatment *Giardia* and viruses
- If >10,000 – 100,000 /100 mL, then 5-log or 6-log treatment *Giardia* and viruses

The median for total coliform (measured twice per month) was 2,400/100 mL, meaning the suggested treatment for *Giardia* and viruses is 4-logs and 5-logs, respectively. Based on preliminary discussions with DDW, pathogen treatment for the new WTP is expected to be 2-log *Cryptosporidium*, 4-log *Giardia*, and 5-log virus.

3.4 Pesticides other Synthetic Organic Chemicals (SOCs)

The monitoring program also included pesticides and other SOCs applied to crops within the Lower Tuolumne River watershed, along with those measured in the historical source water quality data. The pesticides were divided into two categories: (a) high usage based on mass applied per year (>5,000 lbs/yr) and acreage covered (>10,000 acres), and (b) those on one of the candidate future regulatory lists – Unregulated Contaminant Monitoring Rule (UCMR), Candidate Contaminant List (CCL), California Notification Level (NL), or archived Notification Level (aNL) – or with an EPA health advisory (HA) level.

3.4.1 Pesticides Highly Used in the Watershed

Several high-use pesticides applied in the project area, without a regulatory limit, were also selected for monitoring. Pesticides considered to be high-use were applied at a rate of 5,000 lbs/year or greater or applied to an area of 10,000 acres or greater. These high-use pesticides were: chloropicrin, chlorothalonil, methyl bromide, oxyfluorfen, paraquat dichloride, and pendimethalin. None of the pesticides were detected in any of the samples collected from October 2016 to October 2017.

3.4.2 Pesticides with a Health Advisory Level or Considered for Future Regulation

A summary table also is not provided for this section because only one of the twelve pesticides monitored was measured above its detection limit during quarterly sampling. Diuron was detected in two of the four samples, and its maximum measured concentration (0.000066 mg/L) was substantially below the lifetime health advisory (HA) level of 0.015 mg/L.

[1] "Appendix B, Guidelines for Determining when Surface Waters will Require More than the Minimum Levels of Treatment Defined in the Surface Water Treatment Regulations".

3.4.3 SOCs Reported in the Historical Data

Six additional SOCs that had been detected in water samples collected within the study area (i.e., between the La Grange dam and the Infiltration Gallery location) since 1995 were also monitored. No SOCs in this monitoring category were detected in any of the quarterly samples collected from October 2016 to October 2017.

3.5 Additional Unregulated Constituents

The monitoring program also included the organic chemical 1,2,3-Trichloropropane (1,2,3-TCP) as an unregulated constituent. This contaminant previously had a California NL of 0.005 µg/L, but DDW recently established this value as the MCL (in December 2017) because this compound is a known human carcinogen. 1,2,3-TCP was not detected in any of the samples collected from October 2016 to October 2017.

Additional parameters were included in the Tuolumne River monitoring program to understand the impact of local cattle and poultry operations in the source water quality and to understand the potential for algae growth. Antibiotics and hormones are commonly used in livestock operations, and can end up in receiving waters (e.g., the source water for this project) via stormwater and irrigation runoff. Animal operations may also introduce nitrogen compounds (i.e., ammonia, nitrate, nitrite) to the source water. Under stagnant river conditions, these nutrients can cause algae to grow, which can lead to aesthetic (i.e., taste and odor) problems in the source water. The hormones, antibiotics, and algae indicators included in the monitoring program are found in EPA's UCMR and CCL lists, which provide a basis for future regulatory actions to protect public health.

3.5.1 Unregulated Constituents Related to Animal Operations

A summary table is not provided for this section because from the list of eight total hormones (e.g., equilin) and antibiotics (i.e., erythromycin) that were monitored, only one was measured above its detection limit. That compound is 17-α-ethynylestradiol, an unregulated synthetic hormone (estrogen) listed in the third UCMR. 17-α-ethynylestradiol was detected in one of the quarterly samples collected, as indicated in Table A.9.

3.5.2 Unregulated Constituents Related to Algae Occurrence

The presence of algae in source water can lead to taste and odor problems and potentially the occurrence of algal toxins. For these reasons, the characterization of algae occurrence can help the future WTP predict when and if these issues are expected to occur. Identification of the algae present in the source water can be used to anticipate potential water quality issues associated with different algae types. Diatoms (e.g., *Melosira*, *Navicula*, etc.) are a class of algae known for clogging filters, although certain members of cyanobacteria are known to cause similar problems. Cyanobacteria (*e.g. Oscillatoria*) have been associated with the production of geosmin, 2-methylisoborneol (MIB), and cyanotoxins.

A technique known as flow cytometry was used to (a) identify the algae of the source water, (b) quantify the detected algae in units of counts per sample volume, and (c) determine the

biovolume or the volume each algae group occupies in the sample volume. For flow cytometry, a controlled stream of sample fluid is passed through a laser beam, which measures fluorescence to determine the presence of Chlorophyll-a. Chlorophyll-a was used as a surrogate for algal biomass, as it is the predominant type of chlorophyll found in green plants and algae.

The quantification of algae in the samples collected between October 2016 and October 2017 are summarized in Table 7. The algae in the Tuolumne River consist primarily of diatoms, with green algae (i.e., *Scenedesmus*) and Cyanobacteria or blue-green algae (i.e., *Oscillatoria*). The chlorophyll-a concentration found in all four samples was < 10,000 ng/L, a level associated with low nutrient concentrations and low algal growth. Additionally, the World Health Organization (WHO) classifies conditions with chlorophyll-a < 10,000 ng/L (dominated by cyanobacteria) in recreational waters as having a low risk for adverse health effects (WHO, 1999).

Table 7. Summary of Algae Enumeration, Identification, Biovolumes, and Concentrations Measured in the Tuolumne River from October 2016 to October 2017

Date	Genus	Count/mL	Biovolume (µm^3)
12/12/16	*Melosira* (Diatom)	6	1.29E+06
	Synedra (Diatom)	12	1.93E+05
	Scenedesmus (Green Algae)	6	1.59E+04
	Total	24	1.50E+06
	Chlorophyll A, ng/L	1000	
3/13/17	*Melosira* (Diatom)	18	1.03E+07
	Navicula (Diatom)	12	7.10E+04
	Total	30	1.04E+07
	Chlorophyll A, ng/L	1100	
6/12/17	*Melosira* (Diatom)	6	3.55E+05
	Cymbella (Diatom)	6	9.58E+03
	Oscillatoria (Cyanobacteria)	6	2.01E+04
	Navicula (Diatom)	6	2.92E+04
	Unidentified Algae	12	1.85E+04
	Total	36	4.32E+05
	Chlorophyll A, ng/L	2100	
9/11/17	*Oscillatoria*	24	1.61E+05
	Navicula	6	2.36E+04
	Nitzschia	6	9.52E+04
	Unidentified Algae	6	9.01E+03
	Total	42	2.89E+05
	Chlorophyll A, ng/L	1000	

Cyanobacteria (also known blue-green algae) can produce toxins known as cyanotoxins that are harmful to humans. At this time, there are no legally enforceable federal standards governing cyanotoxins in finished drinking water; however, the EPA has developed 10-day Health Advisories (HAs) for total microcystins and cylindrospermopsin. HAs "provide technical guidance on health effects, analytical methodologies and treatment technologies associated with contaminants that are known or expected to occur in drinking water," (EPA 2015). In addition, the EPA has included the following ten cyanotoxin contaminants in their fourth UCMR: total microcystins, mycrocystin-LA, mycrocystin-LF, mycrocystin-LR, mycrocystin-LY, mycrocystin-RR, mycrocystin-YR, nodularin, cylindrospermopsin, and anatoxin-a.

No cyanotoxins were detected during Phase 1 monitoring, however only one of the two originally scheduled samples were completed during this time period. The additional cyanotoxin analysis missed from September 2017 will be incorporated in the Phase 2 extended monitoring program. The proposed Phase 2 monitoring program will also include the UCMR cyanotoxins, so more information about occurrence and concentrations of these algae and algal toxins are forthcoming.

The most common and effective treatment strategies for the removal of the taste and odor compounds, geosmin and MIB, are oxidation with ozone, powdered activated carbon (PAC), and granular activated carbon (GAC) (Crittenden et al. 2012). Oxidation with ozone has also been shown to effectively oxidize microcystins, cylindrospermopsin, and anatoxin-a (AWWA and Ohio EPA 2015, EPA 2015). The proposed treatment train for SRWA's new WTP includes both ozone and GAC/sand biologically active carbon (BAC) filters; PAC is not included. With ozone and BAC in SRWA's process train, potential future detections of these constituents would be mitigated.

4 COMPARISON WITH HISTORICAL WATER QUALITY DATA

Prior to initiating the year-long SRWA monitoring program, a thorough review and assessment of historical source water quality was performed using data from the Tuolumne River, at locations between the Don Pedro Reservoir and the confluence of Dry Creek at Modesto (Trussell, 2016b). Historical monitoring was completed from the same infiltration gallery sampling location by Turlock Irrigation District (TID) from May 2006 to October 2008, as part of their watershed sanitary survey monitoring program. A statistical comparison between the historical data provided by TID and the results collected for this SRWA monitoring program (October 2016 – October 2017) are summarized in Table 8.

From Table 8, the following observations about the Tuolumne River were made:

- The results from SRWA's Phase 1 monitoring period (October 2016 – October 2017) were similar to the historical monitoring values from the infiltration gallery (May 2006 – October 2008) for the majority of the monitoring parameters.
- Chloride, sulfate, specific conductance (conductivity), and TDS concentrations for both periods remained low, and well under their sMCLs.
- All of the nitrogen species remained substantially below their pMCLs.

- Bromide concentrations remained low. This is significant, since ozonation can oxidize bromide and form bromate. Bench testing demonstrated that bromate formation through ozonation is not expected to be an issue with this source water (Trussell, 2017), with the maximum concentration measured being 1.2 µg/L. The pMCL for bromate is 10 µg/L.
- The median values for total suspended solids (TSS) and turbidity were low for both periods. For TSS, the maximum concentration during the May 2006 to October 2008 sampling (62 mg/L) was much higher than during Phase 1 (<10 mg/L). For turbidity, the maximum measurement during Phase 1 (15.4 NTU) was about 50% higher than during the 2006-2008 timeframe, and occurred during the January and February 2017 storm events.
- The median values for total iron remained below the sMCL during both periods. The maximum reported concentration during the May 2006 to October 2008 (6.5 mg/L) sampling was much higher than during 2016-2017 Phase 1 sampling (0.68 mg/L).
- The median values for total manganese remained below the sMCL and NL for both periods, but were above the finished water quality target level of 0.015 mg/L. The maximum concentration during 2006-2008 (0.85 mg/L) was much higher than the 2016-2017 period (0.21 mg/L).
- The TOC and alkalinity concentrations were about the same for both periods. The median TOC concentrations for the 2006-2008 period and during SRWA's Phase 1 sampling program were 3.0 mg/L and 2.3 mg/L, respectively. The median alkalinity concentration was 37 mg/L as $CaCO_3$ for the 2006-2008 period and 20 mg/L as $CaCO_3$ during Phase 1.
- *Cryptosporidium* and *Giardia* concentrations were consistent with historical monitoring values. For the SRWA 2016-2017 data, only one of 12 samples had a detected oocyst for *Cryptosporidium* (1 oocyst, yielding a concentration of 0.1 oocysts/L). The maximum concentrations of *E. coli* and total coliform increased from the 2006-2008 period to the 2016-2017 period by a factor of 2.9 and 1.5, respectively.

