

**QUALITY ASSURANCE PROJECT PLAN FOR  
THE SACRAMENTO WATERSHED COORDINATED  
MONITORING PROGRAM**

February 2009

**FINAL**



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# 1.0 Approval Signatures

## Approvals:

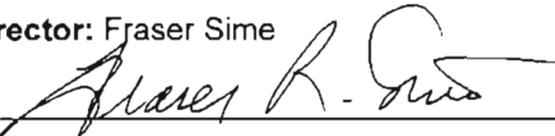
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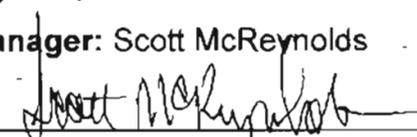
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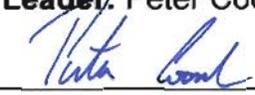
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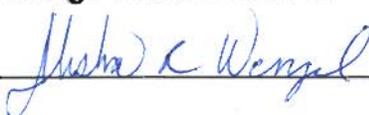
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### 3.0 Distribution List

All project staff at the Department of Water Resources (DWR) Northern District and all Central Valley Regional Water Quality Control Board (Regional Board) staff listed in the table below will receive copies of this Quality Assurance Project Plan (QAPP) and any approved revisions of the plan. The plan will be held at the DWR Northern District and will be available to any interested parties after final approval. To receive a copy a request can be made to the DWR Northern District Technical Leader.

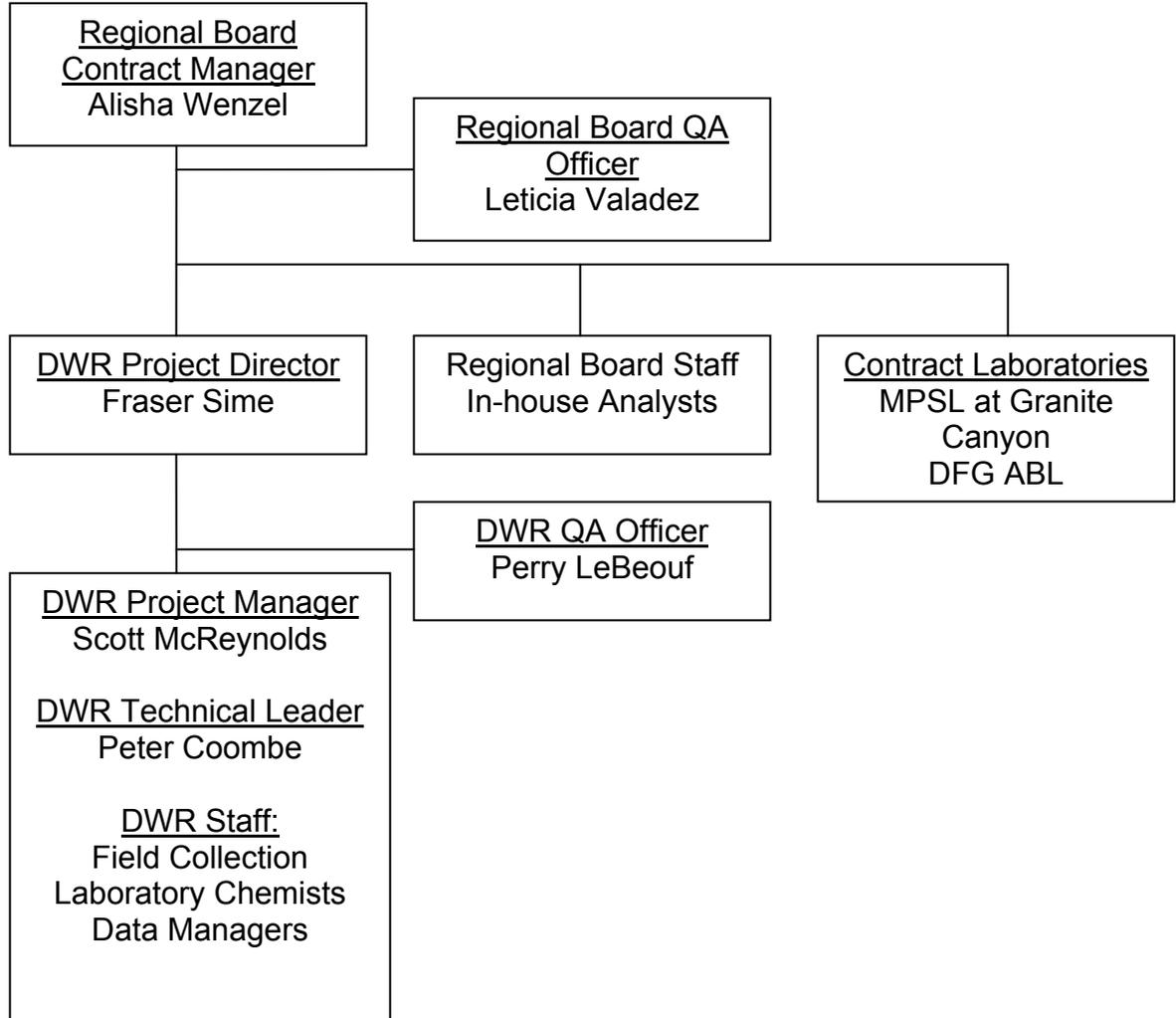
**Table 3.1 Distribution list**

<b>Title</b>	<b>Name and Affiliation</b>	<b>Telephone Number</b>	<b>QAPP Copy Number</b>
Contractor Project Director	Fraser Sime (DWR)	(530) 529-7374	1-1
Contractor Project Manager	Scott McReynolds (DWR)	(530) 529-7304	2-1
Contractor QA Officer	Perry Lebeouf (DWR)	(530) 529-7345	3-1
Contractor Technical Leader	Peter Coombe (DWR)	(530) 529-7377	4-1
Contract Manager	Alisha Wenzel (Regional Board)	(916) 464-4717	Original
QA Officer	Leticia Valadez (Regional Board)	(916) 464-4634	5-1
Technical Advisor	Dennis Heiman (Regional Board)	(530) 224-4851	6-1

### 4.0 Project-Task Organization

A coordinated monitoring program has been initiated by the Regional Board and DWR Northern District. The Regional Board has contracted the DWR Northern District to conduct all field activities, including the collection of field measurements. The DWR Northern District is responsible for laboratory analyses of inorganic and conventional analytes, with the exception of pathogens. These constituents will be analyzed at DWR Bryte Laboratory in West Sacramento. The Regional Board is responsible for the laboratory analyses of pathogens, water column toxicity, and bioassessment. Pathogen analyses will be conducted in house by the Regional Board. The Regional Board has contracted the UC Davis Marine Pollution Studies Laboratory (MPSL) at Granite Canyon to analyze water column toxicity and Department of Fish and Game (DFG) Aquatic Bioassessment Laboratory (ABL) to analyze bioassessment samples. Below is a list of all necessary Project Personnel roles to assure data quality and timely delivery of reliable and usable monitoring data.

- The **Project Director** will provide supervision of all tasks and people related to the project. The director will be responsible for various project audits at their discretion in order to ensure the Monitoring Plan and QAPP directives are met.

**Figure 4.1 Project organizational chart**

- The **Project Manager** will be responsible for all contract management tasks including; invoicing and reporting, oversight of project progress, and for collaboration with other agencies and stakeholders active in the watershed.
- The **Technical Leader** of this Project is the author of the QAPP and co-author of the Monitoring Plan and will be responsible for the scientific integrity of the data collection effort throughout the duration of the project. The Technical Leader is responsible for maintaining the official, approved quality assurance project plan. The Technical Leader is also responsible for technical dialogs with advisors and experts related to the project.
- The **Quality Assurance Officer** works independently from the Project Manager and Technical Leader and is responsible for the data meeting all quality objectives.

- CA DWR Field Data Collectors, Laboratory Personnel, and Data Managers will provide the workforce for all field collection activities, laboratory analyses, and data management functions of the project.

## 5.0 Problem Definition and Background

The California Department of Water Resources (DWR) has monitored water quality at sites in the Northern Sacramento River Watershed of California since its formation in 1956. Water quality data in the region had been collected previously by the Department's water quality predecessor, the Division of Water Resources of the Department of Public Works since the early 1900's.

Water quality data collected by DWR is used by a wide range of individuals, public and private agencies, and is ultimately the foundation on which these agencies base water planning and management decisions. This monitoring provides data and reports that are useful for determining long-term changes in water quality, as well as to determine if water quality parameters are meeting Basin Plan Objectives established by the California Regional Water Quality Control Boards.

Due to technological improvements and budgetary constraints, parameters assessed have varied over the course of monitoring throughout the northern Sacramento River Watershed. During much of the earlier monitoring at water quality stations, field measurements were taken and samples were submitted for laboratory analyses for mainly a few mineral parameters only when a general indicator such as conductivity was outside the range of previous measurements. This practice tended to skew the data to the extremes outside of normal measurements and provided data on only a very limited set of parameters.

Currently samples are collected on a more regular basis where timing plays a key role in providing representative data. Samples and field data are collected quarterly at defined water quality stations in the Northern Sacramento Watershed. DWR now has the ability to analyze a wide range of physical, chemical, and biological parameters with its own in-house lab, Bryte Laboratory, located in West Sacramento.

As the importance and scope of water quality regulations increase over time in the California, we will need to provide the State and its constituents with easily accessible, current, and defensible water quality data in the DWR's Water Data Library (WDL). The WDL database is managed by DWR which has streamlined the process of organizing and distributing water quality data. ([www.wdl.water.ca.gov](http://www.wdl.water.ca.gov)).

A coordinated monitoring program has been initiated between the Central Valley Regional Water Quality Control Board and the Northern District office of the Department of Water Resources to continue water quality data collection in the

Northern Sacramento Region. The new monitoring program has been designed to coincide with many of DWR's historical water quality stations. Several new stations which are of concern to the Regional Board have been added. The program will include 41 stations selected to meet the requirements of the Program Design Concept.

## 5.1 Decision Statement

This monitoring effort will address long term water quality issues and 303(d) reporting needs of the Northern Sacramento Watershed. The effort will provide critical water quality data needed to determine if stream and river conditions over time are getting generally better or worse. Two key questions will be addressed in this Monitoring Program:

1. What are the ambient water quality conditions and are current management activities protecting beneficial uses?
2. What does the evaluation of trends with respect to water quality and the biological communities tell us about the state of the watershed?

In order to answer these questions monitoring work will be performed at designated stations on a quarterly basis. Samples will be acquired using the guidelines of this QAPP document.

## 6.0 Project Task / Description

Sample events will be scheduled to represent the winter runoff, spring snowmelt, irrigation, and dry seasons. During the 2008-2009 fiscal year samples will be collected two times. During the 2009-10 and 2010-11 fiscal years, samples will be collected four times. Table 6.1 lists target completion dates for key products.

**Table 6.1 Project schedule**

<b>Product</b>	<b>Target Completion Date</b>
Field Sampling	Beginning March 2009 and repeating quarterly through June 2011
Access to Field and Laboratory Data	3 months sampling event*
Annual Data Summary Reports to Contract Manager	June 15 of each project year
Fact Sheets Summarizing Project Findings	
-Year 1 Data	June 2010
-Completed Project Data	September 2011

\*Toxicity and bioassessment data may take longer

Table 6.2 lists minimum constituents which will be measured at all sample sites. Information on the sampling schedule is in the Monitoring Plan.

**Table 6.2 Minimum constituents to be monitored**

<b>Conventional Analytes</b>	
<b>Physical Parameters:</b>	<b>Nutrients:</b>
Temperature- 15 Minute Continuous	Total Ammonia as Nitrogen
pH	Total Kjeldahl Nitrogen
Electrical Conductivity	Total Organic Nitrogen
Dissolved Oxygen	Dissolved Ammonia
Turbidity	Dissolved Nitrate + Nitrite
Total Suspended Solids	Dissolved Ortho-phosphate
<b>Minerals:</b>	Total Phosphorus
Alkalinity	Total Organic Carbon
Total Hardness	Dissolved Organic Carbon
<b>Inorganic Analytes</b>	
<b>Metals:</b>	
Total Arsenic	
Dissolved Arsenic	
Total Copper	
Dissolved Copper	

As funding permits, the Regional Board will analyze additional constituents listed in Table 6.3. Limited funding and logistics may require that fewer sites are sampled and/or that sites are sampled less frequently for these constituents. The sites are prioritized in the Monitoring Plan. Sample sites and coordinates are listed in Table 6.4.

**Table 6.3 Optional constituents to be monitored**

<b>Pathogens</b>
Total Coliform
E. Coli
<b>Toxicity</b>
96-Hour Ceriodaphnia dubia
96-Hour Hyalella azteca
<b>Bioassessment</b>
Benthic Macroinvertebrates

## 6.1 Constraints

While making the best effort to collect data project constraints include:

- Intermittent streams and rivers can not be sampled certain times of year when water is not present.
- Flow data may be unavailable at some locations, and flow data gaps may exist when using data from other agencies.
- Inclement weather- snow or flooding may cause station to be inaccessible or unsafe to sample.
- Vandalism or theft of in-situ temperature loggers will result in loss of continuous data.

In the event one of these project constraints or unforeseen constraints occur the Project Manager will be notified immediately; the problem will be addressed and recorded in the project notes.

## 6.2 Study Site Description

The Sacramento River Watershed is approximately 27,000-square-miles and covers 17 percent of California's land area. The watershed consists of a major valley (Sacramento Valley) bounded by several mountain ranges: the Coast Range to the west, the Cascade and Klamath Ranges to the north and the Sierra Nevada Mountains to the east. The watershed drains from northern California from the Oregon border to the Delta, where it joins the San Joaquin River and San Francisco Bay.

