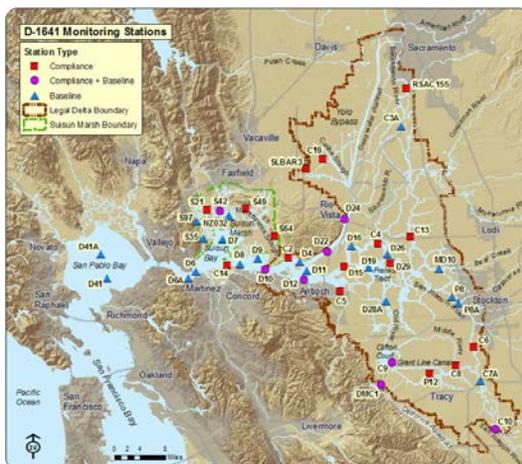


Quality Assurance Project Plan For the Bay-Delta Monitoring and Analysis Section

Environmental Water Quality and Estuarine Studies Branch
Office of Water Quality
Division of Environmental Sciences
California Department of Water Resources



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Table of Contents

TABLE OF CONTENTS	2
TABLES.....	5
FIGURES	5
1.0 INTRODUCTION	6
2.0 PURPOSE AND SCOPE.....	6
3.0 DISTRIBUTION LIST	6
4.0 PROJECT-TASK ORGANIZATION.....	6
FIGURE 4.1 PROJECT ORGANIZATIONAL CHART.....	7
5.0 PROBLEM DEFINITION AND BACKGROUND.....	8
5.1 DECISION STATEMENT.....	10
6.0 PROJECT TASK / DESCRIPTION	10
6.1 CONSTRAINTS.....	10
6.2 STUDY SITE DESCRIPTION.....	11
7.0 DATA QUALITY OBJECTIVES AND ACCEPTABILITY CRITERIA FOR MEASUREMENT DATA.....	11
7.1 REPRESENTATIVENESS AND BIAS.....	12
7.2 COMPLETENESS.....	12
7.3 ACTION LIMITS	12
TABLE 7.1 MEASUREMENT QUALITY OBJECTIVES FOR FIELD MEASUREMENTS.....	13
TABLE 7.2 MEASUREMENT QUALITY OBJECTIVES FOR LABORATORY ANALYSES	14
8.0 SPECIAL TRAINING REQUIREMENTS/SAFETY	16
8.1 TRAINING AND CERTIFICATION DOCUMENTS	16
8.2 TRAINING PERSONNEL	16
9.0 DOCUMENTATION AND RECORDS.....	16
9.1 DATA RECORDS.....	16
DOCUMENTATION FOR ANALYTICAL DATA WILL BE KEPT ON FILE AT THE LABORATORY AND WILL BE AVAILABLE FOR REVIEW DURING ANY EXTERNAL AUDITS. 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.	17
9.2 QAPP UPDATES AND DISTRIBUTION	17
9.3 DATA ARCHIVAL.....	17
9.3.1 Sample Collection Records	17
9.3.2 Field Records	17
9.3.3 Analytical Record Chain of Custody.....	18
9.3.4 Assessment Records.....	18

9.3 RECORDS RESPONSIBILITY18

9.4 ARCHIVE LOCATION AND DURATION18

9.5 RECORDS RESPONSIBILITY19

9.6 ELECTRONIC RECORDS RESPONSIBILITY19

10.0 SAMPLING PROCESS DESIGN19

10.1 PROGRAM DESIGN CONCEPT.....19

 10.1.1 Station Selection Rationale19

10.2 STATION TYPE20

10.3 STATION SELECTION INTENT20

10.4 TIMING SELECTION INTENT20

10.5 REACH SELECTION DESIGN20

10.6 STATION SELECTION DESIGN.....21

10.7 SEASONAL SAMPLING DESIGN21

10.8 DIURNAL SAMPLING DESIGN21

10.9 FIELD MEASUREMENTS TO SUPPORT LAB DATA.....21

10.10 NUMBER OF SITE VISITS21

10.11 SAMPLING FREQUENCY22

10.12 SAMPLING INTERVAL22

10.13 CONTINUOUS MONITORING.....22

10.14 SAMPLING WORK STATEMENT22

10.15 SOURCES OF UNCERTAINTY22

10.16 LOGISTICS, CONSTRAINTS, AND CONTINGENCIES.....23

10.17 RELATIVE IMPORTANCE OF COMPONENTS23

11.0 SAMPLING23

11.2 FIELD PREPARATION DESCRIPTION23

11.3 SAMPLE CONTAINERS23

11.4 SAMPLE PRESERVATION AND HOLDING TIMES24

TABLE 11.1 SAMPLE CONTAINERS, PRESERVATION, AND HOLDING TIMES25

(PLEASE SEE METADATA – SAMPLE HANDLING TABLE AT:25

[HTTP://WWW.WATER.CA.GOV/BDMS/DOCS/METADATA-SAMPLE-HANDLING.HTM](http://www.water.ca.gov/bdms/docs/metadata-sample-handling.htm))25

