SWAMP
Surface Water Ambient Monitoring Program

Monitoring Plan	2012

SWAMP Safe-to-Swim Study, 2011-2013

Version 1.1

April 2012

Water Boards

www.waterboards.ca.gov/swamp

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I. Introduction

This plan documents the key aspects of the SWAMP Safe-to-Swim Study, 2011through 2013. This study is sponsored by the Central Valley Regional Water Quality Control Board (Central Valley Water Board) Surface Water Ambient Monitoring Program (SWAMP). The purpose of this study is to evaluate Recreation Beneficial Use achievement at selected sites within specific water bodies in the Central Valley Region, using *E. coli* as the indicator, and evaluate overall water quality.

Sampling sites will generally consist of:

- Sites utilized by local stakeholders for contact recreation (specifically, swimming holes, defined as places in fresh, moving water, such as rivers, streams, creeks, springs, or similar natural bodies of water, which are large enough and deep enough for a person to swim in. This criterion excludes lakes and/or shallow stream sections);
- Locations identified in previous studies as areas of concern for recreational Beneficial Use;
- Up and/or downstream sites may also be included in watersheds with elevated levels of *E. coli* in an effort to identify potential sources of bacteria load.

As with previous Safe-to-Swim studies, citizen's monitoring groups and other local stakeholder groups will be invited to participate in site selection and sampling.

II. Background

One of the purposes of the Surface Water Ambient Monitoring Program (SWAMP) is to determine whether there is any evidence that Beneficial Uses are not being protected. The Central Valley Regional Water Quality Control Board Basin Plans (Basin Plans) identify contact recreation as a Beneficial Use throughout the Region, utilizing fecal coliform as the indicator to determine whether the water body being examined supports the Contact Recreation Beneficial Use objective. However, the United States Environmental Protection Agency (USEPA) has developed contact recreation guidelines for *E. coli,* and the State Water Resources Control Board (State Water Board) is in the process of establishing statewide freshwater water quality objectives using *E. coli* as an indicator, which will be used in this study for consistency with the direction the Water Boards seem to be moving.

In 2007, staff from the Central Valley Water Board conducted a pilot Safe-to-Swim study in a limited number of watersheds to understand the feasibility and logistical issues with conducting a region-wide study. This was followed in 2008

by a region-wide water recreation use study of local swimming holes during a period of anticipated elevated recreation use (Central Valley Water Board, 2009). The 2008 study consisted of sampling before, during, and after the 2008 Labor Day weekend, using *E. coli* as a pathogen indicator. Based on the information collected in 2008, a follow-up study was conducted in 2009 to develop a more thorough analysis of water quality in the impacted watersheds of the Lower American River, Deer Creek (Nevada County), Dry Creek (Placer County) and South Yuba River (Central Valley Water Board, 2010). In 2010, two studies were conducted for Safe-to-Swim. The first was a small study conducted in June 2010 to further evaluate water quality conditions in the Lower American River Watershed and the Dry Creek Watershed (Placer County). The second study during August through September of 2010 was a return to a region-wide assessment of the water quality at swimming holes. Instead of sampling before, during and after the holiday weekend (as in 2008), the 2010 study had 3 sampling events spread over a 5 week period. It included an adaptive approach to evaluating sites with elevated *E.coli* levels with the addition of upstream and/or downstream sites to the swimming hole sites. Draft reports for both 2010 studies are in process and will be available by mid-2011.

This 2011through 2013 Safe-to-Swim study will also be a region-wide assessment and will be conducted throughout the entire swimming season (April through September). As with previous region-wide Safe-to-Swim studies, citizen monitoring groups and other stakeholders will be invited to participate with the identification and sampling of local swimming holes.

III. Study Design Overview

This Monitoring Plan (MP)has been designed based on SWAMP's template. The following sections provide details of the plan, including constituents to be analyzed and sampling sites.

III.a Monitoring Design

This monitoring effort will provide water quality data within the Sacramento River, San Joaquin River and Tulare Lake Basins at selected contact recreation areas to support SWAMP objectives. This project will primarily investigate the occurrence of *E. coli,* a fecal indicator bacteria. Major questions being asked by this study are:

1. Is there any evidence that beneficial uses (specifically contact recreation) are being impacted, and if so, what are potential contributors?
2. Are there any noticeable regional, seasonal or trends observed in the water quality data?
3. Are any of the waterbodies included in this study listed by the State as impaired?

4. What are pathogen (*E. coli* O157:H7, *Salmonella*, *Giardia*, and *Cryptosporidium)* concentrations at selected monitoring sites?

The primary objectives of this project are:

- Evaluate water quality at selected sampling sites across the Sacramento River, San Joaquin River and Tulare Lake Basin watersheds during the months of April through September, 2011through 2013.
    - Evaluate seasonal and temporal trends of field parameters (temperature, dissolved oxygen, pH, conductivity[1], and turbidity), *E. coli* and total coliform concentrations at selected swimming areas
    - Evaluate pathogen (*E. coli* 057:H7, *Salmonella*, *Giardia*, and *Cryptosporidium* concentrations at selected sites and their relationships to other constituents.
    - Expand monitoring to upstream and downstream of selected swimming holes that have *E. coli* concentrations above 235 MPN/100mL.
- Evaluate the potential contributors of bacteria in watersheds with elevated *E. coli* levels, based on available information (including local knowledge, Department of Water Resources land use surveys, wastewater discharge permits, sanitary surveys, etc.)
- Compare reported results to values obtained from previous Safe-to-Swim studies (when applicable).
- Compare water chemistry and *E. coli* concentrations to appropriate water quality objectives and guidelines.
- Provide recommendations for future monitoring.

III.a.1 Sampling Locations

Sampling locations will generally be selected by identifying key swimming hole sites sampled during previous SWAMP Safe-to-Swim studies and using local stakeholder input for the addition of new swimming hole sites.

Sampling site selection is based on several factors, including the following:

- Sites with a history of recreational use, based on local stakeholder input and other available sources

- Sites that meet the definition of a swimming hole (defined as places in fresh, moving water, such as rivers, streams, creeks, springs, or similar natural bodies of water, which are large enough and deep enough for a person to swim in. This criterion excludes lakes and/or shallow stream sections, *unless they pertain to up and/or downstream sites*)

[1] Water Quality Objectives and samples collected by Regional Board staff specify that Specific Conductivity is analyzed. However, conductivity is used throughout documents for this study because certain Citizen Monitoring groups are collecting conductivity samples.

- Sites sampled during previous Safe-to-Swim studies or new sites provided by local stakeholders.