The Sacramento River is the largest river in the watershed, with an annual average stream flow volume of 22 million acre-feet. The river is also the longest in the State, extending over 327 miles. Major tributaries to the Sacramento River include the Feather, Yuba, American, and Pit Rivers. The main stem of the Sacramento River and most of its major tributaries have been developed for water storage, flood control, and power generation.

As California's most productive watershed more than 2 million acres of irrigated agriculture are sustained in the watershed. In the Sacramento Valley, the river is a main water source for irrigating the valley's crops including: rice, orchard crops, vegetables and grains. The Sacramento River is also an important source of drinking water for people in the watershed, and for millions of Californians south of the Delta, including those living in Southern California.

The Sacramento Valley and its tributaries provide important habitat for many varieties of fish, birds and terrestrial species. The river corridor is a critical part of the Pacific Flyway, one of four main North American bird migration routes between the Arctic and Central and South America. The river and its tributaries are also important conduits for salmon migrating between spawning grounds.

**Table 6.4 Sample sites description and coordinates**

Station #	Station Name	DWR Station Number	LATITUDE	LONGITUDE
1	North Fork Pit River at Alturas	A1210000	41.48198393	-120.5385893
2	South Fork Pit River near Alturas	A1415000	41.46114992	-120.5499788
3	Pit River near Canby	A1168000	41.40009903	-120.9349596
4	Fall River at Glenburn	A1723000	41.08848464	-121.4931669
5	Pit River at Pittville	A1127000	41.04555265	-121.3317534
6	McCloud River above Shasta Lake	A2215000	40.94034040	-122.2452817
7	Sacramento River at Delta	A2130000	40.93828017	-122.4169114
8	Pit River near Montgomery Creek	A1102000	40.84027902	-122.0163045
9	Cow Creek near Millville	A4811000	40.53210129	-122.2384127
10	Clear Creek near mouth near Redding	A3601000	40.50922234	-122.3799984
11	Churn Creek near Anderson	A0079000	40.48031800	-122.3067090
12	Stillwater Creek near Anderson	A0079500	40.47981100	-122.2590940
13	Bear Creek near Anderson	A0407000	40.44772800	-122.1966070
14	Sacramento River at Balls Ferry	A0281500	40.41761741	-122.1933392
15	Battle Creek at Jelly's Ferry Road Bridge	A4708000	40.39197613	-122.1785906
16	Cottonwood Creek at Cottonwood	A0352050	40.37636267	-122.2824620
17	Paynes Creek near Red Bluff	A4605001	40.31462347	-122.0712628
18	Sacramento River at Bend Bridge	A0278500	40.26363967	-122.2231135
19	Sacramento River below Red Bluff	A0275890	40.15336978	-122.1993204
20	Red Bank Creek at Highway 99W near Red Bluff	A0025800	40.14158373	-122.2121252
21	Antelope Creek near mouth near Red Bluff	A0452050	40.10900306	-122.1102875
22	Elder Creek at Gerber	A0332000	40.05086555	-122.1666056
23	Mill Creek near mouth near Los Molinos	A0442050	40.04294563	-122.1002747
24	Thomes Creek at Hall Road	A0321800	39.97557881	-122.2233350
25	Deer Creek at Hwy 99E near Vina	A0432101	39.94680910	-122.0533036
26	Sacramento River at Vina bridge	A0270000	39.90881935	-122.0918883
27	Sacramento River at Hamilton City	A0263000	39.75110185	-121.9979773
28	Big Chico Creek at Chico	A0425000	39.72716425	-121.8630784
29	Butte Creek below Western Canal Siphon	A0416000	39.72573570	-121.7088705
30	Stony Creek at The Nature Conservancy	A0290000	39.69427000	-121.9896040
31	Honcut Creek at Highway 70	A0571001	39.30929300	-121.5954400
32	Sacramento River at Colusa	A0242000	39.21414646	-122.0003096
33	Butte Slough near Meridian	A0297200	39.17007343	-121.9004622
34	Yuba River at Marysville	A6101050	39.12862241	-121.5970337
35	Bear River near mouth	A6501050	38.95135045	-121.5610630
36	Sacramento River above CBD near Knights Landing	A0223002	38.80502695	-121.7237114
37	Colusa Basin Drain near Knights Landing	A0294710	38.79923112	-121.7250358
38	Feather River near Verona	A5101050	38.79251941	-121.6275467
39	Sutter Bypass at RD-1500 Powerplant	A0292700	38.78455606	-121.6543868
40	Sacramento River at Verona	A0215000	38.77965008	-121.6037306
41	Sacramento River below Knights Landing	A0219501	38.76064223	-121.6782414

## 7.0 Data Quality Objectives and Acceptability Criteria for Measurement Data

There are two types of quality objectives. Measurement Quality Objectives (MQOs) relate to the quality of the measurement itself (e.g. accuracy or precision). The Data Quality Objectives (DQOs) relate to the entire data set its ability to answer a study question (e.g. completeness or representativeness).

DQOs for the proposed project will be based on MQOs for the analytes listed in Tables 7.1 through 7.2. All monitoring data obtained will be SWAMP-comparable.

The MQOs for field measurements are listed in Table 7.1. Table 7.2 lists the MQOs for laboratory analyses. Because the method for pathogen analysis in this study does not require filtering, the MQOs listed in Table 7.2 differ from those listed in the SWAMP QAPrP. Details on the specific pathogens method and quality assurance procedures can be found in Appendix E, and were reviewed and approved by SWAMP in August, 2007.

Toxicity analyses will comply with all SWAMP protocols. Additional MQOs for data acceptability, test conditions, water chemistry, and sample handling are listed in Appendix A of the SWAMP QAPrP.

MQOs for the equipment used to measure water temperature, dissolved oxygen, conductivity, pH, and turbidity in this project are detailed in Table 7.1. With proper calibration, the range, accuracy, and resolution of each instrument will meet the manufacturer's specifications and meet the MQOs for individual parameters. These parameters are:

- **Accuracy:** A measure of confidence that the data collected in the field and in the laboratory reflect the true value of a given parameter.
- **Range:** Expected values of instruments used to obtain a range of water quality parameters.
- **Resolution:** A measure of how repeatable the data collected is between samples. It determines the consistency of repeated samples that are tested.

Adherence to the three data quality objectives of accuracy, range, and resolution is essential to the QA/QC objectives of the project; these objectives will be monitored by the QA officer to produce viable data of known and accepted quality.

Acceptability criteria for previously collection information are described in Element 18.

## 7.1 Representativeness and Bias

Representativeness describes how relevant the data are to the actual environmental condition. An important role of the Technical Advisory Personnel is required to actively participate in sample design development, training, and assessment of representativeness of the resulting data. Bias or lack of representativeness can occur if:

- Samples are taken in a stream reach that fails to describe the area of interest,
- Samples are collected in an unusual location, for example: a stagnant pool instead of the flowing portion of the creek,
- Samples are not preserved, stored, or analyzed appropriately, causing conditions in the sample to change, for example: bacteria samples not being analyzed within the 24 hour holding time from collection.

Representativeness and resulting bias will be controlled by appropriate sample site selection and collection as described in this document, the Monitoring Plan, and the SWAMP QAPrP, and by strictly adhering to all aspects of these documents and method SOPs (Appendix A and B).

## 7.2 Completeness

Completeness is a measure of the amount of valid data obtained from a measurement system as compared to the expected amount – usually expressed as a percentage. Completeness will affect our ability to assess ambient water quality conditions at all sites and to interpret water quality trends over time. This project will comply with SWAMP's completeness MQO of 90%.

## 7.3 Action Limits

An Action Limit is a measurement threshold at which a decision is made to take management action. The primary purposes of this study are to assess beneficial use protection and water quality trends; no management actions will be taken as part of this study. However, where potential concerns are detected in the assessment, the information will be provided to the appropriate Regional Board program for follow-up. Additionally, all data collected in this study will be assessed in the 2010 or 2012 cycle of the Clean Water Act Section 305(b) and 303(d) Integrated Report. Exceedences will be determined by the criteria in *The Water Quality Control Plan for the Sacramento River Basin and the San Joaquin River Basin* and the listing criteria for the current Integrated Report cycle.

**Table 7.1 Measurement quality objectives for field measurements**

Parameter	Instrument	Units	Range	Detection Limit	Resolution	Accuracy	Completeness	Calibration	Calibration Interval
Temperature	YSI 85	°C	-5 to 65	0.1	0.1	± 0.1	90%	not required	not required
Temperature	Onset HOBO Logger	°C	-20 to 70	0.2	0.02	± 0.2	90%	not required	not required
Dissolved Oxygen	YSI 85	mg/l	0 to 20	0.1	0.01	± 0.3	90%	saturated air	each station
Specific Conductivity	YSI 85	µS/cm	0 to 499.9	1	1	± 0.5	90%	1000 uS/cm standard	one month
pH	Hach sension1	pH Units	-2.00 to 19.99	0.1	0.01	± 0.2	90%	buffer solutions pH 4,7, and 10	weekly
Turbidity	Hach Model 2100P	NTU	0 to 1,000	0.1	0.01	± 0.2	90%	StabiCal 2100P Calibration Set	three months

**Table 7.2 Measurement quality objectives for laboratory analyses**

<b>Quality Control</b>	<b>Frequency of Analysis</b>	<b>Measurement Quality Objective</b>
<b>Conventional Analytes</b>		
Calibration Standard	Per analytical method or manufacturer's specifications	Per analytical method or manufacturer's specifications
Continuing Calibration Verification	Per 10 analytical runs	80-120% recovery
Laboratory Blank	Per 20 samples or per analytical batch, whichever is more frequent	<RL for target analyte
Reference Material	Per 20 samples or per analytical batch, whichever is more frequent	80-120% recovery
Matrix Spike	Per 20 samples or per analytical batch, whichever is more frequent	80-120% recovery
Matrix Spike Duplicate	Per 20 samples or per analytical batch, whichever is more frequent	80-120% recovery RPD<25% for duplicates
Laboratory Duplicate	Per 20 samples or per analytical batch, whichever is more frequent	RPD<25% (n/a if native concentration of either sample is <RL)
Internal Standard	Accompanying every analytical run as method appropriate	Per method
Field Duplicate	5% of project sample count	RPD<25% (n/a if native concentration of either sample <RL)
Field Blank, Equipment Blank	One per field run or per method	<RL for target analyte
<b>Conventional Analytes - Solids</b>		
Calibration Standard	Per analytical method or manufacturer's specifications	Per analytical method or manufacturer's specifications
Laboratory Blank	Per 20 samples or per analytical batch, whichever is more frequent	<RL for target analyte
Laboratory Duplicate	Per 20 samples or per analytical batch, whichever is more frequent	RPD<25% (n/a if native concentration of either sample <RL)
Field Duplicate	5% of project sample count	RPD<25% (n/a if native concentration of either sample <RL)

Quality Control	Frequency of Analysis	Measurement Quality Objective
Field Blank, Equipment Blank	One per field run or per method	<RL for target analyte
<b>Conventional Analytes - Pathogens</b>		
Calibration	Temperature recorded at beginning and end of incubation period. Tested with a NIST Certified or NIST Traceable thermometer semiannually.	35°C +/- 0.5°C
Laboratory Blank	Per analytical batch	< RL for target analyte
Laboratory Duplicate	Per 10 samples or per analytical batch, whichever is more frequent	RPD<25% (n/a if native concentration of either sample<RL)
Comparison Counts	Monthly	>90% agreement
Colilert Media Verification	Per lot	Per kit instructions
Field Duplicate	Per 10 samples or per analytical batch, whichever is more frequent	RPD<25% (n/a if native concentration of either sample<RL)
Field Blank	One per field run or per method	<RL for target analyte
<b>Inorganic Analytes</b>		
Calibration Standard	Per analytical method or manufacturer's specifications	Per analytical method or manufacturer's specifications
Continuing Calibration Verification	Per 10 analytical runs	80-120% recovery
Laboratory Blank	Per 20 samples or per analytical batch, whichever is more frequent	<RL for target analyte
Reference Material	Per 20 samples or per analytical batch, whichever is more frequent	75-125% recovery
Matrix Spike	Per 20 samples or per analytical batch, whichever is more frequent	75-125% recovery
Matrix Spike Duplicate	Per 20 samples or per analytical batch, whichever is more frequent	75-125% recovery RPD<25% for duplicates
Laboratory Duplicate	Per 20 samples or per analytical batch, whichever is more frequent	RPD<25% (n/a if native concentration of either sample is <RL)
Internal Standard	Accompanying every analytical run as method appropriate	Per method
Field Duplicate	5% of project sample count	RPD<25% (n/a if native concentration of

Quality Control	Frequency of Analysis	Measurement Quality Objective
Field Blank, Equipment Blank	One per field run or per method	either sample<RL) <RL for target analyte
<b>Toxicity Testing</b>		
Laboratory Control Water	Laboratory Control Water consistent with Section 7 of the appropriate EPA method must be tested with each analytical batch	Laboratory Control Water must meet all test acceptability criteria for the species of interest
Conductivity Control Water	A conductivity control must be tested with each analytical batch when the conductivity of any freshwater ambient sample approaches the species' tolerance for conductivity per method	Follow EPA guidance on interpreting data
Reference Toxicant Tests	Reference Toxicant Tests must be conducted monthly for species that are raised within a laboratory. Reference Toxicant Test must be conducted per analytical batch for species from commercial supplier settings.	Last plotted data point must be within 2 SD of the cumulative mean (n=20)
Field Duplicate	5% of project sample count	RPD<25% (n/a if native concentration of either sample<RL)
Field Blank, Equipment Blank	One per field run or per method	<RL for target analyte
<b>Bioassessment</b>		
Taxonomy Verification	20% of samples	
Field Duplicate	10% of project sample count	

## **8.0 Special Training Requirements/Safety**

Specialized training required for this project is an eight hour DWR water quality basics training course. This will be required for all the leaders of field crews and for other crew members. Course participants will receive a completion certificate that will be maintained with periodic updates, for this or other projects that require this kind of specialized training.

