Quality Assurance Project Plan

The Central Coast Areas of Special Biological Significance Regional Monitoring Program and Reference Site Monitoring



Prepared for:

Monterey Regional Water Pollution Control Agency

Submitted by:

APPLIED marine SCIENCES

Version 1.3
March 13, 2014

1. (A1) Title and Approval Sheet

Program Title Central California Coast Regional Monitoring Program

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Effective Date March 13, 2014

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1.1. Approval Signatures:

Table 1-1. Managing Organization:

Title	Name	Signature	Date
Contract Manager / Director of Admin Services, MRWPCA	John Tiernan		
Chair, Central California ASBS Management Committee	Thomas Quattlebaum		
Project Coordinator, SCCWRP	Ken Schiff		
State Water Board	Mariela Paz Carpio-Obeso		
Project Manager, AMS	Dane Hardin		
QA Officer, AMS	Paul Salop		
Monitoring Coordinator, ADH	Christian Kocher		
Monitoring Coordinator, MBNMS	Lisa Emanuelson		
Lab Project Manager, Granite Canyon	Brian Anderson		
Lab Project Manager, MBAS	David Holland		
Lab Project Manager, MPSL	Autumn Bonnema		
Lab Project Manager, UCSC	Peter Raimondi		
Lab Project Manager, WPCL	Mary Curry		
Water Board QAO	Karen Worcester		

2. (A2) Table of Contents

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List of Acronyms

AMS	Applied Marine Sciences, Inc.
ASBS	Area of Special Biological Significance
ASTM	American Society for Testing and Materials
CCASBS	Central Coast ASBS Monitoring Project
CEDEN	California Environmental Data Exchange Network
CWA	Clean Water Act
DQO	Data Quality Objective
EDD	Electronic Data Deliverable
GC	Granite Canyon
IDL	Instrument Detection Limits
IDW	Investigation-Derived Waste
IM	Information Manager
LPM	Laboratory Project Manager
MBAS	Monterey Bay Analytical Services
MBNMS	Monterey Bay National Marine Sanctuary
MDL	Method Detection Limit
MPC	Monitoring Program Coordinator
MPSL	Marine Pollution Studies Laboratory
MQO	Measurement Quality Objective
NPDES	National Pollutant Discharge Elimination System
OC	Organochlorine
PAH	Polycyclic Aromatic Hydrocarbon
PCB	Polychlorinated Biphenyl
PM	Program Manager
PPE	Personal Protective Equipment
QA	Quality Assurance
QAO	Quality Assurance Officer
QAPP	Quality Assurance Project Plan
QC	Quality Control
RL	Method Reporting Limit
RWQCB	Regional Water Quality Control Board
SAP	Sampling and Analysis Plan
SOP	Standard Operating Procedure
SSC	Suspended Sediment Concentration
SWAMP	California Surface Water Ambient Monitoring Program
SWRCB	California State Water Resources Control Board
TMDL	Total Maximum Daily Load
TSS	Total Suspended Solids
UCSC	University of California at Santa Cruz
WPCL	Water Pollution Control Laboratory

3. (A3) Distribution List and Contact Information

The CCASBS QAPP was developed by the Project to be comparable with the SWAMP Quality Assurance Program Plan (QAPrP), Version 1.0 (SWAMP 2008).

Table 3-1. Project QAPP Distribution List

Title	Name	Telephone No.	QAPP #
Stormwater Program Manager, MRWPCA	Doug Dowden	831-645-4621	1
Project Director Reference Site Monitoring, SCCWRP	Ken Schiff	714-755-3202	2
State Water Board	Mariela Paz Carpio-Obeso	916-341-5858	3
Chair, Central Coast ASBS Management Committee	Sarah Hardgrave	831-648-5722	4
Project Manager, AMS	Dane Hardin	831-426-6326	5
QA Officer, AMS	Paul Salop	925-373-7142	6
Monitoring Coordinator, ADH	Christian Kocher	831-477-2003	7
Monitoring Coordinator, MBNMS	Lisa Emanuelson	831-647-4209	8
Lab Project Manager, Granite Canyon	Brian Anderson	831-624-0947	9
Lab Project Manager, MBAS	David Holland	831-375-6227	10
Lab Project Manager, MPSL	Autumn Bonnema	831-771-4175	11
Lab Project Manager, UCSC	Peter Raimondi	831-459-5674	12
Lab Project Manager, WPCL	Mary Curry	916-358-4398	13
Water Board QAO	Karen Worcester	805-549-3333	14

4. (A4) Project Organization

4.1. Involved Parties and Roles

In the 1970s, the California State Water Resources Control Board (Water Board) identified thirty-four Areas of Special Biological Significance (ASBS) along the California coast. These areas were so designated due to their unique biological assemblages, species, and geologic features, and were established to provide protection for species or biological communities from undesirable alterations of natural water quality. Together, the ASBS areas cover 500 miles of shoreline, or about 32 percent of the State's coast.

This QAPP covers monitoring associated with two separate but related projects: (1) reference site monitoring under contract to the Southern California Coastal Water Resources Project (SCCWRP) and (2) regional monitoring under contract to Monterey Regional Water Pollution Control Agency (MRWPCA).

Parties implementing the sampling and analysis program will be under the direction of Applied Marine Sciences, Inc. (AMS). As the Program lead, AMS will organize the monitoring and be responsible for analysis of samples and data, the maintenance of contracts with the analytical laboratories, and all report preparation.

AMS will be supported in this effort by the Monterey Bay National Marine Sanctuary (MBNMS), ADH Environmental (ADH), Granite Canyon Laboratory (GC), Monterey Bay Analytical Services (MBAS), Marine Pollution Studies Laboratory at Moss Landing (MPSL), the University of California at Santa Cruz (UCSC) and the Water Pollution Control Laboratory in Rancho Cordova (WPCL). Responsibilities of each of the respective organizations are shown in Table 4-1, and an organization chart is presented in Figure 4-1. A description of Project Team member roles and responsibilities is presented in the sections that follow.

Table 4-1. CCASBS Organizational Responsibilities

Organizational Affiliation	Responsibility
MBNMS	Field Sampling, Water Quality
ADH	Field Sampling, Water Quality
GC	Laboratory Analysis, Toxicity
MBAS	Laboratory Analysis, Conventional Water Quality
MPSL	Laboratory Analysis, Trace Metals
WPCL	Laboratory Analysis, Organics
UCSC	Rocky Intertidal Monitoring

4.2. Project Manager and Assistant Project Manager

The Project Manager (PM), with assistance from the Assistant Project Manager (APM), will be responsible for oversight of management level activities, including budgeting, reporting, and overall project implementation. In addition, the Program Manager will coordinate with the Project participants

and key regional agencies, including the Water Board, and oversee preparation of required reports and data submittals.

4.3. Quality Assurance Officer Role

The Quality Assurance Officer's (QAO's) role is to establish the quality assurance and quality control procedures found in this QAPP as part of the sampling and analysis programs. The QAO will also work with the Laboratory Manager from the analytical labs by communicating all quality assurance and quality control issues contained in this QAPP.

The QAO will also review and assess all procedures during the life of the contract against QAPP requirements. The QAO will report all findings to the PM, including all requests for corrective action. The QAO may stop all actions, including those conducted by subcontractors, if there are significant deviations from required practices or if there is evidence of a systematic failure.

4.4. Monitoring Program Coordinator Role

The Monitoring Program Coordinator (MPC) will oversee the technical conduct of the field related components of the monitoring, including developing monitoring protocols and training field personnel.

4.5. Field Team Lead

Field Team Leads (FTLs) will be responsible for the activities of field personnel under their supervision. Activities will include ensuring that properly trained individuals are selected for field monitoring and that field personnel adhere to this QAPP.

4.6. Information Manager

The Information Manager (IM) will serve as the primary contact for communication with contract laboratory(ies). The IM will be responsible for reviewing field datasheets and, as applicable, ensuring correction of errors and providing feedback to FTLs. The IM will also receive and store laboratory electronic data deliverables (EDDs) and be responsible for their export to CEDEN.

4.7. Laboratory Project Manager

The Laboratory Project Manager (LPM) at the selected analytical laboratory(ies) will be responsible for ensuring that the laboratory's quality assurance program and standard operating procedures are consistent with this QAPP, and that laboratory analyses meet all applicable requirements or explain any deviations. The LPM will also be responsible for coordinating with the QAO as required for the Project.

Titles and contact information for the Project personnel responsibilities at central and local levels are provided in Table 4-2.

Table 4-2. ASBS Regional Monitoring Program Personnel Responsibilities

Name	Organizational Affiliation	Title	Contact Information (Telephone, fax, email)
Dane Hardin	AMS	PM	831-426-6326, 925-373-7834, hardin@amarine.com
Mine Berg	AMS	APM	831-426-6326, 925-373-7834, berg@amarine.com
Bryan Bemis	AMS	MPC, IM	925-373-7142, 925-373-7834, bemis@amarine.com
Paul Salop	AMS	QAO	925-373-7142, 925-373-7834, salop@amarine.com
Lisa Emanuelson	MBNMS	FTL	831-647-4209, 831-647-4250, Lisa.Emanuelson@noaa.gov
Christian Kocher	ADH	FTL	831-477-2003, 831-477-0895, ckocher@adhenvironmental.com
Brian Anderson	GC	LPM	831-624-0947, 831-626-1518, anderson@ucdavis.edu
Dave Holland	MBAS	LPM	831-375-6227, 831-641-0734, Montereybayanalytical@usa.net
Autumn Bonnema	MPSL	LPM	831-771-4175, 831-633-0805, bonnema@mlml.calstate.edu
Peter Raimondi	UCSC	LPM	831-459-5674, 831-459-3383, raimondi@ucsc.edu
Mary Curry	WPCL	LPM	916-358-4398, 916-985-4301, mcurry@ospr.dfg.ca.gov

4.8. 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 PM and QAO, and with the concurrence of SCCWRP, MRWPCA, and the Central Coast ASBS Management Committee. The PM will be responsible for making the changes, submitting drafts for review, preparing a final copy, submitting the final for signature, and distribution.

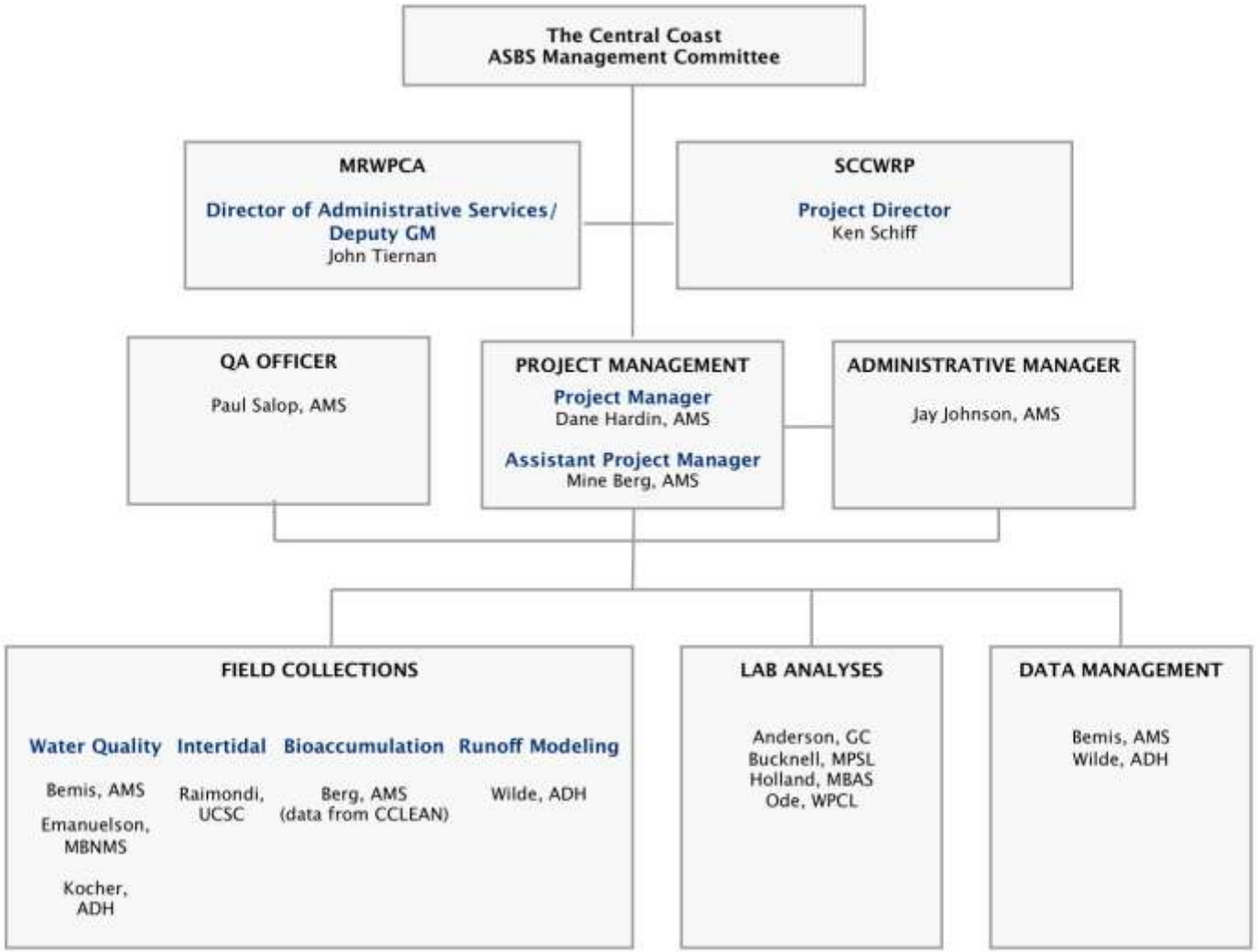

Figure 4-1. Organization Chart for Central Coast ASBS Monitoring Program

5. (A5) Problem Definition/Background

5.1. Problem Statement

The coastal environment of California is an important ecological and economic resource. It is home to diverse and abundant marine life and has some of the richest habitats on earth. The SWRCB has created 34 Areas of Special Biological Significance (ASBS) in order to preserve and protect these especially valuable biological communities.