 11.4.1 Sample Preservation Description26

11.5 SAMPLE CONTAINER STERILIZATION26

 11.5.1 - Sample Container Cleaning26

11.6 SAMPLE CONTAINER LABELS26

11.7 SAMPLE EQUIPMENT26

11.8 RESPONSIBLE PERSON26

11.9 STANDARD OPERATING PROCEDURES27

12.0 SAMPLE HANDLING AND CUSTODY27

13.0 ANALYTICAL METHODS AND FIELD MEASUREMENTS28

13.1 CONTINUOUS MONITORING POTENTIAL PROBLEMS AND SOLUTIONS30

13.2 LABORATORY NAME30

13.3 RESPONSIBLE PERSON'S NAME CORRECTIVE ACTION AT THE LABORATORY30

13.4 LABORATORY METHOD FAILURE31

13.5 DOCUMENTING METHOD FAILURE	31
13.6 SAMPLE DISPOSAL	31
13.7 TURNAROUND TIME	31
14.1 QC SAMPLE DESCRIPTIONS	32
15.0 INSTRUMENT/EQUIPMENT TESTING, INSPECTION AND MAINTENANCE	34
15.1 FIELD MEASUREMENTS	35
15.2 LABORATORY ANALYSES	35
15.3 BIOLOGICAL MEASUREMENTS	35
16.0 INSTRUMENT/EQUIPMENT CALIBRATION AND FREQUENCY	36
16.1 FIELD MEASUREMENTS	36
16.2 LABORATORY ANALYSES	36
16.3 BIOLOGICAL MEASUREMENTS	36
17.0 INSPECTION/ACCEPTANCE OF SUPPLIES AND CONSUMABLES	37
18.0 NON-DIRECT MEASUREMENTS	37
18.1 USAGE LIMITS	38
19.0 DATA MANAGEMENT	38
19.1 FIELD DATA RECORD KEEPING	38
19.2 FIELD DATA SOP	38
19.3 FIELD DATA SHEETS	38
19.4 RESPONSIBILITY FOR FIELD MEASUREMENTS DATA	38
19.5 CONTINUOUS MONITORING DATA RECORD KEEPING	39
19.6 RESPONSIBILITY FOR CONTINUOUS MONITORING ANALYTICAL DATA	39
19.7 LABORATORY DATA MANAGEMENT SOP	39
19.8 LAB MEASUREMENT TYPES	39
19.9 RESPONSIBILITY FOR LABORATORY DATA MANAGEMENT	39
20.0 ASSESSMENTS AND RESPONSE ACTIONS	39
20.1 TYPES OF FIELD ASSESSMENTS	40
20.1.1 Responsibility for Readiness Reviews	40
20.1.2 Frequency for Readiness Reviews	40
20.1.3 Readiness Review Activities	40
20.1.4 Readiness Review Corrections	41
20.1.5 Responsibility for Field Activity Audits	41
20.1.6 Frequency for Field Activity Audits	41
20.1.7 Types of Field Activity Audits	41
20.1.8 Field Audit Corrections	41
20.1.9 Authority for Field Activity Stop Work	41
20.1.10 Responsibility for Post Sampling Event Reviews	41
20.1.11 Frequency of Post Sampling Event Reviews	42
20.1.12 Post Sampling Event Reviews	42
20.1.13 Post Sampling Event Documentation	42
20.2 LABORATORY ASSESSMENTS	42

