Los Angeles River Watershed Monitoring Program

Quality Assurance Project Plan

Prepared by
Council for Watershed Health
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&

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June, 2024

Group A Elements: Project Management

1.1 Title & Approval Sheets

Quality Assurance Project Plan

PROJECT: Los Angeles River Watershed Monitoring Program (LARWMP)

DATE: June 24, 2024

RESPONSIBLE ORGANIZATION: Aquatic Bioassay & Consulting Laboratories
29 N. Olive St.
Ventura, CA 93001

APPROVAL SIGNATURES

Grant Organization

_____ _____
Yareli Sanchez, Project Director Date
Council for Watershed Health

_____ _____
Scott Johnson, Project Manager Date
Aquatic Bioassay & Consulting Laboratories

_____ _____
Karin Wisenbaker, QA Officer Date
Aquatic Bioassay & Consulting Laboratories

_____ _____
Raphael Mazor, LARWMP Stakeholder Workgroup Date
SCCWRP

Funding Organizations

_____ _____
Farhana Mohamed, Division Manager, EMD Date
City of Los Angeles, LA Sanitation and Environment

_____ _____
Rizalina Hamblin, EMD QA Officer Date
City of Los Angeles, LA Sanitation and Environment

_____ _____
Stephen Walker, Assistant Public Works Director Date
City of Burbank, Department of Public Works

2.0 Table of Contents

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Distribution List

The final Quality Assurance Project Plan (QAPP) will be kept on file at Council for Watershed Health (CWH) offices and can be downloaded from the LARWMP program page www.watershedhealth.org/reports. The following individuals will receive copies of the approved QAPP and any subsequent revisions:

Name, Affiliation, Contact Information	Project Title
Yareli Sanchez Council for Watershed Health 177 E. Colorado Blvd., Suite 200 yareli@watershedhealth.org (213) 229-9945	Project Director
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3.0 Project/Task Organization

3.1 Involved Parties and Roles

Council for Watershed Health (CWH) is a 501(c)(3) non-profit organization working cooperatively with community groups, government agencies, business and academia to solve environmental issues in the Los Angeles River Watershed. The mission of the Council is to facilitate an inclusive consensus process to preserve, restore, and enhance the economic, social, and ecological health of watersheds through education, research, and planning. As the lead agency in this project, CWH will oversee and administer the sample collection, analysis of samples, data management, annual summary report and the maintenance of contracts with the Cities of Los Angeles and Burbank.

Other agencies participating in the program, either through provision of in-kind services, budgetary support or participation on the Los Angeles River Watershed Monitoring Program (LARWMP) Stakeholder Workgroup includes:

Stakeholder Workgroup
Arroyo Seco Foundation
City of Burbank
City of Downey
City of Los Angeles
Friends of the Los Angeles River
Heal the Bay
Las Virgenes Municipal Water District (LVMWD)
Los Angeles County Flood Control District (LACFCD)
Council for Watershed Health (CWH)
Los Angeles Regional Water Quality Control Board
Southern California Coastal Water Research Project (SCCWRP)
U.S. Environmental Protection Agency (USEPA)
U.S. Forest Service

In addition to these workgroup members, invited experts provided valuable information and advice on a number of key issues.

Aquatic Bioassay and Consulting Laboratories (Aquatic Bioassay) is the lead consultant on this project, responsible for project management, organization of sample collection, analysis of samples and data, quality assurance (QA), assisting with the coordination of stakeholder groups, reporting to the LARWMP Workgroup, and ensuring the timely completion of all electronic data submittal products. In addition, Aquatic Bioassay will collect bioassessment, water and sediment samples, and analyze bioassessment samples. Scott Johnson will be the Project Manager for this study and has established a project team for planning and conducting the study (Table 1, Figure 1).

Several agencies will be providing field sampling and analytical services to the project including the City of Los Angeles' LA Sanitation and Environment (CLA EMD) and the Los Angeles County Flood Control District (LACFCD). Weston Solutions Laboratories will conduct bioassessment sampling for the LACFCD.

3.2 Quality Assurance Officer Role

Karin Wisenbaker will be the QA Officer. Ms. Wisenbaker's role is to establish the quality assurance and quality control (QA/QC) procedures found in this QAPP as part of the sampling and analysis procedures. Ms. Wisenbaker will work with field and laboratory managers by communicating all QA/QC issues contained within this QAPP.

Ms. Wisenbaker will also review and assess all procedures during the life of the contract against QAPP requirements. Ms. Wisenbaker will report all findings to Scott Johnson, including all requests for corrective action. Ms. Wisenbaker may stop all tasks, including those conducted by Aquatic Bioassay, and Weston, CLA EMD Labs, if there are significant deviations from required practices or if there is evidence of a systematic failure. Pertinent QC issues will be communicated by Scott Johnson or Karin Wisenbaker to Yareli Sanchez (Project Director).

3.3 Persons Responsible for QAPP Update and Maintenance.

Changes and updates to this QAPP may be made after a review of the evidence for change by the Project Director, Project Manager, QA Officer, and Stakeholder Workgroup Representative. The Project Manager will be responsible for making the changes, submitting drafts for review, preparing a final copy, and submitting the final for signature. Changes to the 2024 QAPP are presented in Table 2.

Table 1. Personnel responsibilities.

Name	Organizational Affiliation	Title	Contact Information
Yareli Sanchez	CWH	Project Director	Tel: 213 229 9945 FAX: 213 229 9945 yareli@watershedhealth.org
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Karin Wisenbaker	Aquatic Bioassay	Project QC Officer; Project Data Manager	Tel: 805 643 5621 x170 FAX: 805 643 2930 karin@aquaticbioassay.com
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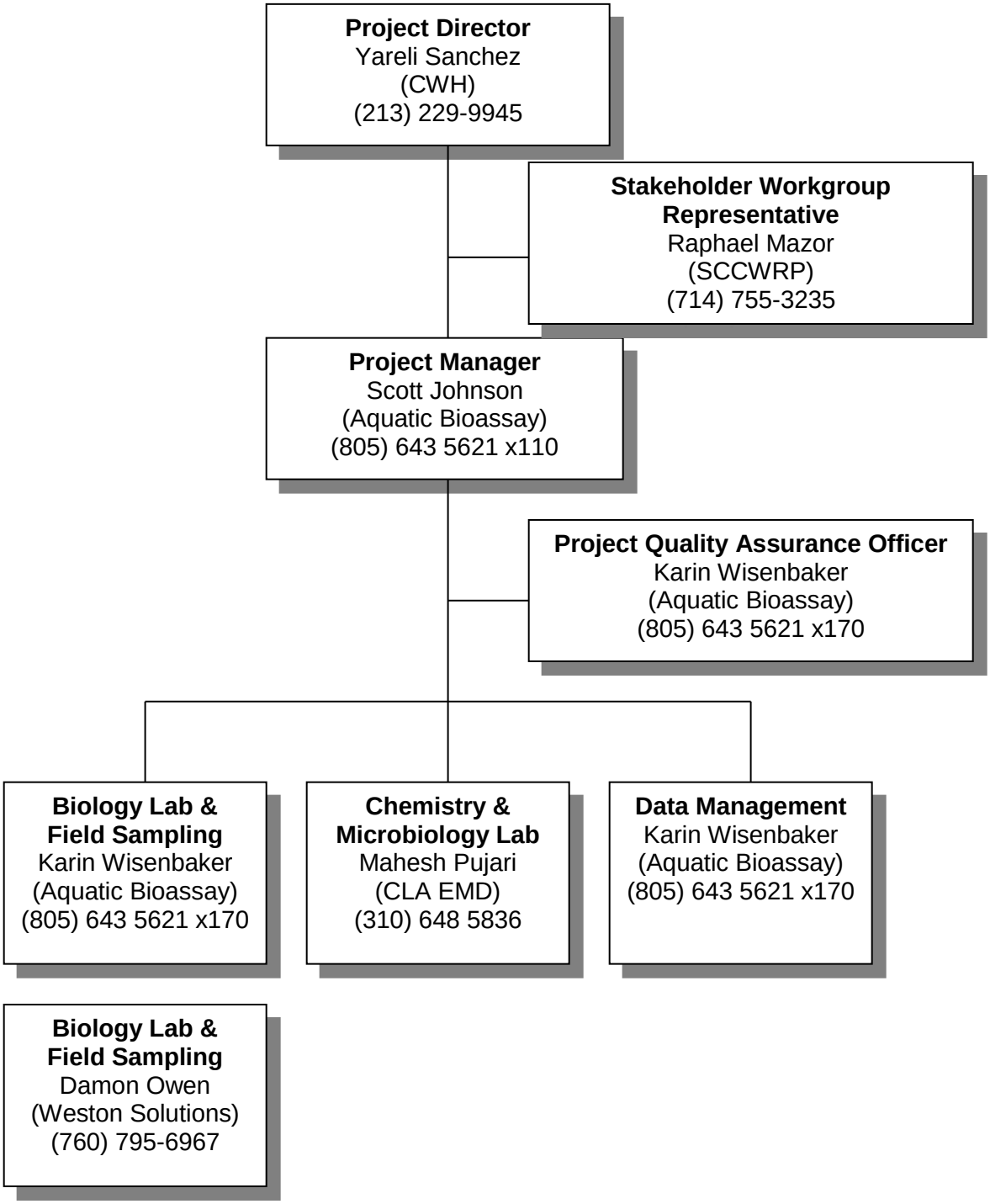
Table 2. Summary of changes to the 2024 QAPP.

Section	Changes
Section 5.3 Project Schedule	Project tasks start and end dates updated.
Section 13.1.1 Sample Equipment Cleaning Procedures	Sampling gear decontamination options updated. Hot water immersion increased soak time to 30 minutes at 50° C and drying time to 14°C for 8 days OR 35°C for 30 hours OR 70°C for 15 minutes. Freezing is no longer an option.

3.4 Organizational Chart and Responsibilities

Figure 1. Organization chart



4.0 Problem Statement/Background

4.1 Problem Statement

The development of a watershed-wide monitoring program for the Los Angeles River is a direct response to a NPDES permit requirement established by the Los Angeles Regional Water Quality Control Board (LARWQCB) for the City of Los Angeles' Los Angeles-Glendale and Donald C. Tillman Water Reclamation Plants, for the Burbank Water Reclamation Plant, and for Las Virgenes Municipal Water District's (LVMWD) Tapia Treatment Plant. For purposes of discussion, this program is termed the Los Angeles River Watershed Monitoring Program (LARWMP). This requirement stemmed, not from any specific contamination problem or discharge condition, but from a broader desire by LARWQCB staff for more information on the environmental conditions of the entire length of the Los Angeles River, integrated information about ambient conditions across the watershed as a whole and about patterns and trends in those conditions. This was a natural response to the growing awareness that watersheds involve habitats, physical features, and processes (both human and natural) that stretch across typical regulatory and management boundaries and are not well captured by current compliance monitoring programs. The regional monitoring design proposed here can be seen as a watershed-scale counterpart to existing larger-scale regional monitoring efforts in the southern California region (e.g., the state's Surface Water Ambient Monitoring Program (SWAMP), the Stormwater Monitoring Coalition's (SMC) regional watershed assessment program, U.S. EPA's Western Environmental Monitoring and Assessment Program (EMAP), and the Southern California Bight Regional Monitoring that attempt to address questions and concerns about regional condition and trends. The program presented here parallels the program implemented for the San Gabriel River Watershed in its intent to incorporate local and site-specific issues within a broader watershed-scale perspective.