Table 8. Comparison of Water Quality Parameters at the Tuolumne River Intake Location with Historical Water Quality Data from the TID

Analyte	Statistics	Period	
		May 2006-Oct 2008 (TID WSS at Infiltration Gallery)	Oct 2016-Oct 2017 (SRWA Source Water Characterization at Infiltration Gallery)
General Water Characteristics (Physical and Chemical)			
Alkalinity, Total mg/L as $CaCO_3$	Min	23	11
	Max	80	26
	Median	37	20
	Mean	37	18.5
	N	40	15
Ammonia mg/L as N	Min	<0.1	<0.050
	Max	<0.1	0.059
	Median	<0.1	<0.050

Analyte	Statistics	Period	
		May 2006-Oct 2008 (TID WSS at Infiltration Gallery)	Oct 2016-Oct 2017 (SRWA Source Water Characterization at Infiltration Gallery)
	Mean	<0.1	0.051
	N	11	12
Bromide mg/L	Min	<0.1	<0.005
	Max	<0.1	0.0088
	Median	<0.1	<0.005
	Mean	<0.1	0.0061
	N	30	12
Calcium mg/L	Min	5.0	2.7
	Max	11	5.9
	Median	9.2	4.6
	Mean	9.2	4.5
	N	23	4
Chloride mg/L	Min	2.1	<1.0
	Max	11	2.9
	Median	4.8	<1.0
	Mean	5.1	1.5
	N	5	4
Color Color units	Min	<1	5
	Max	10	20
	Median	5	7.5
	Mean	4	10
	N	14	4
Dissolved Oxygen mg/L	Min	7.9	9.2
	Max	14.5	11.7
	Median	10.5	10.2
	Mean	10.6	10.3
	N	66	24
Total Iron mg/L	Min	<0.050	0.032
	Max	6.5	0.68
	Median	<0.10	0.24
	Mean	0.19	0.33
	N	94	15
Magnesium mg/L	Min	2.2	0.97
	Max	5.6	2.6

Analyte	Statistics	Period	
		May 2006-Oct 2008 (TID WSS at Infiltration Gallery)	Oct 2016-Oct 2017 (SRWA Source Water Characterization at Infiltration Gallery)
	Median	4.3	1.6
	Mean	4.4	1.7
	N	23	4
Total Manganese mg/L	Min	<0.010	0.010
	Max	0.85	0.21
	Median	0.017	0.015
	Mean	0.029	0.030
	N	95	15
Nitrate mg/L as N	Min	0.29	<0.10
	Max	0.86	0.53
	Median	0.43	0.13
	Mean	0.47	0.22
	N	19	12
Nitrite mg/L as N	Min	<0.1	<0.050
	Max	<0.1	<0.050
	Median	<0.1	<0.050
	Mean	<0.1	<0.050
	N	6	12
Odor TON	Min	<1	2
	Max	4	2
	Median	<1	2
	Mean	1	2
	N	13	4
Organic carbon, Dissolved mg/L	Min	1.3	1.8
	Max	4.0	4.4
	Median	2.4	2.1
	Mean	2.5	2.4
	N	47	15
Organic carbon, Total mg/L	Min	1.4	1.8
	Max	6.5	7.3
	Median	3.0	2.3
	Mean	3.3	2.8
	N	47	14
	Min	6.7	7.2

Analyte	Statistics	Period	
		May 2006-Oct 2008 (TID WSS at Infiltration Gallery)	Oct 2016-Oct 2017 (SRWA Source Water Characterization at Infiltration Gallery)
pH (Field Measurement) pH units	Max	8.3	8.2
	Median	7.4	7.7
	Mean	7.4	7.6
	N	68	19
Specific Conductance (Field Measurement) µS/cm	Min	33	20.8
	Max	201	68.2
	Median	77	44.8
	Mean	90	46.4
	N	67	24
Sulfate mg/L	Min	2.3	1.0
	Max	6.5	3.6
	Median	3.0	2.0
	Mean	3.5	2.1
	N	5	4
Temperature ºC	Min	4.4	7.6
	Max	27.7	16.6
	Median	15.2	12.1
	Mean	16.0	12.7
	N	70	24
Total Solids, Dissolved (TDS) mg/L	Min	<30	25.0
	Max	150	54.0
	Median	64	37.5
	Mean	61	38.5
	N	54	4
Total Solids, Suspended (TSS) mg/L	Min	<5	<10
	Max	62	<10
	Median	<5	<10
	Mean	6.5	<10
	N	37	4
Turbidity (Field Measurement) NTU	Min	0.62	0.59
	Max	7.3	15.4
	Median	2.0	2.9
	Mean	2.3	4.4
	N	72	24

Analyte	Statistics	Period	
		May 2006-Oct 2008 (TID WSS at Infiltration Gallery)	Oct 2016-Oct 2017 (SRWA Source Water Characterization at Infiltration Gallery)
Inorganic Contaminants			
Aluminum mg/L	Min	<0.020	0.046
	Max	0.29	0.53
	Median	0.046	0.11
	Mean	0.091	0.20
	N	5	4
Barium mg/L	Min	0.02	0.0078
	Max	0.10	0.018
	Median	Not Reported	0.014
	Mean	0.04	0.013
	N	4	4
Microbiological Parameters			
Coliform, Total MPN/100 mL	Min	4	380
	Max	>1600	>2420
	Median	130	2400
	Mean	282	1953
	N	73	24
Cryptosporidium oocysts/L	Min	0	0
	Max	0.09	0.10
	Median	0	0
	Mean	0.004	0.008
	N	24	12
E. coli MPN/100 mL	Min	0	6.3
	Max	160	460
	Median	12.7	40.0
	Mean	24.0	73.4
	N	24	24
Giardia cysts/L	Min	0.00	0
	Max	2.0	0.4
	Median	0.09	0
	Mean	0.33	0.075
	N	12	12

5 LONG-TERM SOURCE WATER MONITORING (PHASE 2)

Additional monitoring (Phase 2) is proposed to track long-term trends in source water quality throughout the design and construction phases of the project, as summarized in Table 9 and further detailed in Appendix C. It is proposed that selected parameters with greater relevance to the WTP design be monitored on a monthly frequency through 2018 and corresponding with the required monthly LT2 sample collection. It is also proposed that continued monitoring of Title 22 parameters with a MCL occur on a semi-annual basis through 2018 and 2019, to the start of WTP construction (assumed at or before the start of 2020). The monitoring categories shown in Table 9 are consistent with Phase 1 monitoring, with the addition of the USEPA's UCMR4 parameters (USEPA, Dec. 20, 2016). The UCMR4 list includes 10 cyanotoxins that were monitored separately during Phase 1, as well as two metals, 8 pesticides and one pesticide manufacturing byproduct, additional disinfection byproducts, alcohols, semivolatile chemicals, and two indicator parameters (TOC and bromide) that have already been monitored for this source water.

Table 9. Proposed Source Water Monitoring Schedule for Phase 2

Parameter	Frequency of Collection	
	Year One (March – Oct, 2018)	Jan 2019 to Start of Construction*
General Water Characteristics (Physical and Chemical)	semi-annual (Spring, Fall)	semi-annual (Winter, Summer)
Select Field and Other General Parameters:		
pH, Temperature, Dissolved Oxygen, Turbidity, Alkalinity, Iron, Manganese, TOC, DOC	monthly **	semi-annual (Winter, Summer)
Turbidity (lab)	monthly **	semi-annual (Winter, Summer)
Inorganic chemicals with DDW MCLs	semi-annual (Spring, Fall)	semi-annual (Winter, Summer)
Organic chemicals with DDW MCLs (includes regulated pesticides)	semi-annual (Spring, Fall)	semi-annual (Winter, Summer)
Radionuclides with DDW MCLs	semi-annual (Spring, Fall)	semi-annual (Winter, Summer)
Microbial Parameters:		
Cryptosporidium, Giardia	monthly	--
Total Coliform, E. coli	monthly **	semi-annual (Winter, Summer)
Nitrogen Compounds (NH_3, NO_2, NO_3)	semi-annual (Spring, Fall)	--
Select Unregulated Pesticides and SOCs ***	semi-annual (Spring, Fall)	--

Parameter	Frequency of Collection	
	Year One (March – Oct, 2018)	Jan 2019 to Start of Construction*
Additional Unregulated Parameters with a DDW Notification Level	Winter, Spring	--
UCMR4 Parameters	Summer, Fall	--

*It is anticipated that the long-term monitoring proposed for 2019 will continue until construction of the WTP begins at or before the start of 2020.

**Monthly monitoring for these parameters is already included for October 2017 – October 2018 as part of the Phase 1 monitoring per LT2.

***"Select Unregulated Pesticides and SOCs includes all high-use pesticides applied to crops within the Lower Tuolumne River watershed, plus constituents measured during prior sampling events, provided that an appropriate analytical method is available.

6 REFERENCES

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APPENDIX A – PHASE 1 MONITORING RESULTS FROM OCT 2016 TO OCT 2017

Table A.1. Results for General Water Quality Parameters, Phase 1

Parameter/ Sampling Date	Alkalinity, total	Ammonia	Bromide	Calcium	Chloride	Color	Dissolved Oxygen (Field Measure)	Foaming Agents (MBAS)	Iron, Dissolved	Iron, Total	Magnesium
Units	mg/l as CaCO3	mg/l as N	µg/l	mg/l	mg/l	Color Units	mg/l	mg/l	mg/l	mg/l	mg/l
10/31/16							9.3				
11/14/16	26	0.059	8.8				9.7		0.054	0.16	
11/28/16							10.9				
12/12/16	26	<0.050	8.4	5.9	2.9	5	10.2	<0.10	0.021	0.14	2.6
12/27/16							11.7				
1/9/17	22	<0.050	7.3				9.8		0.087	0.62	
1/23/17	16						10.8		0.098	0.67	
2/13/17	18	<0.050	<5.0				10.9		0.073	0.4	
2/27/17	22						10.7		0.033	0.68	
3/13/17	20	<0.050	<5.0	4.5	<1.0	20	11.0	<0.10	0.067	0.48	1.7
3/13/17 (Duplicate)	21								0.071	0.52	
3/27/17							11.5				
4/10/17	20	<0.050	<5.0				11.5		0.035	0.24	
4/24/17							11.3				
5/8/17	17	<0.050	<5.0				10.6		0.02	0.16	
5/22/17							10.4				
6/12/17	15	<0.050	<5.0	4.7	<1.0	10	10.2	<0.10	0.037	0.29	1.5
6/26/17							10.3				
7/10/17	12	<0.050	<5.0				10.1		0.023	0.19	
7/24/17							10.0				
8/14/17	11	<0.050	<5.0				9.2		<0.02	0.17	
8/28/17							9.2				
9/11/17	11	<0.050	<5.0	2.7	<1.0	5	9.5	<0.10	0.03	0.032	0.97
9/25/17							9.2				
10/9/17	21	<0.050	8.5				9.4		0.068	0.24	

Note: Parameters are monitored either every two weeks, monthly, or quarterly.