20.2.1 Responsibility for Laboratory Data Review42

20.2.2 Frequency of Laboratory Data Reviews.....42

20.2.3 Laboratory Data Corrections42

20.2.4 Lab Re-testing Authority.....43

20.2.5 Responsibility for Laboratory Audits.....43

20.2.6 Frequency of Lab Audits43

20.2.7 Laboratory Audit Corrections.....43

20.2.8 Laboratory Proficiency.....43

21.0 REPORTS TO MANAGEMENT43

22.0 DATA REVIEW.....44

22.0.1 Responsibility for Data Reviews.....44

22.0.2 Checking for Typical Errors44

22.0.3 Checking Against MQOs44

22.0.4 Checking Against QA/QC.....44

22.0.5 Checking Field Data44

22.0.6 Checking Lab Data.....45

22.1 DATA VERIFICATION45

22.1.1 Responsibility for Data Verification45

22.2 DATA VALIDATION45

22.2.1 Responsibility for Data Validation.....45

22.3 DATA SEPARATION.....45

23.0 VERIFICATION AND VALIDATION METHODS46

24.0 RECONCILIATION WITH USER REQUIREMENTS46

25.0 REFERENCES47

APPENDIX A. FIELD SAMPLING PROCEDURES.....48

APPENDIX B. BASIC FIELD MEASUREMENTS49

APPENDIX C. BRYTE LABORATORY QUALITY ASSURANCE MANUAL52

APPENDIX D. DWR CHAINS OF CUSTODY.....52

APPENDIX E. MONITORING STATION LOCATION MAP.....53

TABLES

Table 11.1 Sample containers, preservation, and holdina times.....25

FIGURES

Figure 4.1 Project organizational chart.....7

1.0 Introduction

This Quality Assurance Project Plan (QAPP) documents the plans for collecting data required for the Bay-Delta Monitoring and Analysis ([BDMA](#)) Section of the Environmental Water Quality and Estuarine Studies ([EWQES](#)) Branch in the California Department of Water Resources, Division of Environmental Sciences, Office of Water Quality in West Sacramento, CA. We are including the sound, scientific approaches that are used in our data collection and analysis.

2.0 Purpose and Scope

The purpose of the BDMA sections' monitoring is to help answer the question "Do our data represent actual conditions that exist in the waters of the Bay-Delta?" In this document, we describe how and what we do in the collection and processing of discrete sampling of water quality, benthic, phytoplankton, zooplankton, and continuous real-time water quality data. We describe our verifications, and validation procedures used in our assessments to help assure that our data are as good as they possibly can be.

3.0 Distribution List

Project staff at the [BDMA Section](#) and State Water Resources Control Board (SWRCB) staff will receive copies of this Quality Assurance Project Plan (QAPP) and any approved revisions of the plan. The plan will be available online (<http://www.water.ca.gov/bdma>) so other interested parties also will be able to benefit from its content.

4.0 Project-Task Organization

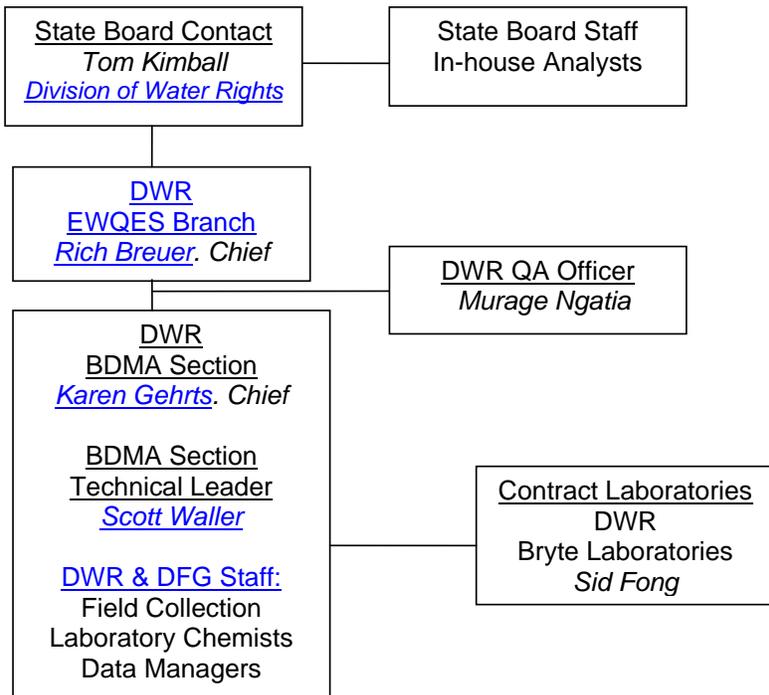
A coordinated monitoring program has been operated since the 1970's between the California Department of Water Resources ([DWR](#)) and the State Water Resources Control Board ([SWRCB](#)) in cooperation with the U.S. Bureau of Reclamation ([USBR](#)), with assistance from the California Department of Fish and Game ([DFG](#)), the U.S. Fish and Wildlife Service ([USFWS](#)), and the U.S. Geological Survey ([USGS](#)) under the Interagency Ecological Program ([IEP](#)) umbrella to provide information for water resource management in compliance with flow-rated water quality standards set forth in a series of Water Right Decisions ([D-1379](#), [D-1485](#), and [D-1641](#)). Since 1975, the [DWR Bryte Laboratory](#) has been responsible for laboratory analyses of inorganic and conventional analytes. The DWR Bryte Lab has maintained certification by the Environmental Protection Agency and the California Department of Health Services for water analysis since 1978. The results are entered into the Field and Laboratory Information Management System (FLIMS) data base. The Bay Delta Monitoring and Analysis ([BDMA](#)) Section has a contract with the Hydrozoology