The LARWMP is designed to complement and/or coordinate with the State Water Resources Control Board's SWAMP effort in the Los Angeles River watershed and with the related SMC southern California watershed assessment program. This includes both the coordination of sampling effort and the use of consistent field sampling and laboratory analysis methods. In addition, the proposed program uses tools developed by the SWAMP and the Southern California Wetlands Recovery Project for the regional assessment of biologic conditions in streams and channels, as well as monitoring design approaches developed by the SMC's model stormwater monitoring program.

The LARWMP Workgroup identified a subset of the beneficial uses in the region's Basin Plan that served as the central focus for the proposed regional monitoring design. These beneficial uses relate primarily to habitat conditions and to recreational uses of the watershed (Table 3).

Table 3. LARWMP Workgroup's beneficial uses in the region's Basin Plan.

Beneficial use	Q1: Stream condition	Q2: Unique areas	Q3: Discharges	Q4: Safe to Recreate	Q5: Safe to eat fish

Warm freshwater habitat	X	X	X		
Cold freshwater habitat	X	X			
Estuarine habitat		X	X		
Wildlife habitat	X	X	X		
Water Contact recreation				X	
Commercial, sport fishing					X

The LARWMP Workgroup articulated five core management questions, related to the priority beneficial uses:

- Question 1: What is the condition of streams in the watershed?
- Question 2: Are conditions at areas of unique interest getting better or worse?
- Question 3: Are receiving waters near discharges meeting water quality objectives?
- Question 4: Is it safe to recreate?
- Question 5: Are locally caught fish safe to eat?

These questions reflect specific concerns about different aspects of the Los Angeles River watershed and the impacts of human activities. For each question, the LARWMP describes a monitoring design, including its overall approach and rationale, indicators to be measured, recommended monitoring sites and frequencies, and expected data products. The LARWMP also identifies recommended modifications to some existing efforts that would bring them into line with the proposed regional program. The monitoring program document can be obtained from CWH's website (https://www.watershedhealth.org/larwmp).

4.2 Decisions or Outcomes

The objective of this monitoring program is to assess the status of five key Los Angeles River watershed beneficial uses that include: the condition of stream health, areas of unique interest, adherence of receiving waters near discharges with water quality objectives, water contact recreation, and fish consumption. The data generated by this monitoring program will be used to assess the condition of each of these beneficial uses over time, so that watershed managers can make decisions regarding the preservation of resources that are found to be unimpaired and the development of best management practices (BMPs) where resources are found to be impaired.

5.0 Project/Task Description

5.1 Work Statement and Produced Products

Aquatic Bioassay shall be responsible for performing the work as described below and for the preparation of products and a final report as specified in the LARWMP Program Document. Aquatic Bioassay shall promptly notify the CWH Program Director of events or proposed changes that could affect the scope, budget, or schedule of work performed under this Agreement. Unless otherwise specified in the Agreement, all deliverables shall be provided to the Program Manager, Contract Manager, and members of the LARWMP Workgroup.

The monitoring program can be divided into three main components:

Core monitoring includes long-term monitoring, intended to track compliance with regulatory requirements or limits, to conduct ongoing assessments, and to track trends in certain important conditions over time. Thus, core monitoring generally occurs at fixed stations that are sampled routinely over time.

Regional monitoring includes cooperative studies that provide a larger-scale view of conditions and can be used to assess the cumulative anthropogenic and natural effects on the environment. Regional monitoring also helps to place particular impacts in perspective by comparing local results (i.e., core monitoring) to the breadth and depth of human impacts and natural variability found throughout a larger region.

Special projects include targeted studies included as adaptive elements within core or regional monitoring designs. These are shorter-term efforts, with a specified beginning, middle, and end, intended to extend or provide more insight into core monitoring results. For example, these efforts include investigating sources that may be contributing to a receiving water problem.

The regional program focuses primarily on core monitoring and regional monitoring priorities, leaving special projects, at this point, as the responsibility of the individual program partners.

Question 1: What is the Condition of Streams in the Watershed?

The monitoring design recommended to address this question has the following elements:

- A randomized, or probabilistic, sampling scheme that includes the entire watershed, except for ephemeral streams, down to the upper boundary of the estuary;
- To ensure a representative distribution of sampling sites, the watershed is treated as a single stratum, with subpopulations. Subpopulations are defined for the upper watershed streams dominated by natural flows, effluent dominated flows, and tributaries in the lower watershed dominated by urban runoff;

- Monitoring includes two randomly selected sites and eight revisit sites. Revisit sites include:
    - 2 revisit sites sampled annually
    - 2 revisit sites sampled annually for 4 years (2022-2025)
    - 4 new revisit sites each year
- Monitoring occurring in the late spring and summer, which includes bioassessment and water chemistry; and
- Measures of physical habitat characteristics collected coincident with bioassessment, including both the SWAMP Bioassessment Procedures (2016) method and the California Rapid Assessment Method (CRAM).

The types of data products resulting from this monitoring design and appropriate for answering Question 1 may include several deliverables:

- Cumulative frequency distribution plots of key individual indicators or metrics and of synthesized triad results or condition scores;
- Estimates of the stream reach miles in the watershed above/below benchmarks of interest for key indicators and for synthesized triad results;
- Maps of the areal distribution of monitoring sites in the watershed above/below benchmarks of interest for key indicators and for synthesized triad results;
- Estimates of difference in status between the upper and lower watershed, and between the mainstem and tributaries;
- Trends over time in the estimates of watershed condition; and
- Classify sites as improving, degrading, or stable.

Question 2: Are Conditions at Areas of Unique Interest Getting Better or Worse?

The component of the regional monitoring program to address these questions is intended primarily as a trend monitoring effort and has the following three recommended elements:

- For high value / high risk sites in the freshwater portion of the watershed:
    - A fixed design that focuses on a small number (e.g., 5 – 10) of specific locations and minimally impacted sites;
    - An emphasis on habitat conditions rather than water quality;
    - Sampling will take place in the spring to coordinate with monitoring for Question 1; and
    - Monitoring will be structured around the CRAM approach.
- For targeted sites with special concerns:
    - A fixed design that focuses on specific locations;
    - Monitoring based on the triad of bioassessment, and water quality; and
    - Sampling will take place in the spring to coordinate with monitoring for Question 1.

Several types of data products resulting from this monitoring design are appropriate for answering Question 2:

- For high value / high risk sites in the freshwater portion of the watershed:
  - Site-by-site summaries of the quantitative scoring of CRAM attributes and trends in these sites over time;
  - Site-by-site comparisons of CRAM attributes between high value / high risk and minimally impacted sites; and
  - Site-by-site interpretations and conclusions of habitat status and trends.

Question 3: Are Receiving Waters Near Discharges Meeting Water Quality Objectives?

The monitoring design recommended to address this question has the following elements:

- Water chemistry monitoring at a regular frequency above and below each major discharge point.

Several types of data products resulting from this monitoring design are appropriate for answering Question 3:

- Site-by-site summaries of each sampled data type (tables and figures of individual measurements and relevant averages);
- Site-by-site interpretations and conclusions based on synthesized results (narrative conclusions, decision trees specifying adaptive responses to monitoring results);
- Comparisons across sites for each sampled data type (tables highlighting differences, cumulative frequency distributions, maps);
- Comparisons across sites for synthesized results (narrative conclusions, decision trees, cumulative frequency distributions, maps); and
- Trend plots over time of increases / decreases in parameters of interest.

Question 4: Is It Safe to Recreate?

This information could be used by Los Angeles County Department of Public Health (LACDPH) to help manage health risk and by the LARWQCB to assess progress toward meeting water quality objectives both at the watershed scale and within selected reaches of the river. There is currently only limited monitoring at locations where recreational use most commonly occurs. Monitoring at sentinel sites will be conducted by the regional monitoring program. Monitoring at inland recreation areas could be conducted in cooperation with volunteer agencies and/or with the County Department of Health Services. Beach monitoring is conducted by the City of Long Beach.

The monitoring design developed to address this question has three main elements:

- A focus on sites with the highest observed recreation use;

- Weekly monitoring during the recreation season at recreational sites to assess average levels of indicator bacteria throughout the watershed; and
- Use of *E. coli* as the bacteria indicator species.

Several types of data products resulting from this monitoring design are appropriate for answering Question 4:

- Weekly, site-by-site measures of bacterial indicator values;
- Comparisons of bacterial indicator values with relevant standards or objectives on spatial and temporal scales that match sampling scales as closely as possible (e.g., data tables or charts that highlight exceedances);
- Site-by-site and regional trends over time in the numbers of exceedances; and
- Ability to adopt new indicators and new methods as they are approved.

Question 5: Are Locally Caught Fish Safe to Eat?

The monitoring design recommended to address this question has several elements:

- Sample annually in summer;
- Focus on one or two locations (lakes, rivers, estuary) each year where fishing is most frequent;
- Focus on fish species most commonly caught and consumed at each site; and
- Focus on the chemicals (mercury, selenium, DDTs, and PCBs) ingested with California's sport fish that contribute the greatest human health risk.

Several types of data products are appropriate for answering Question 5:

- Site-by-site muscle tissue concentration estimates of key chemical contaminants in commonly consumed fish species;
- Site-by-site measures of the frequency with which such tissue concentrations exceed advisory levels and/or critical thresholds of potential human health risk;
- Trends over time in both tissue concentrations and the frequency of exceedances of advisory levels and critical thresholds.

5.2 Constituents to be Monitored and Measurement Techniques

Water and tissue chemistry; marine and freshwater bioassessments; and bacteria will be used to measure the condition of beneficial uses in the watershed. Existing USEPA, Standard Methods, SWAMP, and Southern California Regional Monitoring protocols will be used (Table 4).

Table 4. Analytical constituents and method requirements.