Table A.1. Results for General Water Quality Parameters, Phase 1 (Continued)

Parameter/ Sampling Date	Manganese, Dissolved	Manganese, Total	Nitrate	Nitrite	Nitrite + Nitrate	Odor - Threshold	Organic Carbon, Dissolved (DOC)	Organic Carbon, Total (TOC)	pH (Field Measure)	pH (Lab Measure)
Units	µg/l	µg/l	mg/l as N	mg/l as N	mg/l as N	Odor units	mg/l	mg/l	pH units	pH units
10/31/16									6.3[1]	
11/14/16	<2	15	0.36	<0.05	0.36		2	2.1	8.0[1]	7.4
11/28/16									9.2[1]	
12/12/16	4.4	14	0.49	<0.05	0.49	2	2	2	9.2[1]	7.5
12/27/16									8.9[1]	
1/9/17	<2	28	0.27	<0.05	0.27		3.9	3.5	7.4	7.4
1/23/17	<2	20					3.2	3.4	7.6	7.3
2/13/17	<2	13	0.17	<0.05	0.17		2.8	7.3	7.9	7.5
2/27/17	<2	22					4.4	3.9	7.8	7.4
3/13/17	<2	13	0.12	<0.05	0.12	2	2.3	2.3	7.4	7.4
3/13/17 (Duplicate)	<2	13					2.2			7.4
3/27/17									7.9	
4/10/17	3.3	210	0.12	<0.05	0.12		2.2	2.8	7.6	7.4
4/24/17									8.2	
5/8/17	<2	10	<0.1	<0.05	<0.1		1.9	2.2	7.7	7.5
5/22/17									7.9	
6/12/17	7.9	29	0.13	<0.05	0.13	2	2.1	2.4	7.7	
6/26/17									7.7	
7/10/17	5	14	<0.1	<0.05	<0.1		2.1	2.1	7.4	7.3
7/24/17									7.7	
8/14/17	4.9	12	<0.1	<0.05	<0.1		1.8	1.9	7.7	7.3
8/28/17									7.4	
9/11/17	3.4	15	<0.1	<0.05	<0.1	2	1.8	1.9	7.2	7.4
9/25/17									7.4	
10/9/17	13	22	0.53	<0.05	0.53		1.8	1.8	7.4	7.3

Note: Parameters are monitored either every two weeks, monthly, or quarterly.

[1]Erroneous Measurements.

Table A.1. Results for General Water Quality Parameters, Phase 1 (Continued)

Parameter/ Sampling Date	Potassium	Sodium	Specific Conductance (Field Measure)	Sulfate	Temperature	Total Dissolved Solids (TDS)	Total Suspended Solids (TSS)	Turbidity (Field Measure)	Turbidity (Lab Measure)	UV-254, Dissolved
Units	mg/l	mg/l	µS/cm	mg/l	ºC	mg/l	mg/l	NTU	NTU	cm -1
10/31/16			61.5		14.8			2.4	1.3	
11/14/16			61.8		15.5			0.59	0.72	0.05
11/28/16			65		11			1.2	0.65	
12/12/16	1	4.2	67.5	3.6	11.9	54	<10	1.5	1.2	0.052
12/27/16			68.2		7.6			1.8	0.99	
1/9/17			59.3		11.9			7.6	5.5	0.117
1/23/17			47.8		9.9			15.4	12	0.096
2/13/17			51		10.1			7.7	5.6	0.086
2/27/17			68.2		10.9			11.0	7.2	0.07
3/13/17	1	1.9	43.1	2.3	10.7	39	<10	11.8	8.8	0.075
3/13/17 (Duplicate)										0.075
3/27/17			37.9		10.1			7.6	5.4	
4/10/17			43.6		10.7			3.3	2.5	0.065
4/24/17			41.6		10.9			2.8	1.9	
5/8/17			46		12			2.9	1.3	0.065
5/22/17			33.8		12.3			3.5	1.5	
6/12/17	<1	2	36.3	1.6	12.2	36	<10	2.9	1.2	0.064
6/26/17			32.6		13.7			2.0	1.3	
7/10/17			20.8		13.9			2.6	0.58	0.059
7/24/17			27.1		15			2.0	0.83	
8/14/17			28.2		15.1			2.9	0.75	0.055
8/28/17			24.4		15.6			2.0	0.64	
9/11/17	<1	1.5	25.4	1	15.9	25	<10	4.3	1.4	0.052
9/25/17			60.5		16.6			3.1	1.7	
10/9/17			62.7		16.1			1.9	0.72	0.053

Note: Parameters are monitored either every two weeks, monthly, or quarterly.

Table A.2. Results for Inorganic Parameters, Phase 1

Parameter/ Sampling Dates	Units	12/12/16	3/13/17	6/12/17	9/11/17
Aluminum	mg/L	0.046	0.53	0.14	0.087
Antimony	mg/L	<0.0010	<0.0010	<0.0010	<0.0010
Arsenic	mg/L	<0.0010	<0.0010	<0.0010	<0.0010
Asbestos	MFL	<0.20	<0.19	<0.19	<5.8
Barium	mg/L	0.018	0.016	0.011	0.0078
Beryllium	mg/L	<0.0010	<0.0010	<0.0010	<0.0010
Cadmium	mg/L	<0.00050	<0.00050	<0.00050	<0.00050
Chromium (Total)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010
Chromium-6 (Hexavalent)	mg/L	0.000038	0.000028	0.000036	0.000034
Copper	mg/L	<0.0020	<0.0020	<0.0020	<0.0020
Cyanide	mg/L	<0.025	<0.025	<0.025	<0.025
Fluoride	mg/L	<0.050	<0.050	<0.050	<0.050
Lead	mg/L	<0.00050	<0.00050	<0.00050	<0.00050
Mercury (inorganic)	mg/L	<0.00020	<0.00020	<0.00020	<0.00020
Nickel	mg/L	<0.0050	<0.0050	<0.0050	<0.0050
Perchlorate	mg/L	<0.0040	<0.0040	<0.0040	<0.0040
Selenium	mg/L	<0.0050	<0.0050	<0.0050	<0.0050
Silver	mg/L	<0.00050	<0.00050	<0.00050	<0.00050
Thallium	mg/L	<0.0010	<0.0010	<0.0010	<0.0010
Zinc	mg/L	<0.020	<0.020	<0.020	<0.020

Table A.3. Results for Organic Parameters, Phase 1

Parameter/ Sampling Date	Units	12/12/16	12/27/16	3/13/17	6/12/17	9/11/17
1,1,1-Trichloroethane (1,1,1-TCA)	µg/L		<0.5	<0.5	<0.5	<0.5
1,1,2,2-Tetrachloroethane	µg/L		<0.5	<0.5	<0.5	<0.5
1,1,2-Trichloro-1,2,2-Trifluoroethane (Freon 113)	µg/L		<0.5	<0.5	<0.5	<0.5
1,1,2-Trichloroethane (1,1,2-TCA)	µg/L		<0.5	<0.5	<0.5	<0.5
1,1-Dichloroethane (1,1-DCA)	µg/L		<0.5	<0.5	<0.5	<0.5
1,1-Dichloroethylene (1,1-DCE)	µg/L		<0.5	<0.5	<0.5	<0.5
1,2,4-Trichlorobenzene	µg/L		<0.5	<0.5	<0.5	<0.5
1,2-Dichlorobenzene	µg/L		<0.5	<0.5	<0.5	<0.5

Parameter/ Sampling Date	Units	12/12/16	12/27/16	3/13/17	6/12/17	9/11/17
1,2-Dichloroethane (1,2-DCA)	µg/L		<0.5	<0.5	<0.5	<0.5
1,2-Dichloropropane	µg/L		<0.5	<0.5	<0.5	<0.5
1,3-Dichloropropane	µg/L		<0.5	<0.5	<0.5	<0.5
1,4-Dichlorobenzene (p-DCB)	µg/L		<0.5	<0.5	<0.5	<0.5
2,3,7,8-TCDD (Dioxin)	pg/L	<5			<2	<1.9
2,4,5-TP (Silvex)	µg/L		<0.2	<0.2	<0.2	<0.2
2,4-Dichlorophenoxyacetic acid (2,4-D)	µg/L		<0.1	<0.1	<0.1	<0.1
Alachlor	µg/L	<0.05	<0.1	<0.1	<0.1	<0.1
Atrazine	µg/L	<0.05	<0.005	<0.05	<0.05	<0.05
Bentazon	µg/L		<0.5	<0.5	<0.5	<0.5
Benzene	µg/L		<0.5	<0.5	<0.5	<0.5
Benzo(a)pyrene	µg/L	<0.02		<0.02	<0.02	<0.02
Carbofuran	µg/L		<0.5	<0.5	<0.5	<0.5
Carbon Tetrachloride	µg/L		<0.5	<0.5	<0.5	<0.5
Chlordane	µg/L		<0.1	<0.1	<0.1	<0.1
cis-1,2-Dichloroethylene	µg/L		<0.5	<0.5	<0.5	<0.5
Dalapon	µg/L		<1	<1	<1	<1
Di(2-ethylhexyl)adipate	µg/L	<0.6		<0.6	<0.6	<0.6
Di(2-ethylhexyl)phthalate	µg/L	<0.6		<0.6	<0.6	<0.6
Dibromochloropropane (DBCP)	µg/L		<0.01	<0.01	<0.01	<0.01
Dichloromethane (Methylene chloride)	µg/L		<0.5	<0.5	<0.5	<0.5
Dinoseb	µg/L		<0.2	<0.2	<0.2	<0.2
Diquat	µg/L	<0.4		<0.4	<0.4	<0.4
Endothall	µg/L	<5		<5	<5	<5
Endrin	µg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Ethyl benzene	µg/L		<0.5	<0.5	<0.5	<0.5
Ethylene Dibromide (EDB)	µg/L		<0.01	<0.01	<0.01	<0.01
Glyphosate	µg/L	<6		<6	<6	<6
Heptachlor	µg/L	<0.03	<0.01	<0.01	<0.01	<0.01
Heptachlor Epoxide	µg/L	<0.05	<0.01	<0.01	<0.01	<0.01
Hexachlorobenzene	µg/L	<0.05		<0.05	<0.05	<0.05
Hexachlorocyclopentadiene	µg/L	<0.05		<0.05	<0.05	<0.05
Lindane	µg/L	<0.04	<0.01	<0.01	<0.01	<0.04
Methoxychlor	µg/L	<0.1		<0.1	<0.1	<0.1

Parameter/ Sampling Date	Units	12/12/16	12/27/16	3/13/17	6/12/17	9/11/17
Methyl tert butyl ether (MTBE)	µg/L		<0.5	<0.5	<0.5	<0.5
Molinate	µg/L	<0.1		<0.1	<0.1	<0.1
Monochlorobenzene (chlorobenzene)	µg/L		<0.5	<0.5	<0.5	<0.5
Oxamyl	µg/L		<0.5	<0.5	<0.5	<0.5
Pentachlorophenol	µg/L	<1	<0.04	<0.04	<0.04	<1
Picloram	µg/L		<0.1	<0.1	<0.1	<0.1
Total Polychlorinated Biphenyls (PCBs)	µg/L		<0.1	<0.1	<0.1	<0.1
Simazine	µg/L	0.69	0.093	<0.005	<0.005	<0.005
Styrene	µg/L		<0.5	<0.5	<0.5	<0.5
Tetrachloroethylene (PCE)	µg/L		<0.5	<0.5	<0.5	<0.5
Thiobencarb	µg/L	<0.2		<0.2	<0.2	<0.2
Toluene	µg/L		<0.5	<0.5	<0.5	<0.5
Total Xylenes	µg/L		<0.5	<0.5	<0.5	<0.5
Toxaphene	µg/L		<0.5	<0.5	<0.5	<0.5
trans-1,2-Dichloroethylene	µg/L		<0.5	<0.5	<0.5	<0.5
Trichloroethylene (TCE)	µg/L		<0.5	<0.5	<0.5	<0.5
Vinyl Chloride	µg/L		<0.3	<0.3	<0.3	<0.3

Table A.4. Results for Disinfection By-Products, Phase 1

Parameter/ Sampling Date	Bromate	Chlorite	Total Haloacetid Acids (HAA5)	Total Trihalomethanes (TTHMs)
Units	**µg/L**	**mg/L**	**µg/L**	**µg/L**
11/28/16			<2	<0.5
12/12/16	<1	<0.01	<2	<0.5
12/27/16			<2	<0.5
3/13/17	<1	<0.01	<2	<0.5
6/12/17	<1	<0.01	<2	<0.5
9/11/17	<1	<0.01	<2	<0.5