Laboratory in Newcastle, CA to identify and enumerate macro-benthic organisms. On a regular basis data from the FLIMS database are loaded into DWR's Water Data Library ([WDL](#)) database. BDMA's laboratory results are retrieved from the WDL into BDMA's Discrete Water Quality database. After reviewing of the results for accuracy and completeness, BDMA's discrete water quality data are ??? exported electronically to the Bay-Delta and Tributaries Database (BDAT). All data have been available for download through the [BDAT web interface](#) that is now under re-development.. In the interim, the California Water Quality Monitoring Council ([CWQMC](#)) has been formed in response to [Senate Bill 1070](#) to improve coordination and cost-effectiveness of water quality and ecosystem monitoring and assessment, enhance integration of monitoring data, and increase public access to monitoring data. A [preliminary inventory](#) of monitoring programs has been produced and an online GIS-based [monitoring directory meta database](#) is being developed to help improve the coordination and integration of existing monitoring efforts.

Comment [b1]: 2008-present data have not been exported to BDAT due to issues between our discrete database and problems with BDAT. Currently, data is available upon request from Brianne or Scott. If BDAT is going to stay around we will work to resolve these issues and get our data exported.

The Project Organizational Chart (Figure 4.1) and job descriptions for the key project personnel are provided below to help assure data quality and timely delivery of reliable and usable monitoring data.

Figure 4.1 Project organizational chart



- The [EWQES Branch Chief](#) will provide supervision of all DWR tasks and people related to the project. The Branch Chief will be responsible for various project audits at their discretion in order to ensure the QAPP directives are met.
- The [BDMA Section Chief](#) 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 area. The [BDMA Section Technical Leader](#) of this Project is the author of the QAPP 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 DES **Quality Assurance (QA) Officer** works independently from the BDMA Section Chief and the BDMA Section Technical Leader and is responsible for the [DWR Division of Environmental Services \(DES\)](#) data meeting all quality objectives. **BDMA Staff 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

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 State Water Resources Control Board ([SWRCB](#)).

The SWRCB sets water quality objectives to protect beneficial uses of water in the Sacramento-San Joaquin Delta and Suisun Bay. These objectives are met by establishing standards mandated in water right permits issued to the Department of Water Resources (DWR) and U.S. Bureau of Reclamation (USBR) by the SWRCB. The standards include minimum Delta outflows, limits to Delta water export by the State Water Project (SWP) and the Central Valley Project (CVP), and maximum allowable salinity levels.

In 1971, the SWRCB established Water Right Decision 1379 ([D-1379](#)). This Decision contained new water quality requirements for the San Francisco Bay-Delta Estuary. D-1379 was also the first water right decision to provide terms and conditions for a comprehensive monitoring program to routinely determine water quality conditions and changes in environmental conditions within the estuary. The monitoring program described in D-1379 was developed by the Stanford

Research Institute through a contract with the SWRCB. Implementation of the monitoring program began in 1972, as SWRCB, DWR, and USBR met to define their individual responsibilities for various elements of the monitoring program. In 1978, amendments to water quality standards were implemented and resulted in Water Right Decision 1485 ([D-1485](#)). More recently these standards were again amended under the 1995 Water Quality Control Plan and Water Right Decision 1641 ([D-1641](#)) established in 1999. The SWP and CVP are currently operated to comply with the monitoring and reporting requirements described in D-1641. D-1641 requires DWR and USBR to conduct a comprehensive environmental monitoring program to determine compliance with the water quality standards and also to submit an annual report to SWRCB discussing data collected.

The original set of stations included both continuous recorders for salinity and temperature at shore stations and discrete sampling sites reached by boat or by road. The original number of discrete stations was expanded in 1978 to accommodate compliance monitoring for new water quality standards. In 1995, the number of stations was reduced to streamline monitoring efforts in the face of budgetary constraints and to free up funds for more special studies within the IEP. With the exception of one continuous multi-variable shore station (Sacramento River at Hood) and two entrapment zone stations (with variable location depending on bottom specific conductivity values), no completely new stations have been added throughout the program. Some [discrete currently sampled stations](#) have been moved over time to a nearby location to alleviate access problems or to shift from shore sampling to vessel sampling (or vice versa). In the BDMA data base, all moved stations are identified by a modified station name (usually the letter A is added). However, the original station names are generally retained in the successive water right decisions specifying monitoring requirements for the BDMA section. The list of all historically sampled discrete monitoring stations is available [online](#).