Analyte	Method	Units	Reporting Limit
Conventional Water Chemistry			
Temperature	Probe	°C	-5
pH	Probe	None	NA
Specific Conductivity	Probe	mS/cm	2.5
Dissolved Oxygen	Probe	mg/L	N/A
Salinity	Probe	ppt	N/A
Water Chemistry: freshwater			
Alkalinity as CaCO3	SM 2320 B	mg/L	10
Hardness as CaCO3	SM 2340 C	mg/L	5
Turbidity	SM 2130 B	NTU	0.3
Chemical Oxygen Demand	SM5220D	mg/L	10
Total Suspended Solids	SM 2540 D	mg/L	1
Nutrients			
Ammonia as N	EPA 350.1	mg/L	0.1
Nitrate as N	EPA 300.0	mg/L	0.1
Nitrite as N	EPA 300.0	mg/L	0.1
TKN	EPA 351.2 (1° Method) or SM4500-NH3 C (2° Method)	mg/L	0.1
Total Nitrogen	Calculated	NA	NA
Total Organic Carbon	SM 5310 C	mg/L	0.1
Dissolved Organic Carbon	SM 5310 C	mg/L	0.1
OrthoPhosphate as P	SM 4500-P E	mg/L	0.1
Phosphorus as P	SM 4500-P E	mg/L	0.1
Major Ions			
Chloride	EPA 300.0	mg/L	1.0
Calcium	EPA 200.7	ug/L	200
Magnesium	EPA 200.7	ug/L	200
Sodium	EPA 200.7	ug/L	200
Sulfate	EPA 300.0	mg/L	1.0
Metals (Dissolved)			
Arsenic	EPA 200.8	ug/L	1
Cadmium	EPA 200.8	ug/L	0.2
Chromium	EPA 200.8	ug/L	0.5
Copper	EPA 200.8	ug/L	0.5
Iron	EPA 200.7	ug/L	50

Lead	EPA 200.8	ug/L	0.5
Mercury	EPA 1631E	ug/L	0.2
Nickel	EPA 200.8	ug/L	1
Selenium	EPA 200.8	ug/L	1
Zinc	EPA 200.8	ug/L	1
Benthic Macroinvertebrate	SWAMP (2007), SAFIT STE	Count	NA
Quantitative Diatom	SWAMP (2019)	Count	NA
Quantitative Algae	SWAMP (2019)	Count; um3/cm3	NA
Habitat Assessments: Freshwater			
Freshwater Bioassessments	SWAMP (2016)	NA	NA
California Rapid Assessment Method (CRAM)	Collins et al., 2013	NA	NA
Tissue Chemistry: Fish			
Percent Lipids	Bligh, E.G. and Dyer ,W.J. 1959.	%	0.05
Metals			
Mercury	EPA 7471A	mg/kg ww	0.02
Selenium	EPA 6010B	mg/kg ww	1
Organics			
Organochlorine Pesticides (DDTs)	EPA 8081A	µg/kg ww	1.0-20
Polychlorinated Biphenyl (PCBs)	EPA 8082	µg/kg ww	0.5-1.0
Indicator Bacteria			
E. coli	SM 9223 B	MPN/100mL	10

5.3 Project Schedule

Table 5. Project Schedule.

Project Task	Start	End
Project Management		
Technical Workgroup Meeting	Oct-23	Sept-24
Quarterly Status Reports	Oct-23	Sept-24
QAPP	Oct-23	Sept-24
Site Reconnaissance		
Map Review and Preliminary Selection of Randomized Sites	Jan-24	May-24
Site Reconnaissance	Feb-24	May-24
Secure Entry Permits	Feb-24	May-24
Present Finalized Station List to TSG	May-24	May-24
Bacteria Testing		
Recreation Sites	May-24	Sept-24
Fish Tissue Sampling		
Field Sampling	Apr-24	Jul-24
Preliminary Analyses	Dec-24	Jan-25
Watershed Monitoring Sampling		
Urban		
Water Chemistry; Bioassessment; CRAM; Algae	Apr-24	Aug-24
Natural		
Water Chemistry; Bioassessment; CRAM; Algae	Apr-24	Aug-24
Effluent		
Water Chemistry; Bioassessment; CRAM; Algae	Apr-24	Aug-24
Laboratory Analyses		
Chemistry		
Water	Apr-24	Dec-24
Tissue	Apr-24	Dec-24
Taxonomy		
Benthic Macroinvertebrates	Apr-24	Feb-25
Data Management, Analysis & Reporting	Apr-24	May-25
Reporting		
Draft Report	May-25	Aug-25
Annual Report Finalized	Aug-25	Sept-25

5.4 Geographic Setting

The Los Angeles River watershed encompasses western and central portions of Los Angeles County. It is bounded by the San Gabriel, Santa Susana, and Santa Monica Mountains to the north and west, the San Gabriel River to the east, and the Pacific Ocean to the south. The Los Angeles River's headwaters originate in the Santa Monica, Santa Susana, and San Gabriel Mountains and the river terminates at the San Pedro Bay/Los Angeles and Long Beach Harbor complex, which is semi-enclosed by a 7.5-mile breakwater. The river's tidal prism/estuary begins in Long Beach at Willow Street and runs approximately three miles before joining with Queensway Bay (Figure 2).

Figure 2. Los Angeles River Watershed.

5.5 Constraints

The randomized design portion of the program is constrained by the ability of the contractors to access sites located on private, federal, and state lands that do not allow public access. To resolve this issue, the team will review the locations of randomly selected sites prior to the initiation of sampling and begin work to secure the necessary access permits. If entry approval to a site cannot be obtained, the site will be dropped in favor of a more accessible site.

Sampling at bioassessment sites (random, revisit, or sites of special interest) is dependent on the presence of flowing water. During drought years, sites normally thought to be perennial may not flow past mid-spring. As a result, fall site reconnaissance may reveal flow at some sites that will be dry when revisited during the spring sampling survey. The LARWMP Workgroup has determined that the SMC sampling criteria will be adhered to where possible.

The bioaccumulation portion of the program is constrained by the availability of targeted fish species in the required size classes. To resolve this issue, the team will adaptively sample so that when the targeted species are not available, other reasonable species will be collected. The list of taxa collected during the previous year will be presented to the LARWMP Workgroup.

6.0 Quality Objectives and Criteria

Data Quality Objectives (DQOs) are quantitative and qualitative statements that specify the tolerable levels of potential errors in the data (U. S. EPA, 2000) and ensure that the data generated meet the quantity and quality of data required to support the study objectives. The DQOs focused on five aspects of data quality: completeness, precision, accuracy, representativeness, and sensitivity (Table 6). These DQOs address the sampling and laboratory analysis phases for producing chemistry, toxicity, bacterial and biological data. Each data quality category is described below. Numerical DQOs for field and laboratory analyses are listed in Appendix B, Table 13. Corrective actions are described in Section 11.4.

Table 6. Program measurement and analysis types with associated DQOs.

Measurement or Analyses	Type Applicable Data Quality Objective
Field Measurements	Accuracy, Completeness
Bacterial Analyses	Precision, Presence/Absence, Completeness
Trace Metals Analyses	Accuracy, Precision, Recovery, Completeness
Synthetic Organic Analyses	Accuracy, Precision, Recovery, Completeness
Organics Sediment Analyses	Accuracy, Precision, Recovery, Completeness
Conventional Analyses	Accuracy, Precision, Recovery, Completeness
Flow	Completeness
Benthic Macroinvertebrates	Accuracy, Precision, Completeness
Benthic Infauna	Accuracy, Precision, Completeness
Habitat Assessments	Completeness, Intercalibration, Field Audits

6.1 Quantitative Objectives

6.1.1 **Accuracy** describes how close the measurement is to its true value. Accuracy is the measurement of a sample of known concentration and comparing the known value against the measured value.

6.1.1.1 Field Measurements: The accuracy of in-situ field measurements listed in Table 13 is described by the manufacturer of the instrument. To achieve accuracy in in-situ field measurements (e.g., pH, DO, and EC) during this program the field probes will be calibrated before every sampling event. Calibration records will be stored as a hard copy and these calibration records are maintained by the laboratory conducting the field measurements. To achieve accuracy of flow measurements, the flowmeter will be used in accordance with manufacturer's instructions and standard methods outlined by the USGS.

6.1.1.2 Laboratory Measurements (chemistry): The accuracy of laboratory measurements will be checked by performing tests on Quality Control Standards (QCs) prior to and/or during sample analysis at the contract laboratories. Quality Control Samples (QCs) containing a known

concentration of each analyte are purchased from a certified outside reputable source or may also be prepared by a professional partner, e.g., a commercial or research laboratory. The concentration of the standards will be unknown to the analyst until after measurements are determined.

6.1.1.3 Bacteria: Accuracy criteria for bacterial testing will be based on presence/absence testing rather than numerical limits owing to the difficulty in preparing solutions of known bacterial concentration.

6.1.1.4 Biological Assessments: Accuracy criteria for the sorting and identification of benthic macroinvertebrates are based on criteria established by the Southwest Association of Freshwater Invertebrate Taxonomists (SAFIT) the Southern California Regional Watershed Monitoring Program (SMC) QAPP and the SWAMP SOP. Sample sorting accuracy requires a resort of 10% of all samples by a senior lab technician who determines if a 90% sorting efficiency is met. Taxonomic identification accuracy is accomplished through an audit of 10% of all samples by an outside laboratory or expert who determines if the samples meet a 90% enumeration and identification efficiency.

6.1.1.5 Physical habitat and CRAM Assessments: Accuracy criteria for the qualitative assessment of physical habitat conditions and CRAM assessments are based on the field staff training and ability to pass biennial field audits. The lead field staff conducting these assessments is required to have participated in formal training classes administered by the California Department of Fish and Wildlife (CADF&W) and SWAMP. Observations collected by field teams are audited each year by the Southern California Coastal Water Research Project (SCCWRP) for physical habitat and CRAM.

6.1.2 **Precision** describes how well repeated measurements agree. The precision objectives apply to duplicate and split samples taken during field sampling and laboratory analysis. In accordance with protocols described by SWAMP, these field and laboratory splits are two grab samples collected in rapid succession or two aliquots from the same composite sample, respectively.

6.1.2.1 During field sampling, duplicate samples will be collected at ten percent of the sampling sites (1 per sampling event for 10 sites) to evaluate the precision of the sampling technique and to assess short-term environmental variability at the sample site.

6.1.2.2 For each laboratory analysis, one sample is analyzed in duplicate at the rate of one per sample batch, or 1 in 20 samples, whichever is more frequent to demonstrate the precision of the analytical measurement. The relative percent difference between the measured sample and split/ duplicate sample is used to qualify the precision of the measurement (Equation 1).

$$RPD = \left| \frac{(X_1 - X_2)}{(X_1 + X_2)/2} \right| * 100$$

Where:

X_1: is the concentration of the original sample

X_2: is the concentration of the duplicate sample

For most chemical constituents listed in Appendix B, Table 13, the RPD between duplicate samples should not exceed 25%.

6.1.2.3 The precision objectives for toxicity testing apply to laboratory reference toxicant tests and USEPA DMR studies. Reference toxicant results for each species should fall within ± 2 standard deviations (SD) of the mean of the preceding 20 tests. A reference toxicant test is run with each batch of test samples.

6.1.3 **Recovery** is the accuracy of an analytical test measured against a known analyte addition to a sample. The recovery of a sample can vary widely depending on the matrix (e.g., freshwaters vs brackish water), therefore matrix spike and matrix spike duplicates are used to demonstrate the performance of the method in a particular medium. The **matrix spike** sample is prepared by adding a known concentration of an analyte to a replicate sample at a concentration at least ten times the Method Detection Limit (MDL).

Recovery =

$$\% \text{ Recovery} = \left| \frac{(X_1 - X_2)}{X_3} \right| * 100$$

Where:

X_1 : is the concentration of the spiked sample

X_2: is the concentration of the original (unspiked) sample

X_3: is the concentration of the spike added

6.1.4 **Matrix spikes** and matrix spike duplicates will be analyzed at a frequency of one pair per sample batch, or one in 20 samples, whichever is more frequent. The DQO for the recovery of most constituents listed in Table 13 is between 75%- 125% and recoveries outside of this acceptable range indicate a matrix interference or bias. In this case, attempt to correct the problem (prepare batch again, by dilution, change spike concentration, etc.) and reanalyze the samples and the matrix spikes. If the matrix spike problem cannot be corrected, flag the results with an appropriate qualifier.