California's coasts are also a repository for waste discharges from the State's ever-increasing population. Treated municipal and industrial wastewaters, urban runoff, and power generating station discharges all represent a number of risks to aquatic life from human activities. As a result, the SWRCB, in the California Ocean Plan (SWRCB 2009), has prohibited the discharge of waste to ASBS. All ASBS are State Water Quality Protection Areas that require special protection under state law.

A recent survey of ASBS has observed approximately 1,658 outfalls (SCCWRP 2003). As a result, the SWRCB initiated regulatory actions, establishing special protections through the Ocean Plan's exception process. The intent of these regulatory actions is to maintain natural water quality within the ASBS.

One large problem faced by both ASBS dischargers and regulators is a lack of information. The lack of information falls into at least four categories. First, it is uncertain what constitutes natural water quality. Second, it is uncertain which discharges exceed natural water quality limits. Third, it is uncertain what the extent and magnitude of natural water quality impacts are on a statewide basis. Finally, it is also uncertain whether the discharges are impacting marine life in a detrimental way.

5.2. Decisions or Outcomes

In response to the need for additional information, the SWRCB is working with ASBS dischargers to conduct a collaborative statewide ASBS monitoring program. The goal of this monitoring program is to answer two questions:

1) What is the range of natural conditions at reference locations?
2) How do conditions along ASBS coastline compare to the natural conditions at reference locations?

Answering question one will help translate the narrative standard to a numerical interpretation of natural water quality. Answering question two will help to assess if ASBS discharges are meeting the translated narrative standard.

5.3. Water Quality or Regulatory Criteria

There are two narrative criteria for ASBS discharges in the California Ocean Plan.

1) No discharge of waste
2) Maintenance of natural water quality

These narrative standards differ from typical NPDES ocean discharges that must meet numerical standards for a long list of constituents (Ocean Plan Table A, Table B). Standards for NPDES dischargers, which are based on toxicological studies to predict human health or aquatic health impacts, imply that some waste can be discharged so long as it is below levels that will result in adverse effects. No numerical standards for ASBS discharges currently exist.

5.4. Project-specific Action Limits

As there are no numerical standards associated with Project implementation, there are also no project-specific Action Limits. Monitoring will be conducted to generate information on discharge and receiving water quality associated with ASBS along the Central California coast.

6. (A6) Program/Task Description

6.1. Work Statement and Produced Products

This project will consist of three primary tasks including sampling, analysis, and reporting.

6.1.1. Sampling

Sampling will be focused on the water column for chemistry and toxicity analyses. In total, there will be 44 sites covered by this QAPP in Central California; 32 discharge sites, eight of which include receiving water, 11 reference sites and a mooring field site in Stillwater Cove. Site selection criteria are described in task-specific Sampling and Analysis Plans developed for each component (i.e., reference site monitoring, regional monitoring) The product for these tasks will be a sampling summary memo indicating sampling success during the field program.

6.1.2. Analysis

Analytical tasks will involve both laboratory and rocky intertidal data analysis. Laboratory analysis includes chemical measurements of end-of-pipe discharge, seawater, and mussel tissues. Laboratory analysis also includes critical life stage toxicity testing using three test species. Rocky intertidal analyses are identified in Appendix C. The product for this task will be a laboratory analysis summary memo indicating analytical success for all samples delivered to laboratory or rocky intertidal monitoring conducted.

6.1.3. Reporting

The final task will be reporting. This task involves information management, data analysis, and a final report. Information management will ensure consistency with the State's California Environmental Data Exchange Network (CEDEN) database. Report writing will provide a description of all methods, tabulations of raw data, and interpretation of results. The product for this task will include a CEDEN compliant relational database for study results (including metadata) and a written final report.

6.2. Constituents to be Monitored and Measurement Techniques

For this element of the study, we will analyze oil & grease, total suspended solids, Ocean Plan Table B metals for protection of marine life, polynuclear aromatic hydrocarbons (PAHs), pyrethroid pesticides, organophosphorus pesticides, and nutrients (See Section 7, reference table). Toxicity will be measured using critical life stage chronic toxicity tests for a single species in discharge samples and for three species in ocean receiving water samples. The bioaccumulation of metals, PAHs and pesticides will be measured in mussel tissues.

6.3. Project Schedule

The proposed project schedule assumes that a full complement of storms is sampled in each of two years. In the event that sampling must be extended over three years, the schedule shown in Table 6-1 will be revised accordingly.

Table 6-1. Central Coast ASBS Project Schedule.

Activity	Anticipated date of completion	Deliverable	Deliverable due date
QAPP Production	6/15/13	QAPP	6/15/13
Sampling	4/15/14	Sampling Summary Memo	5/15/14
Laboratory Analysis	5/15/14	Laboratory Analysis Summary Memo	8/31/14
Draft Annual Report	9/30/14	Draft Report	9//30/14
Final Annual Report	10/31/14	Final report	10/31/14
Sampling	4/15/15	Sampling Summary Memo	5/15/15
Laboratory Analysis	5/15/15	Laboratory Analysis Summary Memo	8/31/15
Draft Annual Report	9/30/15	Draft Report	9//30/15
Final Annual Report	10/31/15	Final report	10/31/15

6.4. Geographic Setting

There are 34 ASBS located throughout California. Eleven ASBS are located within the range of Central California coastline covered by this program (Figure 6.1) Several of these, including Point Reyes Headland, Double Point, Farallon Islands, Año Nuevo, Point Lobos, Julia Pfeiffer Burns and the mouth of Salmon Creek contain stormwater discharges that are not covered by this program. The discharges in these seven ASBS are either the responsibility of entities not participating in this program or are being sampled be consultants hired by entities that are participating in other aspects of the program. Consequently, this QAPP applies specifically to the stormwater discharges in the Duxbury Reef, Fitzgerald, Pacific Grove/Hopkins and Carmel Bay ASBS, a mooring field site in Stillwater Cove and associated Reference Sites.

In central California, one publicly owned treatment works, Carmel Area Wastewater District (CAWD), discharges to ASBS. Two ASBS receive nonstormwater discharges; CAWD and the Carmel River discharge into Carmel Bay ASBS and Hopkins Marine Station and Monterey Bay Aquarium discharge waste seawater into the Pacific Grove ASBS. The remaining discharges are all stormwater discharges from urban, agricultural or roadway land uses.

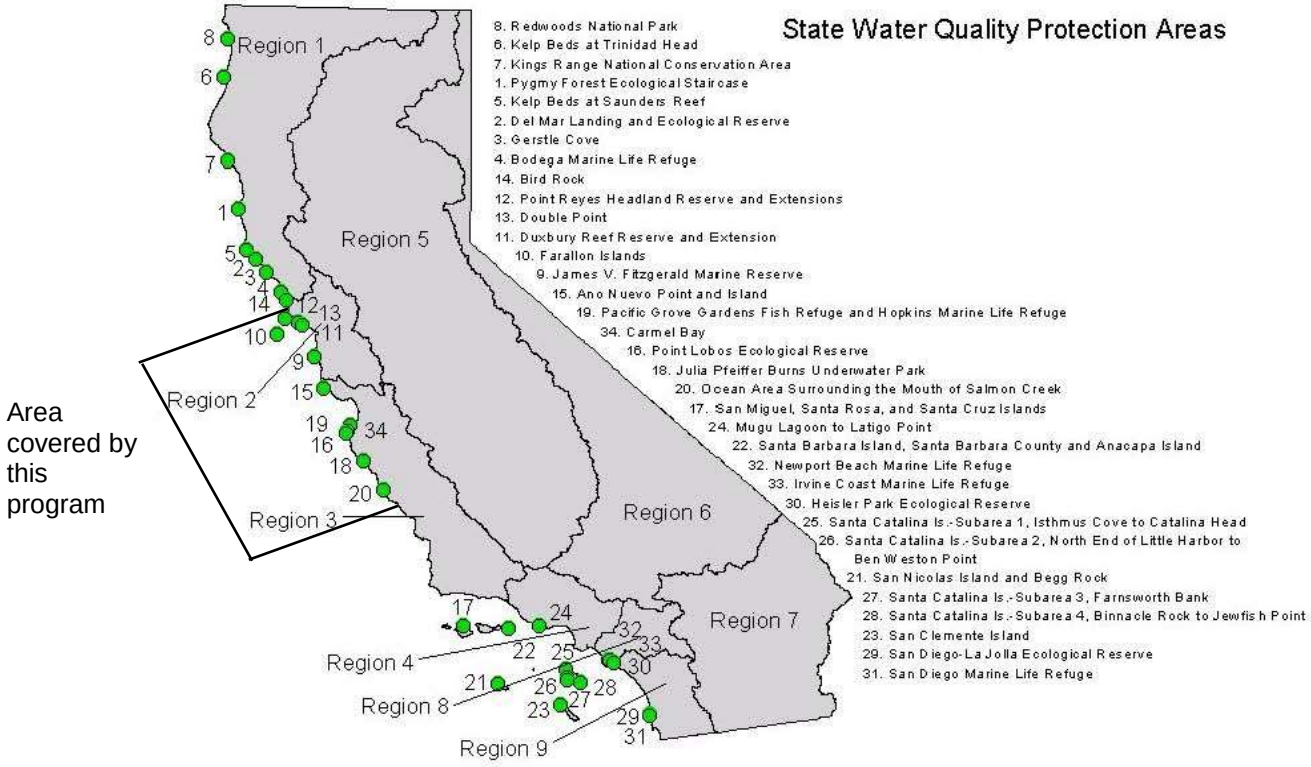

Figure 6-1. Location of Designated ASBS in California.

6.5. Constraints

There are four constraints identified for this study. The first constraint is the ability to capture the full range of reference conditions. All of the sites selected for sampling have met pre-established reference site criteria. The second constraint is sampling wet weather events. Three storms are required to be sampled at each reference site and eight large stormwater discharges, but sampling teams are at the mercy of the weather. Sampling teams will be properly informed by weather forecasting, storm activation, and minimization of false starts, but sampling teams have no control over drought conditions should they occur. The third constraint is the ability to incorporate all upstream land uses when sampling storm runoff. This constraint will be minimized by applying minimum criteria for the amount and duration o rainfall for a storm to qualify for sampling. The fourth constraint is sample transport. Some sampling sites are located in remote areas, and if unsafe travel conditions exist, samples may exceed holding times for those analyses that require 48 hr or less turnaround. This constraint will be minimized through the use of proper sample handling, preservatives where applicable, and optimizing sample transport options.

7. (A7) Quality Objectives and Criteria for Measurement Data

The quantitative measurements that estimate the true value or concentration of a physical or chemical property always involve some level of uncertainty. The uncertainty associated with a measurement generally results from one or more of several areas: (1) natural variability of a sample; (2) sample handling conditions and operations; (3) spatial and temporal variation; and (4) variations in collection or analytical procedures. Stringent QA and QC procedures are essential for obtaining unbiased, precise, and representative measurements and for maintaining the integrity of the sample during collection, handling, and analysis, as well and for measuring elements of variability that cannot be controlled. Stringent procedures also must be applied to data management to assure that accuracy of the data is maintained.

Data Quality Objectives (DQOs) are quantitative and qualitative statements that specify the tolerable levels of potential errors in the data and ensure that the data generated meet the standards for published data in the peer-reviewed literature. As defined in this plan, DQOs specify the quantity and quality of data required to support the study objectives. Each data quality category is described below. *Numerical DQOs for the constituents being sampled are listed in Appendix A.*

7.1. Project-specific Action Limits

There are no project-specific action limits associated with this Project. Action limits are to be developed based upon results of Project implementation after monitoring is completed.

7.2. Representativeness

The representativeness of data is the ability of the sampling locations and the sampling procedures to adequately represent the true condition of the sample sites. Representativeness in this study is addressed at two scales: 1) multiple reference sites to cover a range of reference conditions; and 2) multiple storm events to cover a range of storm conditions.

Field personnel will strictly adhere to the field sampling protocols to ensure the collection of representative, uncontaminated samples. The most important aspects of quality control associated with chemistry sample collection are as follows:

- Field personnel will be thoroughly trained in the proper use of sample collection equipment and will be able to distinguish acceptable versus unacceptable samples in accordance with pre-established criteria.
- Field personnel are trained to recognize and avoid potential sources of sample contamination (e.g., dirty hands, insufficient field cleaning).
- Samplers and utensils that come in direct contact with the sample will be made of non-contaminating materials, and will be thoroughly cleaned between sampling stations.
- Separate samples will be collected for each analysis, thus avoiding the need for sub-sampling and sample splitting between labs.
- Sample containers will be pre-cleaned and of the recommended type.

7.3. Comparability

Comparability is the degree to which data can be compared directly to other relevant studies. All data collected through implementation of the Central Coast ASBS Monitoring Program will also be performed in a manner so that data is comparable with California Surface Water Ambient Monitoring Program (SWAMP) protocols and therefore with ASBS monitoring being conducted in other regions of the State.

7.4. Precision

7.4.1. Chemical Data

Precision describes how well repeated measurements agree. Overall precision usually refers to the degree of agreement for the entire sampling, operational, and analysis system. It is derived from reanalysis of individual samples (laboratory replicates) or multiple collocated samples (field replicates) analyzed on equivalent instruments and expressed as the relative percent difference (RPD) or relative standard deviation (RSD). Analytical precision can be determined from duplicate analyses of field samples, laboratory matrix spikes, and/or reference material samples. The analytical precision of duplicate measurements of samples or spikes will serve as the overall precision for the Program.

Analytical precision is expressed as the RPD for duplicate measurements.

$$RPD = ABS([X1 - X2] / [(X1 + X2) / 2]) * 100$$

Where: X1 = the first sample result
X2 = the duplicate sample result.