Field operators will be required to review the SWAMP training manuals on field measurements, water, sediment, and tissue sampling techniques.

Technical leaders will be required to take a data validation class, a course on Data Quality Objectives (DQOs) and Measurement Quality Objectives (MQOs), and a study design development course, if they have not previously had this training.

### **8.1 Training and Certification Documents**

If additional funds become available and aquatic macroinvertebrate sampling is initiated, a valid CA DFG scientific collecting permit will be required. DWR also requires anyone the works in the field to attend an environmental responsibility course.

### **8.2 Training Personnel**

The Project Manager and the QA Officer will ensure all field collection personnel are appropriately trained in field collection techniques, protocols, and the use of equipment in the field.

## **9.0 Documentation and Records**

Documents and records generated from this project will be organized and stored in compliance with this QAPP. This will allow for future retrieval, and to specify the location and holding times of all records.

### **9.01 Data Records**

All field data gathered by this project will be recorded on weather resistant SWAMP compliant field data entry forms. Field data sheets will be scanned to .PDF format after each sampling run and stored on the Northern District servers indefinitely.

Documentation for analytical data will be kept on file at the laboratory and will be available for review during any external audits by the SWAMP QA Program. The laboratory records will include the analyst's comments on the condition of the

sample and progress of the analysis, raw data, instrument printouts, and results of calibration and QC checks.

## 9.1 QAPP Updates and Distribution

The Technical Leader will be responsible for developing, maintaining, and updating the Quality Assurance Project Plan (QAPP). All original QAPPs will be held at DWR Northern District. This QAPP and its revisions will be distributed to all parties involved with the project. Copies will also be sent to the Bryte Laboratory manager for internal distribution. Upon revision, the replaced QAPPs will be discarded.

## 9.2 Data Archival

Hard copy SWAMP field sheets will be stored in the DWR Northern District's Water Quality and Biology library. After being scanned to a PDF format field sheets will be stored in ring binders for at least 10 years. All PDF files will be stored on the DWR Northern District's servers, which are backed up on a daily basis. PDF files will be stored indefinitely on DWR Northern District's servers or until they are incorporated into the WDL.

### 9.2.1 Sample Collection Records

Hard copy SWAMP field sheets which outline what samples were collected at each sampling event will be stored in the DWR Northern District's Water Quality and Biology library. After being scanned to a PDF format, field sheets will be stored in ring binders for at least 10 years. All PDF files will be stored on the DWR Northern District's servers which are backed up on a daily basis. PDF files will be stored indefinitely on DWR Northern District's servers or until they are incorporated into the WDL.

### 9.2.2 Field Records

Hard copy SWAMP field sheets containing field observations and field data entries will be stored in the DWR Northern District's Water Quality and Biology library. After being scanned to a PDF format, field sheets will be stored in ring binders for at least 10 years. All PDF files will be stored on the DWR Northern District's servers which are backed up on a daily basis. PDF files will be stored indefinitely on DWR Northern District's servers or until they are incorporated into the WDL.

### 9.2.3 Analytical Record Chain of Custody

Chain of Custody forms will be completed for samples received by the laboratory which will follow the samples throughout the analysis and data management

processes. Copies of chain of custody forms will be archived by the labs and accompany the hard copy analysis reports.

#### 9.2.4 Assessment Records

Inspection or assessment reports, corrective action reports, interim progress reports, final reports, evaluation summaries, and copies of presentations made during and after the project will all be stored digitally in a dedicated directory on the DWR Northern District servers. These documents will be organized and kept up-to-date by the Project Manager.

Annually, the Project Manager will prepare a brief report summarizing the data analyzed to date. This report will be submitted to the Contract Manager. The Contract Manager will prepare Fact Sheets summarizing the project findings. All assessment reports will be stored digitally in a dedicated directory on the Regional Board server. Fact Sheets will be made available to the public on the Regional Board website. More information on project assessment can be found in Element 20.

#### 9.3 Records Responsibility

The DWR Project Manager will oversee the maintenance of all records and will arbitrate any issues related to records retention. The Bryte Laboratory Director will be responsible for maintaining and retaining all analytical records, including sample receipt records, chain-of-custody forms, and printed and electronic data from laboratory analyses.

#### 9.4 Archive Location and Duration

All records generated by this project will be stored at Northern District DWR. All lab records will also be stored at Bryte Laboratory in West Sacramento. All records will be forwarded to the State Board contract manager upon project completion. Copies of the records will be maintained at Northern District DWR and Bryte Laboratory in West Sacramento for five years following project completion. Data files will be maintained indefinitely without discarding.

#### 9.5 Records Responsibility

DWR's Bryte Laboratory will archive all analytical records generated for this project. The DWR Project Manager or other assigned DWR staff will be responsible for archiving all other records.

#### 9.6 Electronic Records Responsibility

All field operation records will be entered into electronic formats and maintained in a dedicated directory at [www.wdl.water.ca.gov](http://www.wdl.water.ca.gov). The lab will have a dedicated directory for the project in their data repository. They will deliver data in electronic format to the WDL, and the WDL administrators Eric Senter and Bruce Agee will be responsible for storage, backup and safekeeping of these records.

## 10.0 Sampling Process Design

To address the decision statement in section 5.1 a Program Design Concept was created to address the stated questions.

### 10.1 Program Design Concept

The Program Design Concept for this project by which stations were selected is based on the following criteria:

1. At least one monitoring station on all significant tributaries to the Sacramento River (generally near the mouth) and at selected mainstem Sacramento River locations.
2. To the extent possible, sites are selected with previous monitoring history (including flow gaging).
3. Sites generally coincide with an established watershed management program and or restoration projects within the watershed.
4. Select parameters that are repeatable, not overly burdensome to sample, and are the most information rich with regard to evaluating water quality/beneficial use protection.
5. Focus of the program will be on evaluation of long-term trends, with respect to water quality and the biological community.

#### 10.1.1 Station Selection Rationale

41 stations were selected using the Program Design Concept to adequately cover the Northern Sacramento River Watershed. Stations are listed from the northernmost to the southernmost with rationale for selection:

1. North Fork Pit River at Alturas
  - 303d listed for: nutrients, organic enrichment / low dissolved oxygen, and temperature
  - Impacted by agriculture, agriculture-grazing
  - Water quality data has been collected from this site by DWR since 1959
2. South Fork Pit River near Alturas
  - 303d listed for: nutrients, organic enrichment / low dissolved oxygen, and temperature
  - Impacted by agriculture, agriculture-grazing

- Water quality data has been collected from this site by DWR since 1962
3. Pit River near Canby
    - Characterizes upper portion of the Pit River system
    - Historic flow data and active gage site
    - Historic water quality data set
    - 303d listed for: temperature, dissolved oxygen, and nutrients
    - Water quality data has been collected at this site by DWR since 1951
    - USGS gaging station has been recording flow since 1904
  4. Fall River at Glenburn
    - Fall River is nationally known as a Blue Ribbon trout stream – high public demand for protection
    - Located within river reach of concern with easy year round access
    - Historic water quality data set
    - 303d listed for: sedimentation/siltation
    - Impacted by agriculture-grazing, silviculture, road construction
  5. Pit River at Pittville
    - Characterizes lower portion of the Pit River system
    - Historic flow data (no gage station but flow can be calculated from PG&E records)
    - 303d listed for: nutrients, organic enrichment / low dissolved oxygen, and temperature
    - Pit River is heavily monitored by PG&E downstream to Shasta Lake
    - Integrator site for SWAMP Statewide Stream Contaminant Trend Monitoring
  6. McCloud River above Shasta Lake
    - Major Northern California river system, near pristine condition
    - High public demand for protection
    - Historic flow data and active gage site
    - Water quality data has been collected at this site by DWR since 1951
    - USGS gaging station has been recording flow since 1945
  7. Sacramento River at Delta
    - Characterizes upper Sacramento River water quality above Shasta Lake
    - Historic flow data and active gage site
    - Historic water quality data set
    - High use watercourse for contact recreation and trout fishing
    - Water quality data has been collected at this site by DWR since 1951
    - USGS gaging station has been recording flow since 1944
  8. Pit River near Montgomery Creek

- 303d listed for: temperature, dissolved oxygen, and nutrients
  - Water quality data has been collected at this site by DWR since 1990
  - USGS has been recording flow since 1944
9. Cow Creek at USGS Gage
- Major Northern Sacramento Valley tributary (1.6 million acres)
  - Significant aquatic resources (trout, steelhead, salmon)
  - Historic and active gage site
  - Active watershed improvement programs
  - Mix of land use including: timber, grazing, rural residential
  - Heavy use for contact recreation
10. Clear Creek near mouth near Redding
- Major agency investments in restoration for anadromous fish
  - Historic and active gage site
  - Urban runoff impacts from the City of Redding
  - Water quality data has been collected from this site by DWR since 1993
11. Churn Creek near Anderson
- Recently completed Watershed Assessment and Watershed Management Plan
  - Active watershed improvement program
  - Anticipate future stream improvement projects
  - Major Redding urban area watershed with potential water quality issues
12. Stillwater Creek near Anderson
- Recently completed Watershed Assessment and Watershed Management Plan
  - Active watershed improvement program
  - Anticipate future stream improvement projects
  - Major Redding urban area watershed with potential water quality issues
13. Bear Creek near Anderson
- Active locally directed watershed management program
  - Significant salmon and steelhead tributary to the Sacramento River
  - Potential water quality issues from irrigation agriculture and rural residential development
14. Sacramento River at Balls Ferry
- 303d listed for: unknown toxicity
  - Historic and active gage site
  - Historic water quality data set

- Integrator site for SWAMP Statewide Stream Contaminant Trend Monitoring
- 15. Battle Creek at Jelly's Ferry Road Bridge
  - Major agency investments in restoration for anadromous fish
  - Water quality concerns related to the operation of the Coleman Fish Hatchery
  - Significant aquatic resources (anadromous fish)
- 16. Cottonwood Creek at Cottonwood
  - Largest western watershed tributary
  - Significant aquatic resources (trout, steelhead, salmon)
  - Historic and active gage site
  - Active watershed improvement programs
  - Heavy use for contact recreation
- 17. Paynes Creek near mouth
  - Department of Fish and Game investments in restoration for anadromous fish
  - Water quality data has been collected from at site by DWR since 1958
  - Watershed Assessment and Watershed Management Plan currently under development
- 18. Sacramento River at Bend Bridge
  - Historic and active gage site
  - Historic water quality data set
  - Water quality data has been collected from this site by DWR since 1961
- 19. Sacramento River downstream from Red Bluff Diversion
  - 303d listed for: unknown toxicity
  - Historic water quality data collected by DWR
- 20. Red Bank Creek at Hwy 99 near Red Bluff
  - Water quality data has been collected from this site by DWR since 1959
  - Drainage basin of about 73,000 acres
- 21. Antelope Creek near mouth near Red Bluff
  - Water quality data has been collected at this site by DWR since 1955
  - Anadromous fish concerns
- 22. Elder Creek near mouth
  - 303d listed for: Chlorpyrifos, Diazinon
  - Impacted by urban runoff / storm sewers and agriculture

- Water Quality data has been collected at this site by DWR since 1955
23. Mill Creek near mouth near Los Molinos
- Major eastside tributary with spring run salmon
  - Historic and active gage site
  - Concern with metals from Lassen geology, chronically turbid
  - Water quality data has been collected from this site by DWR since 1952
  - USGS has been recording flow since 1909
24. Thomes Creek at Hall Road
- Major Westside tributary to the Sacramento River
  - Gravel extraction activities in watershed
  -
25. Deer Creek at Hwy 99E near Vina
- Major eastside tributary with spring run salmon
  - Historic and active gage site
  - 1993-1994 DWR intensive water quality study
  - Active watershed improvement program
26. Sacramento River at Vina Bridge
- 303d listed for: unknown toxicity
  - Historical DWR water quality site
27. Sacramento River at Hamilton City
- Strategic main stem site as the river transitions into irrigated agriculture land use
  - Basin plan objectives associated with this site (metals, dissolved oxygen, and temperature)
  - Water quality data has been collected from this site by DWR since 1951
  - Integrator site for SWAMP Statewide Stream Contaminant Trend Monitoring
  - 303d listed for: unknown toxicity, mercury (from Hamilton City downstream to Knights Landing)
28. Big Chico Creek at Chico
- Significant eastside tributary with spring run salmon
  - Urban runoff impacts from the City of Chico
  - Historic and active gage site
  - Active watershed program with concerns about urban runoff
  - Water quality data has been collected at this site by DWR since 1956
  - Integrator site for SWAMP Statewide Stream Contaminant Trend Monitoring

29. Butte Creek downstream from Western Canal Siphon
  - Major agency investments in restoration for anadromous fish
  - Major eastside tributary (510,000 acres) with spring run salmon
  - Gravel and tree encroachment issues
  - Concerns with habitat and temperature above Chico, urban runoff from Chico, and irrigated agriculture below Chico
  - Active watershed improvement programs (Butte Creek Watershed Conservancy, Butte County RCD, Friends of Butte Creek, and the Butte Environmental Counsel)
  - Heavy use for contact recreation
  
30. Stony Creek near mouth (USGS gage)
  - Second largest Westside watershed
  - Major local concerns with watershed condition (erosion and invasive species)
  - Active watershed improvement program
  - Historic and active gage site
  - Gravel extraction activities in watershed
  
31. Honcut Creek at Hwy 70
  - Potential salmonid spawning and rearing habitat enhancement projects
  - Watershed Assessment currently under development and anticipate future development of a Watershed Management Plan
  - Likely to see future watershed improvement work
  
32. Sacramento River at Colusa
  - Critical main stem station location
  - Historic and active gage site
  - Water Quality data has been collected from this site by DWR since 1955
  - USGS gaging station has recorded flow since 1921
  - Integrator site for SWAMP Statewide Stream Contaminant Trend Monitoring
  