- Sites that are readily accessible and within transport holding time limitations

- Sites that do not meet the above criteria will be evaluated to determine potential for being able to address the questions and objectives of this study. Justification for inclusion in the study will be included Appendix A: Site Descriptions of the study report to be published at the end of the study. Site Descriptions will be completed by April 1, 2012.

Sites will be placed into one of the following three groups based on availability of staff to ensure the samples can be collected:

- Primary monitoring sites – These sites will be sampled once a month in April and September and twice a month from May through August. Samples will primarily be collected by Central Valley Water Board staff.

- Secondary monitoring sites – These sites will be sampled once a month from May through August, by local stakeholders or Central Valley Water Board staff. Selection will generally be based on stakeholder interest and availability.

- Tertiary monitoring sites – These sites will have limited monitoring, and generally be sampled by Central Valley Water Board staff. Some of these sites will provide upstream and downstream data for sampling sites where *E. Coli* results are above 235 MPN/100mL.

Eighty one sampling sites are anticipated to be included in this study: 41 Primary, 40 Secondary, and 1 tertiary (**Error! Reference source not found.**, Figure 1 Safe-to-Swim Study Sampling Sites, 2011-1, Figure 2 Selected Watershed Closeup Maps).

For all sites, safety and all-weather access are priorities for sampling activities. Based on field and weather conditions, the sampling plan may be modified by the project team during the sampling event to provide for field safety and make the collection accurate and thorough. Any changes will be documented on SWAMP field sheets. Any additions to the sampling locations listed in Table 1 (e.g., tertiary sites) will be added as Appendix 2.

Table 1 Sampling Sites Summary

No.	Watershed	Station Number	Site Description	Sampling Site Type	Samples Collected By[2]	Samples Analyzed By	*E. coli* Historic Range	Sample Count	Latitude	Longitude
Sacramento River Basin										
1	Sacramento River	506SHA951	Sacramento River at Dog Creek confluence	Secondary	RS	RS	1 – 7	7	40.9382	-122.4177
2	Sacramento River	504TEH900	Sacramento River at Red Bluff, east end of Willow Street	Secondary	RS	RS	6 – 75	6	40.1718	-122.2246
3	Sacramento River	508SHA901	Sacramento River at Woodson Bridge Boat Ramp	Secondary	RS	RS	4 – 866	14	39.9054	-122.0878
4	Sacramento River	504BUT001	Sacramento River above Big Chico Creek Confluence	Secondary	RS	RS	13 – 91	3	39.7036	-121.9431
5	Sacramento River	508SHA904	Clear Creek at Hwy 299 bridge	Secondary	RS	RS	15 – 114	7	40.6644	-122.6350
6	Sacramento River	508SHA903	Clear Creek at Hwy 273 bridge	Secondary	RS	RS	8 – 64	14	40.5089	-122.3800
7	Sacramento River	508SHA902	Cow Creek at Hwy 44 bridge	Secondary	RS	RS	35 – 1300	8	40.5549	-122.2309
8	Sacramento River	508SHA900	Cottonwood Creek at Interstate 5 bridge	Secondary	RS	RS	68-248	4	40.3771	-122.2851
9	Pit River	506SHA950	Pit River at Big Bend	Secondary	RS	RS	6 – 23	6	41.0207	-121.9103
10	Butte Creek	520BUT900	Butte Creek at Honey Run Bridge	Secondary	RS	RS	21 – 687	7	39.7622	-121.7923
11	Big Chico Creek	520BUT901	Big Chico Creek at Bidwell Park below swimming pool	Secondary	RS or BCCWG	RS	47 – 231	7	39.729	-121.7053
12	Feather River	518INABSP	Indian Creek at Indian Falls near HWY 89	Secondary	RS	RS	<1 – 23	4	40.0591	-120.9614
13	Feather River	518PLU902	Spanish Creek at Keddie Resort Road	Secondary	RS	RS	90	1	40.0137	-120.9648

[2] RS – Redding Staff; BCCWG – Big Chico Creek Watershed Group; SYRCL – South Yuba River Citizen's League; RCS – Rancho Cordova Staff; ARC – American River Conservancy; SSI – Sierra Streams Institute (formerly Friends of Deer Creek); TRT – Tuolumne River Trust; UMRWC – Upper Merced River Watershed Council; RTV – River Tree Volunteers; FS – Fresno Staff

No.	Watershed	Station Number	Site Description	Sampling Site Type	Samples Collected By[2]	Samples Analyzed By	*E. coli* Historic Range	Sample Count	Latitude	Longitude
14	Feather River	518PLU901	Feather River, Middle Fork at Sloat	Secondary	RS	RS	1 – 9	3	39.8609	-120.7279
15	Yuba River	517NEV111	South Yuba River at Van Norden Dam	Secondary	SYRCL	RCS	<1 – 4	2	39.3215	-120.3788
16	Yuba River	516NEV910	South Yuba River at Towle Mountain Road	Secondary	SYRCL	RCS	1 - 26	3	39.3292	-120.4094
17	Yuba River	517NEV110	South Yuba River at Plavada	Secondary	SYRCL	RCS	2 – 4	2	39.3171	-120.4412
18	Yuba River	516NEV901	South Yuba River at Purdon	Secondary	SYRCL	RCS	<1 – 291	5	39.3277	-121.0473
19	Yuba River	516NEV900	South Yuba River at Bridgeport	Secondary	SYRCL	RCS	<1 – 6	4	39.2927	-121.1978
20	Yuba River	517YUB001	Oregon Creek Swimming Hole	Secondary	SYRCL	RCS	13 – 64	3	39.4043	-121.0758
21	Yuba River	571YUB002	Middle Yuba River at Oregon Creek	Secondary	SYRCL	RCS	54	1	39.3953	-121.0834
22	Yuba River	571YUB003	Middle Yuba River above Oregon Creek	Secondary	SYRCL	RCS	2 – 16	3	39.3942	-121.0828
23	Yuba River	517NEV109	Upper Rush Creek near Rush Creek Way	Secondary	SYRCL	RCS	4 – 50	2	39.2740	-121.0801
24	Deer Creek (Nevada County)	517NEV106	Squirrel Creek at Rough and Ready Highway and Rex Reservoir Road	Secondary	SSI	RCS	73 - 201	5	39.2245	-121.1451
25	Deer Creek (Nevada County)	517NEV103	Squirrel Creek at Valley Drive	Secondary	SSI	RCS	91 - 866	5	39.2120	-121.1629
26	Deer Creek (Nevada County)	516NEV908	Squirrel Creek above confluence with Clear Creek	Primary	RCS	RCS	45 – 1046	19	39.2009	-121.1764
27	Deer Creek (Nevada County)	517NEV101	Squirrel Creek at Creekside Mobile Home Park Swim Hole	Secondary	SSI	RCS	127 -461	5	39.2014	-121.1782
28	Deer Creek (Nevada County)	516NEV906	Squirrel Creek in Western Gateway Park, Penn Valley, CA	Primary	RCS	RCS	55 – 579	23	39.2041	-121.1906
29	Deer Creek (Nevada County)	517NEV104	Clear Creek at Long Valley Road	Secondary	SSI	RCS	75 - 1046	5	39.183	-121.1414
30	Deer Creek (Nevada County)	517NEV102	Clear Creek at Lazy Valley Road	Secondary	SSI	RCS	186 – 921	3	39.1876	-121.1596
31	Deer Creek (Nevada County)	516NEV907	Clear Creek above confluence with Squirrel Creek	Primary	RCS	RCS	31 – 435	19	39.2005	-121.1764