In cases where more than one replicate is measured from a single sample or taken from a given site (on a scale presumed to be homogenous), rather than deriving RPDs for each pairwise combination, RSD can instead be calculated:

$$RSD = 100 * [stdev (X,,X2 ,..XN)] / [average (X,, X2 , ..XN)]$$

Where: X1 = the first sample result
XN = each successive sample result

If the laboratory-reported RPD (or RSD) exceeds the target for over 30% of the parameters in an analysis, the analysis is rerun. If after rerunning the analysis, RPD (or RSD) for a substantial number of analytes still exceeds the target, the problem is further investigated to identify whether potential problems originate in field sampling or laboratory handling and analysis. Additional corrective actions including flagging of data or reanalysis of samples are taken where possible and as needed.

In cases where there is insufficient field sample to analyze both lab duplicates and matrix spike duplicates, a duplicate of the unspiked sample is generally preferred, due to the possibility of spiking too high, resulting in precision measurement for a concentration range not found in typical samples. Analyzing a laboratory replicate for a field sample different from that used for matrix spikes can alleviate a problem of insufficient sample material. In extreme cases where there is sufficient material for only a single analysis of each sample from the Program, other samples such as blank spikes, reference materials,

or samples from another project may be used to evaluate analytical precision, again with caveats on the relevance of evaluations for samples with much higher concentrations.

7.5. Accuracy

Accuracy describes how close the measurement is to its true value. The accuracy of chemical measurements in this study applies to laboratory control standards (LCS) and matrix spike (MS) samples. The accuracy of chemical measurements is quantified as percent recovery. Accuracy objectives for toxicity measurements focus on reference toxicant results. Accuracy for toxicity measurements is quantified relative to the mean and standard deviation of previous reference toxicant exposures.

For the Project, analytical accuracy, characterized through the use of reference samples and laboratory matrix spikes in the laboratory operation, is considered acceptable for the overall accuracy of the Project. Accuracy is expressed as percent recovery for reference materials:

$$\% \text{ Recovery} = 100 * (MV / EV)$$

Where: MV = the measured value
EV = the true expected (reference) value.

For matrix spikes, recovery is calculated from the original sample result, the expected value (EV = native + spike concentration), and the measured value with the spike (MV):

$$\% \text{ Recovery} = [(MV-N) / (EV-N)] \times 100\%$$

Where: MV = the measured value of the spiked sample
EV = the true expected (reference) value (i.e., native + spike)
N = the native, unspiked result

Surrogate standards are also spiked into samples for some analytical methods and used to correct for losses in the analytical process. Although recoveries on surrogates are to be reported, control limits for surrogates are method and laboratory specific, and no project specific recovery targets for surrogates are specified, so long as overall recovery targets for accuracy (with matrix spikes and reference materials) are achieved.

Recovery targets for Project analytes are shown in Appendix A. If a laboratory's reported recovery falls outside of this range for over 30% of reported parameters in analysis of reference materials, the problems need to be identified, corrected, and the instrument re-calibrated, and samples in that batch rerun if possible. If the recovery for a matrix spike/duplicate falls outside of target range, possible causes must be investigated, and the analysis needs to be rerun where possible. If the spike continues to fall outside of the target range, the analysis will be rerun if sufficient material is available, and/or other corrective actions such as data flagging may be taken in consultation with IM.

No individual analyte value shall exceed the target limits more than once in consecutive batches (or when an adverse trend is observed) without appropriate documentation and consultation with the IM and / or QAO. Additional leeway may be granted for analytes with reference but not certified values, or for those

with 95% confidence intervals already outside the recovery targets. Due to the inherent variability in analyses near the method detection limit, control limit criteria for relative accuracy only apply to analytes with true values that are greater than the reporting limit.

In cases where Project field samples have insufficient material, the laboratory may instead spike a similar blank matrix (e.g., sand for sediment) or samples from other projects with similar expected concentrations. Spikes should be at least double the native concentrations in samples to allow quantitative assessment, but less than 100 times higher. If spiking concentrations are found too high in the first analyzed batch, additions in later analysis batches must be reduced. If expected native concentrations are unknown, spikes should be made at approximately 100 times the MDL or 10 times the quantification limit, and adjusted upward in later batches as needed.

7.6. Completeness

Completeness describes the success of sample collection and laboratory analysis, which should be sufficient to fulfill the statistical criteria of the project. Completeness is measured as the fraction of samples sampled and/or analyzed relative to the quantity targeted in the study design. While no specific statistical criteria have been established for this study, it is expected that 90% of all measurements could be taken when anticipated. This DQO accounts for adverse weather conditions, safety concerns, and equipment problems. A loss of 10% of the samples in this study would represent a minimal loss in statistical power to address the study objectives.

7.7. Bias

Bias describes the tendency for under or over prediction of sampled or measured values relative to the true value. Bias is typically assessed through the use of matrix spikes and reference materials. Commercially available proficiency samples spiked with known concentrations are tested annually by the analytical labs as part of their ELAP requirements. Bias will be assessed through negative controls (Blanks). Detectable quantities in the blank would indicate positive bias.

7.8. Contamination

Collected samples may inadvertently be contaminated with target analytes at many points in the sampling and analytical process, from the materials shipped for field sampling, to the air supply in the analytical laboratory. Blank samples evaluated at multiple points in the process chain help assure that pollutants measured in samples actually originated from the target matrix in the sampled environment and are not artifacts of the collection or analytical process.

Method blanks (also called laboratory reagent blanks, extraction blanks, procedural blanks, or preparation blanks) are used to assess laboratory contamination during all stages of sample preparation and analysis. The method blank will be processed through the entire analytical procedure in a manner identical to the samples. Method blanks should be less than the MRL. A method blank concentration greater than two times the MDL or 10% of the lowest reported sample concentration will require corrective action to identify and eliminate the source(s) of contamination before proceeding with sample analysis. If eliminating the blank contamination is not possible, all impacted analytes in the analytical batch shall be flagged. In addition, a detailed description of the likely contamination source(s) and the steps taken to eliminate/minimize the contaminants shall be included in narrative of the data report. If supporting data is

presented demonstrating sufficient precision in blank measurement that the 99% confidence interval around the average blank value is less than MDL or 10% of the lowest measured sample concentration, then the average blank value may be subtracted.

A field blank is collected to assess potential sample contamination levels that occur during field sampling activities. Field blanks are taken to the field, transferred to the appropriate container, preserved (if required by the method), and treated the same as the corresponding sample type during the course of a sampling event. The inclusion of field blanks is dependent on the requirements specified in the relevant MQO tables or in the sampling method or SOP.

8. (A8) Special Training Needs / Certification

8.1. Specialized Training or Certification

All field crew will be required to take training in sampling procedures prior to participating in monitoring. Analytical laboratories are to be certified for the analyses conducted at each laboratory by ELAP, NELAP, or an equivalent accreditation program as approved by the PM.

8.2. Training and Certification Documents

The QAO will be responsible for overseeing actual training efforts. The PM is responsible for ensuring all required training is conducted properly. The MPC is responsible for ensuring that all proposed field staff receive training specific to their sampling tasks prior to being assigned to any field activities.

All training materials, handouts, class rosters, and certification records related to the Project will be kept at the office of the MPC. All laboratories contracted through this Program are required to maintain their own training documents and certification records, and to make these available to the Project representatives as requested.

8.3. Training

All agencies, contractors, and participating laboratories must 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. Standard Operating Procedures (SOPs) for field, laboratory, and data management tasks have been developed and shall be updated on a regular basis in order to maintain procedural consistency. 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.

9. (A9) Documents and Records

The PM will also ensure that all field measurements and laboratory analytical data are uploaded to the CEDEN database in a timely fashion and per the requirements outlined in the contracting documents. A discussion of some of the key parts of the documentation process is shown below.

9.1. Field Documentation

9.1.1. Sampling Plans, COCs, and Sampling Reports

MPC will be responsible for development and submission of field sampling plans and sampling reports to the PM. Field sampling crews will collect records for sample collection, and will be responsible for maintaining these records in an accessible manner. Samples sent to analytical laboratories will include standard Chain of Custody (COC) procedures and forms; field crews will maintain a copy of originating COCs at their individual offices, and will forward copies to the MPC as soon as possible following sampling events. Analytical laboratories will collect records for sample receipt and storage, analyses, and reporting. All records, except lab records, generated by this Project will be stored at the office of the PM. All laboratory records pertinent to this Program will be maintained by the IM.

9.1.2. Data Sheets

All field data gathered by this Program will be recorded on standardized field data entry forms, as described in more detail in the field SOPs (AMS 2013).

9.1.3. Field Logbooks

In addition to completing field data sheets, sampling personnel may record relevant information in bound logbooks. All information should be recorded in permanent ink. Any changes made to recorded information will be made using single strike-through and will be initialed and dated by the person making the change.

9.1.4. Photographic Documentation

Photographic documentation is an important part of sampling procedures. An associated photo log will be maintained documenting sites and subjects associated with photos. If an option, the date function on the camera shall be turned on. A copy of all photographs should be provided to the IM at the conclusion of sampling efforts and maintained for the duration of the Project.

9.2. Laboratory Documentation

Successful implementation of the Project requires specific actions to be taken by contract laboratories, including requirements for data deliverables, quality control, and on-site archival of Project-specific information. Each of these aspects is described below.

9.2.1. Data Reporting Format

Each laboratory will deliver electronic narrative reports and electronic data deliverables (EDDs) to the IM. The IM will maintain at least two back-up copies on compact disc or off-site storage.

The analytical laboratory will report the analytical data to the IM via an analytical report consisting of, at a minimum:

1. Letter of transmittal

2. Chain of custody information
3. Analytical results for field and quality control samples
4. Case narrative
5. Copies of raw data.

The QAO will review the data deliverables provided by the laboratory for review of QA/QC. In addition to the laboratory's standard reporting format, all results meeting data quality objectives and results having satisfactory explanations for deviations from objectives shall be reported in tabular format on electronic media, in a format consistent with SWAMP templates. The specific format and any needed templates for this electronic data deliverable (EDD) are to be agreed upon by the IM and each LPM prior to onset of any sampling activities related to that laboratory.

As they become available, and after internal laboratory QA/QC review, draft data produced from laboratory analyses are sent in electronic format. These draft data are not for distribution or application in any manner, other than for the initial review by QAO and IM. Upon completion of their preliminary review of the draft data, Project staff will provide any concerns / comments (if any) in writing to the respective laboratory and the PM. Project staff will notify the lab if it approves of this draft data in its current format. If there are any concerns regarding the draft data, the concerns must be addressed in writing by the analytical lab. After the concerns are addressed and corrective actions taken (such as reviewing for transcription errors, reanalysis, and data flagging), data will be resubmitted as draft data for re-review. After all concerns have been addressed, they will notify the laboratory and approve the data as final.

Documentation for analytical data is kept on file at the laboratories, or may be submitted with analytical results. These may be reviewed during external audits of the Project, as needed. These records include the analyst's comments on the condition of the sample and progress of the analysis, raw data, instrument printouts, and results of calibration and QC checks. Paper or electronic copies of all analytical data, field data forms and field notebooks, raw and condensed data for analysis performed on-site, and field instrument calibration notebooks are kept as part of the Project archives for a minimum period detailed in Table 9-1.

9.2.2. Other Laboratory QA/QC Documentation

All laboratories will have the latest version of the Project QAPP in electronic format. In addition, the following documents and information from the laboratories will be current, and they will be available to all laboratory personnel participating in the processing of Project samples:

1. Laboratory QA plan: Clearly defines policies and protocols specific to a particular laboratory, including personnel responsibilities, laboratory acceptance criteria, and corrective actions to be applied to the affected analytical batches, qualification of data, and procedures for determining the acceptability of results.

2. Laboratory SOPs: Contain instructions for performing routine laboratory procedures, describing exactly how a method is implemented in the laboratory for a particular analytical procedure. Where published standard methods allow alternatives at various steps in the process, those approaches chosen by the laboratory in their implementation (either in general or in specific

analytical batches) are to be noted in the data report, and any deviations from the standard method are to be noted and described.

3. Instrument performance information: Contains information on instrument baseline noise, calibration standard response, analytical precision and bias data, detection limits, scheduled maintenance, etc.

4. Control charts: Control charts are developed and maintained throughout the Program for all appropriate analyses and measurements for purposes of determining sources of an analytical problem or in monitoring an unstable process subject to drift. Control charts serve as internal evaluations of laboratory procedures and methodology and are helpful in identifying and correcting systematic error sources. Control limits for the laboratory quality control samples are ±3 standard deviations from the certified or theoretical concentration for any given analyte.

Records of all quality control data, maintained in a bound notebook at each workstation, are signed and dated by the analyst. Quality control data include documentation of standard calibrations, instrument maintenance and tests, and analyses of Certified Reference Materials (CRMs). Control charts of the data are generated by the analysts monthly or for analyses done infrequently, with each analysis batch. The laboratory quality assurance specialist will review all QA/QC records with each data submission, and will provide QA/QC reports to the IM with each batch of submitted field sample data.

9.3. Program Management Documentation

The IM is responsible for managing key parts of the Project information management system. These efforts are described below.

9.3.1. QAPP

All original QAPPs will be held by the IM. This QAPP and its revisions will be distributed to all parties involved with the Program, including FTLs and Water Board representative(s). Copies will also be sent to the each participating analytical laboratory's LPM for internal distribution.

Associated with each update to the QAPP, the PM will notify Project participants of the updated QAPP, with a cover memo compiling changes made. After appropriate distributions are made to affected parties, these approved updates will be filed and maintained by the QAO for the Program. Upon revision, the replaced QAPPs will be discarded.

9.3.2. Program Information Archival

The PM will oversee the actions of all personnel with records retention responsibilities, and will arbitrate any issues relative to records retention and any decisions to discard records. Each analytical laboratory will archive all analytical records generated for this Program. The IM will be responsible for archiving all other records associated with implementation of the Project. The PM will be responsible for archiving all management-level records.

Persons responsible for maintaining records for this Program are shown in Table 9-1.