33. Butte Slough near Meridian
  - Integrator site for SWAMP Statewide Stream Contaminant Trend Monitoring
  - 303d listed for: Diazinon
  - Impacted by agricultural activities
  - Prime migration route and rearing area for Butte Creek spring run salmon
  
34. Yuba River at Marysville
  - Major eastside tributary with spring run salmon
  - Historic and active gage site

- 2002-2004 DWR intensive water quality study
  - Integrator site for SWAMP Statewide Stream Contaminant Trend Monitoring
35. Bear River near Mouth
- 303d listed for: Diazinon
  - Agriculture impacts
  - Integrator site for SWAMP Statewide Stream Contaminant Trend Monitoring
36. Sacramento River above CBD near Knights Landing
- One mile upstream from the mouth of the Colusa Basin Drain
  - Water quality data collected by DWR since 1960
37. Colusa Basin Drain at Knights Landing
- The single largest source of agricultural return flows to the Sacramento River
  - 303d listed for: Azinphos-methyl, Carbofuran/Furadan, Diazinon, Malathion, Methyl Parathion, Molinate/Odram
  - Water quality data collected by DWR since 1957
  - Runoff and agricultural return flows from about 1 million acres of watershed
  - Integrator site for SWAMP Statewide Stream Contaminant Trend Monitoring
38. Feather River near Verona
- 303d listed for: Chlorpyrifos, Group A Pesticides, Mercury, Unknown Toxicity
  - Impacted by agriculture, urban runoff/storm sewers, resource extraction (abandoned mines)
  - Upstream from the main stem Sacramento River near the mouth
  - Integrator site for SWAMP Statewide Stream Contaminant Trend Monitoring
39. Sutter Bypass at RD-1500 Power plant
- Integrator site for SWAMP Statewide Stream Contaminant Trend Monitoring
  - Prime migration route and rearing area for Butte Creek spring run salmon
40. Sacramento River at Verona
- 303d listed for unknown toxicity, mercury
  - Historical water quality data
41. Sacramento River below Knights Landing
- 303d listed for unknown toxicity, mercury

- Water quality data has been collected from this site by DWR since 1960

## 10.2 Station Type

All stations are on rivers or streams. Samples will not be collected when water body is clearly not flowing or dry. A no-sample event will be recorded on the field data sheet.

## 10.3 Station Selection Intent

Station selection criteria include the following:

- Source identification – to identify the source of a given constituent within the Sacramento River network and/or related to land use activities.
- Impact assessment - monitoring to determine whether an impact to the ecosystem has occurred through watershed management and or restoration activities.
- Water quality criteria compliance monitoring - monitoring for the purpose of comparison with water quality benchmarks to determine if criteria are meeting state and federal standards.
- Characterization of spatial variability - measurements to determine how the values of selected water quality parameters change when you move to lower order streams, or how concentrations of selected analytes change within the Sacramento Watershed.
- Fixed station for long term monitoring - monitoring at the same location each time to create a long-term record of conditions at each selected location.

## 10.4 Timing Selection Intent

The purpose behind the timing of the monitoring at the selected stations includes the following reasons:

- Routine monitoring – Repeated quarterly monitoring on a year to year basis to provide long-term data.
- Snapshot - One-time monitoring of multiple stations. This provides a "snapshot" in time of the conditions at the selected stations each season or quarter of the year.
- Pre-monitoring – Many of the chosen sampling locations have historical water quality data collection; therefore, basic conditions and / or locations are well characterized.

## 10.5 Reach Selection Design

The reach selection design is a knowledge-based approach where selection is:

- Directed (to the environment) - A deterministic approach in which locations are selected deliberately based on knowledge of their attributes of interest as related to the environmental site being monitored. Additional documentation can be found in the Station Selection Rational Section 10.1.1.

## 10.6 Station Selection Design

The station selection design is a knowledge-based and systematic approach where selection is:

- Directed (to the environment) - A deterministic approach in which locations are selected deliberately based on knowledge of their attributes of interest as related to the environmental site being monitored.
- Systematic - A deterministic approach in which station locations are selected deliberately due to the existence of a previously established water quality location.

Additional documentation can be found in the Station Selection Rational Section 10.1.1.

## 10.7 Seasonal Sampling Design

- Systematic - A deterministic approach where temporal sampling points are selected deliberately on a seasonal or quarterly basis. Sample events will be scheduled to represent the winter runoff, spring snowmelt, irrigation, and dry seasons.

## 10.8 Diurnal Sampling Design

- Non-deliberate - Points are selected anecdotally (when you happen to be there), or opportunistically (additional stations may be sampled if there is more time in a given sampling day). Samples will typically be sampled on or near the same time at each station in each sampling run; however, if unforeseen circumstances arise, samples and measurements may be collected at different times.

## 10.9 Field Measurements to Support Lab Data

Interpretation of laboratory data often requires knowledge of the ambient conditions at the time samples were collected; so, DWR field crews will conduct field measurements at the same time and the same place when water samples are collected for analysis at the lab.

The DWR field crew will measure Dissolved Oxygen, Temperature, Specific Conductivity, pH, and Turbidity at the same spot and the same time where/when they collect grab water samples for lab analyses. The crew will also record site conditions by completing the SWAMP Field Data Sheets at each station visit.

### 10.10 Number of Site Visits

Each site will be visited every quarter for the duration of the contract, each visit will include three basic types of field activities (observations, field measurements, and sample collection). Additional information and tables are presented in the Monitoring Plan.

### 10.11 Sampling Frequency

Sampling will occur 4 times per year, with the exception of the HOBO temperature loggers which will be recording continuous temperature every 15 minutes for the duration of the project. Additional information and tables are presented in the Monitoring Plan.

### 10.12 Sampling Interval

The sampling interval for this project is 3 months, where each site occupation will occur.

### 10.13 Continuous Monitoring

Continuous monitoring data loggers will be employed to collect water temperature data for the project. The following list gives details about the temperature monitoring portion of the project:

- Hobo Temp Loggers will be installed at each of the 41 station locations.
- Hobo Temp Loggers are already deployed at existing stations and will be deployed at new stations effective of the November 2008 sampling run.
- Each Station will have 1 Hobo Temp Logger deployed.
- Deployment duration will last for the length of the project
- 15 minute measurement intervals will be used for the project.
- Each logger will be secured in an inconspicuous location with stainless steel cables and hardware.
- Data will be downloaded onto a Hobo shuttle at every station occupation event.

### 10.14 Sampling Work Statement

DWR field crews will:

- Prepare field equipment and label appropriate bottles for water collection.

- Two crews will visit 41 Stations at each event.
- Fill sample bottles according to EPA and SWAMP protocols.
- Measure: DO, temperature, specific conductivity, pH, and turbidity.
- Fill out SWAMP data sheets recording field data and site observations
- Download Hobo temperature logger data onto Hobo Shuttle

### 10.15 Sources of Uncertainty

There are major sources of uncertainty in environmental monitoring that are independent of each other. These sources are below as follows:

- 1. Measurement error- combines all sources of error related to the entire sampling and analysis process, i.e., to the Measurement System. The actions you will take to assure sample integrity and to reduce measurement error is described in other Elements of this QAPP.
- 2. Natural (inherent) - variability occurs in any environment you will monitor, and is often much wider than the measurement error. Natural variability includes seasonal changes in flow levels and source waters. One of the goals of this study is to characterize seasonal and interannual trends in water quality within the study area.
- 3. Sample misrepresentation- happens at the level of an individual sample or field measurement (e.g., collecting a water sample at a backwater pool that does not represent the bulk of the flow) and will be minimized by using SWAMP compliant training and sampling methods. Representativeness and bias are addressed in more detail in Element 7.1.

### 10.16 Logistics, Constraints, and Contingencies

Following each quarterly sampling event, all samples will be delivered or shipped to the appropriate laboratory in a timely manner to ensure adequate time for analysis within the holding time. Additional information on logistics, constraints, and contingencies is in the Monitoring Plan.

### 10.17 Relative Importance of Components

Critical information for this project includes all parameters listed in Table 6.1 and optional parameters listed in Table 6.2. All other information collected for the project such as field observations or additional laboratory analyses will be treated as for informational purposes only.

## 11.0 Sampling

Field personnel will adhere to recommended SWAMP sample collection protocols or approved and documented alternative protocols, in order to ensure

the collection of representative, uncontaminated (contaminants not introduced by the sample handling procedure itself) water, sediment, tissue, and biological samples for laboratory analyses. If protocols are revised or altered, the deviations from the standard protocols will be documented.

Any problems occurring during field collection will be reported directly to the Program Manager. Problems will be documented on the field collection sheets. If necessary the QA Officer will be informed and corrective measures will be put in place to mitigate the sampling issue.

## 11.2 Field Preparation Description

Certain samples require filtering in the field. SOPs for these procedures are in Appendix A- Field Sampling Procedures.

## 11.3 Sample Containers

Selection of the appropriate sample containers is an important part of the sampling plan. In order to ensure sample integrity, the SWAMP Quality Assurance Program Plan (QAPrP) specifies the types of containers that are acceptable for each kind of sample. The QAPrP also suggests the amount of sample that needs to be collected for each analyte. See Table 11.1 for a list of sample containers and sample volume. The laboratories will supply all necessary sampling containers to the DWR Northern District Water Quality and Biology Section.

## 11.4 Sample Preservation and Holding Times

Using properly cleaned containers and correct preservatives, as well as adhering to proper holding times, is essential to maintaining sample integrity and correctness. Requirements for sample containers, preservation techniques, and holding times are found in one of the following references (or later editions):

- *Standard Methods for the Examination of Water and Waste Water*. American Public Health Association, et al., 19th Edition, or later
- Federal Register Volume 49, No. 209, Friday, October 26, 1984, EPA, 40 Code of Federal Regulations, Part 136
- *Handbook for Sampling and Sample Preservation of Water and Wastewater*. EPA 600/4-82-029, September 1982.

Sufficient sample volumes must also be collected to ensure that the required detection limits can be met, the QC samples can be analyzed, and any necessary sample re-analyses can be performed. Sample holding times, and preservation methods are listed in Table 11.1.

**Table 11.1 Sample containers, preservation, and holding times**

Analyte	Holding Time	Container	Sample Volume	Field Filtered	Preservation
<b>Conventional Analytes</b>					
Total Suspended Solids	7 days	Polyethylene Bottle	900 mL	Yes	Cool to 4° C
Alkalinity	14 days	Polyethylene Bottle	900 mL	No	Cool to 4° C and store in the dark
Total Hardness	6 months	Polyethylene Bottle	200 mL	No	Cool to 4° C and store in the dark. Acidify with HNO <sub>3</sub> to pH<2
Total Ammonia as Nitrogen	48 hours; 28 days if acidified	Polyethylene Bottle	200 mL	Yes	Cool to 4° C and store in the dark. May be preserved with 2 mL H <sub>2</sub> SO <sub>4</sub> per L
Total Kjeldahl Nitrogen	7 days; 28 days if acidified	Polyethylene Bottle	600 mL		Cool to 4° C and store in the dark. May be preserved with 2 mL H <sub>2</sub> SO <sub>4</sub> per L
Total Organic Nitrogen	7 days; 28 days if acidified	Polyethylene Bottle	600 mL		Cool to 4° C and store in the dark. May be preserved with 2 mL H <sub>2</sub> SO <sub>4</sub> per L
Dissolved Ammonia	48 hours; 28 days if acidified	Polyethylene Bottle	200 mL	Yes	Cool to 4° C and store in the dark. May be preserved with 2 mL H <sub>2</sub> SO <sub>4</sub> per L
Dissolved Nitrite + Nitrate	48 hours, 28 days if acidified	Polyethylene Bottle	200 mL	Yes	Cool to 4° C and store in the dark. May be preserved with 2 mL H <sub>2</sub> SO <sub>4</sub> per L
Dissolved Ortho-phosphate	48 hours	Polyethylene Bottle	200 mL	Yes	Cool to 4° C and store in the dark
Total Phosphorus	28 days	Polyethylene Bottle	200 mL	No	Cool to 4° C and store in the dark
Total Organic Carbon	28 days	Glass Vial	40 mL	No	Cool to 4° C and store in the dark. Acidify with H <sub>3</sub> PO <sub>4</sub> to pH<2
Total Dissolved Carbon	28 days	Glass Vial	40 mL	Yes	Cool to 4° C and store in the dark. Acidify with H <sub>3</sub> PO <sub>4</sub> to pH<2
<b>Inorganic Analytes</b>					

Analyte	Holding Time	Container	Sample Volume	Field Filtered	Preservation
Total Arsenic	6 months	High Density Polyethylene Bottle	250 mL	No	Cool to 4° C and store in the dark. Acidify with HNO <sub>3</sub> to pH<2
Dissolved Arsenic	6 months	High Density Polyethylene Bottle	250 mL	No	Cool to 4° C and store in the dark. Acidify with HNO <sub>3</sub> to pH<2
Total Copper	6 months	High Density Polyethylene Bottle	250 mL	No	Cool to 4° C and store in the dark. Acidify with HNO <sub>3</sub> to pH<2
Dissolved Copper	6 months	High Density Polyethylene Bottle	250 mL	No	Cool to 4° C and store in the dark. Acidify with HNO <sub>3</sub> to pH<2
<b>Pathogens</b>					
Total Coliform	24 hours	Factory-sealed Sterile High Density Polyethylene Bottle pretreated with Sodium Thiosulfate	100 mL	No	Cool to 4° C and store in the dark.
E. Coli	24 hours	Factory-sealed Sterile High Density Polyethylene Bottle pretreated with Sodium Thiosulfate	100 mL	No	Cool to 4° C and store in the dark.
<b>Toxicity</b>					
96-Hour Ceriodaphnia dubia	48 hours	2.5 L Amber Glass	500 mL	No	Cool to 4° C and store in the dark.
96-Hour Hyalella azteca	48 hours	2.5 L Amber Glass	500 mL	No	Cool to 4° C and store in the dark.
<b>Bioassessment</b>					
Benthic Macroinvertebrates	n/a	Wide-mouth 500 mL or 1000 mL Plastic Jar(s)	n/a	No	Fill jars with 95% ethanol

Upon returning to the DWR Northern District office following field collection activities, staff place samples into the appropriate storage location (for example, refrigerator, freezer, or locked cabinet) until they are transported or shipped to the laboratory performing the analyses. Properly completed chain-of-custody forms corresponding to the samples are placed into boxes next to the storage locations. The chain-of-custody forms accompany the corresponding samples when they are transported or shipped to the laboratories.