No.	Watershed	Station Number	Site Description	Sampling Site Type	Samples Collected By[2]	Samples Analyzed By	*E. coli* Historic Range	Sample Count	Latitude	Longitude
32	Auburn Ravine (Placer County)	519PLA930	Auburn Ravine at Hwy 193 Bridge	Primary	RCS	RCS	50 - >2420	18	38.8904	-121.2829
33	Auburn Ravine (Placer County)	519PLA931	Auburn Ravine at Joiner Parkway/1st Street	Primary	RCS	RCS	54 - >2420	20	38.8844	-121.3109
34	Auburn Ravine (Placer County)	519PLA932	Auburn Ravine at Nelson	Primary	RCS	RCS	88 - >2420	18	38.8763	-121.3402
35	Dry Creek (Placer County)	541PLA906	Miner's Ravine at Glenbrook Estates	Primary	RCS	RCS	65 – 214	2	38.7987	-121.1328
36	Dry Creek (Placer County)	531PLA905	Miners Ravine at Dick Cook Road	Primary	RCS	RCS	114 – 1986	9	38.7965	-121.1361
37	Dry Creek (Placer County)	519PLA912	Miner's Ravine above confluence with Secret Ravine	Primary	RCS	RCS	161 – 179	2	38.7592	-121.2563
38	Dry Creek (Placer County)	519PLA910	Secret Ravine above confluence with Miner's Ravine	Primary	RCS	RCS	86 – 99	2	38.7594	-121.2565
39	Dry Creek (Placer County)	531PLA902	Miners Ravine/Secret Ravine	Primary	RCS	RCS	32 – 308	22	38.7598	-121.2566
40	Dry Creek (Placer County)	531PLA903	Dry Creek at Royer Park	Primary	RCS	RCS	86 – 435	20	38.7436	-121.2837
41	Dry Creek (Placer County)	519PLA920	Linda Creek at Champion Oaks	Primary	RCS	RCS	147 – 866	18	38.7278	-121.2469
42	Dry Creek (Placer County)	519PLA921	Linda Creek at Condor Court	Primary	RCS	RCS	179 – 866	19	38.7314	-121.2562
43	Dry Creek (Placer County)	519PLA922	Linda Creek at Oak Ridge	Primary	RCS	RCS	105 – 1414	18	38.7321	-121.2673
44	Dry Creek (Placer County)	531PLA904	Cirby Creek at Elisa Way near I80	Primary	RCS	RCS	130 – 816	20	38.7306	-121.2812
45	Dry Creek (Placer County)	531PLA900	Dry Creek/ Cirby Confluence	Primary	RCS	RCS	99 – 2420	30	38.7335	-121.2885
46	Dry Creek (Placer County)	531PLA901	Dry Creek at Walerga Bridge	Primary	RCS	RCS	55 – 345	21	38.7369	-121.3645
47	American River	514AMR807	Silverfork American River at China Flat Campground	Secondary	ARC	RCS	1 – 28	6	38.7536	-120.2681
48	American River	514AMR806	South Fork American River at Kyburz	Secondary	ARC	RCS	<1 – 6	6	38.7630	-120.3256
49	American River	514LSAC52	American River at Sunrise Blvd.	Primary	RCS	RCS	2 – 99	9	38.6326	-121.2715

No.	Watershed	Station Number	Site Description	Sampling Site Type	Samples Collected By[2]	Samples Analyzed By	*E. coli* Historic Range	Sample Count	Latitude	Longitude
50	American River	514SAC012	American River at Hagan Community Park	Primary	RCS	RCS	3 – 308	18	38.6053	-121.3120
51	American River	519SAC102	American River at River Bend Park	Primary	RCS	RCS	6 – 687	17	38.5966	-121.3309
52	American River	519SAC103	American River at Harrington Street	Primary	RCS	RCS	8 – 44	15	38.5806	-121.3410
53	American River	514SAC011	American River at Watt Avenue Bridge	Primary	RCS	RCS	9 – 980	18	38.5658	-121.3819
54	American River	514SAC009	American River at North 10th Street	Primary	RCS	RCS	11 – 201	17	38.601	-121.4843
55	American River	519AMNDVY	American River at Discovery Park	Primary	RCS	RCS	15 - >2420	36	38.6009	-121.5055
San Joaquin River Basin										
56	Tuolumne River	535TR5xxx	Tuolumne River at Waterford Riverwalk Park	Secondary	TRT	RCS	23 - 172	3	37.6350	-120.7589
57	Tuolumne River	535STC218	Tuolumne River at Fox Grove	Secondary	TRT	RCS	19 - 461	4	37.6192	-120.8427
58	Tuolumne River	535STC217	Tuolumne River at Ceres River Bluff Park	Secondary	TRT	RCS	12 - 205	4	37.6156	-120.9270
59	Tuolumne River	535STC216	Tuolumne River at Legion Park	Secondary	TRT	RCS	11 – 613	23	37.6211	-120.9486
60	Tuolumne River	535STC215	Tuolumne River at Audie Peeples (Riverdale) Fishing Access	Secondary	TRT	RCS	27 – 613	25	37.6128	-121.0386
61	Tuolumne River	535STC513	Tuolumne River at Shiloh Fishing Access	Secondary	TRT	RCS	7 - >2420	62	37.6031	-121.1317
62	Tuolumne River	535STC206	Dry Creek at La Loma Road	Secondary	TRT	RCS	39 - >2420	44	37.6457	-120.9808
63	Merced River	537MAR210	Crane Creek upstream of the Merced River Confluence	Secondary	UMRWC	Fresno Staff	1 – 16	4	37.678	-119.7767
64	Merced River	537MAR900	“Patty’s Hole”, Merced River at El Portal	Secondary	UMRWC	Fresno Staff	3 – 7	4	37.6722	-119.7875
65	Merced River	537MAR204	Merced River at Briceburg Beach	Secondary	UMRWC	Fresno Staff	2 – 8	4	37.6041	-119.969
Tulare Lake Basin										