Table 9-1. Document and Record Retention, Archival, and Disposition.

Type	Retention (yrs)	Archival	Disposition	Responsible Party
Field Notebooks	5	Paper	Maintain indefinitely	MPC
Field Datasheets	5	Paper, electronic	Maintain indefinitely	IM
COC Forms	5	Paper, electronic	Maintain indefinitely	IM
Calibration Logs	5	Paper, electronic	Recycle / delete	LPM
Raw Analytical Data	5	Paper, electronic	Recycle / delete	LPM
Lab QC Records	5	Paper, electronic	Recycle / delete	LPM
EDDs	Indefinite	Electronic	Maintain indefinitely	IM, LPM
Reports	Indefinite	Electronic	Maintain indefinitely	PM
Field Audits	Indefinite	Electronic	Maintain indefinitely	QAO

The PM will oversee the actions of all personnel with records retention responsibilities, and will arbitrate any issues relative to records retention and any decisions to discard records. As discussed previously, each analytical laboratory will archive all analytical records generated for this Program. The IM will be responsible for archiving all other records associated with implementation of the Project.

10. (B1) Sampling Process Design

The study questions underlying the Project focus upon defining water quality conditions at "natural" sites and how they might differ within ASBS locations along the Central Coast. Stations were identified with the intent of impact assessment. Sampling personnel from AMS, ADH, MPSL, and MBNMS volunteers will visit multiple sites within the same storm / dry weather event to collect grab water samples as identified in the Project Sampling and Analysis Plan (AMS 2013).

10.1. Sampling Site Selection

Actual sampling locations will be selected based upon the direct sampling design principle. Monitoring station locations and a justification for selection of these sites are fully described in the SAP, including a station location map, and briefly summarized here. A total of 44 sites will be sampled for this study. Eleven sites are reference receiving water locations, 32 are ASBS discharge sites, with eight of these also including receiving water sampling. In addition, one mooring field will be sampled. Site selection criteria are listed in the SAP (AMS 2013).

10.2. Timing of Monitoring

The timing of monitoring will be selected with the intent of monitoring significant runoff events. The minimum requirement for a storm shall be >0.10 inches of rainfall resulting in runoff, >72 hours from the previous storm. Moreover, every attempt shall be made to sample only after sheeting water on roadways and heavy flow through the storm drain system has occurred and sufficient time has passed after the initiation of rainfall to allow for time of concentration to include flow runoff from all parts of the catchment or watershed.

10.3. Sample Collection

Samples for laboratory analysis will be collected as a combination of grab and composite samples, as identified within the Project SOPs (AMS 2013).

10.4. Continuous Monitoring

The Project will not require continuous monitoring.

10.5. Field Measurements

For initial sampling event(s), field crews will measure salinity in receiving waters. Measurements will be made from sample media collected in transfer containers. This data is being gathered to inform analytical laboratories in selection of sampling equipment, and based upon direction from laboratories, may not be required for subsequent sampling events.

Field crews will also document site observations on field datasheets (AMS 2013).

10.6. Critical Activities

Collection of sample media to support all identified laboratory analyses is considered critical to Project success. Field measurements of salinity are for informational purposes only and not deemed critical.

10.7. Sampling Uncertainty

There are multiple sources of potential sampling uncertainty associated with the Project, including: (1) measurement error; (2) natural (inherent) variability; (3) sample misrepresentation (or poor representativeness); and (4) sampling bias (statistical meaning). Measures incorporated to address these areas of uncertainty are discussed below:

(1) Measurement error combines all sources of error related to the entire sampling and analysis process (i.e., to the measurement system). All aspects of dealing with uncertainty due to measurement error have been described elsewhere within this QAPP.

(2) Natural (inherent) variability occurs in any environment monitored, and is often much wider than the measurement error. This will be taken into consideration when interpreting results of the various lines of inquiry.

(3) Sample misrepresentation happens at the level of an individual sample or field measurement where an individual sample collected is a poor representative for overall conditions encountered. To address this situation, the Project will be developing and implementing a number of QA-related measures, including development of training protocols, Standard Operating Procedures (SOPs), and auditing of field crews to ensure their proper implementation.

(4) Sampling bias relates to the sampling design employed and whether the appropriate statistical design is employed to allow for appropriate understanding of environmental conditions. To a large degree, the sampling design is judgmental, which will therefore incorporate an unknown degree of sampling bias into the Project.

11. (B2) Sampling Methods

The Project has developed SOPs to support Project implementation, including methods for field collection, sample preparation, sample equipment cleaning, sample handling, and sample labeling. Those are described in the sections that follow, summarized in Table 11-1, and included as Appendix J.

Table 11-1. List of Relevant SOPs Governing Methods Employed for ASBS Discharge and Receiving Water Monitoring

SOP #	SOP	Source
FS-1	Collection of Water Samples	RMP
FS-2	Field Equipment Cleaning Procedures	RMP
FS-3	Sample Container, Handling, and Chain of Custody Procedures	RMP
FS-4	Site and Sample Naming Convention	RMP
FS-5	Completion and Processing of Field Datasheets	RMP
FS-6	Collection of Sediment Samples	RMP

11.1. Discharge Monitoring

Sampling outfalls requires the manual collection of grab samples by direct bottle filling, where possible. Sampling methods were developed based upon those employed for southern California ASBS monitoring (SCCWRP 2012). This complete sampling SOP appears in AMS (2013).

Sample containers and preservatives are identified in the field sampling SOP. Appropriate pre-cleaned sample containers will be used. Sample bottles and caps will be protected from contact with solvents, dust, or other contaminants. Sample bottles for this project will not be reused.

The FTL and MPC have 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 in order to alert rescue agencies should an accident occur. 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 documented in the field (narrative and photographic) promptly reported to the PM, who will determine if any corrective action is needed and make arrangements to collect a replacement sample (if possible). The QAO will document sampling failures and the effectiveness of corrective actions.

11.2. Receiving Water Monitoring

Sampling receiving waters requires the manual collection of grab samples, typically through use of a transfer container. When not possible, an alternative technique will be employed. Sampling methods were developed based upon those employed for southern California ASBS monitoring (SCCWRP 2012). The complete sampling SOP appears in AMS (2013).

Sample containers and preservatives are identified in the field sampling SOP. Appropriate pre-cleaned sample containers will be used. Sample bottles and caps will be protected from contact with solvents, dust, or other contaminants. Sample bottles for this project will not be reused.

The FTL and MPC have 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 in order to alert rescue agencies should an accident occur. 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 PM, who will determine if any corrective action is needed and make arrangements to collect a replacement sample (if possible). The QAO will document sampling failures and the effectiveness of corrective actions.

11.3. Mooring Field Monitoring

Mooring Field monitoring involves collection of both receiving water and sediment samples. Ocean receiving water samples will be collected monthly from May through October on a high use weekend in each month using a watercraft to access the sampling site. Sampling receiving waters requires the manual collection of grab samples by direct bottle filling, where possible. Sampling methods were developed based upon those employed for southern California ASBS monitoring (SCCWRP 2012). This complete sampling SOP appears in AMS (2013). Sediment samples will be collected annually from within the mooring field and below the pier in Stillwater Cove.

11.4. Rocky Intertidal Monitoring

Methods to be employed for conducting rocky intertidal monitoring are summarized in Appendix C.

11.5. Field Preparation

Samples will be prepared in the field as needed to conform to USEPA and/or SWAMP requirements, to ensure sample integrity from time of sample collection to delivery at the analytical laboratory. Detailed information on sample containers, required preservation, holding times, and sample volumes is shown in SOP FS-3, Sample Container, Handling, and Chain of Custody Procedures.

11.6. Sampling Containers

The Project will implement standard methods associated with sample container, handling and chain of custody procedures that is identified in Project SOP FS-3. Collection of pathogens in water requires the use of sterilized sample containers. Containers will be provided by contracted laboratories pre-sterilized. Individual laboratories will be responsible for the integrity of containers provided. No other containers required for collection of Project samples will require sterile containers.

All sampling containers used for the ASBS water quality analysis will be provided pre-cleaned by contracted analytical laboratories. The individual laboratories will be responsible for ensuring integrity of the containers. Should sampling containers lose their integrity during the sampling process, they will be discarded and replaced with a pre-cleaned container. A list of sampling containers required for Project implementation is compiled in SOP FS-3, Sample Container, Handling, and Chain of Custody Procedures.

11.7. Sample ID Numbers

Every sample must have a unique sample number so that the analytical results from each sample can be differentiated from every other sample. This information should follow the sample through the COC, analytical, and interpretation and reporting processes. As described in SOP FS-4, Site and Sample Naming Convention, samples collected will adopt a naming convention that is consistent throughout Project implementation.

11.8. Sample Equipment Cleaning

Cleaning techniques required for sampling equipment will vary depending on the media sampled and analyte measured. Cleaning techniques to be used are described in SOP FS-2, Equipment Cleaning Procedures, and individual SOPs associated with the relevant type of sampling to be conducted.

11.9. Waste Disposal

Proper disposal of all waste is an important component of field activities. At no time will any waste be disposed of improperly. The proper methods of waste disposal are outlined below:

11.9.1. Routine Garbage

Regular garbage (paper towels, paper cups, etc.) is collected by sampling personnel in garbage bags or similar. It can then be disposed of properly at appropriate intervals.

11.9.2. Detergent Washes

Any detergents used or detergent wash water should be collected in the field in a water-tight container and disposed of appropriately.

11.9.3. Chemicals

Solvents, acids, and formalin are hazardous materials and should be disposed of by following all appropriate regulations. They should always be collected when sampling and never be disposed in the field.

11.10. Responsibility and Corrective Actions

If monitoring equipment fails, sampling personnel will first attempt possible repairs in the field or use backup equipment if available. If unable to repair or replace, sampling personnel will report the problem in the comments section of their field notes and will not record data values for the variables in question. Actions will be taken to replace or repair broken equipment prior to the next field use. Under no condition will data be entered into the SWAMP database that were known to be collected with faulty equipment.

12. (B3) Sample Handling and Custody

The QAO will be responsible for overall quality assurance associated with field sampling conducted. The MPC responsible for identifying and ensuring appropriate qualifications and training for all sampling personnel.

One member of each sampling team will be identified as "Team Lead", and will be responsible for overall collection and custody of samples during field sampling. Field crews will keep a field log, which will consist of sampling forms for each sampling event. SOPs for Field Sample Collection, identified in Table 11-1 will be followed, and include instruction for field documentation. In the field log, the following items will be recorded: time of sample collection, sample identification numbers, results of any field measurements and the time that they were made, qualitative descriptions of relevant water and weather conditions at the time of sample collection, and a description of any unusual occurrences associated with the sampling event (especially those that could affect sample or data quality).

The field crews will have custody of samples during field sampling and chain-of-custody (COC) forms will accompany all samples to the analyzing laboratory. COC procedures require that possession of samples be traceable from the time the samples are collected until completion and submittal of analytical results. A detailed description of COC procedures is included in SOP FS-3, Sample Container, Handling, and Chain of Custody Procedures. Each contracted analytical laboratory will maintain custody logs sufficient to track each sample submitted and to analyze or preserve each sample within specified holding times. Each analytical laboratory has a sample custodian who examines the samples for correct documentation, proper preservation and holding times. Each laboratory will follow sample custody procedures as outlined in its QA plans.

In general, all non-biological samples will be packed in wet ice during shipment, so that they will be kept at approximately 4 ± 2º C. When used, wet ice will be double bagged in Zip-top bags to prevent contamination via meltwater. Where appropriate, samples may be frozen to prevent biological degradation. If samples are to be shipped frozen on dry ice, then appropriate handling procedures will be followed, including ensuring use of appropriate packaging materials and appropriate training for shipping personnel.

Additional detail on sample handling procedures is presented in SOP FS-3, Sample Container, Handling, and Chain of Custody Procedures.

12.1. Shipping Containers

All samples will be handled, prepared, transported, and stored in a manner so as to minimize bulk loss, analyte loss, contamination, or biological degradation. Sample containers will be clearly labeled with an indelible marker. All caps and lids will be checked for tightness prior to shipping. Ice chests will be sealed with packing tape before shipping. Samples will be placed in the ice chest with enough ice or frozen ice packs to completely fill the ice chest. COC forms will be placed in a zip-top bag and placed inside of the ice chest. Additional detail on sample handling is included in SOP FS-3, Sample Container, Handling, and Chain of Custody Procedures.

12.2. Commercial Vehicle Transport

Transport of samples to the contracted laboratories will be by commercial carriers. As required, pickup will be pre-arranged with the carrier and all required shipping forms will be completed prior to sample pickup by the commercial carrier.

12.3. Sample Hold Times

Information on sampling containers, preservation techniques, and hold times are shown in SOP FS-3, Sample Container, Handling, and Chain of Custody Procedures.

13. (B4) Method Selection

13.1. In Situ Monitoring

There is no in situ monitoring associated with implementation of the Project.

13.2. Continuous Monitoring

There is no continuous monitoring associated with implementation of the Project.

13.3. Field Measurements

As described previously, for initial sampling event(s), field crews will measure salinity in receiving waters. This data is being gathered to inform analytical laboratories in selection of sampling equipment, and based upon direction from laboratories, may not be required for subsequent sampling events. Field staff will employ equipment listed in Table 13-1 to measure salinity. These measurements will not be reported as part of data reporting requirements.

13.4. Method Reporting Limits

Target method reporting limits (MRLs), or Reporting Limits (RLs), applicable for the Project are presented in Appendix C. It is understood that all targets may not be achievable by laboratories in each media, especially where interferences present may elevate MRLs.