Table A.5. Results for Radionuclides Throughout the Year

Parameter/ Sampling Date	Units	12/12/16	3/13/17	6/12/17	9/11/17
Gross Alpha Particle	pCi/L	<3	<3	<3	<3
Gross Beta Particle	pCi/L	<3	<3	<3	<3
Radium-228 and -226 (combined)	pCi/L	<2	<2	<2	<2
Strontium-90	pCi/L	<0.60	<0.27	<1.3	<0.27
Tritium	pCi/L	<281	<256	<300	<345
Uranium	pCi/L	<0.7	<0.7	<0.7	<0.7

Table A.6. Results for Microbiological Parameters, Phase 1

Parameter/ Sampling Date	*Cryptosporidium*	*E. coli*	*Giardia*	Total Coliform
Units	oocysts/L	MPN/100mL	cysts/L	MPN/100mL
10/31/16		260		>2420
11/14/16	0	17	0.4	1100
11/28/16		26		1700
12/12/16	0	46	0.1	>2420
12/27/16		6.3		820
1/9/17	0	460	0.2	>2420
1/23/17		41		>2420
2/13/17	0.1	79	0.2	1700
2/27/17		39		1700
3/13/17	0	17	0	>2420
3/27/17		25		380
4/10/17	0	7.5	0	770
4/24/17		24		2400
5/8/17	0	96	0	>2420
5/22/17		20		1600
6/12/17	0	31	0	1700
6/26/17		120		>2420
7/10/17	0	43	0	2400
7/24/17		55		>2420
8/14/17	0	75	0	2000
8/28/17		120		>2420
9/11/17	0	91	0	2400
9/25/17		23		>2420
10/9/17	0	39	0	2000

Table A.7. Results for Unregulated Pesticides, Phase 1

Parameter/ Sampling Date	Units	12/12/16	12/27/16	3/13/17	6/12/17	9/11/17
Applied in Watershed - Unregulated, High-Use Pesticides (>5,000 lbs/yr)						
Chloropicrin	µg/L		<0.5	<0.5	<0.5	<0.5
Chlorothalonil (Draconil, Bravo)	µg/L	<0.1		<0.1	<0.1	<0.1
Methyl Bromide	µg/L		<0.5	<0.5	<0.5	<0.5
Oxyfluorfen	µg/L	<0.5		<0.5	<0.5	<0.5
Paraquat Dichloride	µg/L	<2		<2	<2	<2
Pendimethalin	µg/L	<0.1		<0.1	<0.1	<0.1
Additional Unregulated Pesticides Applied in the Watershed, with a Health Advisory Level or Considered for Future Regulation[1]						
Carbaryl	µg/L		<0.5	<0.5	<0.5	<0.5
Dimethoate	µg/L	<0.1		<0.1	<0.1	<0.1
Diuron	ng/L		66	<5	9.1	<5
Hexazinone	µg/L	<0.1		<0.1	<0.1	<0.099
Methomyl	µg/L		<0.5	<0.5	<0.5	<0.5
Metolachlor	µg/L	<0.05		<0.05	<0.05	<0.05
Permethrin	µg/L	<0.1		<0.1	<0.1	<0.1
Ziram	µg/L	<5		<5	<5	<5

[1]The following unregulated pesticides were included on the monitoring list, but not analyzed by Eurofins Lab: acephate, tebuconazole, thiamethoxam, and thiophanate-methyl.

Table A.8. Results for Synthetic Organic Compounds, Phase 1

Parameter/ Sampling Date	Units	12/12/16	12/27/16	3/13/17	6/12/17	9/11/17
Diazinon (Qualitative)	µg/L	<0.1		<0.1	<0.1	<0.1
Tertiary butyl alcohol (TBA)	µg/L		<2	<2	<2	<2
Chlorpyrifos (Dursban)	µg/L	<0.05		<0.05	<0.05	<0.05
EPTC	µg/L	<0.1		<0.1	<0.1	<0.1
Malathion	µg/L	<0.1		<0.1	<0.1	<0.1
Trifluralin	µg/L	<0.1		<0.1	<0.1	<0.1

Table A.9. Results for Additional Unregulated Constituents of Interest, Phase 1

Parameter/ Sampling Date	Units	12/12/16	12/27/16	3/13/17	6/12/17	9/11/17
Select Additional Unregulated Constituents of Interest						
1,2,3-Trichloropropane (1,2,3-TCP)	µg/L		<0.5	<0.5	<0.5	<0.5
Additional Unregulated Constituents of Interest Related to Dairy, Poultry and Ranch Operations						
17-β-estradiol	µg/L	<0.0004		<0.0004	<0.0004	<0.0004
17-α-ethynylestradiol	µg/L	0.0025		<0.0009	<0.0009	<0.0009
Estriol	µg/L	<0.0008		<0.0008	<0.0008	<0.0008
Equilin	µg/L	<0.004		<0.004	<0.004	<0.004
Erythromycin	ng/L		<10	<10	<10	30
Estrone	µg/L	<0.002		<0.002	<0.002	<0.002
Testosterone	µg/L	<0.0001	<0.005	<0.0001	0.0001	<0.0001
4-androstene-3,17-dione	µg/L	<0.0003		<0.0003	<0.0003	<0.0003
Select Additional Unregulated Constituents of Interest Related to Algae Occurrence						
Algae Enumeration	Count/mL	24		30	36	42
Chlorophyll A	ng/L	1000		1100	2100	1000
Total Microcystins	µg/L				<0.16	
Cyanotoxins (Microcystins and Nodularin)	µg/L				<0.1	
Cyanotoxins (Anatoxin a and Cylindrospermopsin)	µg/L				<0.1	

Note: Some parameters were sampled quarterly while others were sampled twice a year.

APPENDIX B – SRWA SOURCE WATER MONITORING PROGRAM (PHASE 1)

The following list summarizes the constituents that were sampled as part of the SRWA source water monitoring program. The monitoring period was one full year (12 months), with the exception of the required LT2 parameters (i.e., *Cryptosporidium, E. coli*, turbidity), *Giardia*, total coliform, and TOC, which will be sampled monthly for two full years (24 months). Because *Giardia* and total coliform are not required parameters for LT2 monitoring compliance, the sampling frequency may be reduced during the second year.

Table B.1. Detailed List of Monitored Constituents

Parameter[1]	List	Method	Units	DDW MCL/NL	DDW DLR	Collection Frequency[1,2]
General Water Characteristics (Physical and Chemical)						
Alkalinity, total	--	SM 2320B	mg/L	--		m
Ammonia	--	EPA 350.1	mg/L	--		m
Bromide	--	EPA 300.0	µg/l	--		m
Calcium	--	EPA 200.7	mg/L	--		q
Chloride	sMCL	EPA 300.0	mg/L	250		q
Color	sMCL	SM 2120B	units	15		q
Dissolved Oxygen (Field Measurement)	--	--	mg/L	--		m
Foaming Agents (MBAS)	sMCL	SM 5540C	mg/L	0.5		q
Iron (total and dissolved)	sMCL	EPA 200.8	mg/L	0.3		m
Magnesium	--	EPA 200.7	mg/L	--		q
Manganese (total and dissolved)	sMCL/NL	EPA 200.8	mg/L	0.05/0.5		m
Nitrate (as N)	pMCL	EPA 300.0	mg/L	10		m
Nitrate + Nitrite (as N)	pMCL	addition	mg-N/L	10	--	m
Nitrite (as N)	pMCL	EPA 300.0	mg-N/L	1	0.4	m
Odor-Threshold	sMCL	SM 6040E	units	3		q
Organic Carbon, Total (TOC)	--	SM5310C	mg/L	TT	0.3	m (24 months)

Parameter[1]	List	Method	Units	DDW MCL/NL	DDW DLR	Collection Frequency[1,2]
Organic Carbon, Dissolved (DOC)		SM5310C	mg/L	--		m
pH	--	SM 4500-H+ B	--	--		m
pH (Field Measurement)						m
Phosphorus (total as P)	--	SM 4500-PE/ EPA 365.1	mg/L	--		q
Potassium	--	EPA 200.7	mg/L	--		q
Sodium	--	EPA 200.7	mg/L	--		q
Specific Conductance (field measurement)	sMCL	SM 2510B	µS/cm	900		m
Sulfate	sMCL	EPA 300.0	mg/L	250		q
Temperature	--	--	°C	--		m
Total Dissolved Solids (TDS)	sMCL	SM2540C	mg/L	500		q
Total Suspended Solids (TSS)	--	SM2510D	mg/L	--		q
Turbidity	pMCL/sMCL	EPA 180.1	NTU	TT/5		2x/m (24 months)
Turbidity (field measurement)	pMCL/sMCL	EPA 180.1	NTU	TT/5		m
UV-254	--	SM 5910	cm^{-1}	--		m
Inorganic Contaminants with a primary (p) or secondary (s) MCL (not included in general water characteristics)						
Aluminum	pMCL/sMCL	EPA 200.8	mg/L	1/0.2	0.05	q
Antimony	pMCL	EPA 200.8	mg/L	0.006	0.006	q
Arsenic	pMCL	EPA 200.8	mg/L	0.010	0.002	q
Asbestos	pMCL	EPA 100.2	MFL*	7	0.2	q
Barium	pMCL	EPA 200.8	mg/L	1	0.1	q
Beryllium	pMCL	EPA 200.8	mg/L	0.004	0.001	q
Cadmium	pMCL	EPA 200.8	mg/L	0.005	0.001	q
Chromium (Total)	pMCL	EPA 200.8	mg/L	0.05	0.01	q
Chromium-6 (Hexavalent)	pMCL	EPA 218.6	mg/L	0.010	0.001	q

Parameter[1]	List	Method	Units	DDW MCL/NL	DDW DLR	Collection Frequency[1,2]
Copper	pMCL/sMCL	EPA 200.8	mg/L	1.3/1.0	0.05	q
Cyanide	pMCL	SM4500CN-F	mg/L	0.15	0.1	q
Fluoride	pMCL	SM4500F-C	mg/L	2.0	0.1	q
Lead	pMCL	EPA 200.8	mg/L	0.015	0.005	q
Mercury (inorganic)	pMCL	EPA 245.1	mg/L	0.002	0.001	q
Nickel	pMCL	EPA 200.8	mg/L	0.1	0.01	q
Perchlorate	pMCL	EPA 314.0	mg/L	0.006	0.004	q
Selenium	pMCL	EPA 200.8	mg/L	0.05	0.005	q
Silver	sMCL	EPA 200.8	mg/L	0.1	0.01	q
Thallium	pMCL	EPA 200.8	mg/L	0.002	0.001	q
Zinc	sMCL	EPA 200.8	mg/L	5	0.05	q
* MFL = million fibers per liter; MCL for fibers exceeding 10 µm in length						
Organic Contaminants with a primary or secondary MCL (excludes DBPs)						
1,1,1-Trichloroethane (1,1,1-TCA)	pMCL	EPA 524.2	mg/L	0.200	0.0005	q
1,1,2,2-Tetrachloroethane	pMCL	EPA 524.2	mg/L	0.001	0.0005	q
1,1,2-Trichloro-1,2,2-Trifluoroethane (Freon 113)	pMCL	EPA 524.2	mg/L	1.2	0.01	q
1,1,2-Trichloroethane (1,1,2-TCA)	pMCL	EPA 524.2	mg/L	0.005	0.0005	q
1,1-Dichloroethane (1,1-DCA)	pMCL	EPA 524.2	mg/L	0.005	0.0005	q
1,1-Dichloroethylene (1,1-DCE)	pMCL	EPA 524.2	mg/L	0.006	0.0005	q
1,2,4-Trichlorobenzene	pMCL	EPA 524.2	mg/L	0.005	0.0005	q
1,2-Dichlorobenzene	pMCL	EPA 524.2	mg/L	0.6	0.0005	q
1,2-Dichloroethane (1,2-DCA)	pMCL	EPA 524.2	mg/L	0.0005	0.0005	q
1,2-Dichloropropane	pMCL	EPA 524.2	mg/L	0.005	0.0005	q
1,3-Dichloropropene [3]	pMCL	EPA 524.2	mg/L	0.0005	0.0005	q
1,4-Dichlorobenzene (p-DCB)	pMCL	EPA 524.2	mg/L	0.005	0.0005	q