No.	Watershed	Station Number	Site Description	Sampling Site Type	Samples Collected By[2]	Samples Analyzed By	*E. coli* Historic Range	Sample Count	Latitude	Longitude
66	San Joaquin River	545FRE504	San Joaquin River at Friant Cove	Primary	RTV	FS	<1 – 5	9	36.9911	-119.7136
67	San Joaquin River	545FRE502	San Joaquin River at Lost Lake County Park	Primary	RTV	FS	1 – 14	10	36.9738	-119.7373
68	San Joaquin River	545FRE503	San Joaquin River at Fort Washington Beach	Primary	RTV	FS	5 – 88	10	36.8885	-119.7875
69	San Joaquin River	545MAD008	San Joaquin River at Wildwood Native park	Primary	RTV	FS	4 – 179	13	36.8761	-119.7936
70	San Joaquin River	551FRE020	San Joaquin River at Palm & Nees	Primary	RTV	FS	3 – 16	4	36.8503	-119.8148
71	San Joaquin River	545SJO144	San Joaquin River at Scout Island	Primary	RTV	FS	1 – 16	7	36.8589	-119.8422
72	San Joaquin River	545MAD011	San Joaquin River at Skaggs Bridge	Primary	RTV	FS	5.2 – 248	7	36.8222	-120.0574
73	Kings River	552KIN900	Kings River, South Fork at Muir Rock and Hwy 180	Primary	FS	FS	<1 – 10	14	36.7935	-118.5838
74	Kings River	552KIN901	Kings River, South Fork at Hotel Creek and Cedar Grove	Primary	FS	FS	<1 – 11	14	36.7893	-118.6691
75	Kings River	552KIN903	Kings River, South Fork at Hwy 180 & Cedar Grove	Primary	FS	FS	1 – 15	14	36.7981	-118.6875
76	Kings River	552KIN902	Kings River, South Fork, at Lewis Creek Trailhead	Primary	FS	FS	<1 – 10	14	36.7993	-118.6916
77	Kings River	552FRE510	Kings River at Winton Park	Primary	FS	FS	<1 – 388	9	36.8163	-119.3869
78	Kings River	552FRE511	Kings River at Reedley Beach	Primary	FS	FS	36 – 435	8	36.5869	-119.4593
79	Kings River	551KIN060	Kings River at Laton-Kingston Park	Primary	FS	FS	33 – 345	9	36.4276	-119.6898
80	Kings River	552HUM020	Ten Mile Creek at Hume Lake	Primary	FS	FS	<1 – 129	23	36.7868	-118.9004
81	Kings River	552HUM030	Long Meadow Creek at Hume Lake	Primary	FS	FS	<1 – 1046	22	36.7871	-118.9136