6.1.5 **Laboratory Blanks** are performed to demonstrate that the analytical procedures do not result in sample contamination. Laboratory blanks will be prepared and analyzed by the contract laboratory at a rate of at least one for each analytical batch. Laboratory blanks will consist of laboratory-prepared blank water processed along with the batch of environmental samples. The laboratory blank should be

prepared and analyzed before analysis of the associated environmental samples. If the result for a single method blank is greater than the RL, the source(s) of contamination shall be corrected, and the associated samples shall be reanalyzed.

6.1.6 **Sensitivity and Method Detection Limits (MDL)** - The Method Detection Limit is the lowest detectable concentration for the instrument, chemical procedure, or equipment. This is important because it can never be determined if a pollutant was not present, only that it was not detected. Sensitivity refers to the detectable differences in concentration for test instruments and is therefore represented in the number of decimal places. The desired method detection limits and sensitivity of field and Laboratory measurements are described by SWAMP for most analytes such as the metals, organics and coliforms. For other analytes, the Target Reporting Limits are provided by the analytical laboratory and represent the lowest amount of an analyte in a sample that can be quantitatively determined with stated, acceptable precision and accuracy under stated, analytical conditions (i.e. the lower limit of quantitation).

6.1.7 **Reporting Limits (RL)** are the lowest level that can be quantified within the specified limits of precision and accuracy during routine laboratory operating conditions. It is often the lowest non-zero point of the calibration curve. The desired reporting limits and sensitivity of field and laboratory measurements are described by SWAMP for most analytes such as the metals, organics, and coliforms. For other analytes, the Target Reporting Limits are provided by the analytical laboratory.

6.2 Qualitative Objectives

6.2.1 **Completeness** is the fraction of planned data that must be collected in order to fulfill the statistical criteria of the project. There are no statistical criteria that require a certain percentage of data. However, it is expected that 95% of all measurements could be taken when anticipated. This accounts for adverse weather conditions, safety concerns, and equipment problems. We will determine completeness by comparing the number of measurements we planned to collect compared to the number of measurements we collected that were also deemed valid. An invalid measurement would be one that does not meet the sampling methods requirements and the data quality objectives. Completeness results will be checked quarterly. This will allow us to identify and correct problems.

6.2.2 **Comparability** of the data can be defined as the similarity of the data generated by different monitoring programs and is important for the utility of the data in the state database. To ensure the comparability of data collected in this monitoring program to other regional and statewide datasets, all sampling and analytical procedures follow standard protocols such as those described by SWAMP. Additionally, comparability of analytical data is addressed by analysis of certified reference materials.

Before modifications can be made to the methods described in this QAPP, or alternative or additional methods are developed, technical advisors will evaluate

and review the effects of the potential modification. It will be important to address their concerns about data quality before proceeding with the monitoring program.

6.2.3 **Representativeness** can be described as the degree to which the environmental data generated by monitoring program accurately and precisely represent the actual environmental conditions and this should be carefully addressed in the overall design of the program. Specifically, assuring the representativeness of the data is addressed primarily by selecting appropriate locations, methods, times, and frequencies of sampling for each environmental parameter, and by maintaining the integrity of the sample after collection. Examples of potential problems resulting from poor program design include samples that are taken in a stream reach that does not describe the area of interest, samples that are taken in an unusual habitat type (e.g., a stagnant backwater instead of in the flowing portion of the creek), or samples that are not analyzed or processed appropriately, causing conditions in the sample to change (e.g., water chemistry measurements are not taken immediately).

6.3 Specialized Training or Certifications

6.3.1 Field Sampling

Aquatic Bioassay and Weston Solutions field staffs have completed all applicable training to conduct bioassessment, CRAM, toxicity, water quality, bacteriological and fish tissue field sampling. Field crew members for the LARWMP have the following training or certifications:

6.3.1.1 Lead field personnel have bachelor's or master's degrees in biology and over five years of experience conducting similar sampling programs.

6.3.1.2 Field crew members have attended bioassessment field and laboratory workshops provided by the California Department of Fish and Wildlife. These workshops included training on physical habitat condition methods.

6.3.1.3 Crew members have attended training conducted by SCCWRP or CRAM Wetlands trainers on the California Rapid Assessment Program (CRAM) for wetland and riparian habitats.

6.3.2 Laboratory Analysis

Each of the participating laboratories hold certifications through the State of California's, Environmental Laboratory Accreditation Program (ELAP) for the areas of testing that they are responsible for including chemistry, toxicity, bacteriology, and taxonomy.

6.3.2.1 The EMD, Aquatic Bioassay, and Weston Solutions have participated in interlaboratory calibration studies conducted by the SMC for chemistry (EMD), and bacteriology (EMD and Aquatic Bioassay).

6.3.2.2 Benthic macroinvertebrate identifications are conducted by taxonomists who are members and active participants in the Southwest Association of Freshwater Invertebrate Taxonomists (SAFIT) and adhere to the identification guidelines specified in the Taxonomic Rules and Standard Taxonomic Effort (STE) documents.

The Aquatic Bioassay and CLAEMD QA officers provide training to their respective personnel and details of the training are described in their respective Standard Operating Procedures (SOPs) and QA Program Documents.

During the duration of the LARWMP, as training and certification are required, the QC officers for each laboratory (EMD, Aquatic Bioassay, and Weston Solutions) will coordinate training of project personnel. The program QC officer (Karin Wisenbaker) will be responsible for ensuring that personnel for each laboratory have received training.

SOPs for field, laboratory, and data management tasks will be developed and updated on a regular basis in order to maintain procedural consistency.

6.4 Training and Certification Documentation

Each laboratory maintains records of their training. Those records can be obtained, if needed, through the Project or Laboratory Directors.

6.5 Training Personnel

EMD, Aquatic Bioassay, and Weston Solutions maintain rigorous field and laboratory training programs based on written, oral, and performance-based guidelines. Training and performance are also evaluated on an ongoing basis based, in part, on the QA parameters defined in this plan. SOPs for field, laboratory, and data management tasks have been developed and will be updated on a regular basis in order to maintain procedural consistency (see Appendices). The maintenance of an SOP Manual will provide project personnel with a reference guide for training new personnel, as well as a standardized information source that personnel can access.

To ensure consistent and comparable field techniques, this study will include annual pre-survey field intercalibration and biennial field audits.

7.0 Documents and Records

The hardcopy documents generated by this project will be stored at each of the participating laboratories (EMD, Aquatic Bioassay, and Weston Solutions) for the duration of the contract (Table 7). Field worksheets, chains of custody, laboratory bench sheets, QA/QC documentation, and data results will be available for review by the Project QC Officer (Karin Wisenbaker) upon request.

Persons responsible for maintaining records for this project are as follows. Karin Wisenbaker will maintain all sample collection, sample transport, chain of custody, field analyses forms, all records associated with the receipt and analysis of samples analyzed for all parameters, and all records submitted by EMD, and Weston Solutions. The EMD QC officers will maintain records for water, sediment, and tissue chemistry, and bacteriology chains-of-custody and bench sheets. Weston Solutions and Aquatic Bioassay will maintain records for bioassessment sampling and taxonomic identifications. Aquatic Bioassay will maintain field and laboratory records for fish tissue bioaccumulation sampling. All agencies and laboratories will make their records available to the Project Director, QC Officer, and Project Manager upon request. Scott Johnson will oversee the actions of these persons and will arbitrate any issues relative to records retention and any decisions to discard records.

All field results will be recorded at the time of completion, using standardized field data sheets. Data sheets will be reviewed for outliers and omissions before leaving the sample site. Chain-of-custody forms will be completed for all samples before leaving each sampling site. Data sheets and chains-of-custody will be stored by Aquatic Bioassay and Weston Solutions in hard copy form for five years from the time the study is completed. The directory where electronic files are stored will be backed up immediately to a mirrored hard drive and backed up nightly.

All data from this project will be made publicly available after approval by the CWH. The final electronic version of the database will be maintained by CWH. Release of data to the public will be in electronic formats only and will include comprehensive documentation. This documentation will include database table structures (including table relationships) and lookup tables used to populate specific fields in specific tables. Release to the public will also include QA classifications of the data (i.e., flags, as appropriate) and documentation of the methods by which the data were collected (metadata). Data will be released to the general public once a final report documenting the study has been prepared.

Table 7. Document and record retention, archival, and disposition information; Db = database.

	Identify Type Needed	Retention	Archival	Disposition
Station Occupation Log	Notebook	Paper	Notebook; Db	5 years
	Field data sheet	Paper	Notebook; Db	5 years
Sample Collection Records	Chain of Custody	Paper	Notebook	5 years
Analytical Records	Lab notebooks	Paper	Notebook	3 years
	Lab Results QA/QC	Paper and electronic	Notebook; Db	5 years
	Electronic data file	Electronic	Db	10 years
Data Records	Data Entry	Electronic	Db	Indefinite
Assessment Records	QA/QC assessment	Paper and electronic	Document	Indefinite
	Final Report	Paper and electronic	Document	Indefinite

8.0 Sampling Process Design

The sampling and analysis design for the program is divided into five components based on the five questions developed by the LARWMP Workgroup to address the status of beneficial uses in the watershed (Table 8). The design approaches range from a fully randomized, probabilistic design to address stream condition, to yearly rotation of fixed sites at popular fishing locations to address bioaccumulation issues.

Table 8. Number and frequency of sample sites.

Question	Approach	Sites	Indicators	Frequency
Q1: Stream Condition	Randomized design for streams in entire watershed	4 new each year, 4 annual revisit, 2 revisit sites	Bioassessment, water chemistry, Phab, riparian habitat	Annually, in spring/summer
Q2: Unique Areas	Fixed stations in freshwater	5 in freshwater • 3 critical habitat • 2 targeted tributaries/mainstem	Bioassessment, water chemistry, Phab, riparian habitat	Annually, in spring/summer
Q3: Discharges	Improve coordination Improve efficiency Reduce overlap			
Q4: Safe to Recreate	Focus on high-use areas	• 6-10 recreation sites • 6 kayak sites	• *E. coli* • *E.coli*	• Weekly May 25 to Labor Day • Weekly May 15 through September
Q5: Safe to Eat Fish	Focus on: • Frequently fished sites • Commonly caught species w/in SWAMP guidelines • High-risk chemicals	LA watershed in lakes, rivers, and estuary	Commonly caught fish at each location Mercury, DDTs, PCBs	Annually in April to September

9.0 Sampling Methods

9.1 Site Characterization

The Los Angeles River watershed encompasses western and central portions of Los Angeles County. It is bounded by the San Gabriel, Santa Susana, and Santa Monica Mountains to the north and west, the San Gabriel River to the east, and the Pacific Ocean to the south. The Los Angeles River's headwaters originate in the Santa Monica, Santa Susana, and San Gabriel Mountains and the river terminates at the San Pedro Bay/Los Angeles and Long Beach Harbor complex, which is semi enclosed by a 7.5-mile breakwater. The river's tidal prism/estuary begins in Long Beach at Willow Street and runs approximately three miles before joining Queensway Bay.