Parameter[1]	List	Method	Units	DDW MCL/NL	DDW DLR	Collection Frequency[1,2]
2,3,7,8-TCDD (Dioxin)	pMCL	EPA 1613	mg/L	3.E-08	5. E-09	q
2,4,5-TP (Silvex)	pMCL	EPA 515.4	mg/L	0.05	0.001	q
2,4-Dichlorophenoxyacetic acid (2,4-D) [3]	pMCL	EPA 515.4	mg/L	0.07	0.01	q
Alachlor	pMCL	EPA 505	mg/L	0.002	0.001	q
Atrazine	pMCL	EPA 525.2	mg/L	0.001	0.0005	q
Bentazon	pMCL	EPA 515.4	mg/L	0.018	0.002	q
Benzene	pMCL	EPA 524.2	mg/L	0.001	0.0005	q
Benzo(a)pyrene	pMCL	EPA 525.2	mg/L	0.0002	0.0001	q
Carbofuran	pMCL	EPA 531.2	mg/L	0.018	0.005	q
Carbon Tetrachloride	pMCL	EPA 524.2	mg/L	0.0005	0.0005	q
Chlordane	pMCL	EPA 505	mg/L	0.0001	0.0001	q
cis-1,2-Dichloroethylene	pMCL	EPA 524.2	mg/L	0.006	0.0005	q
Dalapon	pMCL	EPA 515.4	mg/L	0.2	0.01	q
Di(2-ethylhexyl)adipate	pMCL	EPA 525.2	mg/L	0.4	0.005	q
Di(2-ethylhexyl)phthalate (same as Bis (2-ethylhexyl)phthalate [4])	pMCL	EPA 525.2	mg/L	0.004	0.003	q
Dibromochloropropane (DBCP)	pMCL	EPA 551.1	mg/L	0.0002	0.00001	q
Dichloromethane (Methylene chloride)	pMCL	EPA 524.2	mg/L	0.005	0.0005	q
Dinoseb	pMCL	EPA 515.4	mg/L	0.007	0.002	q
Diquat	pMCL	EPA 549.2	mg/L	0.02	0.004	q
Endothall	pMCL	EPA548.1	mg/L	0.1	0.045	q
Endrin	pMCL	EPA 508	mg/L	0.002	0.0001	q
Ethylbenzene	pMCL	EPA 524.2	mg/L	0.3	0.0005	q
Ethylene Dibromide (EDB)	pMCL	EPA 551.1	mg/L	0.00005	0.00002	q
Glyphosate [3]	pMCL	EPA 547	mg/L	0.7	0.025	q
Heptachlor	pMCL	EPA 505	mg/L	0.00001	0.00001	q

Parameter[1]	List	Method	Units	DDW MCL/NL	DDW DLR	Collection Frequency[1,2]
Heptachlor Epoxide	pMCL	EPA 505	mg/L	0.00001	0.00001	q
Hexachlorobenzene	pMCL	EPA 505	mg/L	0.001	0.0005	q
Hexachlorocyclopentadiene	pMCL	EPA 505	mg/L	0.05	0.001	q
Lindane	pMCL	EPA 505	mg/L	0.0002	0.0002	q
Methoxychlor	pMCL	EPA 505	mg/L	0.03	0.01	q
Methyl tert butyl ether (MTBE)	pMCL/sMCL	EPA 524.2	mg/L	0.013/0.005	0.003	q
Molinate	pMCL	EPA 525.2	mg/L	0.02	0.002	q
Monochlorobenzene	pMCL	EPA 524.2	mg/L	0.07	0.0005	q
Oxamyl	pMCL	EPA 531.2	mg/L	0.05	0.02	q
Pentachlorophenol	pMCL	EPA 515.4	mg/L	0.001	0.0002	q
Picloram	pMCL	EPA 515.4	mg/L	0.5	0.001	q
Polychlorinated Biphenyls (PCBs)	pMCL	EPA 505	mg/L	0.0005	0.0005	q
Simazine [4]	pMCL	EPA 525.2	mg/L	0.004	0.001	q
Styrene	pMCL	EPA 524.2	mg/L	0.1	0.0005	q
Tetrachloroethylene (PCE)	pMCL	EPA 524.2	mg/L	0.005	0.0005	q
Thiobencarb	pMCL/sMCL	EPA 525.2	mg/L	0.07/0.001	0.001	q
Toluene	pMCL	EPA 524.2	mg/L	0.15	0.0005	q
Total Xylenes	pMCL	EPA 524.2	mg/L	1.750	0.0005	q
Toxaphene	pMCL	EPA 505	mg/L	0.003	0.001	q
trans-1,2-Dichloroethylene	pMCL	EPA 524.2	mg/L	0.01	0.0005	q
Trichloroethylene (TCE)	pMCL	EPA 524.2	mg/L	0.005	0.0005	q
Trichlorofluoromethane (Freon 11)	pMCL	EPA 524.2	mg/L	0.15	0.005	q
Vinyl Chloride	pMCL	EPA 524.2	mg/L	0.0005	0.0005	q
Disinfection By-Products						
Haloacetic acids (HAA5)	pMCL	SM 6251B	mg/L	0.060	--	q

Parameter[1]	List	Method	Units	DDW MCL/NL	DDW DLR	Collection Frequency[1,2]
Total Trihalomethanes (TTHMs)	pMCL	EPA 551.1	mg/L	0.080	--	q
Bromate	pMCL	EPA 317.0	mg/L	0.010	0.0010	q
Chlorite	pMCL	EPA 300.0	mg/L	1.0	0.020	q
Radionuclides with an MCL						
Gross Alpha Particle (excluding radon and uranium)	pMCL	EPA 900	pCi/L	15	3	q
Gross Beta Particle	pMCL	EPA 900	mrem/yr	4	4	q
Radium-228 and -226 (combined)	pMCL	GA Method	pCi/L	5	1 for each	q
Strontium-90	pMCL	EPA 905	pCi/L	8	2	q
Tritium	pMCL	EPA 906	pCi/L	20,000	1,000	q
Uranium	pMCL	EPA 200.8	pCi/L	20	1	q
Microbiological						
Cryptosporidium	pMCL	EPA 1623	oocysts/L	TT	--	m (24 months)
E. coli	pMCL	SM 9223F	MPN/100mL	TT	--	2x/m (24 months)
Giardia	pMCL	EPA 1623	cysts/L	TT	--	m (24 months)
Total Coliform	pMCL	SM 9223B	MPN/100mL	TT	--	2x/m (24 months)
Applied in Watershed - Unregulated, High-Use Pesticides (>5,000 lbs/yr)						
Chloropicrin	aNL	551.1	mg/L	0.05	--	q
Chlorothalonil	HA (1-day)	525.2	mg/L	0.2	--	q
Methyl Bromide	CCL3, CCL4	524.2	--	--	--	q
Oxyfluorfen	CCL3, CCL4	525.2	--	--	--	q
Paraquat Dichloride	HA (1-day)	549.2	mg/L	0.1	--	q

Parameter[1]	List	Method	Units	DDW MCL/NL	DDW DLR	Collection Frequency[1,2]
Pendimethalin	none	525.2	mg/L			q
Additional Unregulated Pesticides Applied in the Watershed, with a Health Advisory Level or Considered for Future Regulation						
Acephate	CCL3, CCL4	LCMS-MS		--	--	q
Carbaryl	aNL	531.2	mg/L	0.7	--	q
Dimethoate	aNL	525.2	mg/L	0.001	--	q
Diuron	HA (1-day); CCL4	EPA 532	mg/L	1	--	q
Hexazinone	HA (1-day)	EPA 525.2	mg/L	3	--	q
Methomyl	HA (1-day)	531.2	mg/L	0.3	--	q
Metolachlor [4]	UCMR2; HA (1-day)	525.2	mg/L	2	--	q
Permethrin	CCL3, CCL4	525.2		--	--	q
Tebuconazole	CCL3, CCL4	LCMS-MS		--	--	q
Thiamethoxam	UCMR3	LCMS-MS		--	--	q
Thiophanate-Methyl	CCL4	LCMS-MS		--	--	q
Ziram	CCL4	630.1		--	--	q
Additional SOCs Reported in Historical Data						
Diazinon	aNL; HA	EPA 525.2	mg/L	0.0012	--	q
Tertiary butyl alcohol (TBA)	NL	EPA 524.2	mg/L	0.012	--	q
Chlorpyrifos (Dursban)	UCMR4; HA	525.2	mg/L	0.03	--	q
EPTC	UCMR1	525.2		--	--	q
Malathion	aNL; HA	525.2	mg/L	0.16	--	q
Trifluralin	HA (1-day)	525.2	mg/L	0.08	--	q
Select Additional Unregulated Constituents of Interest						
1,2,3-Trichloropropane (1,2,3-TCP)	Forthcoming pMCL, NL	EPA 524.2	mg/L	5.00E-06	5.00E-06	q
Additional Unregulated Constituents of Interest Related to Dairy, Poultry and Ranch Operations						

Parameter[1]	List	Method	Units	DDW MCL/NL	DDW DLR	Collection Frequency[1,2]
17-β-estradiol	UCMR3, List 2	EPA 539	ng/L			q
17-α-ethynylestradiol	UCMR3, List 2	EPA 539	ng/L			q
Estriol	UCMR3, List 2	EPA 539	ng/L			q
Equilin	UCMR3, List 2	EPA 539	ng/L			q
Erythromycin	CCL3, CCL4	LC-MS-MS	ng/L			q
Estrone	UCMR3, List 2	EPA 539	ng/L			q
Testosterone	UCMR3, List 2	EPA 539	ng/L			q
4-androstene-3,17-dione	UCMR3, List 2	EPA 539	ng/L			q
Select Additional Unregulated Constituents of Interest Related to Algae Occurrence						
Algae Identification	--	Flow Cam	ng/L			q
Algae Enumeration	--	Flow Cam	ng/L			q
Chlorophyll A	--		ng/L			q
Microcystins Screen	UCMR4	ELISA	ng/L			2x/y
Cyanotoxins (Microcystins, Nodularin)	UCMR4	EPA 544	ng/L			2x/y
Cyanotoxins (Anatoxin, Cylindrospermopsin)	UCMR4	EPA 545	ng/L			2x/y

Footnotes:

[1] Limited additional monitoring – beyond what was included in the source water sampling plan submitted to DDW – was completed as part of the initial year of Phase 1 monitoring. The extra monitoring included increased monitoring frequency for select parameters, and/or addition of unregulated constituents of interest related to dairy, poultry, and ranch operations, as well as algae occurrence. DDW accepted the proposed sampling plan in an email from Tahir Mansoor to Michael Brinton, dated July 25, 2016.

[2] m=monthly; q-quarterly, 2x/m=twice per month; 2x/y=twice per year

[3] Also a high-use pesticide in this watershed.

[4] Also reported in historical data.