Samples will be delivered to the laboratories in a timely manner, which will allow sample analysis to proceed before holding times are exceeded. If samples are not delivered by staff, they will be packed in ice to preserve them and then shipped via FedEx Next-Day Air.

#### 11.4.1 Sample Preservation Description

Some samples will require preservation in the field. Preservation of certain samples is achieved by fixing with concentrated acid then storing on ice at less than 4° C. See Table 11.1 for a detailed description.

#### 11.5 Sample Container Sterilization

Collection of pathogens in water requires the use of sterilized sample containers. Containers will be purchased factory sealed and pre-sterilized

##### 11.5.1 - Sample Container Cleaning

Pre-cleaned containers will be used if they are required for ultra low level metals sampling or pathogen sampling. The lab performing the analyses will provide the field crew with the appropriate clean containers.

#### 11.6 Sample Container Labels

Before they are used to collect water samples, containers are labeled with laser printer labels that include the following information: location of collection (station name), the DWR Field and Laboratory Information Management System (FLIMS) sample number, sampling date and time (Pacific Standard Time), type of sample or requested analysis, any acids used for preservation, and holding instructions (for example, on ice, 4 °C, or frozen). The sample tracking system (FLIMS) generates printed labels with this information for samples analyzed at Bryte Laboratory.

#### 11.7 Sample Equipment

A list of equipment required for this study is found in Table 13.2.

## 11.8 Responsible Person

If monitoring equipment fails, DWR personnel will report the problem in the comment section of their field notes and will not record data values for the variables in question. Actions will be taken to replace or repair broken equipment prior to the next field use. No data will be entered into the WDL database that was known to be collected with faulty equipment.

## 11.9 Standard Operating Procedures

DWR Northern District Standard Operating Procedures (SOPs) Field Sampling Procedures are listed in Appendix A. This SOP complies with all SWAMP requirements.

Pathogen sample collection will be conducted according to the Regional Board's *San Joaquin River Bacteria Monitoring Program* (Appendix E). Bioassessment sample collection will be conducted according to *Standard Operating Procedures for Collecting Benthic Macroinvertebrate Samples and Associated Physical and Chemical Data for Ambient Bioassessments in California* available at [http://www.waterboards.ca.gov/water\\_issues/programs/swamp/docs/phab\\_sopr6.pdf](http://www.waterboards.ca.gov/water_issues/programs/swamp/docs/phab_sopr6.pdf).

## 12.0 Sample Handling and Custody

- The Project Manager will be responsible for custody of samples during field sampling.
- Field crews will keep a field log, which will consist of project sampling forms and sampling forms for each sampling event. In the field log the following items will be recorded: time of sample collection, sample identification numbers, results of any field measurements and the time that they were made, qualitative descriptions of relevant water and weather conditions at the time of sample collection, and a description of any unusual occurrences associated with the sampling event (especially those that could affect sample or data quality).
- Field crews will have custody of samples during field sampling and chain-of-custody forms will accompany all samples to the analyzing laboratory. Chain-of-custody procedures require that possession of samples be traceable from the time the samples are collected until completion and submittal of analytical results. The chain-of-custody form to be used for samples to be submitted to Bryte Laboratory included in Appendix F. The chain-of-custody form in Appendix G will be used for all remaining samples.

- The analytical laboratory will maintain custody logs sufficient to track each sample submitted and to analyze or preserve each sample within specified holding times. The analytical laboratory has a sample custodian who examines the samples for correct documentation, proper preservation and holding times. The laboratories will follow sample custody procedures outlined in its QA plans, which are on file.
- In the field, all samples will be packed in wet ice or frozen ice packs during shipment, so that they will be kept at approximately 4°C. Samples will be stored on ice or refrigerated at approximately 4°C in the laboratory or office. Where appropriate, samples may be frozen to prevent biological degradation.
- All samples will be handled, prepared, transported and stored in a manner so as to minimize bulk loss, analyte loss, contamination or biological degradation. Sample containers will be clearly labeled. All caps and lids will be checked for tightness prior to shipping. Ice chests will be sealed with tape before shipping. Samples will be placed in the ice chest with enough ice, or frozen ice packs, to completely fill the ice chest. COC forms will be placed in an envelope and taped to the top of the ice chest or they may be placed in a plastic bag and taped to the inside of the ice chest lid.
- Transport of samples to the laboratory will be by commercial carriers (FedEx). Transport of the samples to the analytical laboratory may also be by DWR or Regional Board staff.

### 13.0 Analytical Methods and Field Measurements

Table 13.1 outlines methods to be used, any modifications to those methods, and reference to the standard method. Information on the necessary equipment and instrumentation for the project analyte can be found in the following documents:

- Conventional and inorganic analytes: Bryte Laboratory Quality Assurance Manual A(appendix C)
- Pathogens: San Joaquin River Bacteria Monitoring Program (Appendix E)
- Toxicity and bioassessment: will comply with Standard Operating Procedures and Standard Methods applicable to each constituent.

**Table 13.1 Analytical methods and reporting limits**

Analyte	Analytical Method	Reporting Limit (mg/L)
<b>Conventional Analytes</b>		
Total Suspended Solids	EPA 160.2	1
Alkalinity	SM 2320 B	1
Total Hardness	SM 2340 B (Total by calculation)	n/a

Analyte	Analytical Method	Reporting Limit (mg/L)
Total Ammonia as Nitrogen	EPA 350.1	0.01
Total Kjeldahl Nitrogen	EPA 351.2	0.1
Total Organic Nitrogen	EPA 351.2 (total by calculation)	n/a
Dissolved Ammonia	EPA 350.1	0.01
Dissolved Nitrite + Nitrate	SM 4500-NO <sub>3</sub> (DWR modified)	0.01
Dissolved Ortho-phosphate	EPA 365.1 (DWR modified)	0.01
Total Phosphorus	EPA 365.4	0.01
Total Organic Carbon	EPA 415.1 (T)	0.5
Total Dissolved Carbon	EPA 415.1 (D)	0.5
<b>Inorganic Analytes</b>		
Total Arsenic	EPA 1638 (T)	0.1 µg/L
Dissolved Arsenic	EPA 1638 (D)	0.1 µg/L
Total Copper	EPA 1638 (T)	0.05 µg/L
Dissolved Copper	EPA 1638 (D)	0.05 µg/L
<b>Pathogens</b>		
Total Coliform	IDEXX Colilert Quanti-Tray / 2000	1 MPN/100 mL
E. Coli	IDEXX Colilert Quanti-Tray / 2000	1 MPN/100 mL
<b>Toxicity</b>		
96-Hour Ceriodaphnia dubia	EPA 821-R-02-012	n/a
96-Hour Hyalella azteca	EPA 821-R-02-012	n/a
<b>Bioassessment</b>		
Benthic Macroinvertebrates	Safit STE Level II Taxonomy	n/a

**Table 13.2 Field instrument measurement principles and major attributes**

Parameter	Instrument	Measurement Principle	Units	Range	Detection Limit	Resolution
Temperature	YSI 85	Thermistor method	°C	-5 to 65	0.1	0.1
Temperature	Onset HOBO Logger	Thermistor method	°C	-20 to 70	0.2	0.02
Dissolved Oxygen	YSI 85	Diaphragm galvanic battery method	mg/l	0 to 20	0.1	0.01
Specific Conductivity	YSI 85	4 AC electrode method	µS/cm	0 to 499.9	1	1
pH	Hach sension1	Glass electrode method	pH Units	-2.00 to 19.99	0.1	0.01
Turbidity	Hach Model 2100P	Penetration and scattering method	NTU	0 to 1,000	0.1	0.01

Table 13.2 describes the field instruments to be used in this project. The MQOs listed in Element 7 will serve as performance criteria for both laboratory methods and field measurements.

### 13.1 Continuous Monitoring Potential Problems and Solutions

There are no known or expected physical impediments that would impair obtaining data that is representative of stations where in-situ monitoring is planned.

However, continuous monitoring at all stations is subject to vandalism and equipment failure. We will provide downloads of the temperature loggers and inspections of the instruments at each site occupation to ensure continuous monitoring. If there are any periods of interruption due to vandalism, equipment failure, or any other problems, then data from that interval will not be used.

### 13.2 Laboratory Name

DWR Bryte Laboratory will provide the analyses for all inorganic and conventional analytes, with the exception of pathogens. MPSL at Granite Canyon will provide analyses for water column toxicity. DFG ABL will provide analyses for bioassessment samples. The Regional Board will conduct pathogen analyses in house.

### 13.3 Responsible Person's Name corrective action at the laboratory

Table 13.1 identifies the person at each laboratory who will be responsible for corrective action in the event that a method fails to provide SWAMP-comparable data during the analysis of the proposed project's samples.

**Table 13.3 Laboratory responsible persons**

Laboratory	Responsible Person	Title
DWR Bryte	Bill Nickels	Laboratory Manager
MPSL Granite Canyon	Bryn Phillips	Research Faculty
DFG ABL	James Harrington	Staff Environmental Scientist
Regional Board	Leticia Valadez	Laboratory Director

### 13.4 Laboratory Method Failure

Failures in laboratory measurement systems include, but are not limited to: instrument malfunction, calibration failure, sample container breakage, contamination, and QC sample failure. If the failure can be corrected, the analyst must document it and its associated corrective actions in the laboratory record and complete the analysis. If the failure is not resolved, it is conveyed to the

respective supervisor who should determine if the analytical failure compromised associated results. Specific laboratory corrective actions are detailed in Appendix D of the SWAMP QAPP.

### 13.5 Documenting Method Failure

When a method fails to provide SWAMP-comparable data, the nature and disposition of the problem must be documented in the data report that is sent to the Project Manager.

### 13.6 Sample Disposal

After analysis of the project samples the laboratories will dispose of samples in compliance with all federal, state, and local regulations. The laboratory has standard procedures for disposing of its waste, including left over sample materials.

### 13.7 Turn Around Time

Turn around times for sample analyses will be as fast as possible based on the laboratory's work load. However, the turn around times will not exceed the SWAMP-comparable holding times that are listed in Table 11.1. The laboratories understand and agree to meet the turn around times needed for our proposed sample analyses.

## 14.0 SWAMP-comparable QA/QC

SWAMP-comparable quality assurance and quality control activities for the sampling process include the collection of field replicates, as applicable, and the preparation of field blanks.

Blanks will be prepared by pouring water known to be free of the parameters being monitored for into a sample collection container and then subsampling into the appropriate number of replicate sampling containers. Ultrapure water (ASTM Type III) will be used for non-biological sample blanks and sterile phosphate dilution water (prepared according to Standard Methods 9020B) will be used for biological sample blanks.

All field measurements will be made in triplicate. Each result will be recorded along with the average of the three results, the difference between the largest and smallest result, and the percent difference between the largest and smallest result.

When pH and conductivity are measured the measurement devices will be checked against a standard whose source is different than that selected for

calibration and this will be done about the middle of a sample run and again at the end. When dissolved oxygen is measured it will be checked against aerated water whose oxygen content is established by the Winkler method. Triplicate measurements, the average of the results, the difference, and percent difference will be recorded. The differences will be calculated as follows:

$$\text{Difference} = \text{Average} - \text{True Value}$$

$$\text{Relative Percent Difference (RPD)} = 100 * (\text{largest-smallest}) / \text{average}$$

The difference or RPD, as appropriate, will be compared against the Resolution criteria established in Element 7. Additional formulas for calculating results for specific quality control samples are found in Appendix A of the SWAMP QAPrP.

Necessary quality control samples, frequency requirements, and control limits are defined in Tables 7.1 and 7.2.

Corrective actions for laboratory analytes and field measurements can be found in Appendix D of the SWAMP QAPrP. Failures of laboratory measurement systems include, but are not limited to: instrument malfunction, calibration failure, sample container breakage, contamination, and QC sample failure. If the failure can be corrected, the analyst must document it and its associated corrective actions in the laboratory record and complete the analysis. If the failure is not resolved, it is conveyed to the respective supervisor who should determine if the analytical failure compromised the associated results. The nature and disposition of the problem must be documented in the data report that is sent to the Project Manager. Field corrective actions are described in Element 15.1.

## 14.1 QC Sample Descriptions

- Field blanks - Field blanks provide bias information for field handling, transport, and storage operations. They will be collected to evaluate whether contaminants have been introduced into the samples during sample collection due to exposure from ambient conditions or from the sampling containers. These blanks will be obtained by pouring de-ionized water into a sampling container at the sampling location. Field blanks will be preserved, packaged, and sealed exactly like the surface water samples and will be submitted blind to the lab. The lab results must be less than the MDL of the target analytes to be acceptable.
- Equipment blanks - Equipment blanks (also known as "rinsate blanks") provide bias information for sampling equipment that may be contaminated. They will be prepared by rinsing sampling equipment in between its use with one or more samples in order to document that it will not contaminate samples with the target analytes that may have been present in a previous sample that the equipment was used to obtain. The

rinsate water will be preserved, packaged, and sealed exactly like the surface water samples and will be submitted blind to the lab. The lab results must be less than the MDL of the target analytes to be acceptable.