Figure 1 Safe-to-Swim Study Sampling Sites, 2011-13

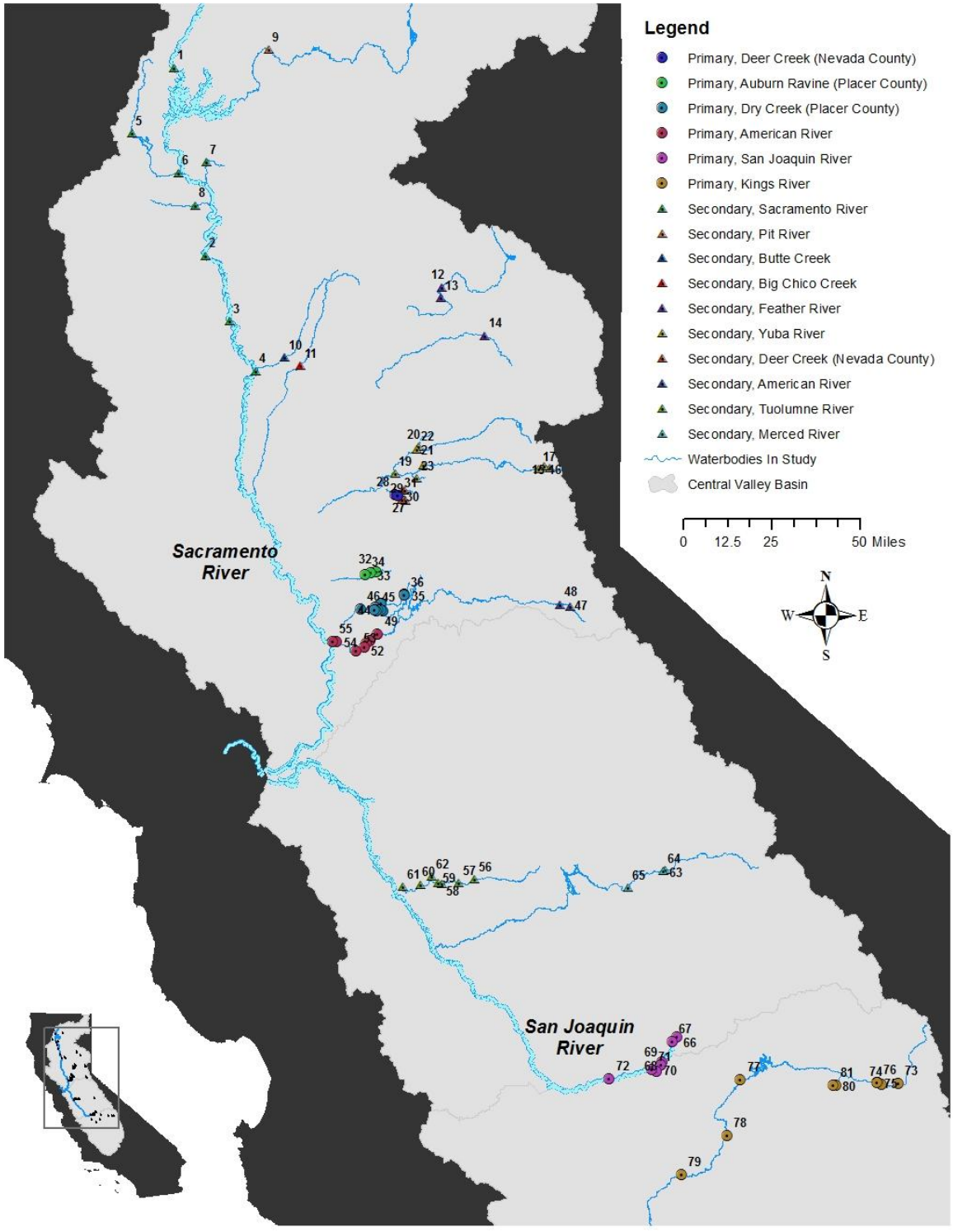
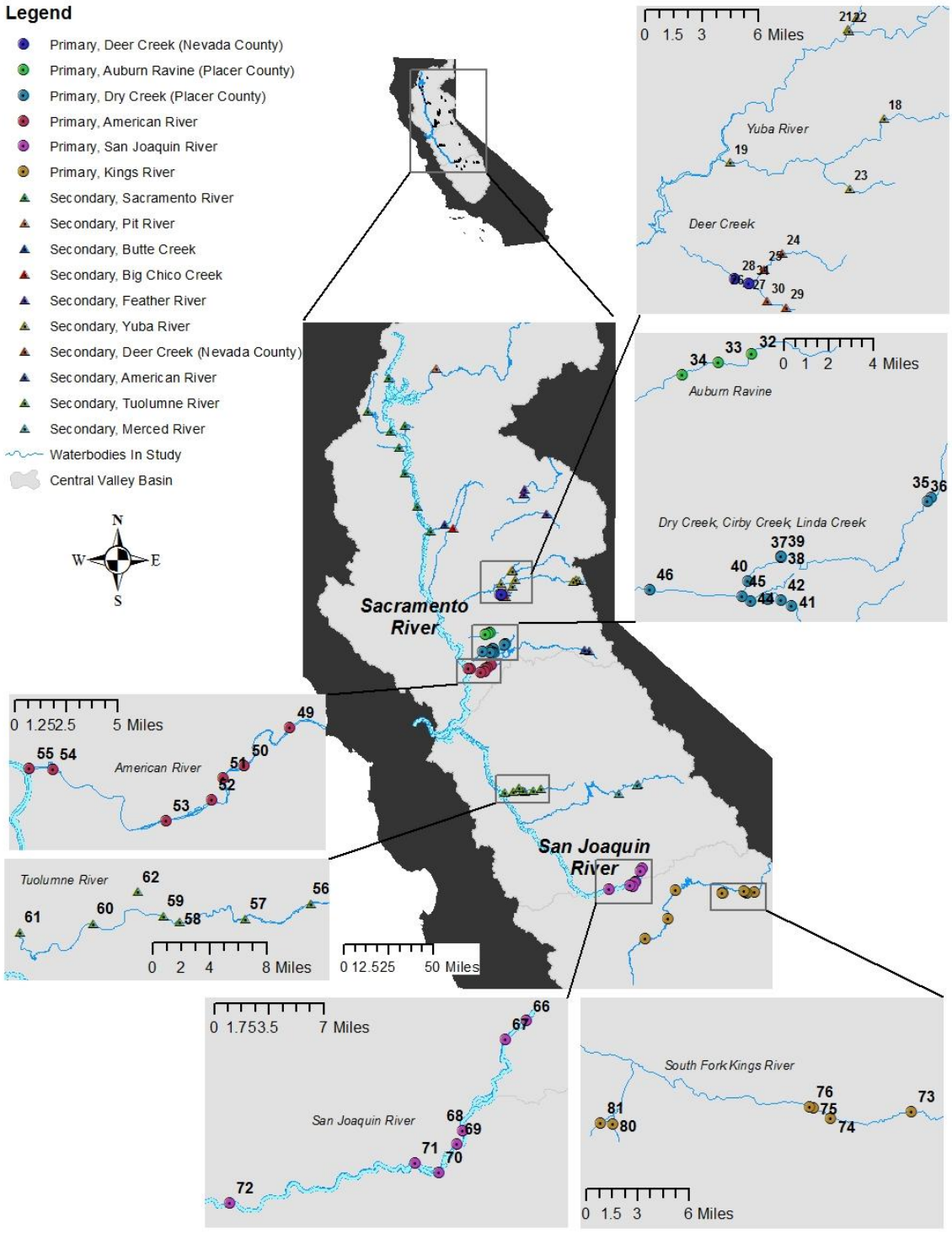


Figure 2 Selected Watershed Closeup Maps



III.a.2 Sample Site Access

Most sample sites are located on public access areas and therefore do not require permission to collect samples. However, certain sites along the Upper Kings River are located in the Kings Canyon National Park and therefore require permission from the National Park Service (NPS) to collect water quality samples. Upon submission of this Monitoring Plan the State Board SWAMP for approval, Fresno office staff will also submit this MP and application for a permit to collect samples with the Kings Canyon National Park office, pursuant to the guidelines at https://science.nature.nps.gov/research/ac/ResearchIndex.

III.b. Indicators and Measurement Parameters

Parameters for this study were selected based on potential to address the primary objectives listed in section III.a. Study parameters at all sites include: field parameters, total coliform and *E. coli*.

Pathogenic constituents *E. coli* 0157:H7, *Salmonella*, *Giardia* and/or *Cryptosporidium* will be added to the following sites:

- 531PLA900 - Dry Creek at Cirby Creek Confluence
- 519PLA931 - Auburn Ravine at 1st Ave/Joiner Pkwy
- 552FRE510 - Kings River at Winton Park
- 552FRE511 - Kings River at Reedley Beach
- 551KIN060 - Kings River at Laton-Kingston Park

The selected pathogens were chosen due to the Central Valley being dominated by agricultural land use, which may have potential to contribute these pathogens to surface waters from practices such as application of manure fertilizers or concentrated animal facility operations. The number of sites was chosen based upon funding availability. Sites in the Dry Creek and Auburn Ravine areas were chosen based on the findings of *Cryptosporidium* during previous Safe to Swim studies. Sites along the Kings River were chosen based on site accessibility.

III.b.1 Field Parameters

Field parameters will include temperature, dissolved oxygen, pH, conductivity and turbidity, dependant upon equipment availability. For sites that Central Valley Regional Water Board staff sample, a YSI multiparameter water quality monitor will be used to collect data for temperature, dissolved oxygen, pH and specific conductivity. Turbidity measurements will be collected with a Hach turbidimeter. The field equipment are calibrated using certified calibration standards and manufacturer specifications prior to each sampling event and the calibration is checked for accuracy following each sampling event. Calibration records are maintained at the Central Valley Water Board offices and are used to

determine instrument accuracy. Specific model numbers and calibration dates for the field equipment will be noted on the field sheets and in the final report.