TT = Treatment Technique

pMCL = Primary Maximum Contaminant Level

sMCL = Secondary Maximum Contaminant Level

Parameter[1]	List	Method	Units	DDW MCL/NL	DDW DLR	Collection Frequency[1,2]
NL = DDW Notification Level aNL = DDW Archived Notification Level UCMR = Unregulated Contaminant Monitoring Rule CCL = EPA's Contaminant Candidate List HA = EPA Health Advisory Level						

APPENDIX C – PROPOSED SRWA SOURCE WATER MONITORING PROGRAM (PHASE 2)

The proposed monitoring for Phase 2 of the SRWA Source Water Monitoring Program is presented in Tables C.1 and C.2. An initial one-year period (Table C.1) includes monthly monitoring of select general water quality parameters and semi-annual monitoring for the remaining parameters. The 2018 monitoring will overlap with the second year of the LT2 monitoring (through October 2018), as indicated with a collection frequency marked with (LT2). In addition, monitoring per the UCMR4 list will be completed twice during 2018. The UCMR4 list includes ten cyanotoxins and will replace the algae-related monitoring from Phase 1. Beyond October 2018 (expected through the start of WTP construction) monitoring will include on-going semi-annual assessment of all parameters listed in Table C.2.

Table C.1. Detailed List of Proposed Phase 2 Monitoring Through October 2018

Parameter	List	Method	Units	DDW MCL/NL	DDW DLR	Collection Frequency[1]
General Water Characteristics (Physical and Chemical)						
Alkalinity, total	--	SM 2320B	mg/L	--		m
Ammonia	--	EPA 350.1	mg/L	--		2x/y
Bromide	--	EPA 300.0	µg/l	--		q (2 only; on UCMR4 list)
Calcium	--	EPA 200.7	mg/L	--		2x/y
Chloride	sMCL	EPA 300.0	mg/L	250		2x/y
Color	sMCL	SM 2120B	units	15		2x/y
Dissolved Oxygen (Field Measurement)	--	--	mg/L	--		m
Foaming Agents (MBAS)	sMCL	SM 5540C	mg/L	0.5		2x/y
Iron (total and dissolved)	sMCL	EPA 200.8	mg/L	0.3		m
Magnesium	--	EPA 200.7	mg/L	--		2x/y
Manganese (total and dissolved)	sMCL/NL	EPA 200.8	mg/L	0.05/0.5		m
Nitrate (as N)	pMCL	EPA 300.0	mg/L	10		2x/y
Nitrate + Nitrite (as N)	pMCL	addition	mg-N/L	10	--	2x/y
Nitrite (as N)	pMCL	EPA 300.0	mg-N/L	1	0.4	2x/y

Parameter	List	Method	Units	DDW MCL/NL	DDW DLR	Collection Frequency[1]
Odor-Threshold	sMCL	SM 6040E	units	3		2x/y
Organic Carbon, Total (TOC)	--	SM5310C	mg/L	TT	0.3	m (LT2, UCMR4 overlap)
Organic Carbon, Dissolved (DOC)		SM5310C	mg/L	--		m
pH	--	SM 4500-H+ B	--	--		m
pH (Field Measurement)						m
Phosphorus (total as P)	--	SM 4500-PE/ EPA 365.1	mg/L	--		2x/y
Potassium	--	EPA 200.7	mg/L	--		2x/y
Sodium	--	EPA 200.7	mg/L	--		2x/y
Specific Conductance (field measurement)	sMCL	SM 2510B	µS/cm	900		m
Sulfate	sMCL	EPA 300.0	mg/L	250		2x/y
Temperature (field measurement)	--	--	°C	--		m
Total Dissolved Solids (TDS)	sMCL	SM2540C	mg/L	500		2x/y
Total Suspended Solids (TSS)	--	SM2510D	mg/L	--		2x/y
Turbidity	pMCL/sMCL	EPA 180.1	NTU	TT/5		2x/m (LT2)
Turbidity (field measurement)	pMCL/sMCL	EPA 180.1	NTU	TT/5		2x/m (LT2)
UV-254	--	SM 5910	cm^{-1}	--		m
Inorganic Contaminants with a primary (p) or secondary (s) MCL (not included in general water characteristics)						
Aluminum	pMCL/sMCL	EPA 200.8	mg/L	1/0.2	0.05	2x/y
Antimony	pMCL	EPA 200.8	mg/L	0.006	0.006	2x/y
Arsenic	pMCL	EPA 200.8	mg/L	0.010	0.002	2x/y
Asbestos	pMCL	EPA 100.2	MFL*	7	0.2	2x/y
Barium	pMCL	EPA 200.8	mg/L	1	0.1	2x/y
Beryllium	pMCL	EPA 200.8	mg/L	0.004	0.001	2x/y
Cadmium	pMCL	EPA 200.8	mg/L	0.005	0.001	2x/y

Parameter	List	Method	Units	DDW MCL/NL	DDW DLR	Collection Frequency[1]
Chromium (Total)	pMCL	EPA 200.8	mg/L	0.05	0.01	2x/y
Chromium-6 (Hexavalent)	pMCL	EPA 218.6	mg/L	0.010	0.001	2x/y
Copper	pMCL/sMCL	EPA 200.8	mg/L	1.3/1.0	0.05	2x/y
Cyanide	pMCL	SM4500CN-F	mg/L	0.15	0.1	2x/y
Fluoride	pMCL	SM4500F-C	mg/L	2.0	0.1	2x/y
Lead	pMCL	EPA 200.8	mg/L	0.015	0.005	2x/y
Mercury (inorganic)	pMCL	EPA 245.1	mg/L	0.002	0.001	2x/y
Nickel	pMCL	EPA 200.8	mg/L	0.1	0.01	2x/y
Perchlorate	pMCL	EPA 314.0	mg/L	0.006	0.004	2x/y
Selenium	pMCL	EPA 200.8	mg/L	0.05	0.005	2x/y
Silver	sMCL	EPA 200.8	mg/L	0.1	0.01	2x/y
Thallium	pMCL	EPA 200.8	mg/L	0.002	0.001	2x/y
Zinc	sMCL	EPA 200.8	mg/L	5	0.05	2x/y
* MFL = million fibers per liter; MCL for fibers exceeding 10 µm in length						
Organic Contaminants with a primary or secondary MCL (excludes DBPs)						
1,1,1-Trichloroethane (1,1,1-TCA)	pMCL	EPA 524.2	mg/L	0.200	0.0005	2x/y
1,1,2,2-Tetrachloroethane	pMCL	EPA 524.2	mg/L	0.001	0.0005	2x/y
1,1,2-Trichloro-1,2,2-Trifluoroethane (Freon 113)	pMCL	EPA 524.2	mg/L	1.2	0.01	2x/y
1,1,2-Trichloroethane (1,1,2-TCA)	pMCL	EPA 524.2	mg/L	0.005	0.0005	2x/y
1,1-Dichloroethane (1,1-DCA)	pMCL	EPA 524.2	mg/L	0.005	0.0005	2x/y
1,1-Dichloroethylene (1,1-DCE)	pMCL	EPA 524.2	mg/L	0.006	0.0005	2x/y
1,2,3-Trichloropropane (1,2,3-TCP)	pMCL, NL	EPA 524.2	mg/L	5.00E-06	5.00E-06	2x/y
1,2,4-Trichlorobenzene	pMCL	EPA 524.2	mg/L	0.005	0.0005	2x/y
1,2-Dichlorobenzene	pMCL	EPA 524.2	mg/L	0.6	0.0005	2x/y
1,2-Dichloroethane (1,2-DCA)	pMCL	EPA 524.2	mg/L	0.0005	0.0005	2x/y

Parameter	List	Method	Units	DDW MCL/NL	DDW DLR	Collection Frequency[1]
1,2-Dichloropropane	pMCL	EPA 524.2	mg/L	0.005	0.0005	2x/y
1,3-Dichloropropene [3]	pMCL	EPA 524.2	mg/L	0.0005	0.0005	2x/y
1,4-Dichlorobenzene (p-DCB)	pMCL	EPA 524.2	mg/L	0.005	0.0005	2x/y
2,3,7,8-TCDD (Dioxin)	pMCL	EPA 1613	mg/L	3.E-08	5. E-09	2x/y
2,4,5-TP (Silvex)	pMCL	EPA 515.4	mg/L	0.05	0.001	2x/y
2,4-Dichlorophenoxyacetic acid (2,4-D) [2]	pMCL	EPA 515.4	mg/L	0.07	0.01	2x/y
Alachlor	pMCL	EPA 505	mg/L	0.002	0.001	2x/y
Atrazine	pMCL	EPA 525.2	mg/L	0.001	0.0005	2x/y
Bentazon	pMCL	EPA 515.4	mg/L	0.018	0.002	2x/y
Benzene	pMCL	EPA 524.2	mg/L	0.001	0.0005	2x/y
Benzo(a)pyrene	pMCL	EPA 525.2	mg/L	0.0002	0.0001	2x/y
Carbofuran	pMCL	EPA 531.2	mg/L	0.018	0.005	2x/y
Carbon Tetrachloride	pMCL	EPA 524.2	mg/L	0.0005	0.0005	2x/y
Chlordane	pMCL	EPA 505	mg/L	0.0001	0.0001	2x/y
cis-1,2-Dichloroethylene	pMCL	EPA 524.2	mg/L	0.006	0.0005	2x/y
Dalapon	pMCL	EPA 515.4	mg/L	0.2	0.01	2x/y
Di(2-ethylhexyl)adipate	pMCL	EPA 525.2	mg/L	0.4	0.005	2x/y
Di(2-ethylhexyl)phthalate (same as Bis (2-ethylhexyl)phthalate [3])	pMCL	EPA 525.2	mg/L	0.004	0.003	2x/y
Dibromochloropropane (DBCP)	pMCL	EPA 551.1	mg/L	0.0002	0.00001	2x/y
Dichloromethane (Methylene chloride)	pMCL	EPA 524.2	mg/L	0.005	0.0005	2x/y
Dinoseb	pMCL	EPA 515.4	mg/L	0.007	0.002	2x/y
Diquat	pMCL	EPA 549.2	mg/L	0.02	0.004	2x/y
Endothall	pMCL	EPA548.1	mg/L	0.1	0.045	2x/y
Endrin	pMCL	EPA 508	mg/L	0.002	0.0001	2x/y
Ethylbenzene	pMCL	EPA 524.2	mg/L	0.3	0.0005	2x/y