- Bottle blanks - Bottle blanks provide bias information for sample containers that may be contaminated. They will be prepared in the laboratory by rinsing randomly selected sample bottles with a small amount of the solvent that is used for sample preparation. If no solvent is used for sample preparation then the sample bottles will be rinsed with a small amount of reagent grade water that has no detectable quantities of the target analytes. Bottle blank data is qualitative, not quantitative, and the objective is to detect any potential contamination by target analytes that may be in the sample bottles. The lab results must show no detectable levels of the target analytes in the bottle blank rinsates.
- Method blanks - Method blanks (also known as laboratory blanks) provide bias information on possible contaminants for the entire laboratory analytical system. These samples will be a matrix similar to the project samples (i.e., water, sediment or tissue) that are known to have no detectable levels (or acceptably low levels) of the target analytes. Method blanks will be analyzed along with the project samples to document background contamination of the analytical measurement system. The lab results must be less than the MDL of the target analytes to be acceptable.
- Temperature blanks - Temperature blanks provide information to ensure that the samples in a particular cooler were maintained at the temperature appropriate for the selected analytical parameter. These samples will be marked "Temperature Blank" and one will be placed in each cooler that will be transported to the laboratory. These blanks will be prepared by the laboratory in the same type of sampling containers that will be used to sample ambient water and they will be used by the laboratory's sample custodian to check and record the temperature of samples upon receipt at the lab. The recorded temperature must not exceed that specified for an analytical parameter by Table 11.1.
- Field replicates - Field replicate samples provide precision information on all steps after sample acquisition. These samples will be collected as duplicates at designated sample locations by alternately filling two distinct sample containers for each analysis. The field duplicate samples will be preserved, packaged, and sealed in the same manner described for the surface water samples. A separate sample number and station number will be assigned to each duplicate and the samples will be submitted blind to the lab. The replicate values must have a RPD of less than 25% to be acceptable.
- Laboratory control samples - Laboratory control samples (LCS, which SWAMP refers to as "Reference Materials") provide bias information

about a laboratory's ability to perform acceptable analyses on a clean matrix with the chosen methods. The LCS will be prepared by the laboratory using an aliquot of the clean matrix (i.e., water, sediment or tissue with no detectable levels of the target analytes) that is spiked with the analytes at known concentrations. The lab results must be within 80 - 120% recovery or control limits based on 3 times the standard deviation of a lab's actual method recoveries for the target analytes in order to be acceptable.

- Matrix spikes - Matrix spikes (MS) provide bias information on sample preparation and analysis. MS will be used to verify that the lab can determine if the sample matrix is causing either a positive or negative bias on sample results. MS samples will be prepared by the laboratory using an aliquot of the sample matrix (i.e., water, sediment or tissue) that is spiked with the analytes at known concentrations. The lab results must be within 80 - 120% recovery or control limits based on 3 times the standard deviation of a lab's actual method recoveries for the target analytes in order to be acceptable.
- Matrix spike duplicates - Matrix spike duplicates (MSD) provide precision information on sample preparation and analysis. The laboratory will prepare separate spiked matrix samples (MS) for analysis. Acceptable lab results for bias are the same as described for matrix spikes. The duplicate values must have a RPD of less than 25% to be acceptable.
- Laboratory duplicates - Laboratory duplicates provide precision information on the analytical methods with the target analytes. The laboratory will generate the duplicate samples by splitting one sample into two parts, each of which will be analyzed separately. The duplicate values must have a RPD of less than 25% to be acceptable.

## 15.0 Instrument/Equipment Testing, Inspection and Maintenance

The Project Manager will be responsible for Element 15 instrument/equipment testing, inspection and maintenance. This will include maintaining the logs that document what was done, who did the work, and when the work was done.

### 15.1 Field Measurements

Field measurement equipment will be checked for operation in accordance with manufacturer's specifications. This includes battery checks and routine replacement and/or cleaning of parts as specified by the manufacturer. All equipment will be inspected for damage when first employed and again when returned from use. Maintenance logs will be kept and each piece of equipment

will have its own log that documents the dates and description of any problems, the action(s) taken to correct problem(s), maintenance procedures, system checks, follow-up maintenance dates, and the person responsible for maintaining the equipment.

Failing equipment must be replaced or repaired prior to subsequent sampling events. It is the combined responsibility of all members of the field organization to determine if the performance requirements of the specific sampling method have been met, and to collect additional samples if necessary. More information on field corrective actions can be found in Appendix D of the SWAMP QAPrP.

Spare parts for field equipment are stored at the DWR Northern District Water Quality and Biology section office. Equipment and spare parts are inventoried and purchased on an annual basis to ensure there are sufficient parts to repair defective or broken equipment.

## 15.2 Laboratory Analyses

Laboratory measurement equipment will be maintained in accordance with the lab's Standard Operating Procedures (SOPs). This includes procedures specified by the manufacturer and also any that are specified by the methods used. Maintenance logs will be kept and each piece of equipment will have its own log that documents the dates and description of any problems, the action(s) taken to correct problem(s), maintenance procedures, system checks, follow-up maintenance dates, and the person responsible for maintaining the equipment. More information on lab corrective actions can be found in Appendix D of the SWAMP QAPrP.

## 15.3 Biological Measurements

Equipment associated with bacterial analysis will be checked using the specifications in the Regional Board's *San Joaquin River Basin Bacteria Monitoring Program* (Appendix E). In particular, incubators will have their temperature recorded before samples are added or removed and the temperature must be 35°C +/- 5°C. Semiannually incubator temperatures will be checked with a NIST certified or NIST traceable thermometer. Additionally, sealers and UV lamps will be checked monthly.

There are no checks of benthic measuring equipment that are required by SWAMP.

## 16.0 Instrument/Equipment Calibration and Frequency

The Project Manager will be responsible for Element 16 instrument/equipment calibration and frequency. This will include documenting and checking that the

specified calibration procedures were performed for each of the selected parameters being measures.

Deficiencies will be documented by the Project Manager and reported to the DWR QA Officer. After resolution of the deficiency the Project Manager will document the problem and will provide recommendations to prevent future occurrences

## 16.1 Field Measurements

- DO - Although there are no SWAMP requirements for instrument calibration and frequency with dissolved oxygen (DO) measurements, the SWAMP suggestion to perform this function at the start of each sample run will be followed.
- Temperature - Even though there are no SWAMP requirements for instrument calibration and frequency with temperature measurements, the SWAMP suggestion to perform this function at least twice a year against a NIST certified thermometer will be followed.
- Conductivity - Although there are no SWAMP requirements for instrument calibration and frequency with conductivity measurements, the SWAMP suggestion to perform this function at the start of each sample run will be followed. If this is not possible then a calibration correction factor table will be used.
- pH - There are no SWAMP requirements for instrument calibration and frequency with pH measurements using a meter. However, the SWAMP suggestion to perform this function at the start of a sample run will be followed.

Turbidity - Although there are no SWAMP requirements for instrument calibration and frequency with turbidity measurements, the SWAMP suggestion to perform this function at the start of a sample run will be followed. 16.2 Laboratory Analyses

Prior to sample analysis of conventional and inorganic constituents in water, external calibrations will be made using 3 - 5 standards that cover the range of sample concentrations. The lowest standard will be at or near the Method Detection Limit (MDL). Linear regression will be <0.995 or better. Calibration verification will be run after every 20 samples after the initial calibration and will use a standard source that is different from that used for the initial calibration. Acceptable recovery for conventional analytes is 80 - 120% and for inorganic analytes is 90 – 110%.

There are no SWAMP requirements for equipment calibration and frequency for toxicity tests. All performance criteria will be followed that are listed in the toxicity method.

### 16.3 Biological Measurements

There are no SWAMP requirements for instrument/equipment calibration and frequency for bacteria. The guidance provided in the Regional Board's *San Joaquin River Basin Bacteria Monitoring Program* (Appendix E) will be followed.

There are no SWAMP requirements for instrument/equipment calibration frequency for benthic macroinvertebrates.

## 17.0 Inspection/acceptance of Supplies and Consumables

–The QA Officer will be responsible for Element 17 inspection/acceptance of supplies and consumables. They will be examined for damage as they are received and document their state as well as the date they were received.

All supplies will be examined for damage as they are received and then again as they are obtained for use with the proposed project. Containers will be inspected for breakage and proper sealing of caps. Standards and other consumables will be inspected for conformance with any labeled expiration dates. Reusable supplies (e.g., coolers and safety equipment) will be examined for acceptable cleaning and reuse. Any supplies deemed to be in unacceptable condition will be replaced.

## 18.0 Non-direct Measurements

Multiple sample sites in this study are historic DWR stations (see Element 10.1.1). Water chemistry and field measurement data collected by DWR from 1998 is stored in DWR's Water Data Library (WDL). Where appropriate, this data may be assessed in this study in order to better characterize long term trends. Because WDL is readily accessible through the internet, no additional resources or support facilities are needed.

Data Quality Indicators (DQIs) will be used to judge whether the external data meets acceptance criteria. These include, for example, precision, accuracy, representativeness, comparability, completeness, bias, and sensitivity.

Measurement performance information such as method detection limits (MDLs), method quantitation levels, and the selectivity of a method (or lack of selectivity) for the target analytes will be used to judge whether the external data meets acceptance criteria.

Acceptance of external data for use will depend on the relevance of the matrix, location of the samples, and the methods that were used for collection and/or

analysis (for example, field versus laboratory-based methods, the method of collection and analysis, etc.).

## 18.1 Usage Limits

External data that fails to meet acceptance criteria will not be used in the proposed project.

If and when external data does not meet acceptance criteria it will, at the very least, be flagged as such. Flagged data may possibly be used under some conditions, but its use will be limited and clearly designated.

## 19.0 Data Management

Data management for the constituents in Table 6.1 will follow the data management scheme outlined in the DWR Field and Laboratory Information Management System (FLIMS) Manual. FLIMS will be used for data entry, data format, record keeping, tracking, and uploading into the DWR Water Data Library (WDL). The SWAMP Information Management System (IMS) will be used for bioassessment, toxicity, and pathogen data. Field data will be stored in both the WDL and SWAMP IMS database.

To ensure information is readily accessible, all records, assessments and reports will be created and stored in Microsoft Excel, Access or Word format.

### 19.1 Field Data Record Keeping

Field data sheets are filled out and checked in the field by the field sample collection staff. The Project Manager will verify sample identification and review the chain of custody forms. Working with field and laboratory staff, the Project Manager will identify any problems where holding times have been exceeded, sample identification is incorrect, where samples were inappropriately handled, calibration information is missing, or data quality objectives have not been met.

If problems are identified by the Project Manager, they will be brought to the attention of the QA Officer for review, and will be flagged.

### 19.2 Field Data SOP

DWR Field and Laboratory Information Management System (FLIMS) Manual is the SOP that will be referred to for managing field data with the proposed project.

### 19.3 Field Data Sheets

The SOP references the SWAMP documentation for producing field data sheets and these protocols will be followed so that SWAMP-comparable data will be produced.

### 19.4 Responsibility for Field Measurements Data

The Project Manager will be responsible for field measurements data management. All field data sheets, lab submittal sheets, and other documentation will be securely stored in duplicate at the DWR Northern District Water Quality and Biology Section.

### 19.5 Continuous Monitoring Data Record Keeping

Continuous water temperature data will be kept in raw format. Data will be uploaded to the WDL after a QA/QC process using Hydstra software. Raw format data will be housed on DWR Northern District Servers indefinitely.

### 19.6 Responsibility for Continuous Monitoring Analytical Data

The Project Manager will be responsible for continuous monitoring analytical data management.

### 19.7 Laboratory Data Management SOP

The DWR Field and Laboratory Information Management System (FLIMS) Field Manual is the SOP that will be used for managing laboratory analytical data for all inorganic and conventional analytes, with the exception of pathogens. The *Surface Water Ambient Monitoring Program Information Management Plan* will be used for managing laboratory analytical data for the SWAMP IMS.

### 19.8 Lab Measurement Types

Chemical/Biological Analyses - Our SOP and/or referenced documents describes how we will manage data involving analysis of chemicals and pathogens.

Toxicity Analyses - Our SOP and/or referenced documents describes how we will manage data involving toxicity analyses.

### 19.9 Responsibility for Laboratory Data Management

The Bryte Laboratory will be responsible for data management involving laboratory analytical data for the constituents in Table 6.1. ABL will be

responsible for data management for bioassessment data. MPSL will be responsible for data management involving toxicity data. The Regional Board will be responsible for data management for pathogen data.

## 20.0 Assessments and Response Actions

Assessment and oversight involves both field and laboratory activities to ensure that the QA Project Plan is being implemented as planned and that the project activities are on track. By implementing proper assessment and oversight, finding critical problems toward the end of the project is minimized, when it may be too late to apply corrections to remedy them.

The Project Manager will report any problems detected and the corrective measures taken to the Project Manager as part of the quarterly project status reports and annual summary reports.

### 20.1 Types of Field Assessments

- Readiness reviews assess field team preparations prior to starting field activities;
- Field activity audits assess field team activities during their execution; and
- Post sampling event reviews assess field sampling and measurement activities methodologies and documentation at the end of all events or a selected event.

#### 20.1.1 Responsibility for Readiness Reviews

The Project Manager will be responsible for reviewing all field equipment, instruments, containers, and paperwork in order to ensure that all will be ready prior to each sampling event. Any problems that are noted will be corrected before the field measurement activities begin.

#### 20.1.2 Frequency for Readiness Reviews

Before every sampling event a readiness review will be conducted. All sampling personnel will be given a brief review of the goals and objectives of the sampling event and the sampling procedures and equipment that will be used to achieve them.

#### 20.1.3 Readiness Review Activities

- Equipment checks - It is important that all field equipment be clean and ready to use when it is needed. Therefore, prior to using all sampling and/or field measurement equipment, each piece of equipment will be checked to make sure that it is in proper working order.