For sites sampled by stakeholders, field parameter measurements may vary depending on field equipment availability. Specific details on the field measurements and the equipment used by stakeholders will be documented on the field sheets and in the final report. Central Valley Water Board staff and volunteer stakeholders will conduct an intercalibration exercise for field equipment when Central Valley Water Board staff delivers the initial set of sampling supplies to ensure that data for the same parameters are comparable.

III.b.2 *E. coli*

The Central Valley Water Board is able to analyze for total coliform and *E. coli* in-house using the IDEXX Colilert® QuantiTray system (Standard Method 9223B). *E. coli* is bacteria that serves as an important indicator for the protection of recreational beneficial uses because of its relationship with warm blooded animals, and may indicate when disease-causing agents are present at densities that may be problematic. However, *E. coli* levels may not accurately represent the actual human health risk or actual presence of pathogens.

III.b.3 *E. coli 0157:H7*

Water samples may be analyzed for the presence/absence of *E. coli* 0157:H7 in the laboratories of Pacific Coast Analytical (Sylmar, CA) using the United States Food and Drug Administration's (USFDA) Standard Method 99D-4488&4489 or the laboratory of Robert Atwill (University of California, Davis) using an enrichment and immuno-magnetic separation method documented by Cooley et. al, 2007. *E. coli* 0157:H7 is a pathogenic strain of *E. coli* and can cause illness in humans. *E. coli* 0157:H7 has been associated with healthy cattle that harbor and shed the bacteria without any ill effect. The illness in humans has been associated with contaminated meat, water, foods and unpasteurized or incorrectly pasteurized dairy products. The symptoms include nausea, vomiting, cramps and bloody diarrhea and can be very severe and lead to death if untreated, especially in young children and the elderly.

III.b.4 *Cryptosporidium*

Water samples may be analyzed for *Cryptosporidium* in the laboratories of BioVir (Benicia, CA) or the laboratories of Robert Atwill (University of California, Davis) using the USEPA's Standard Method 1623. *Cryptosporidium* is a protozoan parasite that can cause disease in animals and humans, especially immunocompromised individuals. The parasite is transmitted by an environmentally resistant oocyst and is shed in the stool from an infected human or animal. Symptoms of cryptosporidiosis include stomach cramps, dehydration,

nausea, vomiting, fever and weight loss. Young children, pregnant women and people with severely weakened immune systems are most at risk to develop serious illness.

III.b.5 *Giardia*

Water samples may be analyzed for *Giardia* in the laboratories of BioVir (Benicia, CA) or the laboratories of Robert Atwill (University of California, Davis) using the USEPA's Standard Method 1623. *Giardia* is a protozoan parasite that can cause disease in humans and animals. The parasite is transmitted by an environmentally resistant cyst, shed from the stool of an infected human or animal. Symptoms include bloating, nausea with or without vomiting, malaise and fatigue. Giardiasis is the most common cause of water-borne parasitic illness in the United States. Also known as "traveler's diarrhea", it is also associated with drinking water in less developed countries. Most patients recover after 2 to 4 weeks, but children with chronic infection may fail to thrive and others may suffer for months to years with symptoms.

III.b.6 *Salmonella*

Water samples may be analyzed for *Salmonella* in the laboratories of BioVir (Benicia, CA) or the laboratories of Robert Atwill (University of California, Davis) using the USEPA's Standard Method 1682. A presence/absence test for *Salmonella* may also be conducted at the laboratories of Pacific Coast Analytical (Sylmar, CA) using USFDA's Standard Method FDA99D-4488&4489. *Salmonella* is bacteria that can cause illness and be transmitted between humans and animals, including poultry, cattle, pigs, and domestic animals. Eating undercooked poultry and drinking unpasteurized milk are among the ways human can become infected. More recently, the source of infections have been associated with vegetables and nuts, indicating that these products were handled unsafely and became contaminated with bacteria from animal feces, raw poultry or an infected food handler. Although usually a mild disease, salmonellosis can become severe or deadly if the symptoms of vomiting and diarrhea lead to extreme dehydration. Typhoid fever can occur when some of the *Salmonella* organisms are not killed by the normal human immune defenses. *Salmonella* can then survive and grow in the human spleen, liver or other organs and may reach the blood and cause high fevers, inflammation of the stomach and intestines and diarrhea. Many patients become *Salmonella* carriers even after the symptoms resolve.

III.c. Data Analysis

Data will be analyzed using methods to answer the major questions asked by this study and primary objectives of this project, as outlined in section III.a. Monitoring Design.

All data from this study will be assessed in the 2014 cycle of the Clean Water Act Section 305(b) and 303(d) Integrated Report. There are no water quality guidelines in the Basin Plans for pathogenic *E. coli* O157:H7, *Cryptosporidium*, *Giardia* or *Salmonella*. In addition, there are no specific water quality objectives in the Basin Plans to protect recreation for any of the field parameters (dissolved oxygen, specific conductivity, pH, temperature or turbidity). However, the Basin Plans do contain guidelines to protect the beneficial uses of aquatic life, drinking water and/or agriculture.

Table 2 shows the water quality objectives and guidelines from the Basin Plans along with other commonly used guidelines for the different parameters included in this study. A final project report will evaluate the data against these objectives and guidelines.

Seasonal and temporal trends will be evaluated using graphic comparisons to include line graphs, bar graphs, and GIS maps.

Potential contributors of bacteria in the watersheds will be evaluated to a limited degree. Microbial Source Tracking is beyond the scope of this project, but would be the ideal avenue to pursue to identify sources of microbial load. Since this is not available, we will utilize available information compiled from each watershed. This includes local knowledge (gathered from the stakeholders we will be working with and available agency information), Department of Water Resources land use surveys, wastewater discharge permits, and sanitary surveys. Additionally, data may be gathered from sites upstream of sites with high *E. coli* concentrations. These sites will be upstream of potential sources of *E. coli* loads to evaluate the potential of the source to affect the results at the swimming hole.