Parameter	List	Method	Units	DDW MCL/NL	DDW DLR	Collection Frequency[1]
Ethylene Dibromide (EDB)	pMCL	EPA 551.1	mg/L	0.00005	0.00002	2x/y
Glyphosate [2]	pMCL	EPA 547	mg/L	0.7	0.025	2x/y
Heptachlor	pMCL	EPA 505	mg/L	0.00001	0.00001	2x/y
Heptachlor Epoxide	pMCL	EPA 505	mg/L	0.00001	0.00001	2x/y
Hexachlorobenzene	pMCL	EPA 505	mg/L	0.001	0.0005	2x/y
Hexachlorocyclopentadiene	pMCL	EPA 505	mg/L	0.05	0.001	2x/y
Lindane	pMCL	EPA 505	mg/L	0.0002	0.0002	2x/y
Methoxychlor	pMCL	EPA 505	mg/L	0.03	0.01	2x/y
Methyl tert butyl ether (MTBE)	pMCL/sMCL	EPA 524.2	mg/L	0.013/0.005	0.003	2x/y
Molinate	pMCL	EPA 525.2	mg/L	0.02	0.002	2x/y
Monochlorobenzene	pMCL	EPA 524.2	mg/L	0.07	0.0005	2x/y
Oxamyl	pMCL	EPA 531.2	mg/L	0.05	0.02	2x/y
Pentachlorophenol	pMCL	EPA 515.4	mg/L	0.001	0.0002	2x/y
Picloram	pMCL	EPA 515.4	mg/L	0.5	0.001	2x/y
Polychlorinated Biphenyls (PCBs)	pMCL	EPA 505	mg/L	0.0005	0.0005	2x/y
Simazine [3]	pMCL	EPA 525.2	mg/L	0.004	0.001	2x/y
Styrene	pMCL	EPA 524.2	mg/L	0.1	0.0005	2x/y
Tetrachloroethylene (PCE)	pMCL	EPA 524.2	mg/L	0.005	0.0005	2x/y
Thiobencarb	pMCL/sMCL	EPA 525.2	mg/L	0.07/0.001	0.001	2x/y
Toluene	pMCL	EPA 524.2	mg/L	0.15	0.0005	2x/y
Total Xylenes	pMCL	EPA 524.2	mg/L	1.750	0.0005	2x/y
Toxaphene	pMCL	EPA 505	mg/L	0.003	0.001	2x/y
trans-1,2-Dichloroethylene	pMCL	EPA 524.2	mg/L	0.01	0.0005	2x/y
Trichloroethylene (TCE)	pMCL	EPA 524.2	mg/L	0.005	0.0005	2x/y
Trichlorofluoromethane (Freon 11)	pMCL	EPA 524.2	mg/L	0.15	0.005	2x/y
Vinyl Chloride	pMCL	EPA 524.2	mg/L	0.0005	0.0005	2x/y

Parameter	List	Method	Units	DDW MCL/NL	DDW DLR	Collection Frequency[1]
Disinfection By-Products						
Haloacetic acids (HAA5)	pMCL	SM 6251B	mg/L	0.060	--	2x/y (on UCMR4 list)
Total Trihalomethanes (TTHMs)	pMCL	EPA 551.1	mg/L	0.080	--	2x/y
Bromate	pMCL	EPA 317.0	mg/L	0.010	0.0010	2x/y
Chlorite	pMCL	EPA 300.0	mg/L	1.0	0.020	2x/y
Radionuclides with an MCL						
Gross Alpha Particle (excluding radon and uranium)	pMCL	EPA 900	pCi/L	15	3	2x/y
Gross Beta Particle	pMCL	EPA 900	mrem/yr	4	4	2x/y
Radium-228 and -226 (combined)	pMCL	GA Method	pCi/L	5	1 for each	2x/y
Strontium-90	pMCL	EPA 905	pCi/L	8	2	2x/y
Tritium	pMCL	EPA 906	pCi/L	20,000	1,000	2x/y
Uranium	pMCL	EPA 200.8	pCi/L	20	1	2x/y
Microbiological						
Cryptosporidium	pMCL	EPA 1623	oocysts/L	TT	--	m (LT2)
E. coli	pMCL	SM 9223F	MPN/100mL	TT	--	2x/m (LT2)
Giardia	pMCL	EPA 1623	cysts/L	TT	--	m (LT2)
Total Coliform	pMCL	SM 9223B	MPN/100mL	TT	--	2x/m (LT2)
Applied in Watershed - Unregulated, High-Use Pesticides (>5,000 lbs/yr)						
Chloropicrin	aNL	551.1	mg/L	0.05	--	2x/y
Chlorothalonil	HA (1-day)	525.2	mg/L	0.2	--	2x/y
Methyl Bromide	CCL3, CCL4	524.2	--	--	--	2x/y
Oxyfluorfen	CCL3, CCL4	525.2	--	--	--	2x/y
Paraquat Dichloride	HA (1-day)	549.2	mg/L	0.1	--	2x/y

Parameter	List	Method	Units	DDW MCL/NL	DDW DLR	Collection Frequency[1]
Pendimethalin	none	525.2	mg/L			2x/y
Additional Unregulated Pesticides Applied in the Watershed, with a Health Advisory Level or Considered for Future Regulation						
Acephate	CCL3, CCL4	LCMS-MS		--	--	2x/y
Carbaryl	aNL	531.2	mg/L	0.7	--	2x/y
Dimethoate	aNL	525.2	mg/L	0.001	--	2x/y
Diuron	HA (1-day); CCL4	EPA 532	mg/L	1	--	2x/y
Hexazinone	HA (1-day)	EPA 525.2	mg/L	3	--	2x/y
Methomyl	HA (1-day)	531.2	mg/L	0.3	--	2x/y
Metolachlor [3]	UCMR2; HA (1-day)	525.2	mg/L	2	--	2x/y
Permethrin	CCL3, CCL4	525.2		--	--	2x/y
Tebuconazole	CCL3, CCL4	LCMS-MS		--	--	2x/y
Thiamethoxam	UCMR3	LCMS-MS		--	--	2x/y
Thiophanate-Methyl	CCL4	LCMS-MS		--	--	2x/y
Ziram	CCL4	630.1		--	--	2x/y
Additional SOCs Reported in Historical Data						
Diazinon	aNL; HA	EPA 525.2	mg/L	0.0012	--	2x/y
Tertiary butyl alcohol (TBA)	NL	EPA 524.2	mg/L	0.012	--	2x/y
Chlorpyrifos (Dursban)	UCMR4; HA	525.2	mg/L	0.03	--	2x/y
EPTC	UCMR1	525.2		--	--	2x/y
Malathion	aNL; HA	525.2	mg/L	0.16	--	2x/y
Trifluralin	HA (1-day)	525.2	mg/L	0.08	--	2x/y
Additional Unregulated Constituents of Interest Related to Dairy, Poultry and Ranch Operations						
17-β-estradiol	UCMR3, List 2	EPA 539	ng/L	--	--	2x/y
17-α-ethynylestradiol	UCMR3, List 2	EPA 539	ng/L	--	--	2x/y
Estriol	UCMR3, List 2	EPA 539	ng/L	--	--	2x/y

Parameter	List	Method	Units	DDW MCL/NL	DDW DLR	Collection Frequency[1]
Equilin	UCMR3, List 2	EPA 539	ng/L	--	--	2x/y
Erythromycin	CCL3, CCL4	LC-MS-MS	ng/L	--	--	2x/y
Estrone	UCMR3, List 2	EPA 539	ng/L	--	--	2x/y
Testosterone	UCMR3, List 2	EPA 539	ng/L	--	--	2x/y
4-androstene-3,17-dione	UCMR3, List 2	EPA 539	ng/L	--	--	2x/y
UCMR4						
total microcystin	UCMR4	EPA 546	µg/L	--	--	2x/y
microcystin-LA	UCMR4	EPA 544	µg/L	--	--	2x/y
microcystin-LF	UCMR4	EPA 544	µg/L	--	--	2x/y
microcystin-LR	UCMR4	EPA 544	µg/L	--	--	2x/y
microcystin-LY	UCMR4	EPA 544	µg/L	--	--	2x/y
microcystin-RR	UCMR4	EPA 544	µg/L	--	--	2x/y
microcystin-YR	UCMR4	EPA 544	µg/L	--	--	2x/y
nodularin	UCMR4	EPA 544	µg/L	--	--	2x/y
anatoxin-a	UCMR4	EPA 545	µg/L	--	--	2x/y
cylindrospermopsin	UCMR4	EPA 545	µg/L	--	--	2x/y
germanium	UCMR4	EPA 200.8	µg/L	--	--	2x/y
manganese	UCMR4	EPA 200.8	µg/L	--	--	2x/y
alpha-hexachlorocyclohexane	UCMR4	EPA 530	µg/L	--	--	2x/y
chlorpyrifos	UCMR4	EPA 530	µg/L	--	--	2x/y
dimethipin	UCMR4	EPA 530	µg/L	--	--	2x/y
ethoprop	UCMR4	EPA 530	µg/L	--	--	2x/y

Parameter	List	Method	Units	DDW MCL/NL	DDW DLR	Collection Frequency[1]
oxyfluorfen	UCMR4	EPA 530	µg/L	--	--	2x/y
profenofos	UCMR4	EPA 530	µg/L	--	--	2x/y
tebuconazole	UCMR4	EPA 530	µg/L	--	--	2x/y
total permethrin (cis- & trans-)	UCMR4	EPA 530	µg/L	--	--	2x/y
tribufos	UCMR4	EPA 530	µg/L	--	--	2x/y
HAA5	UCMR4	EPA 552.3 or 557		--	--	2x/y
HAA6Br	UCMR4	EPA 552.3 or 557		--	--	2x/y
HAA9	UCMR4	EPA 552.3 or 557		--	--	2x/y
1-butanol	UCMR4	EPA 541		--	--	2x/y
2-methoxyethanol	UCMR4	EPA 541		--	--	2x/y
2-propen-1-ol	UCMR4	EPA 541		--	--	2x/y
butylated hydroxyanisole	UCMR4	EPA 525.3		--	--	2x/y
o-toluidine	UCMR4	EPA 525.3		--	--	2x/y
quinoline	UCMR4	EPA 525.3		--	--	2x/y
Organic Carbon, Total (TOC)	UCMR4			--	--	2x/y
Bromide	UCMR4			--	--	2x/y

Footnotes:
[1] m=monthly; q-quarterly, 2x/m=twice per month; 2x/y=twice per year
[2] Also a high-use pesticide in this watershed.
[3] Also reported in historical data.
TT = Treatment Technique
pMCL = Primary Maximum Contaminant Level
sMCL = Secondary Maximum Contaminant Level

Parameter	List	Method	Units	DDW MCL/NL	DDW DLR	Collection Frequency[1]
NL = DDW Notification Level aNL = DDW Archived Notification Level UCMR = Unregulated Contaminant Monitoring Rule CCL = EPA's Contaminant Candidate List HA = EPA Health Advisory Level						

Table C.2. Detailed List of Proposed Phase 2 On-going Monitoring After October 2018

Parameter	List	Method	Units	DDW MCL/NL	DDW DLR	Collection Frequency[1]
General Water Characteristics (Physical and Chemical)						
Alkalinity, total	--	SM 2320B	mg/L	--		2x/y
Bromide	--	EPA 300.0	µg/l	--		2x/y
Calcium	--	EPA 200.7	mg/L	--		2x/y
Chloride	sMCL	EPA 300.0	mg/L	250		2x/y
Color	sMCL	SM 2120B	units	15		2x/y
Dissolved Oxygen (Field Measurement)	--	--	mg/L	--		2x/y
Foaming Agents (MBAS)	sMCL	SM 5540C	mg/L	0.5		2x/y
Iron (total and dissolved)	sMCL	EPA 200.8	mg/L	0.3		2x/y
Magnesium	--	EPA 200.7	mg/L	--		2x/y
Manganese (total and dissolved)	sMCL/NL	EPA 200.8	mg/L	0.05/0.5		2x/y
Odor-Threshold	sMCL	SM 6040E	units	3		2x/y
Organic Carbon, Total (TOC)	--	SM5310C	mg/L	TT	0.3	2x/y
Organic Carbon, Dissolved (DOC)		SM5310C	mg/L	--		2x/y
pH	--	SM 4500-H+ B	--	--		2x/y
pH (Field Measurement)						2x/y