Target MRLs used for the Project were determined based upon laboratory capabilities within the media being analyzed. Most Project analytes achieve SWAMP targets. In some cases, these MRLs are higher than target MRLs proposed by SWAMP (SWAMP QAT 2008), including nitrate, orthophosphate, oil and grease, some PAHs in water, some trace metals in sediment, and pyrethroid pesticides. It is understood that SWAMP target MRLs are not always achievable in all environmental media, especially associated with urban runoff-related samples. This is the rationale behind the move from SWAMP MRLs being requirements to being targets.[1]

13.5. Performance Based Measurement System

Multiple analytical laboratories will provide analytical services. Contracted laboratories will be encouraged to use a Performance Based Measurement System (PBMS). A performance-based approach permits the use of any scientifically appropriate method that demonstrates the ability to meet established method performance criteria (e.g., accuracy, sensitivity, bias, precision) and complies with specified data quality needs or requirements. Using PBMS the data quality needs, mandates, or limitations of the program or project are specified. These will serve as criteria for selecting measurement processes (i.e, methods), which will meet those needs in a cost-effective manner, rather than the use of a mandated method.

[1] Surface Water Ambient Monitoring Program Quality Assurance Team. Memo to Toni Russell, QA Liaison and Dawit Tadesse, Acting SWAMP Coordinator, State Water Resources Control Board. October 15, 2008.

As of publication of this QAPP, the methods identified by each participating analytical laboratory are compiled within Table 13-1. All SOPs are compiled in Appendices.

Table 13-1. Laboratory SOPs for Processing and Analysis of ASBS Samples

Lab	Analyte / Activity	SOP
Alpha	Enterococcus	MSOP2.15 Enterolert: Enterococci: Most Probable Number (MPN) in Waste and Recreational Water by IDEXX Enterolert
Alpha	Fecal Coliform	MSOP2.01a: Total and Fecal Coliforms: Most Probable Number (MPN) 15 Tube by SM9221
GC	Sediment Toxicity	SOP 2.5: Eohaustorius estuarius Sediment Test
GC	Aquatic tox – mussel	SOP 2.9: Mytilus galloprovincialis Larval Development Test
GC	Aquatic tox – echinoderm	SOP 2.17: Echinoderm Fertilization Test
GC	Aquatic tox – kelp	SOP 2.23: Macrocystis pyrifera Germination Test
MBAS	Fecal coliform	Chromogenic Substrate Test (SM 9223)
MBAS	Fecal coliform	Standard Total and Fecal Coliform Multiple-Tube Fermentation Technique Fifteen Tube Test (SM 9221B&E)
MBAS	Enterococcus	Enterolert enterococcus test, defined Chromogenic Substrate Test (SM 9230E)
MBAS	Oil and Grease	Oil and Grease, Hexane Extraction (EPA 1664)
MBAS	Inorganic Ions	Determination of Inorganic Anions by Gas Chromatography (EPA 300.0)
MBAS	TSS	Total Suspended Solids, Gravimetric (SM 2540-D)
MBAS	Ammonia	Ammonia-Nitrogen, Ion Selective Electrode (SM 4500-NH3D)
MPSL	Trace Elements	Determination of Trace Elements in Waters and Wastes by Inductively Coupled Plasma – Mass Spectrometry, Method 200.8
MPSL	Mercury	EPA 1631 (with modifications)
MPSL	Trace Elements	Determination of Trace Elements in Ambient Waters by Inductively Coupled Plasma – Mass Spectrometry, Method 1638 (with modifications)
MPSL	Acid Digestion	Microwave Assisted Acid Digestion of Siliceous and Organically Based Matrices, Method 3052 (with modifications)
MPSL	Mercury	Mercury in Solids and Solutions by Thermal Decomposition, Amalgamation, and Atomic Absorption, Method 7473
MPSL	Glassware	Sample Container Preparation for Organics and Trace Metals, Including Mercury and Methylmercury, Method MPSL-101
MPSL	Sample Receiving	Sample Receipt and Check-In, Method # MPSL-104
WPCL	OP Pesticides	Determination of Organophosphorus Pesicides in Water Samples, WPCL-GC-052, Rev 10
WPCL	Extraction	Extraction of Organochlorine, Organophosphorus, PCBs, and Pyrethroids Pesticides in Water Samples (Separatory Funnel), WPCL-PR-007, Rev 1.
WPCL	Pyrethroids	Determination of Synthetic Pyrethroids in Water Samples, WPCL Method #53, Rev 3.

13.6. PBMS Methods Validation

Each analytical laboratory should adhere to its individual QA program for method validation techniques for specific methods. Individual QA plans should be maintained on-site and be made available to Project representatives upon request. When using the PBMS, the labs will have to follow all PBMS procedures related to obtaining quality data, but the labs are not required to submit the results to anyone except upon request. The results are to be kept on file by each individual lab.

13.7. Method Failures

The PM will be responsible for any corrective actions that may be needed in the event that methods fail to produce SWAMP-comparable data. If a method fails to provide SWAMP-comparable data for any reason, including analyte or matrix interferences, instrument failures, etc., then the involved samples will be analyzed again if possible. The laboratory in question's SOP for handling these types of problems will be followed. When a method fails to provide SWAMP-comparable data, then the laboratory's SOP for documenting method failures will be used to document the problem and what was done to rectify it.

Corrective actions are taken when an analysis is deemed suspect for some reason. These reasons include exceeding accuracy ranges and/or problems with sorting and identification. 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 taxonomists.
- A complete re-identification of the sample.

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

13.8. Sample Disposal

After analysis of the Project samples have been completed by the laboratory and results have been accepted by the IM, they will be disposed by each laboratory of in compliance with all federal, state, and local regulations. The laboratory has standard procedures for disposing of its waste, including left over sample materials

13.9. Laboratory Sample Processing

Methods and procedures to be employed by laboratories are contained within Appendices Field samples sent to the laboratories will be processed within their recommended hold time (SOP FS-3) using methods agreed upon method between the PM and LPMs. Each sample may be assigned unique laboratory sample identification (ID) numbers for tracking processing and analyses of samples within the laboratory. This laboratory sample ID (if differing from the field team sample ID) must be included in the data submission, within a lookup table linking the field sample ID to that assigned by the lab.

Samples arriving at the laboratory are to be stored under conditions appropriate for the planned analytical procedure(s), unless they are processed for analysis immediately upon receipt. Samples to be analyzed should only be removed from storage when laboratory staff is ready to proceed.

As contracted, laboratories are required to meet a turn around time (TAT) of 90 calendar days following submission of samples. It is not anticipated that expedited TATs will be required of laboratories.

Table 13-2. Field Measurements for CCASBS Analytes

Water Quality Analyte	Instrument Type	Model	Range and Units
Salinity	Digital meter	EXTECH ExStikII EC400	1 to 9.99 ppt
Salinity	Digital meter	EXTECH ExStikII EC500	1 to 9.99 ppt
Salinity	Digital meter	SaltScan	0 to 10 ppt
Salinity	Refractometer	ATC A366ATC	0 to 32 ppt

14. (B5) Quality Control

Concentrations of pollutants in environmental samples are often low. Therefore, a quality-assurance program for the chemical analysis of samples requires stringent laboratory conditions and careful control over all aspects of the analyses. Each step in the analytical process is a potential source of contamination and must be consistently monitored to ensure that the final measurement is not adversely affected by any processing steps. Various aspects of the Project quality control program are summarized below.

14.1. Laboratory Quality Control

Laboratories providing analytical support to the Project will have the appropriate facilities to store, prepare, and process samples in an ultra-clean environment, and will have appropriate instrumentation and staff to perform analyses and provide data of the required quality within the time period dictated by the Program. The laboratories are expected to satisfy the following:

1. Demonstrate capability through pertinent certification and satisfactory performance in inter-laboratory comparison exercises.
2. Provide qualification statements regarding their facility and personnel.
3. Maintain a program of scheduled maintenance of analytical balances, laboratory equipment and instrumentation.
4. Conduct routine checking of analytical balances using a set of standard reference weights (American Society of Testing and Materials Class 3, NIST Class S-1, or equivalents). Analytical balances are serviced at six-month intervals or when test weight values are not within the manufacturer's instrument specifications, whichever occurs first.
5. Check fresh calibration standards against second source standards to verify composition and concentration.
6. Record all analytical data in bound (where possible) logbooks, with all entries in ink, or electronically.
7. Monitor and document the temperatures of cold storage areas and freezer units on a continuous basis.
8. Verify the efficiency of fume/exhaust hoods.
9. Have a source of reagent water meeting specifications described in Section 8.0 available in sufficient quantity to support analytical operations.
10. Label all containers used in the laboratory with date prepared, contents, initials of the individual who prepared the contents, and other information as appropriate.
11. Date and safely store all chemicals upon receipt. Proper disposal of chemicals when the expiration date has passed.
12. Have QAPP, SOPs, analytical methods manuals, and safety plans readily available to staff.
13. Have raw analytical data readily accessible so that they are available upon request.

In addition, laboratories involved in the Project are required to demonstrate capability continuously through the following protocols:

1. Strict adherence to routine QA/QC procedures.
2. Routine analysis of CRMs, if available.
3. Regular participation in annual certification programs.

4. Satisfactory performance at least annually in the analysis of blind Performance Evaluation Samples and/or participation in inter-laboratory comparison exercises.

Laboratory QC samples must satisfy SWAMP measurement quality objectives (MQOs) and frequency requirements. MQOs are specified in Appendix A. Frequency requirements are provided on an analytical batch level. The Project defines an analytical batch as 20 or fewer samples and associated quality control that are processed by the same instrument within a 24-hour period (unless otherwise specified by method). Details regarding sample preparation are method- or laboratory SOP-specific, and may consist of extraction, digestion, or other techniques.

14.2. Calibration and Working Standards

All calibration standards must be traceable to a certified standard obtained from a recognized organization. If traceable standards are not available, procedures must be implemented to standardize the utilized calibration solutions (e.g., comparison to a certified reference material (CRM – see below). Standardization of calibration solutions must be thoroughly documented, and is only acceptable when pre-certified standard solutions are not available. Working standards are dilutions of stock standards prepared for daily use in the laboratory. Working standards are used to calibrate instruments or prepare matrix spikes, and may be prepared at several different dilutions from a common stock standard. Working standards are diluted with solutions that ensure the stability of the target analyte. Preparation of the working standard must be thoroughly documented such that each working standard is traceable back to its original stock standard. Finally, the concentration of all working standards must be verified by analysis prior to use in the laboratory.

14.3. Instrument Calibration

Prior to sample analysis, utilized instruments must be calibrated following the procedures outlined in the relevant analytical method or laboratory SOP. Each method or SOP must specify acceptance criteria that demonstrate instrument stability and an acceptable calibration. If instrument calibration does not meet the specified acceptance criteria, the analytical process is not in control and must be halted. The instrument must be successfully recalibrated before samples may be analyzed.

Calibration curves will be established for each analyte covering the range of expected sample concentrations. Only data that result from quantification within the demonstrated working calibration range may be reported unflagged by the laboratory. Quantification based upon extrapolation is not acceptable. Data reported outside of the calibration range must be flagged as “Detected not Quantified”. Alternatively, if the instrumentation is linear over the concentration ranges to be measured in the samples, the use of a calibration blank and one single standard that is higher in concentration than the samples may be appropriate. Samples outside the calibration range will be diluted or concentrated, as appropriate, and reanalyzed.

14.4. Initial Calibration Verification

The initial calibration verification (ICV) is a mid-level standard analyzed immediately following the calibration curve. The source of the standards used to calibrate the instrument and the source of the standard used to perform the ICV must be independent of one another. This is usually achieved by the purchase of standards from separate vendors. Since the standards are obtained from independent sources

and both are traceable, analyses of the ICV functions as a check on the accuracy of the standards used to calibrate the instrument. The ICV is not a requirement of all SOPs or methods, particularly if other checks on analytical accuracy are present in the sample batch.

14.5. Continuing Calibration Verification

Continuing calibration verification (CCV) standards are mid-level standards analyzed at specified intervals during the course of the analytical run. CCVs are used to monitor sensitivity changes in the instrument during analysis. In order to properly assess these sensitivity changes, the standards used to perform CCVs must be from the same set of working standards used to calibrate the instrument. Use of a second source standard is not necessary for CCV standards, since other QC samples are designed to assess the accuracy of the calibration standards. Analysis of CCVs using the calibration standards limits this QC sample to assessing only instrument sensitivity changes. The acceptance criterion and required frequency for CCVs are detailed in Appendix A, Measurement Quality Objectives. If a CCV falls outside the acceptance limits, the analytical system is not in control, and immediate corrective action must be taken.

Data obtained while the instrument is out of control is not reportable, and all samples analyzed during this period must be reanalyzed. If reanalysis is not an option, the original data must be flagged with the appropriate qualifier and reported. A narrative must be submitted listing the results that were generated while the instrument was out of control, in addition to corrective actions that were applied.

14.6. Laboratory Blanks

Laboratory blanks (also called extraction blanks, procedural blanks, or method blanks) are used to assess the background level of target analyte resulting from sample preparation and analysis. Laboratory blanks are carried through precisely the same procedures as the field samples. For both organic and inorganic analyses, a minimum of at least one laboratory blank must be prepared and analyzed in every analytical batch. Some methods may require more than one laboratory blank with each analytical run. Acceptance criteria for laboratory blanks are detailed in Appendix A, Measurement Quality Objectives. Blanks that are too high require corrective action to bring the concentrations down to acceptable levels. This may involve changing reagents, cleaning equipment, or even modifying the utilized methods or SOPs. Although acceptable laboratory blanks are important for obtaining results for low-level samples, improvements in analytical sensitivity have pushed detection limits down to the point where some amount of analyte will be detected in even the cleanest laboratory blanks. The magnitude of the blanks must be evaluated against the concentrations of the samples being analyzed and against Program objectives.

14.7. Reference Materials and Demonstration of Laboratory Accuracy

Evaluation of the accuracy of laboratory procedures is achieved through the preparation and analysis of reference materials with each analytical batch. Ideally, the reference materials selected are similar in matrix and concentration range to the samples being prepared and analyzed. The acceptance criteria for reference materials are listed in Appendix A, Measurement Quality Objectives. The accuracy of an analytical method can be assessed using CRMs only when certified values are provided for the target analytes. When possible, reference materials that have certified values for the target analytes should be used. This is not always possible, and often times certified reference values are not available for all target analytes. Many reference materials have both certified and non-certified (or reference) values listed on the

certificate of analysis. Certified reference values are clearly distinguished from the non-certified reference values on the certificate of analysis.