- Equipment maintenance records - Equipment maintenance records will be checked to ensure that all field instruments have been properly maintained and that they are ready for use.
- Supply checks - Adequate supplies of all preservatives, bottles, labels, waterproof pens, etc. will be checked before each field event to make sure that there are sufficient supplies to successfully support each sampling event.
- Paperwork checks - It is important to make sure that all field activities and measurements are properly recorded in the field. Therefore, prior to starting each field event, necessary paperwork such as logbooks, chain of custody record forms, etc. will be checked to ensure that sufficient amounts are available during the field event.

#### 20.1.4 Readiness Review Corrections

If there is a problem discovered during a readiness review for field activities, then it must be corrected before the team deploys.

In the event that a problem is discovered during a readiness review, it will be noted in the field log book and corrected before the field crew is deployed. The actions taken to correct the problem will also be documented in the field log book.

#### 20.1.5 Responsibility for Field Activity Audits

Scott McReynolds will be responsible for reviewing all field activity audits. Any problems that are noted will be documented along with recommendations for correcting the problem.

#### 20.1.6 Frequency for Field Activity Audits

Field activity audits will be held quarterly during the project's field sampling activities.

#### 20.1.7 Types of Field Activity Audits

Field activity audits will assess the sample collection methodologies, field measurement procedures, and record keeping of the field crew in order to ensure that the activities are being conducted as planned and as documented in this QA Plan.

#### 20.1.8 Field Audit Corrections

In the event that a problem is discovered during a field audit it will be corrected immediately (or as soon as possible) so that all subsequent samples and field

measurements collected are valid. The problems and the actions taken to correct them will become a part of the field audit report.

#### 20.1.9 Authority for Field Activity Stop Work

The QA Officer will have the authority to stop any sampling or field measurement activity that could potentially compromise data quality.

#### 20.1.10 Responsibility for Post Sampling Event Reviews

The Project Manager will be responsible for post sampling event reviews. Any problems that are noted will be documented along with recommendations for correcting the problem.

#### 20.1.11 Frequency of Post Sampling Event Reviews

Post sampling event reviews will be conducted following each sampling event in order to ensure that all information is complete and any deviations from planned methodologies are documented.

#### 20.1.12 Post Sampling Event Reviews

Post sampling event reviews will include field sampling activities and field measurement documentation in order to help ensure that all information is complete.

#### 20.1.13 Post Sampling Event Documentation

The reports for each post sampling event will be used to identify areas that may be improved prior to the next sampling event. A combined post sampling event report will be an integral part of the final report on this proposed project.

### 20.2 Laboratory Assessments

Laboratory oversight and assessments may involve two types of activities.

- Data reviews of each data package submitted by a laboratory; and
- Audits of laboratory practices and methodology.

#### 20.2.1 Responsibility for Laboratory Data Review

The QA Officer will be responsible for reviewing the laboratory's data for completeness and accuracy. The data will also be checked to make sure that the specified methods were used and that all related QC data was provided with the sample analytical results.

### 20.2.2 Frequency of Laboratory Data Reviews

Laboratory data reviews will be conducted following receipt of each data package from a laboratory in order to ensure that all information is complete and any deviations from planned methodologies are either corrected or the reasons for change are documented.

### 20.2.3 Laboratory Data Corrections

Any laboratory data that is discovered to be incorrect or missing will immediately be reported to the laboratory's QA officer. The laboratory's QA manual details the procedures that will be followed by laboratory personnel to correct any invalid or missing data.

### 20.2.4 Lab Re-testing Authority

The Project Director has the authority to request re-testing if a review of any of the laboratory data is found to be invalid or if it would compromise the quality of the data and resulting conclusions from the proposed project.

### 20.2.5 Responsibility for Laboratory Audits

The QA Officer will be responsible for reviewing all laboratory audits. Any problems that are noted will be documented along with recommendations for correcting the problem.

### 20.2.6 Frequency of Lab Audits

Laboratory audits will be held annually during the project's analytical activities.

### 20.2.7 Laboratory Audit Corrections

In the event that a problem is discovered during a laboratory audit the laboratory QA officer will be notified. Problems will be corrected immediately (or just as soon as possible) so that all subsequent laboratory analyses are valid. The procedures for implementing such corrections are covered in the laboratory's QA SOP. The problems and the actions taken to correct them will become a part of the laboratory audit report.

### 20.2.8 Laboratory Proficiency

Blind samples will be submitted as part of a laboratory audit for a proficiency test. The results of the lab's analysis will be compared to the known analytes and their concentrations in those samples. Periodic proficiency tests will ensure that the

laboratory's staff is able to accurately analyze samples from the proposed project using the methods specified for them.

## **21.0 Reports to Management**

1. Three months after each sample submission the Project Director shall provide an update to the Contract Manager describing activities undertaken, accomplishment of milestones, and any problems encountered, and delivery of intermediate products, if any.
2. Not later than June 15 each year, the Project Director shall submit an Annual Report to the Contract Manger summarizing all analytical data collected to date.

## **22.0 Data Review**

Data review, verification, and validation procedures helps to ensure that project data will be reviewed in an objective and consistent manner. Data review is the in-house examination to ensure that the data have been recorded, transmitted, and processed correctly.

### **22.0.1 Responsibility for Data Reviews**

The Project Manager and the QA Officer will be responsible for data review. This includes checking that all technical criteria have been met, documenting any problems that are observed and, if possible, ensuring that deficiencies noted in the data are corrected.

### **22.0.2 Checking for Typical Errors**

In-house examination of the data produced from the proposed project will be conducted to check for typical types of errors. This includes checking to make sure that the data have been recorded, transmitted, and processed correctly. The kinds of checks that will be made will include checking for data entry errors, transcription errors, transformation errors, calculation errors, and errors of data omission.

### **22.0.3 Checking Against MQOs**

Data generated by project activities will be reviewed against method quality objectives (MQOs). This will ensure that the data will be of acceptable quality and that it will be SWAMP-comparable with respect to minimum expected MQOs.

## 22.0.4 Checking Against QA/QC

QA/QC requirements were developed and documented in Elements 14, 15, 16, and 17 and the data will be checked against this information. Checks will include evaluation of field and laboratory duplicate results, field and laboratory blank data, matrix spike recovery data, and laboratory control sample data pertinent to each method and analytical data set. This will ensure that the data will be SWAMP-comparable with respect to quality assurance and quality control procedures.

## 22.0.5 Checking Field Data

Field data consists of all information obtained during sample collection and field measurements, including that documented in field log books and/or recording equipment, photographs, and chain of custody forms. Checks of field data will be made to ensure that it is complete, consistent, and meets the data management requirements of the data management section of this QAPP.

## 22.0.6 Checking Lab Data

Lab data consists of all information obtained during sample analysis. Initial review of laboratory data will be performed by the laboratory QA/QC Officer in accordance with the lab's internal data review procedures. However, once we receive the lab data then we will perform independent checks to ensure that it is complete, consistent, and meets the data management requirements of the data management section of this QAPP.

## 22.1 Data Verification

Data verification is the process of evaluating the completeness, correctness, and conformance / compliance of a specific data set against the method, procedural, or contractual specifications. We will conduct data verification, as described in the Quality Control section, in order to ensure that it is SWAMP-comparable with respect to completeness, correctness, and conformance with minimum requirements.

### 22.1.1 Responsibility for Data Verification

The Project Manager will be responsible for verification of data going into the WDL. Regional Board staff and the SWAMP Data Management Team will be responsible for verification of data going into the SWAMP IMS.

## 22.2 Data Validation

Data validation is an analyte- and sample-specific process that evaluates the information after the verification process (i.e., determination of method, procedural, or contractual compliance) to determine analytical quality and any limitations. We will conduct data validation in order to ensure that the data is SWAMP-comparable with respect to its end use.

### 22.2.1 Responsibility for Data Validation

The Project Manager will be responsible for validation of data going into the WDL. Regional Board staff and the SWAMP Quality Assurance Team will be responsible for validation of data going into the SWAMP IMS.

## 22.3 Data Separation

Data will be separated into three categories for use with making decisions based upon it. These categories are:

1. data that meets all acceptance requirements,
2. data that has been determined to be unacceptable for use, and
3. data that may be conditionally used and that is flagged as per US EPA specification.

## 23.0 Verification and Validation Methods

Defining the methods for data verification and validation helps to ensure that project data are evaluated objectively and consistently. Information on these methods is provided below.

All data records for the proposed project will be checked visually and will be recorded as checked by the checker's initials as well as with the dates on which the records were checked. For data in the SWAMP IMS, the Regional Board will perform an independent re-check of at least 10% of these records as the validation methodology.

All of the laboratory's data will be checked as part of the verification methodology process. At least 10% of the laboratory's data will be independently checked as part of the validation methodology. For data in the SWAMP IMS, the Regional Board will perform independent re-checks of at least 10% of them as the validation methodology.

Any data that is discovered to be incorrect or missing during the verification or validation process will immediately be reported to the Project Director. If errors involve laboratory data then this information will also be reported to laboratory's QA officer. The laboratory's QA manual details the procedures that will be

followed by the laboratory personnel to correct any invalid or missing data. For data in the SWAMP IMS, the Regional Board and SWAMP DMT will be responsible for reporting and correcting any errors that are found in the data during the verification and validation process.

If there are any data quality problems we will try to identify whether the problem is a result of project design issues, sampling issues, analytical methodology issues, or QA/QC issues (from laboratory or non-laboratory sources). If the source of the problems can be traced to one or more of these basic activities then the person or people in charge of the areas where the issues lie will be contacted and efforts will be made to immediately resolve the problem. If the issues are too broad or severe to be easily corrected then appropriate people involved will be assembled to discuss and try to resolve the issue(s) as a group. The Contract Manager has the final authority to resolve any issues that may be identified during the verification and validation process.

During the process of verification and validation for data in the SWAMP IMS, the methods that will be used are described in the *Surface Water Ambient Monitoring Program Information Management Plan*.

## **24.0 Reconciliation with User Requirements**

Information from field data reports (including field activities, post sampling events, corrective actions, and audits), laboratory data reviews (including errors involving data entry, transcriptions, omissions, and calculations and laboratory audit reports), reviews of data versus MQOs, reviews against Quality Assurance and Quality Control (QA/QC) requirements, data verification reports, data validation reports, independent data checking reports, and error handling reports will be used to determine whether or not the project's objectives have been met.

Data from monitoring measurements will not be statistically analyzed. Descriptions of the data will be made with no extrapolation to more general cases.

Data from all monitoring measurements will be summarized in tables. In addition, data that show significant changes over time during the monitoring period will be plotted in graphs and charts. There are no known limitations that are inherent to the data to be collected for this study. Explanations will be provided for any data determined unacceptable for use or flagged for QA/QC concerns.

The proposed project will provide SWAMP-comparable data for the selected analytes described in Element 6. All data will be readily available to the public, and data for the analytes in Table 6.2 will be available from SWAMP's IMS and, subject to physical habitat limitations, the data generated will be useable for comparative purposes by other water monitoring projects within the various components of SWAMP.

The above evaluations will provide a comprehensive assessment of how well the project meets its objectives. No other evaluations will be used.

The Project Manager and Contract Manager will be responsible for reporting project reconciliation. This will include measurements of how well the project objectives were met and the degree to which the data is SWAMP-comparable.

## **25.0 References**

Federal Register Volume 49, No. 209, Friday, October 26, 1984, EPA, 40 Code of Federal Regulations, Part 136

*Handbook for Sampling and Sample Preservation of Water and Wastewater*, EPA 600/4-82-029, September 1982.

*Standard Methods for the Examination of Water and Waste Water*, American Public Health Association, et al., 19th Edition, or later.  
<http://www.standardmethods.org/>

*The Water Quality Control Plan for the Central Valley Region*, California Regional Water Quality Control Board, Central Valley Region. 4th Edition.

[http://www.waterboards.ca.gov/water\\_issues/programs/swamp/qamp](http://www.waterboards.ca.gov/water_issues/programs/swamp/qamp)



## Appendix A. DWR Northern District Standard Operating Procedures Field Sampling Procedures

### **Bacteria**

To collect for bacteria, a sterile Corning Brand Coliform Water Test Sample Container of 100mL volume with a sodium thiosulfate tablet is filled to the 100mL mark with sample water. For surface water, dip the container about 0.15 m below surface if possible, open the lid and then seal the lid again once the appropriate amount of water has filled the container. Do not rinse container and do not remove sodium thiosulfate tablet. After collection, Cap container and pull tie-down through the hole in front top of the container to seal the container until the sample is processed. Leave room in the top of the container for mixing. Sample can be stored below 10°C for up to 24 hours before filtering.

### **Standard minerals ,Total Hardness,TDS/ Suspended Solids**

Two polyethylene (PE) ½ pint bottles and two PE quart bottles are used for collection of standard minerals, TDS, and suspended solids. A quart (Suspended Solids) and a ½ pint (Total Hardness) are used for unfiltered sample water, the remaining quart (TDS) and ½ pint are used for filtered sample water. The unfiltered samples are collected directly from the water body. Subsurface samples are collected similarly using a 2.2 liter, acrylic Van-Dorn Bottle Sampler. The bottles are rinsed with sample water and then filled full and the cap replaced. Filtered samples are obtained by filtering sample water from a grab sample, collected into a sample-rinsed PE ½ gallon bottle, through a 142 mm diameter 0.45µm HA nitrocellulose filter. Filter head is rinsed with a ½ pint of field blank water (distilled water). The filter is placed onto the filter head and then rinsed with another ½ pint of field blank water. The samples are filtered into the ½ pint and quart bottles after a rinse with filtered sample water. TDS and suspended solid samples are stored at 4°C for up to 7 days before holding time expires. Total hardness and Code 1 (filtered) are preserved with 1.0 ml of 70% nitric acid in the field and stored at 4°C for up to 180 days before holding time expires.