Parameter	List	Method	Units	DDW MCL/NL	DDW DLR	Collection Frequency[1]
Phosphorus (total as P)	--	SM 4500-PE/ EPA 365.1	mg/L	--		2x/y
Potassium	--	EPA 200.7	mg/L	--		2x/y
Sodium	--	EPA 200.7	mg/L	--		2x/y
Specific Conductance (field measurement)	sMCL	SM 2510B	µS/cm	900		2x/y
Sulfate	sMCL	EPA 300.0	mg/L	250		2x/y
Temperature (field measurement)	--	--	°C	--		2x/y
Total Dissolved Solids (TDS)	sMCL	SM2540C	mg/L	500		2x/y
Total Suspended Solids (TSS)	--	SM2510D	mg/L	--		2x/y
Turbidity	pMCL/sMCL	EPA 180.1	NTU	TT/5		2x/y
Turbidity (field measurement)	pMCL/sMCL	EPA 180.1	NTU	TT/5		2x/y
UV-254	--	SM 5910	cm^{-1}	--		2x/y
Inorganic Contaminants with a primary (p) or secondary (s) MCL (not included in general water characteristics)						
Aluminum	pMCL/sMCL	EPA 200.8	mg/L	1/0.2	0.05	2x/y
Antimony	pMCL	EPA 200.8	mg/L	0.006	0.006	2x/y
Arsenic	pMCL	EPA 200.8	mg/L	0.010	0.002	2x/y
Asbestos	pMCL	EPA 100.2	MFL*	7	0.2	2x/y
Barium	pMCL	EPA 200.8	mg/L	1	0.1	2x/y
Beryllium	pMCL	EPA 200.8	mg/L	0.004	0.001	2x/y
Cadmium	pMCL	EPA 200.8	mg/L	0.005	0.001	2x/y
Chromium (Total)	pMCL	EPA 200.8	mg/L	0.05	0.01	2x/y
Chromium-6 (Hexavalent)	pMCL	EPA 218.6	mg/L	0.010	0.001	2x/y
Copper	pMCL/sMCL	EPA 200.8	mg/L	1.3/1.0	0.05	2x/y
Cyanide	pMCL	SM4500CN-F	mg/L	0.15	0.1	2x/y
Fluoride	pMCL	SM4500F-C	mg/L	2.0	0.1	2x/y
Lead	pMCL	EPA 200.8	mg/L	0.015	0.005	2x/y

Parameter	List	Method	Units	DDW MCL/NL	DDW DLR	Collection Frequency[1]
Mercury (inorganic)	pMCL	EPA 245.1	mg/L	0.002	0.001	2x/y
Nickel	pMCL	EPA 200.8	mg/L	0.1	0.01	2x/y
Perchlorate	pMCL	EPA 314.0	mg/L	0.006	0.004	2x/y
Selenium	pMCL	EPA 200.8	mg/L	0.05	0.005	2x/y
Silver	sMCL	EPA 200.8	mg/L	0.1	0.01	2x/y
Thallium	pMCL	EPA 200.8	mg/L	0.002	0.001	2x/y
Zinc	sMCL	EPA 200.8	mg/L	5	0.05	2x/y
* MFL = million fibers per liter; MCL for fibers exceeding 10 µm in length						
Organic Contaminants with a primary or secondary MCL (excludes DBPs)						
1,1,1-Trichloroethane (1,1,1-TCA)	pMCL	EPA 524.2	mg/L	0.200	0.0005	2x/y
1,1,2,2-Tetrachloroethane	pMCL	EPA 524.2	mg/L	0.001	0.0005	2x/y
1,1,2-Trichloro-1,2,2-Trifluoroethane (Freon 113)	pMCL	EPA 524.2	mg/L	1.2	0.01	2x/y
1,1,2-Trichloroethane (1,1,2-TCA)	pMCL	EPA 524.2	mg/L	0.005	0.0005	2x/y
1,1-Dichloroethane (1,1-DCA)	pMCL	EPA 524.2	mg/L	0.005	0.0005	2x/y
1,1-Dichloroethylene (1,1-DCE)	pMCL	EPA 524.2	mg/L	0.006	0.0005	2x/y
1,2,3-Trichloropropane (1,2,3-TCP)	pMCL, NL	EPA 524.2	mg/L	5.00E-06	5.00E-06	2x/y
1,2,4-Trichlorobenzene	pMCL	EPA 524.2	mg/L	0.005	0.0005	2x/y
1,2-Dichlorobenzene	pMCL	EPA 524.2	mg/L	0.6	0.0005	2x/y
1,2-Dichloroethane (1,2-DCA)	pMCL	EPA 524.2	mg/L	0.0005	0.0005	2x/y
1,2-Dichloropropane	pMCL	EPA 524.2	mg/L	0.005	0.0005	2x/y
1,3-Dichloropropene [2]	pMCL	EPA 524.2	mg/L	0.0005	0.0005	2x/y
1,4-Dichlorobenzene (p-DCB)	pMCL	EPA 524.2	mg/L	0.005	0.0005	2x/y
2,3,7,8-TCDD (Dioxin)	pMCL	EPA 1613	mg/L	3.E-08	5. E-09	2x/y
2,4,5-TP (Silvex)	pMCL	EPA 515.4	mg/L	0.05	0.001	2x/y
2,4-Dichlorophenoxyacetic acid (2,4-D) [2]	pMCL	EPA 515.4	mg/L	0.07	0.01	2x/y

Parameter	List	Method	Units	DDW MCL/NL	DDW DLR	Collection Frequency[1]
Alachlor	pMCL	EPA 505	mg/L	0.002	0.001	2x/y
Atrazine	pMCL	EPA 525.2	mg/L	0.001	0.0005	2x/y
Bentazon	pMCL	EPA 515.4	mg/L	0.018	0.002	2x/y
Benzene	pMCL	EPA 524.2	mg/L	0.001	0.0005	2x/y
Benzo(a)pyrene	pMCL	EPA 525.2	mg/L	0.0002	0.0001	2x/y
Carbofuran	pMCL	EPA 531.2	mg/L	0.018	0.005	2x/y
Carbon Tetrachloride	pMCL	EPA 524.2	mg/L	0.0005	0.0005	2x/y
Chlordane	pMCL	EPA 505	mg/L	0.0001	0.0001	2x/y
cis-1,2-Dichloroethylene	pMCL	EPA 524.2	mg/L	0.006	0.0005	2x/y
Dalapon	pMCL	EPA 515.4	mg/L	0.2	0.01	2x/y
Di(2-ethylhexyl)adipate	pMCL	EPA 525.2	mg/L	0.4	0.005	2x/y
Di(2-ethylhexyl)phthalate (same as Bis (2-ethylhexyl)phthalate [3])	pMCL	EPA 525.2	mg/L	0.004	0.003	2x/y
Dibromochloropropane (DBCP)	pMCL	EPA 551.1	mg/L	0.0002	0.00001	2x/y
Dichloromethane (Methylene chloride)	pMCL	EPA 524.2	mg/L	0.005	0.0005	2x/y
Dinoseb	pMCL	EPA 515.4	mg/L	0.007	0.002	2x/y
Diquat	pMCL	EPA 549.2	mg/L	0.02	0.004	2x/y
Endothall	pMCL	EPA548.1	mg/L	0.1	0.045	2x/y
Endrin	pMCL	EPA 508	mg/L	0.002	0.0001	2x/y
Ethylbenzene	pMCL	EPA 524.2	mg/L	0.3	0.0005	2x/y
Ethylene Dibromide (EDB)	pMCL	EPA 551.1	mg/L	0.00005	0.00002	2x/y
Glyphosate [2]	pMCL	EPA 547	mg/L	0.7	0.025	2x/y
Heptachlor	pMCL	EPA 505	mg/L	0.00001	0.00001	2x/y
Heptachlor Epoxide	pMCL	EPA 505	mg/L	0.00001	0.00001	2x/y
Hexachlorobenzene	pMCL	EPA 505	mg/L	0.001	0.0005	2x/y
Hexachlorocyclopentadiene	pMCL	EPA 505	mg/L	0.05	0.001	2x/y

Parameter	List	Method	Units	DDW MCL/NL	DDW DLR	Collection Frequency[1]
Lindane	pMCL	EPA 505	mg/L	0.0002	0.0002	2x/y
Methoxychlor	pMCL	EPA 505	mg/L	0.03	0.01	2x/y
Methyl tert butyl ether (MTBE)	pMCL/sMCL	EPA 524.2	mg/L	0.013/0.005	0.003	2x/y
Molinate	pMCL	EPA 525.2	mg/L	0.02	0.002	2x/y
Monochlorobenzene	pMCL	EPA 524.2	mg/L	0.07	0.0005	2x/y
Oxamyl	pMCL	EPA 531.2	mg/L	0.05	0.02	2x/y
Pentachlorophenol	pMCL	EPA 515.4	mg/L	0.001	0.0002	2x/y
Picloram	pMCL	EPA 515.4	mg/L	0.5	0.001	2x/y
Polychlorinated Biphenyls (PCBs)	pMCL	EPA 505	mg/L	0.0005	0.0005	2x/y
Simazine [3]	pMCL	EPA 525.2	mg/L	0.004	0.001	2x/y
Styrene	pMCL	EPA 524.2	mg/L	0.1	0.0005	2x/y
Tetrachloroethylene (PCE)	pMCL	EPA 524.2	mg/L	0.005	0.0005	2x/y
Thiobencarb	pMCL/sMCL	EPA 525.2	mg/L	0.07/0.001	0.001	2x/y
Toluene	pMCL	EPA 524.2	mg/L	0.15	0.0005	2x/y
Total Xylenes	pMCL	EPA 524.2	mg/L	1.750	0.0005	2x/y
Toxaphene	pMCL	EPA 505	mg/L	0.003	0.001	2x/y
trans-1,2-Dichloroethylene	pMCL	EPA 524.2	mg/L	0.01	0.0005	2x/y
Trichloroethylene (TCE)	pMCL	EPA 524.2	mg/L	0.005	0.0005	2x/y
Trichlorofluoromethane (Freon 11)	pMCL	EPA 524.2	mg/L	0.15	0.005	2x/y
Vinyl Chloride	pMCL	EPA 524.2	mg/L	0.0005	0.0005	2x/y
Disinfection By-Products						
Haloacetic acids (HAA5)	pMCL	SM 6251B	mg/L	0.060	--	2x/y
Total Trihalomethanes (TTHMs)	pMCL	EPA 551.1	mg/L	0.080	--	2x/y
Bromate	pMCL	EPA 317.0	mg/L	0.010	0.0010	2x/y
Chlorite	pMCL	EPA 300.0	mg/L	1.0	0.020	2x/y

Parameter	List	Method	Units	DDW MCL/NL	DDW DLR	Collection Frequency[1]
Radionuclides with an MCL						
Gross Alpha Particle (excluding radon and uranium)	pMCL	EPA 900	pCi/L	15	3	2x/y
Gross Beta Particle	pMCL	EPA 900	mrem/yr	4	4	2x/y
Radium-228 and -226 (combined)	pMCL	GA Method	pCi/L	5	1 for each	2x/y
Strontium-90	pMCL	EPA 905	pCi/L	8	2	2x/y
Tritium	pMCL	EPA 906	pCi/L	20,000	1,000	2x/y
Uranium	pMCL	EPA 200.8	pCi/L	20	1	2x/y
Microbiological						
E. coli	pMCL	SM 9223F	MPN/100mL	TT	--	2x/y
Total Coliform	pMCL	SM 9223B	MPN/100mL	TT	--	2x/y
Additional SOCs Reported in Historical Data						
Chlorpyrifos (Dursban)	UCMR4; HA	525.2	mg/L	0.03	--	2x/y

Footnotes:

[1] m=monthly; 2x/m=twice per month; 2x/y=twice per year

[2] Also a high-use pesticide in this watershed.

[3] Also reported in historical data.

TT = Treatment Technique
pMCL = Primary Maximum Contaminant Level
sMCL = Secondary Maximum Contaminant Level
NL = DDW Notification Level
aNL = DDW Archived Notification Level
UCMR = Unregulated Contaminant Monitoring Rule
CCL = EPA's Contaminant Candidate List
HA = EPA Health Advisory Level