14.8. Reference Materials vs. Certified Reference Materials

The distinction between a reference material and a certified reference material does not involve how the two are prepared, rather with the way that the reference values were established. Certified values are determined through replicate analyses using two independent measurement techniques for verification. The certifying agency may also provide "non-certified or "reference" values for other target analytes. Such values are determined using a single measurement technique that may introduce bias. When available, it is preferable to use reference materials that have certified values for all target analytes. This is not always an option, and therefore it is acceptable to use materials that have reference values for these analytes. Note: Standard Reference Materials (SRMs) are essentially the same as CRMs. The term "Standard Reference Material" has been trademarked by the National Institute of Standards and Technology (NIST), and is therefore used only for reference materials distributed by NIST.

14.9. Laboratory Control Samples

While reference materials are not available for all analytes, a way of assessing the accuracy of an analytical method is still required. Laboratory control samples (LCSs) provide an alternate method of assessing accuracy. An LCS is a specimen of known composition prepared using contaminant-free reagent water or an inert solid spiked with the target analyte at the midpoint of the calibration curve or at the level of concern. The LCS must be analyzed using the same preparation, reagents, and analytical methods employed for regular samples. If an LCS needs to be substituted for a reference material, the acceptance criteria are the same as those for the analysis of reference materials. These are detailed in Appendix A, Measurement Quality Objectives.

14.10. Prioritizing Certified Reference Materials, Reference Materials, and Laboratory Control Samples

Certified reference materials, reference materials, and laboratory control samples all provide a method to assess the accuracy at the mid-range of the analytical process. However, this does not mean that they can be used interchangeably in all situations. When available, the Project requires the analysis of one certified reference material per analytical batch. Certified values are not always available for all target analytes. If no certified reference material exists, reference values may be used. If no reference material exists for the target analyte, an LCS must be prepared and analyzed with the sample batch as a means of assessing accuracy. The hierarchy is as follows: analysis of a CRM is favored over the analysis of a reference material, and analysis of a reference material is preferable to the analysis of an LCS. Substitution of an LCS is not acceptable if a certified reference material or reference material is available.

14.11. Matrix Spikes

A matrix spike (MS) is prepared by adding a known concentration of the target analyte to a field sample, which is then subjected to the entire analytical procedure. Matrix spikes are analyzed in order to assess the magnitude of matrix interference and bias present. Because matrix spikes are analyzed in pairs, the second spike is called the matrix spike duplicate (MSD). The MSD provides information regarding the precision of the matrix effects. Both the MS and MSD are split from the same original field sample. In

order to properly assess the degree of matrix interference and potential bias, the spiking level should be approximately 2-5x the ambient concentration of the spiked sample. To establish spiking levels prior to sample analysis, laboratories should review any relevant historical data. In many instances, the laboratory will be spiking samples blind and will not meet a spiking level of 2-5x the ambient concentration. In addition to the recoveries, the relative percent difference (RPD) between the MS and MSD is calculated to evaluate how matrix affects precision. The MQO for the RPD between the MS and MSD is the same regardless of the method of calculation. These are detailed in Appendix A: *Measurement Quality Objectives*. Recovery data for matrix spikes provides a basis for determining the prevalence of matrix effects in the samples collected and analyzed for SWAMP. If the percent recovery for any analyte in the MS or MSD is outside of the limits specified in Appendix A, Measurement Quality Objectives, the chromatograms (in the case of trace organic analyses) and raw data quantitation reports should be reviewed. Data should be scrutinized for evidence of sensitivity shifts (indicated by the results of the CCVs) or other potential problems with the analytical process. If associated QC samples (reference materials or LCSs) are in control, matrix effects may be the source of the problem. If the standard used to spike the samples is different from the standard used to calibrate the instrument, it must be checked for accuracy prior to attributing poor recoveries to matrix effects.

14.12. Laboratory Duplicates

In order to evaluate the precision of an analytical process, a field sample is selected and prepared in duplicate. Specific requirements pertaining to the analysis of laboratory duplicates vary depending on the type of analysis. The acceptance criteria for laboratory duplicates are specified in Appendix A, Measurement Quality Objectives.

14.13. Laboratory Duplicates vs. Matrix Spike Duplicates

Although the laboratory duplicate and matrix spike duplicate both provide information regarding precision, they are unique measurements. Laboratory duplicates provide information regarding the precision of laboratory procedures. The matrix spike duplicate provides information regarding how the matrix of the sample affects both the precision and bias associated with the results. It also determines whether or not the matrix affects the results in a reproducible manner. Because the two concepts cannot be used interchangeably, it is unacceptable to analyze only an MS/MSD when a laboratory duplicate is required.

14.14. Replicate Analyses

The Project will adopt the same terminology as SWAMP in defining replicate samples, wherein replicate analyses are distinguished from duplicate analyses based simply on the number of involved analyses. Duplicate analyses refer to two sample preparations, while replicate analyses refer to three or more. Analysis of replicate samples is not explicitly required.

14.15. Surrogates

Surrogate compounds accompany organic measurements in order to estimate target analyte losses during sample extraction and analysis. The selected surrogate compounds behave similarly to the target analytes, and therefore any loss of the surrogate compound during preparation and analysis is presumed to coincide with a similar loss of the target analyte. Surrogate compounds must be added to field and QC samples

prior to extraction, or according to the utilized method or SOP. Surrogate recovery data is to be carefully monitored. If possible, isotopically labeled analogs of the analytes are to be used as surrogates.

14.16. Internal Standards

To optimize techniques coupled with mass spectrometers, internal standards (also referred to as "injection internal standards") may be added to field and QC sample extracts prior to injection. Use of internal standards is particularly important for analysis of complex extracts subject to retention time shifts relative to the analysis of standards. The internal standards can also be used to detect and correct for problems in the GC injection port or other parts of the instrument. The analyst must monitor internal standard retention times and recoveries to determine if instrument maintenance or repair or changes in analytical procedures are indicated. Corrective action is initiated based on the judgment of the analyst. Instrument problems that affect the data or result in reanalysis must be documented properly in logbooks and internal data reports, and used by the laboratory personnel to take appropriate corrective action. Performance criteria for internal standards are established by the method or laboratory SOP.

14.17. Dual-Column Confirmation

Due to the high probability of false positives from single-column analyses, dual column confirmation should be applied to all gas chromatography and liquid chromatography methods that do not provide definitive identifications. It should not be restricted to instruments with electron capture detection (ECD).

14.18. Dilution of Samples

Final reported results must be corrected for dilution carried out during the process of analysis. In order to evaluate the QC analyses associated with an analytical batch, corresponding batch QC samples must be analyzed at the same dilution factor. For example, the results used to calculate the results of matrix spikes must be derived from results for the native sample, matrix spike, and matrix spike duplicate analyzed at the same dilution. Results derived from samples analyzed at different dilution factors must not be used to calculate QC results.

14.19. Reference Toxicants

The health of organisms used for toxicity testing can be impacted by how the animals were collected, handled or shipped. To increase precision as a result of test exposure variability, environmental parameters are kept to a strict range of temperature, pH, salinity, light intensity, photoperiod, and dissolved oxygen. To ensure that a particular batch of organisms is not overly sensitive or tolerant, concurrent reference toxicant tests are conducted using known concentrations of a contaminant in laboratory dilution water. Copper will be used as the reference toxicant in this study. The results of these reference toxicity tests are compared with the mean response for the same organism from previous tests conducted in the toxicity laboratory. Acceptable reference toxicants limits are achieved if the results are within 2 standard deviations of the grand mean calculated for the laboratory's control chart.

14.20. Laboratory Corrective Action

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

complete the analysis. If the failure is not resolved, it is conveyed to the respective supervisor who should determine if the analytical failure compromised associated results. The nature and disposition of the problem must be documented in the data report that is sent to the PM. Corrective actions are detailed in Appendix D.

14.21. Field Quality Control

Field QC results must meet the MQOs and frequency requirements specified in Appendix A, Measurement Quality Objectives, where frequency requirements are provided on a sample batch level. The Project defines a sample batch as 20 or fewer field samples prepared and analyzed with a common set of QC samples. Specific field quality control samples may also be required by the method or SOP selected for sample collection and analysis. If Project MQOs conflict with those prescribed in the utilized method or SOP, the more rigorous of the objectives must be met.

14.22. Field Corrective Actions

Field personnel are responsible for responding to failures in their sampling and field measurement systems. If monitoring equipment fails, personnel are to record the problem according to their documentation protocols. Failing equipment must be replaced or repaired prior to subsequent sampling events. It is the combined responsibility of all members of the field organization to determine if the performance requirements of the specific sampling method have been met, and to collect additional samples if necessary. Associated data is entered into the Project Information Management System (IMS) and flagged accordingly. Specific field corrective actions are detailed in Appendix D.

14.23. Equipment Blanks

Equipment blanks will be generated and collected by the personnel responsible for cleaning the sampling equipment before the equipment is shipped to the sampling site. In order to accommodate any necessary corrective action, equipment blank results should be available well in advance of the sampling event. To ensure that sampling equipment is contaminant-free, water known to be low in the target analyte(s) must be processed though the equipment as during sample collection. The specific type of water used for blanks is selected based on the information contained in the relevant sampling or analysis methods. The water must be collected in an appropriate sample container, preserved, and analyzed for the target analytes (in other words, treated as an actual sample). The inclusion of field blanks is dependent on the requirements specified in the relevant MQO tables, or in the sampling method or SOP. Typically, equipment blanks are collected from new equipment, equipment that has been cleaned after use at a contaminated site, or when equipment that is not dedicated for surface water sampling is used. An equipment blank must be prepared for dissolved metals in water samples whenever a new lot of filters is used.

14.24. Field Blanks

A field blank is collected to assess potential sample contamination levels that occur during field sampling activities. Field blanks are taken to the field, transferred to the appropriate container, preserved (if required by the method), and treated the same as the corresponding sample type during the course of a sampling event. The inclusion of field blanks is dependent on the requirements specified in the relevant MQO tables or in the sampling method or SOP. Field blanks for other media and analytes should be

conducted upon initiation of sampling. If field blank performance is acceptable, further collection and analysis of field blanks should be performed on an as-needed basis. Acceptable levels for field blanks are specified in Appendix A, Measurement Quality Objectives. The water used for field blanks must be free of target analyte(s) and appropriate for the analysis being conducted.

14.25. Field Duplicates

Field samples collected in duplicate provide precision information as it pertains to the sampling process. The duplicate sample must be collected in the same manner and as close in time as possible to the original sample. This effort is to attempt to examine field homogeneity as well as sample handling, within the limits and constraints of the situation.

14.26. Field Corrective Action

The field organization is responsible for responding to failures in their sampling and field measurement systems. If monitoring equipment fails, personnel are to record the problem according to their documentation protocols. Failing equipment must be replaced or repaired prior to subsequent sampling events. It is the combined responsibility of all members of the field organization to determine if the performance requirements of the specific sampling method have been met, and to collect additional samples if necessary.

14.27. Collection of Background Samples

Background samples provide a comparison between the concentrations or levels of the target parameters in the Program's environmental samples with samples from a nearby location that is known or believed to be uncontaminated (i.e., to contain the target parameters at "natural" concentrations or levels. This is necessary in order to differentiate between the project on-site contribution and the off-site natural contribution to the parameter's concentrations or levels.

14.28. Field Sampling Representativeness

Field sampling accuracy is ensured by evaluating if the sample event occurred at the nominal coordinates, within the index period, and within the nominal stratum. Site location shall be measured by global positioning system (GPS) and must be within 10 seconds (~300 m) of the nominal latitude and longitude. All samples must be collected within the established index period and within the nominal stratum.

15. (B6) Instrument/Equipment Testing, Inspection and Maintenance

15.1. Field Equipment

Individual SOPs (e.g., SOP FS-1, Collection of Water Samples, SOP FS-6, Collection of Sediment Samples) list all equipment to be used for sampling for those associated efforts. Sampling equipment shall be checked prior to departure. Duplicate or back-up equipment shall be taken where possible. All replacement parts will be stored at the AMS facility in Livermore, CA, and will be distributed to field personnel on an as-needed basis.

Outside of electronic devices that require periodic charging / battery replacement, the only sampling equipment that requires regular inspection and maintenance is anticipated to be coated stainless buckets, whose coating can lose its integrity with regular contact with hard surfaces. Field personnel shall inspect the coating for its integrity during use, and remove buckets from service as required. Buckets shall also be inspected by field personnel during the decontamination and cleaning process occurring after usage has taken place. Any observations of damage to coating shall be communicated to the MPC.

15.1. Laboratory Equipment

All laboratories providing analytical support for chemical or biological analyses will have the appropriate facilities to store, prepare, and process samples. Moreover, appropriate instrumentation and staff, to generate data of the required quality within the schedule required by the program, are also required. Laboratory operations must include the following procedures:

- A program of scheduled maintenance of analytical balances, microscopes, laboratory equipment, and instrumentation.
- Routine checking of analytical balances using a set of standard reference weights (American Society of Testing and Materials (ASTM) Class 3, NIST Class S-1, or equivalents).
- Checking and recording the composition of fresh calibration standards against the previous lot, wherever possible. Acceptable comparisons are < 2% of the previous value.
- Recording all analytical data in bound (where possible) logbooks, with all entries in ink, or electronic format.
- Monitoring and documenting the temperatures of cold storage areas and freezer units once per week.
- Verifying the efficiency of fume hoods.
- Having a source of reagent water meeting ASTM Type I specifications (ASTM, 1984) available in sufficient quantity to support analytical operations. The conductivity of the reagent water will not exceed 18 megaohms at 25°C. Alternately, the resistivity of the reagent water will exceed 10 mmhos/cm.
- Labeling all containers used in the laboratory with date prepared, contents, initials of the individual who prepared the contents, and other information, as appropriate.
- Dating and safely storing all chemicals upon receipt. Proper disposal of chemicals when the expiration date has passed.
- Having QAPP, SOPs, analytical methods manuals, and safety plans readily available to staff.