Table 2. Water Quality Objectives and Guidelines

Parameter	Recreation	Drinking Water	Aquatic Life	Agriculture
Temperature			Central Valley Water Board Basin Plan (≤ 20ºC) Apr 1 – Jun 30 & Sep 1 – Nov 30[3]	
Dissolved Oxygen			Central Valley Water Board Basin Plans (7 mg/L) Kings River above Kirch Flat and Pine Flat Dam to Friant: (9 mg/L)	
pH	USEPA National Ambient water Quality Criteria (5-9)	USEPA Secondary Maximum Contaminant Level (6.5-8.5)	Central Valley Water Board Basin Plans (6.5 – 8.5) Kings River Watershed: (6.5-8.3)	Food & Ag Org. of United Nations (6.5-8.4)
Specific Conductivity[4]		Secondary Maximum Contaminant Level ≤900 umhos/cm		Water Quality for Agriculture (Ayers & Westcot) ≤700 umhos/cm
Turbidity			Central Valley Water Board Basin Plans Objectives are site specific. [5]	
E. coli	USEPA Contact Recreation Guideline for *E. coli* (<235 MPN/100mL)			
E. coli O157:H7				
Crypto/ *Giardia*				

[3] The Tulare Lake Basin Plan does not include a numeric temperature objective, and the narrative objective is not applicable to samples collected for this study. These samples include those collected in the San Joaquin and Kings River Watersheds.

[4] The electrical conductivity objective sites in the Kings River Watershed are site specific. Unless specified, the electrical conductivity objective is 100 umhos/cm. The objective at Kings River at Reedley beach is 200 umhos/cm, and the objective at Kings River at Laton-Kingston park is 300 umhos/cm.

[5] Turbidity water quality objectives applicable to sites in this study are: ≤ 10 NTU from the Lower American River - Folsom Dam to Sacramento River, and between 0-5 NTUs, increases shall not exceed 1 NTU in the South Fork Kings River sites that are above Kirch Flat.

Parameter	Recreation	Drinking Water	Aquatic Life	Agriculture
Salmonella				

All data will be provided to local stakeholders involved with this project. Where potential water quality problems are identified, this information will be provided to the appropriate Central Valley Water Board program for follow-up study as well as local public health departments. As funding permits, information from this study will also be used to direct expanded SWAMP monitoring.

Seasonal and temporal trends will be evaluated using graphic comparisons to include line graphs, bar graphs, and GIS maps.

Potential contributors of bacteria in the watersheds will be evaluated to a limited degree. Microbial Source Tracking is beyond the scope of this project, but would be the ideal avenue to pursue to identify sources of microbial load. Since this is not available, we will utilize available information compiled from each watershed. This includes local knowledge (gathered from the stakeholders we will be working with and available agency information), Department of Water Resources land use surveys, wastewater discharge permits, and sanitary surveys. Additionally, data may be gathered from sites upstream of sites with high *E. coli* concentrations. These sites will be upstream of potential sources of *E. coli* loads to evaluate the potential of the source to affect the results at the swimming hole.

III.d. Data Collection and Frequency of Sampling

The monitoring frequency for the primary monitoring sites will be once a month in April and September and twice a month from May through August. The number of primary sites and monitoring frequency is limited by Central Valley Water Board staff resources and availability. Depending on the availability and interest of local stakeholders, some primary monitoring may be conducted with their help.

The monitoring frequency for the secondary sites will be once a month from May through August and will be dependent on sample collector availability. Any new monitoring sites will be included in this group and listed in Appendix 2. Central Valley Water Board staff will provide the necessary training and supplies to stakeholder volunteers.

An adaptive approach will be taken in this study. Depending on measured *E. coli* values and available resources, additional sites (tertiary monitoring sites) may be added after the initial sampling event in April of each year.

Pathogen monitoring will occur monthly May through August at the sites identified under III.b.

Changes or additions will be listed in Appendix B.

Procedures for collecting the samples are described in the Quality Assurance Project Plan. All Central Valley Water Board staff and volunteer samplers will be trained in these procedures prior to the start of sample collection.

Consistency of sample location is confirmed by comparing correct latitude/longitude on our field sheets and in field GPS coordinates. Sample site descriptions include information on accessing the sites. Photographs will be taken of each site on each sampling day by samplers who have an available camera. New staff only sample with staff that are familiar with the sample site. Central Valley Water Board staff will provide samplers SWAMP Safe-to-Swim field sheets to be used for recording habitat observations and field measurements.

All water samples will be collected as grab samples either by hand or by sampling pole, approximately three inches below the water surface. Samples collected for total coliform and *E. coli* analysis will be collected in either a 100 ml (normal samples and field duplicates) or 200 ml (lab duplicates), factory sterilized and sealed polyethylene bottle. Samples collected for *E. coli* O157:H7, *Salmonella, Cryptosporidium,* and *Giardia* analysis will be collected in one or two liter autoclavable polypropylene sample bottles for a total volume of 10 liters for each species (40 liters total at each site).

Quality assurance measures include field duplicates and lab duplicates. Per SWAMP requirements, field duplicates will be collected at 5% of the total project sample count by collecting two 100 ml samples at selected sites. Laboratory duplicate samples will be collected at a frequency of one per ten samples to be analyzed per day, at selected sites, in the 200 ml bottle, and then split into two 100 ml bottles in the lab. Field duplicates and lab duplicate samples for pathogens will be collected at the same frequency as total coliform and *E. coli* samples by collecting twice the required sample volume at selected sites. Laboratory duplicate samples will be composited in the lab and then split into two sample volumes.

III.e. Spatial and Temporal Scale

Sampling locations are located in the Sacramento River, San Joaquin River and Tulare Lake Basins at local swimming holes and up or downstream sites as needed.

The overarching goal of this project is to evaluate ambient water quality and how the water quality relates to the contact recreation beneficial use. To provide the most relevant data, the sampling period needed to be when the public was likely to be using streams for contact recreation. However, swim seasons vary throughout the entire Central Valley given the variety in elevations and latitude. Additionally, we needed to plan for a variety of weather patterns and early/late season contact recreation users.

To provide consistency for planning, primary site monitoring will occur each year of this study from April through September. Secondary site monitoring will occur each year of this study from May through August, and tertiary site monitoring will occur periodically.

III.f. Data Management

All data from this study will be managed in accordance with the SWAMP data Management Plan and SWAMP Standard Operating Procedures (SOPs) (State Water Board, 2008). Data will be entered and stored in the SWAMP v2.5 Database. The Central Valley Water Board will load field sheet, field parameter, and bacteria/pathogen data into the database.

Data in the SWAMP Database will be made available to the public through the California Environmental Data Exchange Network (CEDEN). Information on CEDEN is available at www.ceden.org.

IV. Coordination and Review Strategy

The Central Valley Water Board staff is responsible for coordinating sampling events with stakeholders, insuring capacity at laboratory facilities, sampling, field measurements and observations, conducting laboratory analysis, data management, and report to the Central Valley Water Board. Significant findings and/or deviations from this Monitoring Plan and the procedures will be documented in a final study report.

In addition to the review by program staff from the Central Valley Water Board, this document and the draft and final study reports will be provided to local stakeholder groups for review.