The 824 sq. mi. watershed contains a wide diversity of land uses. Approximately 324 sq. mi. of the watershed is open space or forest. Below the mountains, the river flows through highly developed residential, commercial, and industrial areas. From the Arroyo Seco, north of downtown Los Angeles, to its confluence with the Rio Hondo, the river is bordered by rail yards, freeways, and major commercial development. Below the Rio Hondo, the river flows through industrial, residential, and commercial areas, including major refineries and petroleum products storage facilities, major freeways, rail lines, and rail yards serving the Ports of Los Angeles and Long Beach. While most of the river in the developed portion of the watershed is lined with concrete, the unlined bottoms of the Sepulveda Flood Control Basin and the Glendale Narrows provide areas of riparian habitat important for both their ecological and recreational value. In addition, Compton Creek, just before its confluence with the Los Angeles River, supports a wetland habitat. The river is hydraulically connected to the San Gabriel River watershed through the Whittier Narrows Reservoir via the Rio Hondo (normally only during high-storm flows).

9.2 Random Site Selection

The probabilistic sampling design for the LARWMP is based on a random draw of all the unique stream reaches in the Los Angeles River Watershed. The random draw of sites is conducted by SCCWRP as part of the larger SMC regional monitoring program. As a result, the data generated by the LARWMP will be directly comparable to sites throughout the southern California region. Each year four new random sites are selected from the draw list, four revisit sites are selected from previously sampled sites and two annual revisit sites are sampled for five years (2021-2025). The LARWMP sites are divided into three sub-regions: natural, urban, and effluent.

The goal is to find sites where samples can be successfully collected in one day. Site reconnaissance is conducted based on protocols developed by the SMC. In brief, each site is evaluated using topographic maps, GIS, and Google Earth Pro. When possible, people familiar with the sampling location are interviewed in person or by phone. A site reconnaissance visit to each site is required to ensure the site can be sampled. The following criteria are general guidelines for accepting or rejecting a site:

1. Is the site within the watershed boundaries?
2. If private or public land, can entry permits be obtained?
3. Is the site "safely" accessible?
4. Is there flowing water?
5. Can the site be sampled in one day?
6. Can sample holding times be met considering the time necessary to get them to a laboratory to begin processing?

9.3 Water and Sediment Chemistry & Bacteriological Sampling

Sampling for the LARWMP requires the collection of water samples for chemistry and bacteria, using clean methods developed by the EPA and modified by SWAMP and the SMC for use in the southern California region. Sampling standard operating procedures (SOPs) may be obtained by contacting the sampling/analysis laboratory (Appendix A).

The sampling coordinator has responsibility for assessing the safety of sampling teams. A two-person team will conduct all sampling, and the sampling team will have access to a cellular phone to alert rescue agencies should an accident occur. A satellite paging device is carried by the sampling crew when visiting remote sites. Sampling will be postponed if the sampling team determines that the conditions are unsafe.

Failure to collect a sample due to safety concerns or technical issues will be promptly reported to the Project Manager, who will determine if any corrective action is needed and decide to collect a replacement sample (if possible). The QA Officer will document sampling failures and the effectiveness of corrective actions. Should field equipment fail, it will be repaired or replaced as soon as possible.

9.4 Bioassessment

9.4.1 Collection and Analysis of Benthic Macroinvertebrates (BMIs) and Attached Algae

Sampling requires the manual collection of composite benthic macroinvertebrate (BMI) samples using a D-shaped kick net at eleven transects (15 meters apart) along a 150 meters reach. The BMI samples are collected using the reach-wide benthos technique. Algae sampling requires the quantitative collection of algae (diatoms and filamentous algae) from sand, cobble, and bedrock substrate types. Samples are collected simultaneously with the benthic macroinvertebrate samples from the substrate located immediately upstream of the location of the D-kick net. Physical habitat assessments specified by SWAMP are also collected to assess stream habitat conditions. The complete sampling SOP entitled *Standard Operating Procedures for the Collection of*

Field Data for Bioassessments of California Wadable Streams: Benthic Macroinvertebrates, Algae, and Physical Habitat (Ode *et al*., 2016) appears at:

https://www.waterboards.ca.gov/water_issues/programs/swamp/bioassessment/docs/01-combined-sop-final-v4-11mar2016.pdf

In the laboratory, sorting and identification of BMIs and benthic algae is conducted based on protocols established by SWAMP entitled *Standard Operating Procedures for Laboratory Processing and Identification of Benthic Macroinvertebrates in California* (Woodard *et al.,* 2012) and *Standard Operating Procedures for Laboratory Processing, Identification, and Enumeration of Stream Algae* (Stancheva et al., 2015). These documents appear at:

https://www.waterboards.ca.gov/water_issues/programs/swamp/docs/bmi_lab_sop_final.pdf

and

https://www.waterboards.ca.gov/water_issues/programs/swamp/bioassessment/docs/sop_algae_lab_101315.pdf

BMIs for the LARWMP are identified to Level 2 specified by the Southwest Association of Freshwater Invertebrate Taxonomy (SAFIT). The SAFIT List of Freshwater Macroinvertebrate Taxa from California and Adjacent States including Standard Taxonomic Effort (STE) Levels appears at:

http://www.safit.org/ste.html

9.5 California Rapid Assessment Method (CRAM)

Sampling requires the assessment of wetlands and riparian zones. CRAM assesses the condition of a wetland or riparian zone using visual indicators in the field. It includes the assessment of hydrologic connectivity, buffer zone condition, vegetative community conditions and streambed quality. For complete CRAM protocol information go to: www.cramwetlands.org

9.6 Fish Tissue Bioaccumulation)

Sampling requires the manual collection of fish using a beach or hand seine, hook and line or electric shock fishing. Strategies for target species, numbers of species per composite, constituent list and fish size criteria are based on guidelines in *General Protocol for Sport Fish Sampling and Analysis* (2005 CA OEHHA) and can be found at:

https://oehha.ca.gov/media/downloads/fish/document/fishsamplingprotocol2005.pdf

Threshold advisories limits for fish tissue contamination can be found in:

"*Development of Fish Contaminant Goals and Advisory Tissue Levels for Common Contaminants in California Sport Fish*, June 2008"
(http://www.oehha.ca.gov/fish.html).

10.0 Sample Handling and Custody

Samples will be collected and transferred to the analytical laboratories within the holding times specified in Table 9. To provide for proper tracking and handling of the samples, documentation will accompany the samples from the initial collection to the final identification and analysis.

Sample containers and preservatives are identified in Table 9. All bottles will be labeled with station ID, sample date, sample time, and field replicate. Field data sheets and chains-of-custody will accompany the collection of samples.

All samples will be marked with a unique number to track their analysis. These identification labels will also be entered directly onto field and laboratory data sheets. All observations recorded in the field, as well as information recorded in processing all field samples in the laboratory, will be tracked using these identification labels.

The SOP details the procedures for submitting samples to the Project laboratories. These procedures reinforce the use of proper sample containers, chain-of-custody procedures, and unique station codes and sampling agency identifiers.

Table 9. Sample Handling.

Analyte	Bottle Type/Size	Preservative	Maximum Holding Time
Taxonomy			
Benthic Macroinvertebrates	½ G HDPE Plastic Wide-Mouth	95% Ethanol; Transfer to 70 % ethanol in the lab	5 years
Benthic Infauna	½ G HDPE Plastic Wide-Mouth	10% Buffered Formalin; Transfer to 70 % Ethanol	5 years
Algae Collection: Diatoms	50 mL plastic centrifuge tube	10% buffered formalin; keep at 4 °C in dark	2 years
Algae Collection: Algae	50 mL plastic centrifuge tube	25% Glutaraldehyde; keep at 4 °C in dark	2 years
Water Chemistry			
General Chemistry			
Alkalinity as $CaCO_3$	500 mL HDPE Plastic	4 °C	14 days
Hardness as $CaCO_3$	500 mL HDPE Plastic	4 °C, HNO_3 to pH <2	6 months
Total Suspended Solids	2000 mL HDPE Plastic	4 °C	7 days
Chemical Oxygen Demand	250 mL glass	4 °C, H_2SO_4 to pH <2	28 days
Turbidity	500 mL HDPE Plastic	4 °C	48 hours
Ash Free Dry Mass	Filtered in field onto 0.7 µm glass fiber filter, wrapped in foil	Freeze within 4 hours of collection -20 °C	28 days
Chlorophyll a	Filtered in field onto 0.7 µm glass fiber filter, wrapped in foil	Freeze within 4 hours of collection -20 °C	28 days

Analyte	Bottle Type/Size	Preservative	Maximum Holding Time
Nutrients			
Ammonia as N	500 mL HDPE Plastic	4 °C, (1+1) H_2SO_4 to pH <2	28 days
Total Organic Carbon	250 mL amber glass	4 °C, acidify to pH <2 with H_3PO_4	28 days
Dissolved Organic Carbon	250 mL amber glass	4 °C; filter as soon as possible after samples arrive at the laboratory, acidify to pH <2 with H_3PO_4	28 days
Nitrate as N, Nitrite as N, Orthophosphate	500 mL HDPE Plastic	4 °C	48 hours
Total Phosphorous as P	500 mL HDPE Plastic	4 °C, acidify to pH <2 with H_2SO_4	28 days
Kjeldahl Nitrogen, Total	500 mL HDPE Plastic	4 °C, acidify to pH <2 with H_2SO_4	28 days
Dissolved Metals			
As, Ca, Cd, Cr, Cu, Fe, Mg, Pb, Ni, Na, Zn	1000 mL HDPE plastic	4 °C ; filter as soon as possible after samples arrive at the laboratory. HNO_3 to pH <2 w/in 48 hours	6 months after filtration and acidification
Hg	250 mL amber glass	4 °C acidify to pH <2 with HCl	6 months after filtration and acidification
Ions			
Chloride, Sulfate	500 mL HDPE Plastic	4 °C	28 days
Tissue: Fish			
Metals			
Se, Hg	250 mL glass	4 °C within 24 hours; then freeze -20 °C	1 year
Organics			
Organochlorine, PCBs	250 mL glass	4 °C within 24 hours; then freeze -20 °C	1 year
Indicator Bacteria			
E. coli	Sterile 100 mL plastic	4 °C; sodium thiosulfate	1 year

11.0 Analytical Methods

11.1 Field Analysis Methods

Field measurements will have the accuracy as indicated in Appendix B, Table 13.

11.2 Laboratory Analysis Methods

Laboratory measurements will have the accuracy as indicated in Appendix B, Table 13.

11.3 Sample Disposal

After analysis, including QA/QC procedures, sample disposal will follow laboratory protocols. Portions of the bioassessment samples will be retained including unsorted samples (1 year), sorted remnants (5 years), identified sample partitioned into taxa groups (5 years), and a reference collection (indefinitely).

11.4 Corrective Action

Corrective action is taken when an analysis is deemed suspect for some reason. These reasons include exceeding accuracy ranges (chemistry); not meeting test acceptability criteria or control chart criteria (toxicity); not meeting blank checks (bacteriology); and/or problems with sorting and identification (bioassessments). The corrective action will vary on a case-by-case basis, but at a minimum involves the following:

- A check of procedures.
- A review of documents and calculations to identify possible errors.
- Correction of errors based on discussions among analysts.
- A complete re-identification of the bioassessment sample.
- A re-analysis of the sample extract, if sufficient volume is available, to determine if results can be improved.
- A complete reprocessing and re-analysis of additional sample material, if sufficient volume is available and if the holding time has not been exceeded.
- Re-training of staff to ensure the action is not repeated.