- Having raw analytical data, such as chromatograms, accessible so that they are available upon request.

Laboratories will maintain appropriate equipment per the requirements of individual laboratory SOPs and will be able to provide information documenting their ability to conduct the analyses with the required level of data quality. Such information might include results from interlaboratory comparison studies, control charts and summary data of internal QA/QC checks, and results from certified reference material analyses.

16. (B7) Instrument/Equipment Calibration and Frequency

16.1. Laboratory Analyses

16.1.1. In-house Analyses

There are no in-house laboratory-based analyses planned for this project. There is no requirement for calibration for any field equipment used for the Project.

16.1.2. Contract Laboratory Analyses

Laboratory equipment will be used, maintained, and calibrated per individual laboratory protocols. The procedures for and frequency of calibration will vary depending on the chemical parameters being determined. Equipment is maintained and checked according to the standard procedures specified in each laboratory's instrument operation instruction manual and laboratory SOP (Table 13-1).

Upon initiation of an analytical run, after each major equipment disruption, and whenever on-going calibration checks do not meet recommended DQOs (see Appendix A), analytical systems will be calibrated with a full range of analytical standards. Immediately after this procedure, the initial calibration must be verified through the analysis of a standard obtained from a different source than the standards used to calibrate the instrumentation and prepared in an independent manner and ideally having certified concentrations of target analytes of a CRM or certified solution. Frequently, calibration standards are included as part of an analytical run, interspersed with actual samples.

Calibration curves will be established for each analyte and batch analysis from a calibration blank and a minimum of three analytical standards of increasing concentration, covering the range of expected sample concentrations. Only those data resulting from quantification within the demonstrated working calibration range may be reported by the laboratory. Alternatively, if the instrumentation is linear over the concentration ranges to be measured in the samples, the use of a calibration blank and one single standard that is higher in concentration than the samples may be appropriate. Samples outside the calibration range will be diluted or concentrated, as appropriate, and reanalyzed.

The calibration standards will be prepared from reference materials available from the EPA repository, or from available commercial sources. The source, lot number, identification, and purity of each reference material will be recorded. Neat compounds will be prepared weight/volume using a calibrated analytical balance and Class A volumetric flasks. Reference solutions will be diluted using Class A volumetric glassware. Individual stock standards for each analyte will be prepared. Combination working standards will be prepared by volumetric dilution of the stock standards. The calibration standards will be stored at -20º C. Newly prepared standards will be compared with existing standards prior to their use. All solvents used will be commercially available, distilled in glass, and judged suitable for analysis of selected chemicals. Stock standards and intermediate standards are prepared on an annual basis and working standards are prepared every three months.

Sampling and analytical logbooks will be kept to record inspections, calibrations, standard identification numbers, the results of calibrations, and corrective action taken. Equipment logs will document instrument usage, maintenance, repair and performance checks. Daily calibration data will be stored with the raw sample data.

17. (B8) Inspection/Acceptance for Supplies and Consumables

Glassware, sample bottles, and collection equipment will all be inspected prior to their use for chips, cracks, leaks, contamination, and other deformities that can affect the outcome of the study results. Sampling bottles will be obtained from analytical laboratories or purchased directly from a vendor. Supplies will be examined for damage as they are received. Pre-cleaned containers will be used for sampling. Toxicity test organisms will be collected by the analytical laboratory. The MPC and FTLs will be responsible for acquisition and inspection of sampling containers. The chemistry manager will be responsible for acquisition and inspection of chemical supplies including standards.

Inspection requirements for sampling consumables and supplies are summarized in Table 17-1.

Table 17-1. Inspection / Acceptance Testing Requirements for Consumables and Supplies

Project-related Supplies	Inspection / Testing Specifications	Acceptance Criteria	Frequency	Responsible Person Sampling Containers
Sampling supplies	Visual	Appropriateness; no evident contamination or damage; within expiration date	Each purchase	FTL

18. (B9) Non Direct Measurements, Existing Data

This study will not incorporate existing data or other non-direct measurements. Weather forecasting information will be obtained from the National Weather Service (http://www.wrh.noaa.gov/lox/).

19. (B10) Data Management

As previously discussed, Project data management will conform to protocols dictated by relevant SOPs (Table 11-1). A summary of specific data management aspects is provided below.

19.1. Hardware and Software

All data processing hardware and software used by laboratories for the Project will be maintained consistent with laboratory standard procedures. There is no specialized hardware or software employed by AMS for the Project. All data analysis and reporting is anticipated to be performed using Microsoft Office® products, which are updated automatically as updates become available.

19.2. Field Data Management

All field data will be reviewed for legibility and errors as soon as possible after the conclusion of sampling. All field data that is to be entered electronically will be hand-checked at a rate of 10% of entries as a check on data entry. Any corrective actions required will be documented in correspondence to the QAO.

19.3. Laboratory Data Management

Record keeping of laboratory analytical data for the proposed project will employ standard record-keeping and tracking practices. All laboratory analytical data will be entered into electronic files by the instrumentation being used or, if data is manually recorded, then it will be entered by the analyst in charge of the analyses, per laboratory standard procedures. All analytical data will conform to CEDEN requirements that it contain unique identification numbers for tracking.

The management of water quality and toxicological data will be initiated with the use of field and laboratory data sheets. Data handling equipment and procedures for laboratory analytical data will be consistent with laboratory standard procedures. Laboratory analytical data that will be recorded using various analytical instruments will be formatted consistent with California Environmental Data Exchange Network (CEDEN) data management rules. Backup copies of all data files will be made at the laboratory at the end of every day and stored electronically consistent with standard laboratory procedures. .All laboratory data entry will conform to the standardized list available via CEDEN (http://www.ceden.us/Metadata/ControlledVocab.php), so that the data can be loaded into the CEDEN-comparable Project Database with minimal effort.

Following the completion of internal laboratory quality control checks, analytical results will be forwarded electronically to the PM. The analytical laboratories will provide data in electronic format, encompassing both a narrative and electronic data deliverable (EDD). The required form of electronic submittals, including CEDEN-comparable Microsoft Excel® templates 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 a manner to expedite efficient upload into the CEDEN database. Data will be screened for the following major items:

- Conformity check between electronic data provided by the laboratory and the narrative reports
- 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

The PM will be responsible for ensuring that data are entered into the database.

Following the initial screening, a more complete QA/QC review process will be performed, which will include an evaluation of holding times, method and equipment blank contamination, and analytical accuracy and precision. Accuracy will be evaluated by reviewing MS/MSD and LCS recoveries; precision will be evaluated by reviewing MSD and laboratory sample duplicate RPDs.

19.4. Data Management Tracking

Data deliverables will be tracked from initiation through acceptance and archival process using the template shown in Figure 19-1.

Central Coast ASBS Regional Monitoring Program
Data Mgmt Checklist

APPLIED marine SCIENCES

Sampling Event (Date)
Laboratory / Field Activity

	Status (Accept / Un. / Inc. / NA)	Date	Staff	Comments
Field Data Entry	A U I NA			
Field Data Storage (datasheets, photos, logbooks)	A U I NA			
Field Data Review	A U I NA			
Field Data Archival	A U I NA			
Lab Data Receipt	A U I NA			
Lab Data Review	A U I NA			
Lab Data Archival	A U I NA			
Dispensation				
Reviewed by				
Date				

Figure 19-1. Checklist for Tracking Data Deliverable Status

20. (C1) Assessments and Response Actions

The PM will be responsible for the day-to-day oversight of the Project. The QAO will conduct systematic reviews of the data for the specified DQOs every time data packets are delivered and entered into the Project database, prior to uploading to CEDEN. Any problems will be relayed to the PM. The QAO has the power to halt all sampling and analytical work if the deviation(s) noted are considered detrimental to data quality. Problems that cannot be corrected, will be documented by the QAO, flagged in the database, and acknowledged in the final report.

21. (C2) Reports to Management

The status of data collection during this project will be reported by the PM to the Contract Manager with each invoice and continuing until the completion of the Project. A draft final Project report will be filed no later than six months following the completion of sampling. The project schedule may require adjustment if insufficient storms can be sampled in a given water year. The Project QA Officer has complete access to the PM on an ongoing basis. Any QA deviations will be detailed in the sample event summary report and draft/final report.

21.1. Final Report

The final report will contain an introduction with a full description of program background and history, sampling and analytical methods (with descriptions of any problems encountered), results and discussion. Results will be organized according to the major questions the program is intended to answer:

1) What is the range of natural conditions at reference locations?
2) How do conditions along ASBS coastline compare to the natural conditions at reference locations?

The discussion will place the results into context with other ASBS monitoring programs and make recommendations for any necessary program adjustments. Appendices will include tables of raw data, lists of program participants, lists of personnel and organizations that have collected or analyzed samples.

This information is additionally summarized in Table 21-1 below. Reporting schedules may be adjusted, as might be required due to insufficient rainfall for sampling in the early part of 2013.

Table 21-1. Reports to Management

Type of Report	Projected Delivery Dates(s)	Person(s) Responsible for Report Preparation	Report Recipients
Quarterly progress reports	2/15/13 and quarterly thereafter	PM	Contract Manager
Draft Report	4/30/14	PM	Contract Manager
Final report	6/30/14	PM	Contract Manager
Lab data QA report	7/31/14	QAO	Contract Manager
Electronic database, CEDEN comparable	7/31/14	RP	Contract Manager

22. (D1) Data Review, Verification, and Validation

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

Validation and verification of the data generated is the responsibility of the respective laboratory. Laboratories will conduct a 100 percent raw data versus electronic data audit before delivering results to SCCWRP. The LPM will maintain analytical reports in a database format as well as all QA/QC documentation for the laboratory.

AMS will review all data packages received for adherence to guidelines set forth in this QAPP. This includes checking that all technical criteria have been met, documenting any problems that are observed and, if possible, ensuring that deficiencies noted in the data are corrected. COC forms will be reviewed to ensure adherence to collection, transport, and receipt requirements, including test initiation within the required holding time. Data generated by Program activities will be reviewed against method quality objectives (MQOs) that were developed and documented in Element 7. This will ensure that the data will be of acceptable quality and that it will be SWAMP-comparable with respect to minimum expected MQOs.

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

If data validation issues arise, the corrective action process will include: 1) review of original field or laboratory procedures or documents (i.e., field sheets or laboratory bench sheets); 2) severity determination of field or laboratory deviation on resulting data and its impact on the study conclusions; 3) resampling and/or reanalysis of sample(s) as necessary. All deviations will be documented by the PM within the quarterly and/or final reports to the contract manager. Deviations in field sampling or laboratory analysis shall be noted on the field or laboratory sheets and in the Project database.

Data will be separated into three categories for use with making decisions based upon it. These categories are: (1) data that meets all acceptance requirements, (2) data that has been determined to be unacceptable for use, and (3) data that may be conditionally used and that is flagged as per US EPA specifications.

23. (D2) Verification and Validation Methods

Defining the methods for data verification and validation helps to ensure that Program data are evaluated objectively and consistently. For the proposed Program many of these methods have been described in Element 22. Additional information is provided below.

23.1. Field Data

Data collected in the field will be validated and verified initially by the IM. All data records for the proposed Program will be checked visually and will be recorded as checked by the checker's initials as well as with the dates on which the records were checked. The MPC, or their designee, will perform an independent re-check of at least 10% of these records as the validation methodology. Reconciliation and correction will be the responsibility of the PM.

23.2. Laboratory Data

Laboratory validation and verification of the data generated and reported to AMS is the responsibility of the laboratory. Each laboratory supervisor maintains analytical reports in electronic format as well as all QA/QC documentation for the laboratory.

Once data is delivered by the LPM to AMS, the IM will perform independent re-checks of at least 10% of them as the validation methodology. Any data that is discovered to be incorrect, inconsistent, or missing during the verification or validation process will immediately be reported to the QAO, PM, and LQAO. Each laboratory's QA manual details the procedures that will be followed by laboratory personnel to correct any invalid or missing data.

The QAO will perform checks to ensure that laboratory validation and verification process is consistent with this QAPP, including use of review templates as shown in Figures 23-1 and Figure 23-2 to document checks for completeness, sensitivity, blank contamination, recovery, and precision metrics. There are no spreadsheet applications anticipated to be used in completing reviews of analytical data.

The PM is responsible for oversight of data collection and the initial analysis of the raw data obtained from the field and the contracted laboratory. The PM responsibilities also include the generation of rough drafts of quarterly and final reports. The PM has final oversight on the submission of quarterly and final reports.

Any data that is discovered to be incorrect or missing during the verification or validation process will immediately be reported to the PM. If errors involve laboratory data then this information will also be reported to the LPM. Each laboratory's QA manual details the procedures that will be followed by laboratory personnel to correct any invalid or missing data. The IM will be responsible for reporting and correcting any errors that are found in the data during the verification and validation process.

If there are any data quality problems identified, the QAO will try to identify whether the problem is a result of Project design issues, sampling issues, analytical methodology issues, or QA/QC issues (from laboratory or non-laboratory sources). If the source of the problems can be traced to one or more of these basic activities then the person or people in charge of the areas where the issues lie will be contacted and efforts will be made to immediately resolve the problem. If the issues are too broad or severe to be easily

corrected then the appropriate people involved will be assembled to discuss and try to resolve the issue(s) as a group. The QAO has the final authority to resolve any issues that may be identified during the verification and validation process.