### **Ultra-Low Level Metals (EPA Method 1638)**

Collection requires two people, a “dirty hands” that handles the outer bag, and a “clean hands” that handles the inner bag and the collection of the water sample. Both people wear polyethylene or “poly” gloves, with the “clean hands” sampler having shoulder length poly gloves. The person who has “dirty hands” opens the outer bag for the person who has “clean hands” to open the inner bag and remove the clean plastic sample bottle. Clean hands then re-close the inner bag and dirty hands re-close the outer bag. The sample bottle is submerged into the sample water or collected from the spigot of a well or from a Teflon sampler until the bottle is partially filled. The cap is replaced, the sample bottle is shaken, and then the rinse water is discarded. This rinse is performed a total of three times. After the rinse, the sample bottle is filled, the cap replaced and the sample bottle is placed back into the re-opened inner bag by clean hands. The inner bag is sealed with dirty hands holding the outer bag with the inner bag within it. Clean

hands does not touch the outer bag and dirty hands does not touch the inner bag. The outer bag is then sealed by dirty hands and the previously labeled sample is stored at 4 °C. See EPA Method 1669. Dissolved samples should be delivered to the lab within 2 days for filtration/fixing of the dissolved aliquot. The total and filtered/fixed dissolved samples have a 180 day holding time.

### **Mercury / Methyl Mercury**

Collection procedures are as described for Ultra-Low Level Metals (EPA Method 1638). The samples are collected into 250 ml clear glass bottles that are provided by the laboratory, pre-cleaned, and pre-bagged. Mercury and methyl mercury samples are shipped, on ice, next-day air to the analyzing Laboratory the within 48-hours where the samples are fixed with preservative. Fixed samples have a 180 day holding time.

### **Nutrients**

Two PE ½ pint bottles are used for collection of nutrients. The first is unfiltered sample water and the second is used for filtered sample water. The unfiltered sample is collected directly from the sample body. Subsurface samples are collected similarly using a 2.2 liter, acrylic Van-Dorn Bottle Sampler. The ½ pint is rinsed with sample water and then filled 2/3-3/4 full and the cap replaced. Samples are stored at 4°C for 24 hours or frozen for 28 days. The filtered sample is obtained by filtering sample water through a 142 mm diameter 0.45µm HA nitrocellulose filter. Filter head is rinsed with a ½ pint of field blank water (distilled water). The filter is placed onto the filter head and then rinsed with another ½ pint of field blank water. The sample is filtered into the ½ pint bottle after a rinse. Nutrient Field Blanks are processed the same way with lab-prepared blank water instead of ambient site water. Samples are stored at 4°C for up to 24 hours. If delivery to the laboratory will take longer than 24 hours, the sample is frozen for up to 28 days before the holding time expires.

### **Total Ammonia**

Use a PE pint to collect total ammonia samples. First, unscrew lid, fill partially bottle with sample water and shake bottle with lid for a rinse. Fill the pint sample bottle, add 1.0 ml of 1:1 sulfuric acid, and then replace cap. Sample is stored at 4°C for up to 28 days before holding time expires.

### **Total Organic Carbon (TOC)/Dissolved Organic Carbon (DOC)**

Use 40mL, clear vials that are provided by Bryte with phosphoric acid preservative already added (Avoid touching opening of vial or cap to prevent contaminating the samples). Collect water sample into sample rinsed PE ½ pint bottle and slowly add sample water from the ½ pint to the **un-rinsed** TOC vial until the meniscus is below the rim (**Do not over-fill**). The DOC vial is filled during filtration of dissolved mineral and nutrient samples from the same ½ gallon grab (again, do not rinse the vial prior to filling). Samples are stored at 4°C and have a 28 day holding time.

**Organics and pesticides** – Note short holding times for these samples and arrange delivery to Bryte Laboratory to prevent holding time exceedence.

**Chlorinated Organic Pesticides (OCP), Organic Phosphorus Pesticides (OPP), and Chlorinated Phenoxy Acid Herbicides)**

Use 1L amber glass bottles to collect these samples (OCP and OPP samples are combined into one bottle, chlorinated phenoxy acid herbicide sample in its own bottle). First, unscrew lid, fill partially bottle with sample water and shake bottle with lid on for a rinse. Repeat twice for a total of three rinses. Submerge sample bottle in water and fill; replace cap and store on ice. Samples have a 7 day holding time. Include triplicate samples for every tenth monitoring location that is sampled for laboratory QA/QC (MS/MSD).

**Volatile Organics in Water (Purgeable Organics)**

Use two 40mL, amber vials that are provided by Bryte with 1:1 HCl preservative already added. Collect water sample into sample rinsed PE ½ pint bottle and slowly add sample water to one vial at a time until the meniscus just tops the rim (**Do not over-fill; leave no head space/air in vial**). Samples are stored at 4°C and have a 14 day holding time.

**Carbamate Pesticides**

Use 125mL clear glass bottle provided by Bryte with monochloroacetic acid preservative already added. Open bottle, submerge into water column and fill (**Do not rinse**). Re-cap bottle and store at 4 °C. Samples have a 28 day holding time.

**Glyphosate**

Use 125mL amber glass bottle provided by Bryte Laboratory. Open bottle, submerge into water column and fill (**Do not rinse**). Re-cap bottle and store at 4 °C. Samples have a 28 day holding time.

**Oil and grease**

Scan waters visually at each sampling location for oil sheen; record into field notebook if a sheen is present. If oil sheen is present, collect sample from sheened area into a properly labeled, pre-cleaned, wide-mouth, clear glass jar. Transport sample on ice and add oil and grease analysis request to FLIMS laboratory submittal for analysis. Samples have a 28 day holding time.

**Toxicity**

Use one pre-cleaned, 5-gallon HDPE carboy, (or five 1-gallon collapsible containers for remote, hike-in locations), provided by Pacific EcoRisk Laboratory (PER) for each toxicity sampling location. Partially fill sample container in well-mixed ambient site water, re-cap, and vigorously shake container. Empty container and repeat rinse process twice more for a total of three rinses. Fill

container to full and affix label provided by PER, filling in the sampling date, time (PST), and sampler's name. Place clear shipping tape over the label to prevent loss of label/information during transport. Store on ice at 4 °C and deliver to PER laboratory within 24 hours of collection.

## Appendix B. DWR Northern District Standard Operating Procedures Basic Field measurements

### pH

#### **Hach SensION1 portable pH meter with model 51935-00 SensION pH probe**

The pH probe is placed into sample and measurement read off the console. To auto-calibrate, two pH buffer solutions will be prepared, 4.01 and 7.00 or 7.00 and 10.0, depending on expected sample pH. After turning on the meter, press MODE until the pH indicator mode is displayed. Place the pH electrode into one of the buffer solutions and push the CAL key so that CALIBRATE is on the display and P1 is visible in the lower field. When the reading has stabilized, the meter will beep and YES should be pressed to accept the reading. Remove the probe from the first buffer solution, rinse with DI water and then place the probe into the second buffer while the display says P2. When reading has stabilized, the meter will beep and again, YES should be pressed to accept the reading. Readings can now be taken. Measurements from -2.0 to 19.99 pH are possible.

### **Electrical Conductivity**

#### **YSI Model 85 handheld oxygen, conductivity, and temperature system**

1. Turn the meter on- the instrument will activate all segments of the display for a few seconds, which will be followed by a self-test procedure that will last for several more seconds. During this power on self-test sequence, the instruments microprocessor is verifying that the instrument is working properly.
2. Select a measurement mode (dissolved oxygen %, dissolved oxygen mg/L, conductivity, specific conductance, or salinity). Temperature is always displayed. Selecting a measurement mode is accomplished by simply pressing and releasing the mode button. If the instrument is reading specific conductance (temperature compensated), the large numbers on the display will be followed by  $\mu\text{S}$  or  $\text{mS}$ . additionally, the small portion of the display will show the  $^{\circ}\text{C}$  flashing on and off. If the instrument is reading conductivity (NOT temperature compensated), the large numbers on the display will be followed by either a  $\mu\text{S}$  or an  $\text{mS}$ ; however, the small portion of the display will show the  $^{\circ}\text{C}$  NOT flashing.
3. Lower electrode to the desired depth. Be sure not to disturb bottom substrates prior to or during measurement.
4. Record measurement
5. Cycle to the next measurement mode and record the next parameter. This step should be continued until measurements for all parameters are recorded.
6. Turn meter off and place electrode into storage chamber.

## **Water Temperature**

### **YSI Model 85 handheld oxygen, conductivity, and temperature system**

1. Turn the meter on- the instrument will activate all segments of the display for a few seconds, which will be followed by a self-test procedure that will last for several more seconds. During this power on self-test sequence, the instruments microprocessor is verifying that the instrument is working properly.
2. Select a measurement mode (dissolved oxygen %, dissolved oxygen mg/L, conductivity, specific conductance, or salinity). Temperature is always displayed. Selecting a measurement mode is accomplished by simply pressing and releasing the mode button. If the instrument is reading specific conductance (temperature compensated), the large numbers on the display will be followed by  $\mu\text{S}$  or  $\text{mS}$ . Additionally, the small portion of the display will show the  $^{\circ}\text{C}$  flashing on and off. If the instrument is reading conductivity (NOT temperature compensated), the large numbers on the display will be followed by either a  $\mu\text{S}$  or an  $\text{mS}$ ; however, the small portion of the display will show the  $^{\circ}\text{C}$  NOT flashing.
3. Lower electrode to the desired depth. Be sure not to disturb bottom substrates prior to or during measurement.
4. Record measurement
5. Cycle to the next measurement mode and record the next parameter. This step should be continued until measurements for all parameters are recorded.
6. Turn meter off and place electrode into storage chamber.

## **Dissolved oxygen**

### **Winkler Method**

To determine dissolved oxygen, a 300mL sample of water is collected with no air bubbles in a BOD bottle. To the bottle, one small power pillow of alkaline-iodide azide reagent and 1 medium powder pillow of manganous sulfate are added. The stopper is placed in the bottle and the whole thing is inverted repeatedly until solution is mixed. The bottle is left undisturbed until the precipitation has settled to about  $\frac{1}{2}$  the bottle and then 1 large powder pillow of sulfamic acid is added. The stopper is replaced and the bottle is again inverted repeatedly until mixed (a clear yellow to orange solution appears). The sample contents are poured into a 500mL Erlenmeyer flask and the sample solution is titrated (while flask is being agitated or stirred) with 0.037N sodium thiosulfate solution until sample is a pale straw color. A few drops of starch solution are added to the sample solution and the sample is titrated with the thiosulfate until the sample solution is clear and colorless. The dissolved oxygen measurement is read off the buret that dispenses the sodium thiosulfate and 1.0 ml of thiosulfate used to titrate equals 1.0 mg/L of dissolved oxygen. No calibration is needed and range is 0 to  $\sim$  mg/L dissolved oxygen. Note: chemicals used in this procedure are toxic, wear protective gloves while performing the titration.

**YSI Model 85 handheld oxygen, conductivity, and temperature system**

1. Turn the meter on- the instrument will activate all segments of the display for a few seconds, which will be followed by a self-test procedure that will last for several more seconds. During this power on self-test sequence, the instruments microprocessor is verifying that the instrument is working properly.
2. Select a measurement mode (dissolved oxygen %, dissolved oxygen mg/L, conductivity, specific conductance, or salinity). Temperature is always displayed. Selecting a measurement mode is accomplished by simply pressing and releasing the mode button. If the instrument is reading specific conductance (temperature compensated), the large numbers on the display will be followed by  $\mu\text{S}$  or  $\text{mS}$ . Additionally, the small portion of the display will show the  $^{\circ}\text{C}$  flashing on and off. If the instrument is reading conductivity (NOT temperature compensated), the large numbers on the display will be followed by either a  $\mu\text{S}$  or an  $\text{mS}$ ; however, the small portion of the display will show the  $^{\circ}\text{C}$  NOT flashing.
3. Lower electrode to the desired depth. Be sure not to disturb bottom substrates prior to or during measurement. If water is not moving sufficiently, then physically move the probe at least 1ft/second.
4. Record measurement
5. Cycle to the next measurement mode and record the next parameter. This step should be continued until measurements for all parameters are recorded.
6. Turn meter off and place electrode into storage chamber.

Note: If sampling sites are relatively close together, it is acceptable to leave the meter on until all measurements are recorded.

**Odor**

At the sample site, a plastic container is filled with sample water and then smelled by the collector. Odor, if any, is then noted. No calibration necessary. No range other than that of the smeller.

**Color****Hach Color CO-1**

Place the color wheel into the color comparator. Filter sample water through a nitrocellulose  $0.45\mu\text{m}$  HA filter into a sample vial to the top line. Fill the second vial to the line with colorless field blank water. While looking at color comparator, place sample water in right top opening. Place the colorless blank tube into opening on the left. Hold the comparator towards a light source (sun) and turn the wheel until it matches the color of the sample. No calibration is necessary. Range is 0-100 APHA Platinum Cobalt Units.

## **Turbidity**

### **Hach Model 2100P Portable Turbidimeter**

Samples are collected at a depth of 0.15 m with ½ pint bottles. An aliquot of each ½ pint is used for turbidity determination with a Hach Model 2100P Portable Turbidimeter. Sample water is gently mixed by turning the sample container over a few times, taking care not to create air bubbles. Water is then gently poured (again with no air bubbles) into a clean sample cell up to the line, the cell is capped and the sample cell is allowed to sit undisturbed for a few moments until any air bubbles that may have occurred have dissipated. Wipe any water off outside of glass with lint free tissue such as Kimwipes. Trail a thin line of silicon oil down side of glass and rub oil, enough to coat the sample cell, with provided black cloth. The Hach Model 2100P Portable Turbidimeter is turned on and sample cell is placed with downward arrow towards line near front of meter and lid is closed. The READ button is pressed and the average turbidity is recorded in NTUs.