The field and laboratory coordinators each have systems in place to document problems and make corrective actions. All corrective actions will be documented to the Project Manager.

Chemistry laboratories will be required to provide deliverables before the end of the sampling year. The deliverable package will include hard copy and Electronic Data Deliverable (EDD). The hard copy will include standard narratives identifying any analytical or QA/QC problems and corrective actions, if any. The following QA/QC elements will be included in the data package: sample collection, extraction, and analysis dates and times, results of method blanks or controls, summary of analytical accuracy,

summary of analytical precision, and reporting limits. The electronic data files will contain all information found in the hard copy reports submitted by the laboratories. Individual data sets will be submitted as either Microsoft Excel® workbook files or as Microsoft Access® database files.

12.0 Quality Control

Samples for QA/QC will be collected both in the field and in the lab. Field QA/QC samples are used to evaluate precision due to sampling bias or field variability. Field QA/QC samples include field duplicates and travel blanks. Lab QA/QC samples are used to evaluate the analytical process for precision and accuracy. Internal laboratory QC checks will include:

- Bioassessments: sample re-sorts and re-identification;
- Bacteriology: acceptable laboratory blank and positive controls; and
- Chemistry: method blanks, laboratory control materials, duplicates, matrix spikes, matrix spike duplicates, where appropriate (based on method requirements), instrument calibrations, and internal standards.

12.1 Field Sampling Quality Control

QA/QC activities for sampling processes include the collection of field duplicates for bacterial and chemical testing, and field checks by sampling staff. In order to monitor the sampling process, the Aquatic Bioassay QA Officer will randomly observe sampling processes and compare the actual actions against the sampling SOP. Daily field briefings will be held prior to the initiation of work to ensure that field staffs are aware of the days sampling objectives and any method issues they might face.

Laboratory results will validate cleanliness of equipment. If contamination of sample by field or equipment occurs during the sampling, the contaminated sample will be discarded.

12.2 Field Duplicates

Field duplicates help quantify potential bias associated with sampling activities. Field duplicates are comprised of a replicate sample taken at 10% of the program's sites. Each result will be recorded along with the average of the two results, the difference between the largest and smallest result, and the percent difference between the largest and smallest result. The percent difference will be calculated as follows:

$$\text{Relative Percent Difference (RPD)} = 100 * (\text{Largest-Smallest}) / \text{Average}$$

There are no specific criteria for field duplicate precision but results within a RPD of ± 25% are generally considered acceptable.

12.3 Bioassessment Sample Re-sorting

Sample re-sorting is used to quantify the sorting accuracy of the laboratory. Once samples are sorted, a laboratory leader will re-sort the sample remnants to ensure that all organisms have been removed. The acceptable accuracy limit for re-sorts is ≥90% (Table 13). Percent sorting accuracy is calculated as:

- Percent Sorting Accuracy = [(number of organisms in re-sort *100)/ number of organisms in original sort]

12.4 Bioassessment Sample Identification

Sample re-identification is used to quantify the identification and enumeration accuracy of the laboratory. Once samples are identified, 10% of all samples will be sent to a second biologist at the CA Department of Fish and Games Aquatic Bioassessment Laboratory (ABL) who will re-identify the sample to ensure that all organisms have been accurately identified and enumerated. The acceptable accuracy limits for identification are ≥90% (Appendix B, Table 13). Percent identification and enumeration accuracy are calculated as:

- Percent Identification Accuracy = [(number of organisms misidentified)/ number of organisms in original ID]*100

- Percent Enumeration Accuracy = (number of organisms in re-identification/number of organisms enumerated in original sample)*100

Identification discrepancies between the laboratories are discussed and resolved by the biologists. The final dataset is modified to reflect the agreed upon resolution.

12.5 Bacteriology

- Laboratory reagent blank samples must be below detection (<10 MPN/100 mL) for all samples for tests to be valid.

- Positive and negative controls must be verified within specified ranges or presence/absence periodically with each new lot of media or culture prepared or purchased for the associated tests to be valid.

12.6 Chemistry

A batch is defined as a group of 20 or fewer samples of similar matrix, processed together under the same conditions and with the same reagents. QC samples are associated with each batch and are used to assess the validity of the sample analyses. Control limits can be found in Table 10. Each batch must include the following QC checks:

- Method Blank- A method blank is a sample that contains no analyte of interest. For solid matrices, no matrix is used. The method blank serves to measure contamination associated with processing the sample within the laboratory.

- Laboratory Control Material (LCM) or Certified Reference Material (CRM) - A LCM or CRM is a sample with a matrix similar to the client samples that contains

analyte of interest at known or certified concentrations. It is used to determine the accuracy of the results based on the comparison of the measured concentration with the true value. For analytes that are greater than 10 times the MDL, the acceptable percent recovery is presented in Appendix B, Table 13.

- Duplicate Analyses- Duplicate analyses are samples that have been split and processed within a single batch. They are used to determine the precision of the results based on the percent relative difference (% PRD) between the two sets of results. Control limits for % PRD are presented in Appendix B, Table 13.

- Matrix Spike/Matrix Spike Duplicates (MS/MSD) - MS/MSD are samples of similar matrix to the client's samples that are spiked with a known amount of analyte. Spike recovery measures the effect of interferences caused by the sample matrix and reflects the accuracy of the determination. The spike level should be at least ten times the MDL. The duplicate spike may be used to determine the precision of the analytical results.

- Initial Calibration- Initial calibration is performed by analyzing standards of known levels of concentration. The lowest level should be less than or equal to ten times the MDL and the remaining levels should represent the entire range of expected concentrations in the samples.

- Calibration Verification- When a calibration curve is not performed for each run, a calibration verification is performed with a standard from preferably a second source, to verify that the instrument is still operating within the original calibration curve.

- Internal Standard- An internal standard is a non-target analyte that is added to samples and QC checks after the preparation of the sample, just prior to analysis. It is used to compensate for variations in the instrument response from one sample to the next.

- Recovery Surrogate- A recovery surrogate is a non-target analyte or analytes that are added to the sample prior to processing. It is used to indicate the extraction efficiency and instrument variation from sample to sample.

Table 10. Quality Control

Analyte	Quality Control	Instrument Calibration
Water Column Samples		
pH	Two-point calibration (minimum), plus general maintenance and calibration practices	Calibration at the start of each sample run.
Conductance	One point calibration, plus general maintenance and calibration practices.	
DO		
Temperature	Annual comparison with a NIST thermometer, with a correction factor if necessary, plus general maintenance, and calibration practices.	
General Constituents and Nutrients in Water	Blanks – Laboratory blanks. No detectable amount of substance in blanks. Frequencies – Accuracy, precision, recovery, and blanks at 1 in 20 (5%) with at least one in every batch. All QA/QC procedures and criteria specified by selected method.	External calibration with 3 – 5 standards covering the range of sample concentrations prior to sample analysis. At low end, the lowest standard at or near the RL. Linear regression $R^2 \geq 0.99$. Calibration verification every 20 samples after initial calibration. Standard source different that that used for initial calibration. Recovery 80% - 120%.
Organics in Water		External calibration with 3 – 5 standards covering the range of sample concentrations prior to sample analysis. At low end, the lowest standard at or near the RL. Linear regression $R^2 \geq 0.99$ or RSD < 15%. Calibration verification every 10 samples after initial calibration. Standard source different that that used for initial calibration. Recovery 70% - 130%.
Metals in Water		External calibration with 3 – 5 standards covering the range of sample concentrations prior to sample analysis. At low end, the lowest standard at or near the RL. Linear regression $R^2 \geq 0.99$. Calibration verification every 20 samples after initial calibration. Standard source different that that used for initial calibration. Recovery 85% - 115%
Bacteria indicators	Sterility checks (laboratory blanks) with no detectable amounts. Frequency – accuracy at 1 per culture medium or reagent lot. Precision at 1 in 10 (10%) with at least one per batch. All QA/QC procedures found in *Standard Methods* (22nd edition) section 9020 and in the selected analytical method including confirmation practices.	Follow the requirements of *Standard Methods* (23rd edition) section 9020.

13.0 Instrument/Equipment Testing, Inspection, and Maintenance

13.1 Analytical Instruments

13.1.1 *Sample Equipment Cleaning Procedures*

Equipment used for sample collection such as sample bottles and manual and automated samplers will be cleaned according to the specific procedures documented for each analytical method. Clean sample containers will be provided by the laboratories performing the analyses.

The cleaning procedures for equipment used to collect water quality samples are specific for each analytical approach. Standard conventional parameters typically require cleaning of the equipment with dilute Alconox, followed by de-ionized (DI) water rinse. Sampling equipment is triple rinsed with site water in the field before collecting the sample water.

New Zealand mud snails are an invasive gastropod that was found in some southern California watersheds since 2005. Field crews must ensure their equipment, waders and gloves have been decontaminated prior to sample collection to ensure mud snails are not spread to stream systems in the watershed. All field crews will follow protocols established by CA DF&W. The field crew will have clean, decontaminated gear at the beginning of each sampling day. Used gear will be stored in plastic bags and kept separate from clean gear. There are two equipment decontamination methods for gear. The options are as follows:

Hot Water Immersion: 50° C (122 °F) for 30 minutes

- Scrub gear with a stiff-bristled brush to remove all dirt and debris. Thoroughly brush small crevices such as boot laces, seams, net corners, etc.
- Immerse equipment in 50° C or hotter water. If necessary, weigh it down to ensure it remains immersed
- Maintain the water temperature for the 30-minute soak.

Drying at 14°C (57°F) for 8 days OR 35°C (95°F) for 30 hours OR 70°C (158°F) for 15 minutes

- Scrub gear with a stiff-bristled brush to remove all dirt and debris. Thoroughly brush small crevices such as boot laces, seams, net corners, etc.
- Allow equipment to dry completely. Once completely dry at 14°C (57°F) for 8 days OR 35°C (95°F) for 30 hours OR 70°C (158°F) for 15 minutes.

13.1.2 Water Quality Probe Maintenance

The multi-parameter probes (YSI 556) used by all field teams should be maintained according to the manufacturer instructions so as to assure that the meter and probes are properly functioning during each sampling event. This will include routine replacement of the batteries (and carrying back-up batteries in the field), inspection of the probe, meter, and cable for damage, and properly cleaning and storing the probes in between uses.

13.1.3 Analytical Instrument and Equipment Testing Procedures and Corrective Actions

Testing, inspection, maintenance of analytical equipment used by the contract laboratory, and corrective actions are documented in the Quality Assurance manuals for each analyzing laboratory. Laboratory QA Manuals are made available for review at the analyzing laboratory.

14.0 Instrument/Equipment Calibration and Frequency

14.1 Laboratory and Analytical Equipment

All laboratory equipment is calibrated based on manufacturer recommendations and accepted laboratory protocol. Aquatic Bioassay, and EMD labs maintain calibration practices as part of the method SOPs. Aquatic Bioassay maintains calibration practices as part of the method SOPs. The Aquatic Bioassay QA Officer has reviewed these practices and finds them to be in conformance with the SWAMP requirements.