Similar to the sampling stations, most variables measured today are among the original variables measured in 1970. The most substantial changes occurred relatively recently with the addition of a [continuous monitoring network](#) recording multiple variables starting in 1983 (see [shore-based continuous monitoring metadata](#)), on-board recording of horizontal and vertical profiles of several constituents (see [vessel-based continuous monitoring metadata](#)), and the discontinuation of 15 discrete sampling sites starting in 1996. Heavy metal and pesticides monitoring was conducted twice a year from 1971 to 1995 and then discontinued. Zooplankton sampling was part of the original 1970 monitoring program, but then became a separate program until it was re-integrated in 1996. Water quality field measurements and chlorophyll a samples are taken at all the zooplankton monitoring stations although the complete set of water quality laboratory analyses is not acquired at each of these stations.

5.1 Decision Statement

Discrete water quality monitoring is one element of the Bay-Delta Monitoring and Analysis Section (BDMA) conducted by DWR and USBR with assistance from DFG and the USGS under the Interagency Ecological Program (IEP) umbrella. The BDMA also monitors water quality with a set of continuously recording automated stations, and it has complementary phytoplankton, zooplankton and benthic macro-invertebrates monitoring elements. The overall objective of the water quality monitoring program is to provide information for water resource management in compliance with flow-related water quality standards set forth in the series of Water Right Decisions described above. These decisions permit the USBR and DWR to appropriate water for operation of the CVP and the SWP. In return, the two agencies are required to monitor the effects of diversions and flow manipulations resulting from project operations and ensure the compliance with existing water quality standards. Another objective of the BDMA water quality monitoring is to provide abiotic (non-living chemical and physical factors) information relevant to the interpretation of the results of the biological monitoring elements.

6.0 Project Task / Description

For the discrete water quality monitoring from 1975 to 1994 water samples were acquired monthly in the rainy season (October or November to February or March) and bimonthly in the dry season (from March or April to September or October); with the following exceptions: 1983 monthly sampling all year, 1984 bimonthly in July to September; 1986 and 1994 bimonthly from June to September, 1993 bimonthly in July. Some constituents were sampled less often: metals and pesticides were sampled twice a year in May and September. Since 1995, samples have been acquired monthly, with the exception of three stations (NZ002, NZ004, and NZ325) that are sampled only when the surface specific conductivity is below 20,000 $\mu\text{S}/\text{cm}$.

Since 1975, the sampling times were planned to occur within a one hour window of the expected occurrence of high tide slack at each sampling location.

6.1 Constraints

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

- Flow data may be unavailable at some locations, and flow data gaps may exist when using data from other agencies.
- Inclement weather 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 BDMA Section Chief will be notified immediately; the problem will be addressed and recorded in the project notes.

6.2 Study Site Description

The study area includes the Delta within its legal boundaries, Suisun Bay and Suisun Marsh, and northeastern San Pablo Bay bounded by a line between Pinole Point on the east and the Solano County line on the north shore. The BDMA sampling sites range from San Pablo Bay east through the upper Estuary to the mouths of the Sacramento, Mokelumne, and San Joaquin rivers. These sites represent the main inflows and outflows of the Sacramento-San Joaquin Delta, and Suisun Bay and Suisun Marsh. Currently, 19 sites are sampled monthly throughout the year and three sites are sampled monthly during certain seasons.

The lists of active and historically sampled discrete water quality monitoring stations are available online at: http://water.ca.gov/bdma/docs/discreteWQ_currently_sampled_stations.pdf and at http://water.ca.gov/bdma/docs/discreteWQ_historically_sampled_stations.pdf respectively, and in Appendix E. The map of active and historic stations is available at: http://water.ca.gov/bdma/images/Metadata-DiscreteWQ_stations.jpg and in Appendix B.

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).

The MQOs for field measurements are listed in Table 7.1. (we need to review this table to confirm that it is appropriate for our monitoring). Table 7.2 (we need to review this table to confirm that it is appropriate for our monitoring). lists the MQOs for laboratory analyses. 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 BDMA Technical Leader to produce viable data of known and accepted quality.

7.1 Representativeness and Bias

Representativeness describes how relevant the data are to the actual environmental condition. An important role of technical advisory personnel is 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 and by strictly adhering to all aspects of these documents and method Standard Operating Procedures (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.

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.

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%	StablCal 2100P Calibration Set	three months

Table 7.2 Measurement quality objectives for laboratory analyses

Quality Control	Frequency of Analysis	Measurement Quality Objective
Conventional Analytes		
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
Conventional Analytes - Solids		
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
Inorganic Analytes		
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 either sample<RL)
Field Blank, Equipment Blank	One per field run or per method	<RL for target analyte
Bioassessment		
Taxonomy Verification		
Field Duplicate	20% of samples	

8.0 Special Training Requirements/Safety

Specialized training required for this project is an eight hour DWR water quality basics training course (do we take this course?). This course will be taken by 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.