V. Quality Assurance

Field duplicate samples will be collected at a frequency of 5% of the total project sample count and laboratory duplicates will be collected at a frequency of one per ten samples to be analyzed per day. Water samples will be bottled as appropriate and held at <10°C, before being transferred to the laboratory for analysis. Field and laboratory blanks will be used for each batch of bottles collected and processed. Chain-of-custody documentation will be maintained for all samples.

Sample volumes for total coliform and *E. coli* analysis are 100 ml. Sample volumes for pathogen sample analysis are 10 L for each species.

Measurement Quality Objectives (MQOs) can be found in the QAPP for this project, on the YSI website, and in the method documentation on the EPA website (for *Cryptosporidium* and *Giardia*). However, the methods to be used for analyzing *Salmonella* and *E. coli* O157:H7 are not standard and are listed in Table 3 below, as well as in the QAPP:

Table 3 Measurement Quality Objectives for *Salmonella* and *E. coli* O157:H7 analysis

MQO	Salmonella	*E. coli* O157:H7
Accuracy	Positive and negative standards test >/= 90% accurate	Positive and negative
Precision	Duplicate samples >/= 80% concordant	Duplicate samples >/= 80% concordant
Recovery/Sensitivity	Distinguish 0 from >/= 1 cfu	Distinguish 0 from >/=1 cfu
Method Detection Level	0.26 cfu/100ml	1/1000 ml
Target Reporting Limit	>/= 1 cfu per liter	>/= 1 cfu per liter
Completeness	80%	80%

All aspects of this study will be conducted in accordance with the Quality Assurance Project Plan developed for this project, which complies with the 2008 SWAMP Quality Assurance Program Plan (QAPrP) for the State of California's Surface Water Ambient Monitoring Program (State Water Board, 2008) and the Procedures Manual for the San Joaquin River Water Quality Monitoring Program (Central Valley Water Board, 2010).

VI. Reporting

The Central Valley Water Board will prepare annual Fact Sheets highlighting analytical results and findings. All field sheet and laboratory data will also be posted at the end of this project. Both Fact Sheets and data will be made available to the public on the Central Valley Water Board's SWAMP webpage at: www.waterboards.ca.gov/centralvalley/water_issues/swamp/r5_activities/index.shtml. Target completion dates are shown in Table 4.

Upon completion of the study, staff will submit draft and final reports to the Central Valley Water Board summarizing all analytical data collected.

VII. Project Schedule

A timeline for project activities and target completion dates are provided in Table 4.

Table 4. Target Completion Dates for Products

Activity	Date		Deliverable	Deliverable Target Due Date
	Anticipated Date of Initiation	Anticipated Date of Completion		
Conduct project	7/1/2011	6/30/2014	None	None
Collect and analyze samples, 2011 swim season	7/1/2011	9/30/2011	Analytical and Quality Control Reports, 1 per sampling event	Method dependent
2011 swim season Fact Sheet	10/1/2011	12/31/2011	Fact Sheet which summarizes sampling, participating groups, findings	12/31/2011
Appendix 1: Site Description Sheets	7/1/2011	4/1/2012	Site Description Sheets for all Sampling Sites	4/1/2012
Collect and analyze samples, 2012 swim season	4/1/2012	9/30/2012	Analytical and Quality Control Reports, 1 per sampling event	Method dependent
2012 swim season Fact Sheet	10/1/2012	12/31/2012	Fact Sheet which summarizes sampling, participating groups, findings	12/31/2012
Collect and analyze samples, 2012 swim season	4/1/2013	9/30/2013	Analytical and Quality Control Reports, 1 per sampling event	Method dependent
2013 swim season Fact Sheet	10/1/2013	12/31/2013	Fact Sheet which summarizes sampling, participating groups, findings	12/31/2013
Draft Report	7/1/2011	3/31/2014	Draft Report to Water Board	3/31/2014
Final Report	4/1/2014	5/31/2014	Final Report to Water Board	5/31/2014

References

Central Valley Regional Water Quality Control Board. SWAMP Safe-to-Swim Study, June 2009. 2010.

Central Valley Regional Water Quality Control Board. SWAMP Safe-to-Swim Study, Labor Day 2008. 2009.

Central Valley Regional Water Quality Control Board. Procedures Manual for the San Joaquin River Water Quality Monitoring Program. 2010.

Central Valley Regional Water Quality Control Board. Water Quality Control Plan for the Sacramento River Basin and the San Joaquin River Basin. Fourth Edition. 2007. (http://www.waterboards.ca.gov/centralvalley/water_issues/basin_plans/sacsjr.pdf)

Central Valley Regional Water Quality Control Board, Water Quality Control Plan for the Tulare Lake Basin, Second Edition. 2004. (http://www.waterboards.ca.gov/centralvalley/water_issues/basin_plans/tlbp.pdf)

State Water Resources Control Board, 2008 SWAMP Quality Assurance Program Plan (QAPrP) for the State of California's Surface Water Ambient Monitoring Program. 2008.

United States Environmental Protection Agency, USEPA. Bacterial Water Quality Standards for Recreational Waters (Freshwater and Marine Waters) Status Report. EPA-823-R-03-008. 2003. (http://www.epa.gov/waterscience/beaches/local/statrept.pdf)

Appendix 1: Site Descriptions

Appendix 1 will be completed as part of this project and are anticipated to be complete prior to the 2012 sampling season. Several of the historic sites have existing sheets which may need to be updated and newer sites will need to have these sheets created.

An example of site description follows.

MONITORING SITE INFORMATION

Site Name: Littlejohns Creek at Sonora Road
Site ID: 535STC212
Latitude/Longitude: 37.0000/-120.0000
County: Stanislaus

Site Description and Location:
Littlejohns Creek at Sonora Road is representative of the upper Farmington Basin, before the creek flows into the Farmington flood control basin. This site is located about three miles north of the town of Knight's Ferry at the Sonora Road Bridge. Samples were collected from near the base of the bridge.

Water Source:
Originating from the Sierra Nevada Foothills, Littlejohns Creek is, at this point, a natural ephemeral stream that flows through the Farmington Drainage Basin and small holding reservoirs, and then west to its confluence with French Camp Slough. Grazing is the predominant land use. This site was dry from April 1 to May 6 and again from October 7 to November 17.

Potential Contributors of Bacteria:
This site is located within a cattle grazing pasture. Septic seepage is also possible.

Historic *E. coli* concentration range: 35 – 323 MPN/100ml

Additional Information:

Appendix 2: Changes to this Monitoring Plan

There are no entries at this time