14.2 Field Instruments

Calibration of the multi-parameter probe used for measurement of field are performed as described by the manufacturer and the SOP (Appendix A). The multi-meter should be calibrated prior to sampling and on completion of sampling that day. This will provide for an assessment of the "drift" of the meter over the sampling period. With the exception of DO, all parameters will require a two-point calibration, using laboratory-certified standards that bracket the expected values to be measured. Typical field instrument calibration procedures are as follows:

14.2.1 Temperature calibration is factory-set and requires no subsequent calibration. However, temperature is checked annually using a NIST-certified thermometer.

14.2.2 Calibration for pH measurement is accomplished using two standard buffer solutions, 7 and 10.

14.2.3 Calibration for dissolved oxygen measurements is accomplished using 100% air saturation as specified by the manufacturer.

15.0 Inspection/Acceptance for Supplies and Consumables

Glassware, sample bottles, and collection equipment will all be inspected prior to their use (Table 11). Supplies will be examined for damage as they are received. The following supplies will receive additional checks as follows.

Table 11. Inspection/acceptance testing requirements for consumables and supplies.

Project-Related Supplies / Consumables	Inspection / Testing Specifications	Acceptance Criteria	Frequency	Responsible Individual
Pre-cleaned sample bottles	Open bottle	Lids on bottles screwed on	100%	Field personnel
Lab glassware	Dirty	Clean	100%	EMD

16.0 Non-direct Measurements

The data reports for this study will cite and include monitoring data collected during previous years for this project. These data were collected in accordance with SWAMP protocols. Data collected from other studies in the area will be cited in the monitoring report and used for comparative purposes. The data sets have met all QA requirements consistent with this study.

17.0 Data Management

The management of bioassessment data will be initiated with the use of field and laboratory data sheets. Analytical results will be compiled in SWAMP-compatible electronic formats by each responsible laboratory and verified by the CWH and Aquatic Bioassay. EMD, and Weston Solutions will submit completed data sets electronically in SWAMP compatible formats to the CWH and Aquatic Bioassay after QC checks have been completed. The Aquatic Bioassay Project Manager will receive and review data QC reports from the Aquatic Bioassay Data Manager who will screen all internally and externally generated for the following major items:

- A 10 percent check between data provided by the laboratory.
- Conformity check between the chain-of-custody forms and laboratory reports
- A check for laboratory data report completeness
- A check for typographical errors on the laboratory reports
- A check for suspect values (outliers)
- A check for duplicates

The laboratories will provide data in electronic format. The required form of the SWAMP-compatible electronic submittals will be provided to the laboratories to ensure the files can be imported into the project database with a minimum of editing. The data will be managed in Aquatic Bioassay's project database, which has a relational structure and is compatible for incorporation into the SWAMP database.

Following the initial screening, a more complete QA/QC review process will be performed, which will include an evaluation of analytical accuracy and precision. Accuracy will be evaluated by reviewing bioassay, chemistry, and bacteriology QC results; precision will be evaluated by reviewing field duplicates, and sample completeness will be evaluated by comparing results to chain-of-custody forms.

The finalized data sets will be submitted to the CWH in an Access database and to the SMC Regional Monitoring database in SWAMP formats located at SCCWRP.

Data will be stored on the Aquatic Bioassay network that is backed up nightly in-house. Back-up drives will be stored in a fire proof safe. Hard copies of field and lab data will be stored at Aquatic Bioassay for three years from project completion.

18.0 Assessments and Response Actions

The Project Manager will be responsible for the day-to-day oversight of the project. The Project QA Officer will conduct periodic reviews of the data and relay any problems to the Project Manager.

If an audit reveals any discrepancy, Aquatic Bioassay's QA Officer will discuss the observed discrepancy with the appropriate person responsible for the activity (see organization chart). The discussion will begin with whether the information collected is accurate, what were the cause(s) leading to the deviation, how the deviation might impact data quality, and what corrective actions might be considered.

The QA Officer has the power to halt all sampling and analytical work by the EMD, Aquatic Bioassay, or Weston Solutions if the deviation(s) noted are considered detrimental to data quality.

19.0 Reports to Management

The status of data collection during this project will be reported by the Project Manager to the Contract Manager at the LARWMP Stakeholder Workgroup meeting annually after the summer sampling period and continuing until the completion of the current contract. A draft final project report will be filed no later than September of each year. The Project QA Officer has complete access to the Project Manager on an ongoing basis. Any QA deviations will be detailed in the draft/final report.

Table 12. Management Reports

Report	**Due by**
Quarterly progress reports	September 1st, and quarterly thereafter
Sample event summary	Reported at TSG meeting after summer sampling is complete.
City of Burbank Summary Report	March of each year
Draft final report for review	August of each year
Final Report	September of each year

20.0 Data Review, Verification, and Validation

Laboratory validation and verification of the data generated is the responsibility of the laboratory. The laboratory manager will maintain analytical reports in a database format, as well as all QA/QC documentation for the laboratory.

Aquatic Bioassay will review all data packages received for adherence to the Data Quality Objectives (DQOs) set forth in this QAPP. Chain-of-custody forms will be reviewed to ensure adherence to collection, transport, and receipt requirements, including test initiation within the required holding time. Toxicity data will be evaluated for completeness, adherence to test methodology, passing acceptability criteria, choice of appropriate statistical methods, and proper reporting.

If results fail to meet any DQO, the Project Manager and or the QA Officer will flag them for further review. Batch QA samples will be reviewed to determine the potential cause for failure to meet the DQO. If the cause cannot be readily ascertained, reserve samples will be reanalyzed (if within the designated holding times). If subsequent analyses meet the DQO, the samples will be deemed acceptable.

If samples fail to meet the DQOs a second time or the cause of the failure cannot be identified and rectified, the data will be excluded from inclusion in the study results. All rejected data will be retained in the project database and qualified as “rejected”. The ultimate decision of whether to accept or reject a data point will be made by the Project Manager in consultation with the QA Officer.

If the analysis for more than 10% of any given analyte fails to meet the DQOs, the Project Manager and QA Officer shall meet to discuss the appropriateness of the DQO and any potential modifications. All proposed modifications of DQOs shall be reviewed by the QA Officer at the Regional Water Quality Control Board.

Laboratories will conduct a 50 percent raw data audit before delivering results to the final program database held by Aquatic Bioassay. If their error rate is greater than 5%, a 100% raw data audit will be triggered.

21.0 Verification and Validation Methods

Data collected in the field will be validated and verified by the field coordinator. The laboratory maintains chain-of-custody and sample manifests.

Laboratory validation and verification of the data generated is the responsibility of the laboratory. The laboratory supervisor will maintain analytical reports in a database format, as well as all QA/QC documentation for the laboratory.

The Project Manager and Project QA Officer are responsible for oversight of data collection and the initial analysis of the raw data obtained from the field and the laboratory. The Project Manager's responsibilities also include the generation of rough drafts of monthly and final reports. The Project Manager has final oversight on the submission of monthly and final reports.

Reconciliation and correction of any data that fails to meet the project DQOs will be done by the Project Manager in consultation with the QA Officer. Any corrections require a unanimous agreement that the correction is appropriate.

22.0 Reconciliation with User Requirements

For data that do not meet DQOs, management has two options:

1. Retain the data for analytical purposes but flag these data for QA deviations.
2. Do not retain the data and exclude them from all calculations and interpretations.

The choice of option is the decision of the Project Manager and Project Director. If qualified data are to be used, then it must be made clear in the final report that these deviations do not alter the conclusions of the study.

Appendix A

Standard Operating Procedures

To request Standard Operating Procedures, please contact the following organizations responsible for sampling and/or laboratory analysis.

Habitat Assessments/Sample Collection

- Site Reconnaissance
  - Aquatic Bioassay & Consulting Laboratories
    - Phone: (805)-643-5621
    - Email: info@aquaticbioassay.com
    - Website: www.aquaticbioassay.com

- Bioassessment
  - SWAMP SOP
    - Website: http://www.waterboards.ca.gov/water_issues/programs/swamp/bioassessment/sops.shtml
  - Aquatic Bioassay & Consulting Laboratories
    - Phone: (805)-643-5621
    - Email: info@aquaticbioassay.com
    - Website: www.aquaticbioassay.com
  - Weston Solutions
    - Phone: (760) 795-6928
    - Email: info@westonsolutions.com
    - Website: http://www.westonsolutions.com

- CRAM
  - California CRAM SOP
    - Website: http://www.cramwetlands.org/documents/
  - Aquatic Bioassay & Consulting Laboratories
    - Phone: (805)-643-5621
    - Email: info@aquaticbioassay.com
    - Website: www.aquaticbioassay.com

- Water Collection
  - Aquatic Bioassay & Consulting Laboratories
    - Phone: (805)-643-5621
    - Email: info@aquaticbioassay.com
    - Website: www.aquaticbioassay.com

- Fish Collection
  - California Department of Fish & Game

Phone: (805) 771-4162

Laboratory Analysis

- Chemistry
  City of Los Angeles, EMD
  Phone: (310) 343-0502
  Email: mahesh.pujari@lacity.org

- Bacteria
  City of Los Angeles, EMD
  Phone: (310) 343-0502
  Email: mahesh.pujari@lacity.org

- Benthic Macroinvertebrate
  SAFIT Standard Taxonomic Effort
  Website: http://www.safit.org/ste.html

  Aquatic Bioassay & Consulting Laboratories
  Phone: (805) 643-5621
  Email: info@aquaticbioassay.com
  Website: www.aquaticbioassay.com

- Benthic Algae
  Aquatic Bioassay & Consulting Laboratories
  Phone: (805) 643-5621
  Email: info@aquaticbioassay.com
  Website: www.aquaticbioassay.com

Appendix B

Data Quality Objectives for Each LARWMP Project Phase

Table 13. Data quality objectives for field and laboratory measurements.