Comment [b2]: We don't require this class. Our WQ training is provided on the job by the crew chief or experienced field staff. However, I'm sure this class would be a valuable addition to our training.

Technical leaders will take a data validation class (how about these courses?), 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

Benthic sampling is also a routine part of the BDMA monitoring program with additional special studies like the Small Scale Spatial Variability Study (SSSVS) and Generalized Random Tessellation Stratified (GRTS) sampling . In 2005, the SSSVS provided additional information on species richness, abundance and variability in a 64 hectare neighborhood around each of 6 benthic monitoring sites in April and July. The GRTS sampling was initiated in 2007 and is expected to continue until 2011 at 175 sites from San Pablo Bay to Stockton and lower Cache Slough to Clifton Court Forebay. The goal of both studies are to develop a more comprehensive and accurate method of monitoring and analyzing the Delta benthos. A, valid CA DFG scientific collecting permit is (?) required. DWR also requires anyone the works in the field to attend an environmental responsibility course.

8.2 Training Personnel

The BDMA Section Chief and the BDMA Technical Leader 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.

9.1 Data Records

All field data gathered by this project will be recorded on field data entry forms. Original field data sheets will be stored in binders at the BDMA office and are scanned to PDF format after each sampling run and stored on the Bay Delta Monitoring and Analysis section's servers indefinitely.

Documentation for analytical data will be kept on file at the laboratory and will be available for review during any external audits. 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.

9.2 QAPP Updates and Distribution

The Technical Leader will be responsible for developing, maintaining, and updating the Quality Assurance Project Plan (QAPP) and it will be held at the BDMA section. 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 kept on file for reference.

9.3 Data Archival

Hard copy field sheets will be stored in the BDMA section office. After being scanned to a PDF format field sheets will be stored for at least 10 years. All PDF files will be stored on the BDMA section's servers, which are backed up on a daily basis. PDF files will be stored indefinitely on DWR Bay Delta Monitoring and Analysis section's servers or until they are incorporated into the WDL.

9.3.1 Sample Collection Records

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

9.3.2 Field Records

Hard copy field sheets containing field observations and field data entries will be stored in the DWR Bay Delta Monitoring and Analysis section. After being scanned to a PDF format, field sheets will be stored for at least 10 years. All PDF files will be stored on the DWR Bay Delta Monitoring and Analysis section's servers which are backed up on a daily basis. PDF files will be stored indefinitely on DWR Bay Delta Monitoring and Analysis section's servers or until they are incorporated into the WDL.

9.3.3 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.

9.3.4 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 Bay Delta Monitoring and Analysis section. These documents will be organized and kept up-to-date by the BDMA section Chief or designated DWR staff.

Annually, the BDMA section will prepare a brief report summarizing the data analyzed to date. This report will be submitted to the State Water Resources Control Board in compliance with D-1641. The Bay Delta Monitoring and Analysis section will prepare Fact Sheets (?) summarizing the project findings. All assessment reports will be stored digitally in a dedicated directory on the DWR Bay Delta Monitoring and Analysis section's server. Fact Sheets will be made available to the public on the Bay Delta Monitoring and Analysis section's website..

9.3 Records Responsibility

The BDMA section Chief 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 section will be stored at the BDMA section office. All lab records will also be stored at Bryte Laboratory in West Sacramento. Copies of the records will be maintained at the BDMA and Bryte Laboratory in West Sacramento for five years following project completion. Data files will be maintained indefinitely.

9.5 Records Responsibility

DWR's Bryte Laboratory will archive all analytical records generated for this section. The BDMA section Chief 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. 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 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 Bay-Delta (generally near the mouth) and at selected main stem Sacramento and San Joaquin 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

The BDMA sections discrete monitoring network now contains 20 active stations that were selected using the Program Design Concept to adequately cover the Bay-Delta. Rationale for selection and history for stations may be found online at: http://www.water.ca.gov/bdma/docs/discreteWQ_stations_rationale_and_history.pdf

10.2 Station Type

All stations are on streams or bays

10.3 Station Selection Intent

Station selection criteria include the following:

- Source identification – to identify the source of a given constituent within the BDMA section network and/or related to land use activities. (Delete?)
- 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 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 purposes behind the timing of the monitoring at the selected stations are:

- 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.

10.10 Number of Site Visits

Each site will be visited every month for, each visit will include three basic types of field activities (observations, field measurements, and sample collection).

10.11 Sampling Frequency

Sampling will occur monthly, with the exception of the GRTS and HOBO temperature loggers which will be continuously monitoring every 15 to 60 minutes for water temperature, EC, pH, dissolved oxygen, turbidity, chlorophyll fluorescence, tidal elevation, and meteorological data (air temperature, wind speed and direction, & solar radiation). ?