Parameter	Fraction	Accuracy		Precision	Completeness	Laboratory	Target Reporting Limits	Units
		Requirements	Recovery					
Field Water Quality Measurements								
Dissolved Oxygen	None	± 0.5 mg/L or 10%	N/A	1 point calibration		ABC/Weston	N/A	mg/L
Temperature	None	± 0.5 °C or 10%	N/A	2 point calibration (Annually)		ABC/Weston	N/A	°C
Specific Conductivity	None	± 4 µs or 10%	N/A	1 point calibration	90%	ABC/Weston	2.5	µS/cm
Salinity	None	N/A	N/A	N/A		ABC/Weston	N/A	ppt
pH	None	± 0.5	N/A	2 point calibration		ABC/Weston	N/A	pH units
General Chemistry: Freshwater								
Alkalinity as $CaCO_3$	Total	None	N/A	Laboratory Duplicate - RPD < 25%	90%	CLA EMD	10	mg/L
Hardness as $CaCO_3$	Total					CLA EMD	5	mg/L
Turbidity	Total					CLA EMD	0.3	NTU
Total Suspended Solids	Total					CLA EMD	2	mg/L
Chlorophyll a	None	Reference Material (CRM)	70-130%	30%	90%	Physis	2	µg/cm^2
Ash-Free Dry Mass	None	None	N/A	None		Physis	1	mg/cm^2
Nutrients: Freshwater								
Ammonia as N	Total	Reference Material (CRM, SRM or LCS) and Matrix Spike	80 - 120%	Laboratory Duplicate and Matrix Spike Duplicate - RPD < 25%	90%	CLA EMD	0.1	mg/L
Dissolved Organic Carbon	None					CLA EMD	0.1	mg/L
Total Organic Carbon	None					CLA EMD	0.1	mg/L
Chemical Oxygen Demand	None					CLA EMD	10	mg/L
Nitrate as N	None					CLA EMD	0.1	mg/L
Nitrite as N	None					CLA EMD	0.1	mg/L
OrthoPhosphate as P	None					CLA EMD	0.1	mg/L
Phosphorus as P	Total					CLA EMD	0.1	mg/L
Total Kjeldahl Nitrogen	None					CLA EMD	0.1	mg/L
Total Nitrogen (calculated)	None	N/A	N/A	N/A	90%	CLA EMD	N/A	mg/L
Ions: Freshwater								
Chloride	None	Reference Material (CRM, SRM or LCS) and Matrix Spike	80 - 120%	Laboratory Duplicate and Matrix Spike Duplicate - RPD < 25%	90%	CLA EMD	1.0	mg/L
Sulfate	None					CLA EMD	1.0	mg/L
Magnesium	None					CLA EMD	100.0	ug/L
Sodium	None					CLA EMD	100.0	ug/L
Calcium	None					CLA EMD	100.0	ug/L
Metals: Freshwater								
Arsenic	Dissolved	Reference Material (CRM, SRM or LCS) and Matrix Spike	75 -125% (70 - 130 % for Hg)	Laboratory Duplicate and Matrix Spike Duplicate - RPD < 25%	90%	CLA EMD	1	µg/L
Cadmium	Dissolved					CLA EMD	0.2	µg/L
Chromium	Dissolved					CLA EMD	0.5	µg/L
Copper	Dissolved					CLA EMD	0.5	µg/L
Iron	Dissolved					CLA EMD	50	µg/L
Lead	Dissolved					CLA EMD	0.5	µg/L
Mercury	Dissolved					CLA EMD	0.2	µg/L
Nickel	Dissolved					CLA EMD	1	µg/L
Selenium	Dissolved					CLA EMD	1	µg/L
Zinc	Dissolved					CLA EMD	1	µg/L
Microbiology Analysis: Freshwater								
E. Coli		Laboratory positive and negative cultures	80 - 120%	Laboratory Duplicate - RPD < 25%	90%	CLA EMD	1	MPN/100 mL
Invertebrate and Algae Sampling: Freshwater								
Sampling	N/A	≤10 seconds of nominal Lat/Long (300 m radius)	N/A	Record coefficient of variation of biological measures for duplicate samples, frequency of 5% or at least one per project.	90%	ABC/Weston	1.0 seconds Lat/Long	N/A

Table 13. (Continued)

Parameter	Fraction	Accuracy		Precision	Completeness	Laboratory	Target Reporting Limits	Units
		Requirements	Recovery					
Invertebrate Identifications: Freshwater								
Sorting	N/A	Recount accuracy ≥90%. 10% frequency	N/A	At least three grids or 25% of the total sample volume must be sorted.	Sorting efficiency ≥90%, 100 % frequency (internal); Processing efficiency 100%	ABC/Weston	N/A	N/A
Taxonomic ID	N/A	NA	N/A	Recount error ≤10%. 10% frequency (external reference lab)	100% of all collected and sorted samples are processed	ABC/Weston	SAFIT Level 2	Count
	N/A	Taxa ID error ≤10%. 10% frequency (external reference lab)	N/A	N/A	100% of all collected and sorted samples are processed	ABC/Weston	SAFIT Level 2	Count
	N/A	Individual ID error ≤10%. 10% frequency (external reference lab)	N/A	N/A	100% of all collected and sorted samples are processed	ABC/Weston	SAFIT Level 2	Count
Diatom and Soft Algae Identifications: Freshwater								
Diatom Taxonomic ID	NA	Bray-Curtis similarity ≥ 70%. 10% frequency (external reference lab)	N/A	Bray-Curtis similarity ≥ 70%	100% of all collected and sorted samples are processed	Rhithron	NA	Count
Soft Algae Taxonomic ID	NA	Sorensen similarity ≥ 80%. 10% frequency (external reference lab)	N/A	Sorensen similarity ≥ 80%	100% of all collected and sorted samples are processed	Rhithron	NA	$\mu g^3/cm^2$; Count (Epiphytes only)
Metals: Fish Tissue								
Mercury	Total	Reference Material (CRM, SRM or LCS) and Matrix Spike	75 -125% (70 - 130 % for Hg)	Laboratory Duplicate and Matrix Spike Duplicate - RPD < 25%	90%	CLA EMD	0.02	mg Kg ww
Selenium	Total					CLA EMD	1	mg Kg ww
Lipids: Fish Tissue								
Lipid	Total	N/A	N/A	Lab. Duplicate - RPD < 25%	90%	CLA EMD	0.05	%
Organochlorine Pesticides: Fish Tissue								
Aldrin	Total	Reference Material (CRM, SRM or LCS) and Matrix Spike	50 - 150%	Matrix Spike Duplicate - RPD < 25%	90%	CLA EMD	1	µg/wet Kg
Chlordane, cis-	Total		50 - 150%			CLA EMD	1	µg/wet Kg
Chlordane, trans-	Total		50 - 150%			CLA EMD	1	µg/wet Kg
DDD(o,p')	Total		50 - 150%			CLA EMD	0.5	µg/wet Kg
DDD(p,p')	Total		50 - 150%			CLA EMD	0.5	µg/wet Kg
DDE(o,p')	Total		50 - 150%			CLA EMD	0.5	µg/wet Kg
DDE(p,p')	Total		50 - 150%			CLA EMD	0.5	µg/wet Kg
DDT(o,p')	Total		50 - 150%			CLA EMD	0.5	µg/wet Kg
DDT(p,p')	Total		50 - 150%			CLA EMD	0.5	µg/wet Kg
Dieldrin	Total		50 - 150%			CLA EMD	1	µg/wet Kg
Endosulfan I	Total		50 - 150%			CLA EMD	1	µg/wet Kg
Endosulfan II	Total		50 - 150%			CLA EMD	1	µg/wet Kg
Endosulfan Sulfate	Total		50 - 150%			CLA EMD	1	µg/wet Kg
Endrin	Total		50 - 150%			CLA EMD	1	µg/wet Kg
Endrin Aldehyde	Total		33 - 138%			CLA EMD	1	µg/wet Kg
HCH, alpha	Total		50 - 150%			CLA EMD	1	µg/wet Kg
HCH, beta	Total		50 - 150%			CLA EMD	1	µg/wet Kg
HCH, delta	Total		50 - 150%			CLA EMD	1	µg/wet Kg
HCH, gamma	Total		50 - 150%			CLA EMD	1	µg/wet Kg

Table 13. (Continued)

Parameter	Fraction	Accuracy		Precision	Completeness	Laboratory	Target Reporting Limits	Units
		Requirements	Recovery					
Organochlorine Pesticides: Fish Tissue (Continued)								
Heptachlor	Total		50 - 150%			CLA EMD	1	µg/wet Kg
Heptachlor Epoxide	Total		50 - 150%			CLA EMD	1	µg/wet Kg
Methoxychlor	Total		34 - 143%			CLA EMD	4	µg/wet Kg
Mirex	Total		50 - 150%	Matrix Spike Duplicate - RPD < 25%	90%	CLA EMD	1	µg/wet Kg
Nonachlor, cis-	Total		50 - 150%			CLA EMD	1	µg/wet Kg
Nonachlor, trans-	Total		50 - 150%			CLA EMD	1	µg/wet Kg
Oxychlordane	Total		50 - 150%			CLA EMD	1	µg/wet Kg
Toxaphene	Total		50 - 150%			CLA EMD	30	µg/wet Kg
PCBs: Estuary Fish Tissue								
PCB 018	Total					CLA EMD	0.5	µg/wet Kg
PCB 028	Total					CLA EMD	0.5	µg/wet Kg
PCB 037	Total					CLA EMD	0.5	µg/wet Kg
PCB 044	Total					CLA EMD	0.5	µg/wet Kg
PCB 049	Total					CLA EMD	0.5	µg/wet Kg
PCB 052	Total	Reference Material (CRM, SRM				CLA EMD	0.5	µg/wet Kg
PCB 066	Total	or LCS) and Matrix Spike	50 - 150 %	Matrix Spike Duplicate - RPD < 25%	90%	CLA EMD	0.5	µg/wet Kg
PCB 070	Total					CLA EMD	0.5	µg/wet Kg
PCB 074	Total					CLA EMD	0.5	µg/wet Kg
PCB 077	Total					CLA EMD	0.5	µg/wet Kg
PCB 081	Total					CLA EMD	0.5	µg/wet Kg
PCB 087	Total					CLA EMD	0.5	µg/wet Kg
PCB 099	Total					CLA EMD	0.5	µg/wet Kg
PCB 101	Total					CLA EMD	0.5	µg/wet Kg
PCB 105	Total					CLA EMD	0.5	µg/wet Kg
PCB 110	Total					CLA EMD	0.5	µg/wet Kg
PCB 114	Total					CLA EMD	0.5	µg/wet Kg
PCB 118	Total					CLA EMD	0.5	µg/wet Kg
PCB 119	Total					CLA EMD	0.5	µg/wet Kg
PCB 123	Total					CLA EMD	0.5	µg/wet Kg
PCB 126	Total					CLA EMD	0.5	µg/wet Kg
PCB 128	Total					CLA EMD	0.5	µg/wet Kg
PCB 138	Total					CLA EMD	0.5	µg/wet Kg
PCB 149	Total					CLA EMD	0.5	µg/wet Kg
PCB 151	Total					CLA EMD	0.5	µg/wet Kg
PCB 153	Total					CLA EMD	1	µg/wet Kg
PCB 156	Total					CLA EMD	0.5	µg/wet Kg
PCB 157	Total					CLA EMD	0.5	µg/wet Kg
PCB 158	Total					CLA EMD	0.5	µg/wet Kg
PCB 167	Total					CLA EMD	0.5	µg/wet Kg
PCB 168	Total					CLA EMD	1	µg/wet Kg
PCB 169	Total					CLA EMD	0.5	µg/wet Kg
PCB 170	Total					CLA EMD	0.5	µg/wet Kg
PCB 177	Total					CLA EMD	0.5	µg/wet Kg
PCB 180	Total					CLA EMD	0.5	µg/wet Kg
PCB 183	Total					CLA EMD	0.5	µg/wet Kg
PCB 187	Total					CLA EMD	0.5	µg/wet Kg
PCB 189	Total					CLA EMD	0.5	µg/wet Kg
PCB 194	Total					CLA EMD	0.5	µg/wet Kg
PCB 200	Total					CLA EMD	0.5	µg/wet Kg
PCB 201	Total					CLA EMD	0.5	µg/wet Kg
PCB 206	Total					CLA EMD	0.5	µg/wet Kg