10.12 Sampling Interval

The sampling interval for this project is monthly, except for the GRTS which is semi-annual.

10.13 Continuous Monitoring

Continuous monitoring data loggers are employed to collect water and meteorological data for the project. The following list gives details about the monitoring instrumentation used: ??

- Deployment duration will last for the length of the project

10.14 Sampling Work Statement

DWR field crews will:

- Prepare field equipment and label appropriate bottles for water collection.
- Crews will visit 20 Stations monthly.
- Fill sample bottles according to Bryte Lab protocols.
- Measure: DO, temperature, specific conductance , pH, and turbidity.
- Fill out DWR data sheets recording field data and site observations
- Download temperature logger data

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 taken 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 monitored, and is often much wider than the measurement error. Natural variability includes seasonal changes in flow levels and source waters. ?
- 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 training and sampling methods. Representativeness and bias are addressed in more detail in Element 7.1.

10.16 Logistics, Constraints, and Contingencies

Following each sampling event, all samples will be delivered to the DWR Bryte laboratory in a timely manner to ensure adequate time for analysis within the holding time.

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 for informational purposes only.

11.0 Sampling

Field personnel will adhere to recommended 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 BDMA Section Chief. 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 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 DWR Bryte Laboratory will supply all necessary sampling containers to the DWR Bay Delta Monitoring and Analysis 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 handling methods are listed in Table 11.1.

Table 11.1 Sample containers, preservation, and holdina times

(Please see Metadata – Sample handling table at:

<http://www.water.ca.gov/bdma/docs/Metadata-Sample-handling.htm>)

Upon returning to the DWR BDMA 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.

11.4.1 Sample Preservation Description

Some samples will require preservation in the field (do we have any that require preservation?). 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.

Comment [b3]: I don't think these apply to our sampling. Should they be left in in case we ever sample pathogens or metals for a special study?

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

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

Benthic sample collection will be conducted according to *Standard Operating Procedures for Collecting Benthic Samples and Associated Physical and Chemical Data for Ambient Bioassessments in California* available at <http://???>

12.0 Sample Handling and Custody

- The BDMA Technical Leader 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 Bryte Laboratory will maintain custody logs sufficient to track each sample submitted and to analyze or preserve each sample within specified holding times. The Bryte Laboratory has a sample custodian who examines the samples for correct documentation, proper preservation and holding times. The laboratory follows sample custody procedures outlined in its QA plans, which are on file.
- In the field, all samples are 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.(?)

- 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 the samples to the Bryte Laboratory will be by DWR 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 (Appendix C)
- Benthic sampling and analysis 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)
Conventional Analytes		
Total Suspended Solids	EPA 160.2	1
Alkalinity	SM 2320 B	1
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

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 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

Impediments that would impair obtaining data that is representative of stations where in-situ monitoring is performed include instrument calibration drift and build up of materials on probes. These impediments are minimized by frequent site visits where the instruments are serviced and recalibrated. Data are adjusted as needed following recalibration to produce the most accurate results possible. Continuous monitoring at all stations is subject to vandalism and equipment failure. We will download the data from the temperature loggers and will record 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 enter the analyses for all inorganic and conventional analytes into FLMS???

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 comparable data during the analysis of the proposed project's samples.

Table 13.3 Laboratory responsible persons

Laboratory	Responsible Person	Title
DWR Bryte	Sid Fong	Laboratory Manager
Hydrozoology Laboratory	Wayne Field	Laboratory Manager
DFG-Zooplankton	April Hennessee	Environmental Scientist

Eco-Analysts, Inc.	Julia Eichman	Phytoplankton Analyst
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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.

13.5 Documenting Method Failure

When a method fails to provide comparable data, the nature and disposition of the problem must be documented in the data report that is sent to the BDMA Section Chief.

13.6 Sample Disposal

After analysis of the project samples the Bryte Laboratory staff 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 Turnaround Time

Turnaround times for sample analyses will be as fast as possible based on the laboratory's work load. However, the turnaround times will not exceed the holding times that are listed in Table 11.1. The laboratory understands and agrees to meet the turnaround times needed for our proposed sample analyses.

14.0 QA/QC

Quality Assurance and Quality Control (QA/QC) 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 sub sampling 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.

Comment [b4]: We don't do this.

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 before (?), about the middle of a sample run, and again at the end (?). and the results will be recorded on the field data sheets(?).When dissolved oxygen is measured it is 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 on the field data sheets. 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..

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

- 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 BDMA Section Chief. 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, or Reference Materials") provide bias information about a laboratory's ability to perform acceptable analyses on a clean matrix with the chosen methods. The LCS is 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 BDMA Technical Leader 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..

Spare parts for field equipment are stored at the BDMA 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.

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

16.0 Instrument/Equipment Calibration and Frequency

The BDMA Technical Leader 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 measured.

Deficiencies will be documented by the BDMA Technical Leader and reported to the BDMA Section Chief. After resolution of the deficiency the Technical Leader will document the problem and will provide recommendations to prevent future occurrences

16.1 Field Measurements

- DO - manufacturer's (?) suggestion to perform this function at the start of each sample run will be followed.
- Temperature - Instrument calibration will be performed at least twice a year against a U.S. Department of Commerce, National Institute of Standards and Technology (NIST) certified thermometer.
- Conductivity The manufacturer's suggestion to perform this function at the start of each sample run will be followed.
- pH - Instrument calibration will be performed at the start of each sample run.
- Turbidity - instrument calibration will be performed at the start of each sample run. -

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%.

16.3 Biological Measurements

There are no requirements for instrument/equipment calibration and frequency for benthic, phytoplankton or zooplankton measurements.

17.0 Inspection/acceptance of Supplies and Consumables

–The BDMA Technical Leader 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 by the BDMA Field Staff 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 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 quantification levels, and the selectivity of a method (or lack of selectivity) for the target analytes will be used to judge whether the external ? (do we, or is it possible that we might use other people's data?)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 and reported to the data source agency. 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). Field data will be stored in the WDL and BDMA databases. 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 Technical Leader will verify sample identification and review the chain of custody forms. Working with field and laboratory staff, the Technical Leader 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 BDMA Technical Leader, they will be brought to the attention of the BDMA Section Chief 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 for this project.

19.3 Field Data Sheets

Field data sheets developed for FLIMS and by BDMA staff are used in this project.

19.4 Responsibility for Field Measurements Data

The BDMA Technical Leader will be responsible for field measurement data management. All field data sheets, lab submittal sheets, and other documentation will be securely stored at the BDMA office.

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 EWQES Branch BDMA Servers indefinitely.

19.6 Responsibility for Continuous Monitoring Analytical Data

The BDMA Technical Leader will be responsible for continuously monitored analytical data management. (Do we need to add Mike Dempsey to the Org Chart?)

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. ?

19.8 Lab Measurement Types

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

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. BDMA will be responsible for data management for discrete (benthic and phytoplankton) and Continuous data. DFG Technical Leader will be responsible for data management involving zooplankton 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 BDMA Technical Leader will report any problems detected and the corrective measures taken to the BDMA Section Chief 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 BDMA Technical Leader 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

The BDMA Technical Leader 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? 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 BDMA Technical Leader ??) 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 the DWR Bryte 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 BDMA Section Chief 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 BDMA Section Chief shall provide an update to the EWQES Branch Chief 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 BDMA Section Chief shall submit an Annual Report to the EWQES Branch Chief ? or SWRCB? 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 BDMA Section Chief and the BDMA Technical Leader 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 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 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 the data are comparable with respect to completeness, correctness, and conformance with minimum requirements.

22.1.1 Responsibility for Data Verification

The BDMA Section Chief will be responsible for verification of data going into the WDL.

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 are comparable with respect to their end use.

22.2.1 Responsibility for Data Validation

The BDMA Section Chief will be responsible for validation of data going into the WDL.

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.

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.

Any data that is discovered to be incorrect or missing during the verification or validation process will immediately be reported to the BDMA Section Chief. 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. 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 BDMA Section Chief has the final authority to resolve any issues that may be identified during the verification and validation process.

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 project will provide 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 and, subject to physical habitat limitations, the data generated will be useable for comparative purposes by other water monitoring projects. The above evaluations will provide a comprehensive assessment of how well the project meets its objectives. No other evaluations will be used.

The BDMA Section Chief will be responsible for reporting project reconciliation. This will include measurements of how well the project objectives were met

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/>

Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary, December 13, 2006,
http://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/wq_control_plans/2006wqcp/docs/2006_plan_final.pdf

Appendix A. Field Sampling Procedures

DWR Bay Delta Monitoring and Analysis Section Standard Operating Procedures Field Sampling Procedures

?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.

Appendix B. Basic Field Measurements

DWR Bay Delta Monitoring and Analysis Section 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 μS or 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 μS or an 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 μS or 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 μS or an 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 ~ 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 μS or 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 μS or an 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 μm 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.

Appendix C. Bryte Laboratory Quality Assurance Manual

[Bryte Lab 2006 Quality Assurance Manual](#)

http://www.wq.water.ca.gov/docs/bryte_pubs/Bryte_QA_Manual_2006.pdf

Appendix D. DWR Chains of Custody