Central Coast ASBS Regional Monitoring Program
Chemistry Template

Sampling Event (Date)
Laboratory
Analyses

	Status (Accept / Un. / Inc. / NA)	Date	Staff	Comments
EDD spreadsheet received from Lab	A U I NA			
EDD narrative received from Lab	A U I NA			
Conformity check (COC against EDD)	A U I NA			
Conformity check (narrative against spreadsheet)	A U I NA			
Reporting Limits	A U I NA			
Lab Controls	A U I NA			
Lab Calibration	A U I NA			
Lab Blank	A U I NA			
Lab Dup	A U I NA			
Lab Reference Matl.	A U I NA			
Lab MS/MSD	A U I NA			
Lab Surrogate	A U I NA			
Lab Standard	A U I NA			
Field Dup	A U I NA			
Field Blank	A U I NA			
Dispensation				
Reviewed by				
Date				

Figure 23-1. Laboratory Data Review Template for Chemistry Analyses

Central Coast ASBS Regional Monitoring Program
Toxicity Template

Sampling Event (Date)
Laboratory
Analyses

	Status (Accept / Un. / Inc. / NA)	Date	Staff	Comments
EDD spreadsheet received from Lab	A U NA			
EDD narrative received from Lab	A U NA			
Conformity check (COC against EDD)	A U NA			
Conformity check (narrative against spreadsheet)	A U NA			
Sed Control	A U NA			
Reference Toxicant Test	A U NA			
Water Chemistry	A U NA			
Field Dup	A U NA			
Dispensation				
Reviewed by				
Date				

Figure 23-2. Laboratory Data Review Template for Toxicity Analyses

24. (D3) Reconciliation with User Requirements

Data generated through Project implementation will be used to answer the Project questions identified in Section 5.2. These data can be used directly by the SWRCB for assessment of ASBS conditions. These data can also be used by SWRCB in their assessment of California's waterbodies by inclusion in the State's 305(b) report. Data analysis will address study uncertainty (see Section 6.4).

Information from field data reports, laboratory data reviews, reviews of data versus DQOs, reviews against Quality Assurance and Quality Control (QA/QC) requirements, data verification reports, data validation reports, independent data checking reports, and error handling reports will be used to determine whether or not the Program's objectives have been met.

The reports produced by this project will describe some of the limitations of the data. This includes constraints (Section 6.5) and ability to meet Project DQO's (Section 7.0). 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 PM. 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.

Data will be loaded into a Programmatic database, but data will not be uploaded to SWAMP database.

25. References

Anderson PD, Denslow ND, Drewes JE, Olivieri AW, Schlenk D, Scott GI, Snyder SA, 2012. Ecosystems. Technical Report 692. Southern California Coastal Water Research Project. Costa Mesa, CA.

Applied Marine Sciences, Inc., 2013. Standard Operating Procedures for the Central Coast Areas of Special Biological Significance Regional Monitoring Program and Reference Site Monitoring. Prepared for the Monterey Regional Water Pollution Control Agency. April 2013.

Raimondi P, Schiff K, Gregorio D, 2012. Characterization of the Rocky Intertidal Ecological Communities Associated with Southern California Areas of Special Biological Significance. Technical Report 703. Southern California Coastal Water Research Project. Costa Mesa, CA

Schiff, K, Luk B, Gregorio D, Gruber S, 2011. Southern California Bight 2008 Regional Monitoring Program: II. Areas of Special Biological Significance. Technical Report 641. Southern California Coastal Water Research Project. Costa Mesa, CA.

SCCWRP, 2012. Southern California Bight 2013 Monitoring Survey Areas of Special Biological Significance (ASBS) Quality Assurance Project Plan, Version 2.2. Southern California Coastal Water Research Project. Costa Mesa, CA. December 1, 2012.

SCCWRP, 2003. Final Report: Discharges into State Water Quality Protection Areas. Prepared for State Water Resources Control Board. Sacramento, CA. Contract 01-187-250. Southern California Coastal Water Research Project. Westminster, CA.

SWRCB, 2009. California Ocean Plan. State Water Resources Control Board. Sacramento, CA. 58 pp

Surface Water Ambient Monitoring Program Quality Assurance Team, 2008. SWAMP Quality Assurance Project Plan, Version 1.0. Prepared for the California State Water Quality Control Board. September 1, 2008.

26. Appendix A. Measurement Quality Objectives for Project Analytes

Table 26-1. Quality Control: Conventional Parameters in Fresh and Marine Water

Laboratory Quality Control	Frequency of Analysis	Measurement Quality Objective
Calibration Standard	Per analytical method or manufacturer's specifications	Per analytical method or manufacturer's specifications
Calibration Verification	Per 10 analytical runs	80-120% recovery
Laboratory Blank	Per 20 samples or per analytical batch, whichever is more frequent	<RL for target analyte
Reference Material	Per 20 samples or per analytical batch, whichever is more frequent	80-120% recovery
Matrix Spike	Per 20 samples or per analytical batch, whichever is more frequent (n/a for chlorophyll a and pheophytin a)	80-120% recovery
Matrix Spike Duplicate	Per 20 samples or per analytical batch, whichever is more frequent (n/a for chlorophyll a and pheophytin a)	80-120% recovery; RPD<25% for duplicates
Laboratory Duplicate	Per 20 samples or per analytical batch, whichever is more frequent (chlorophyll a/pheophytin a: per method)	RPD<25% (n/a if native concentration of either sample<RL)
Internal Standard	Accompanying every analytical run as method appropriate	Per method
Field Quality Control	**Frequency of Analysis**	**Measurement Quality Objective**
Field Duplicate[2]	5% of total project sample count	RPD<25% (n/a if native concentration of either sample<RL)
Field Blank, Travel Blank, Equipment Blank	Per method	<RL for target analyte

[1] Unless method specifies more stringent requirements

[2] Field duplicate relative percent differences are not calculated for chlorophyll a analyses for bioassessment

Table 26-2. Quality Control[1]: Solid Parameters in Fresh and Marine Water

Laboratory Quality Control	Frequency of Analysis	Measurement Quality Objective
Laboratory Blank[2]	Per 20 samples or per analytical batch, whichever is more frequent	<RL for target analyte
Laboratory Duplicate[3]	Per 20 samples or per analytical batch, whichever is more frequent	RPD<25% (n/a if native concentration of either sample<RL)
Field Quality Control	**Frequency of Analysis**	**Measurement Quality Objective**
Field Duplicate	5% of total project sample count	RPD<25% (n/a if native concentration of either sample<RL)
Field Blank, Equipment Blank	Per method	<RL for target analyte

[1] Unless method specifies more stringent requirements

[2] Not applicable to volatile suspended solids

[3] Applicable only to total suspended solids, total dissolved solids, and ash-free dry mass

Table 26-3. Quality Control – Conventional Analytes in Fresh Water - Pathogens

Laboratory Quality Control	Frequency of Analysis	Measurement Quality Objective
Sterility Checks	Per lot of dehydrated culture media as instructed in SM 9020B.4.i.52 and SM 9222D.1.a	No growth
	For non-sterile filters and pads per lot as instructed in SM 9020B.4.h.1.1	No growth
	Membrane Filter Media, filters, buffered dilution water, rinse water, and all equipment per series of samples as instructed in SM 9020B.8.a.52	No growth
	Multiple Tube Media, dilution water, and glassware as instructed in SM 9020B.8.a.52	No growth
Laboratory Positive Control	Per new lot of dehydrated culture media for the following methods: Colilert, Colilert -18, Colisure, Enterolert, or other chromogenic/fluorogenic methods. Per new lot of commercially-prepared culture media ampules for USEPA-approved fecal coliform and E. coli membrane filter methods (e.g. SM 9222, m-ColiBlue24, EPA 1603) Per batch for laboratory-prepared culture media for USEPA-approved fecal coliform and E. coli membrane filter methods (e.g., SM 9222)	Positive response
Laboratory Negative Control	Per new lot of dehydrated culture media for the following methods: Colilert, Colilert -18, Colisure, Enterolert, or other chromogenic/fluorogenic methods. Per new lot of commercially-prepared culture media ampules for USEPA-approved fecal coliform and E. coli membrane filter methods (e.g. SM 9222, m-ColiBlue24, EPA 1603) Per batch for laboratory-prepared culture media for USEPA-approved fecal coliform and E. coli membrane filter methods (e.g., SM 9222)	Negative response
Laboratory Duplicate	Per 10 samples or per analytical batch, whichever is more frequent	$R_{log} \leq 4$ Computation of R from duplicate laboratory sample analyses[1]
Laboratory Blank	Required only when samples are diluted; dilution water must be tested	No growth

[1] Method for determining precision as described in 2013 revisions to indicator bacteria analyses in fresh water for SWAMP QAPrP (http://www.swrcb.ca.gov/water_issues/programs/swamp/mqo.shtml)

Table 26-4. Quality Control[1]: Inorganic Analytes in Fresh and Marine Water

Laboratory Quality Control	Frequency of Analysis	Measurement Quality Objective
Calibration Standard	Per analytical method or manufacturer's specifications	Per analytical method or manufacturer's specifications
Calibration Verification	Per 10 analytical runs	80-120% recovery
Laboratory Blank	Per 20 samples or per analytical batch, whichever is more frequent	<RL for target analyte
Reference Material[2]	Per 20 samples or per analytical batch, whichever is more frequent	75-125% recovery (70-130% for MMHg)
Matrix Spike	Per 20 samples or per analytical batch, whichever is more frequent	75-125% recovery (70-130% for MMHg)
Matrix Spike Duplicate	Per 20 samples or per analytical batch, whichever is more frequent	75-125% recovery (70-130% for MMHg); RPD<25%
Laboratory Duplicate	Per 20 samples or per analytical batch, whichever is more frequent	RPD<25% (n/a if native concentration of either sample<RL)
Internal Standard	Accompanying every analytical run when method appropriate	60-125% recovery
Field Quality Control	**Frequency of Analysis**	**Measurement Quality Objective**
Field Duplicate	5% of total project sample count	RPD<25% (n/a if native concentration of either sample<RL), unless otherwise specified by method
Field Blank, Equipment Blank	Per method	Blanks<RL for target analyte

[1] Unless method specifies more stringent requirements

[2] Not applicable to selenium speciation

Table 26-5. Quality Control[1, 2]: Synthetic Organic Compounds in Fresh and Marine Water[3]

Laboratory Quality Control	Frequency of Analysis	Measurement Quality Objective
Tuning[4]	Per analytical method	Per analytical method
Calibration	Initial method setup or when the calibration verification fails	• Correlation coefficient (r^2 >0.990) for linear and non-linear curves • If RSD<15%, average RF may be used to quantitate; otherwise use equation of the curve • First- or second-order curves only (not forced through the origin) • Refer to SW-846 methods for SPCC and CCC criteria[4] • Minimum of 5 points per curve (one of them at or below the RL)
Calibration Verification	Per 12 hours	• Expected response or expected concentration ±20% • RF for SPCCs=initial calibration[4]
Laboratory Blank	Per 20 samples or per analytical batch, whichever is more frequent	<RL for target analytes
Reference Material	Per 20 samples or per analytical batch (preferably blind)	70-130% recovery if certified; otherwise, 50-150% recovery
Matrix Spike	Per 20 samples or per analytical batch, whichever is more frequent	50-150% or based on historical laboratory control limits (average±3SD)
Matrix Spike Duplicate	Per 20 samples or per analytical batch, whichever is more frequent	50-150% or based on historical laboratory control limits (average±3SD); RPD<25%
Surrogate	Included in all samples and all QC samples	Based on historical laboratory control limits (50-150% or better)
Internal Standard	Included in all samples and all QC samples (as available)	Per laboratory procedure
Field Duplicate	5% of total project sample count	Per method
Field Blank, Travel Blank, Equipment Blank	Per method	<RL for target analytes

[1] Unless method specifies more stringent requirements; ELISA results must be assessed against kit requirements.

[2] Pyrethroids quality control guidelines are presented in Table 2 immediately below.

[3] All detected analytes must be confirmed with a second column, second technique, or mass spectrometry.

[4] Mass spectrometry only

Table 26-6. Quality Control[1]: Inorganic Analytes in Freshwater Sediment and Marine Sediment

Laboratory Quality Control	Frequency of Analysis	Measurement Quality Objective
Calibration Standard	Per analytical method or manufacturer's specifications	Per analytical method or manufacturer's specifications
Calibration Verification	Per 10 analytical runs	80-120% recovery
Laboratory Blank	Per 20 samples or per analytical batch, whichever is more frequent	<RL for target analyte
Reference Material	Per 20 samples or per analytical batch, whichever is more frequent	75-125% recovery (70-130% for methylmercury)
Matrix Spike	Per 20 samples or per analytical batch, whichever is more frequent	75-125% recovery (70-130% for methylmercury)
Matrix Spike Duplicate	Per 20 samples or per analytical batch, whichever is more frequent	75-125% recovery (70-130% for methylmercury); RPD<25%
Laboratory Duplicate	Per 20 samples or per analytical batch, whichever is more frequent	RPD<25% (n/a if native concentration of either sample<RL)
Internal Standard	Accompanying every analytical run when method appropriate	60-125% recovery
Field Quality Control	**Frequency of Analysis**	**Measurement Quality Objective**
Field Duplicate	5% of total project sample count	RPD<25% (n/a if native concentration of either sample<RL), unless otherwise specified by method
Field Blank, Equipment Blank	Per method	Blanks<RL for target analyte

[1] Unless method specifies more stringent requirements

Consistent with SWAMP QAPP and as applicable, percent moisture should be reported with each batch of sediment samples. Sediment (and tissue) data must be reported on a dry weight basis.

Table 26-7. Quality Control[1, 2]: Synthetic Organic Compounds in Freshwater Sediment and Marine Sediment[3]

Laboratory Quality Control	Frequency of Analysis	Measurement Quality Objective
Tuning[4]	Per analytical method	Per analytical method
Calibration	Initial method setup or when the calibration verification fails	• Correlation coefficient (r^2 >0.990) for linear and non-linear curves • If RSD<15%, average RF may be used to quantitate; otherwise use equation of the curve • First- or second-order curves only (not forced through the origin) • Refer to SW-846 methods for SPCC and CCC criteria[4] • Minimum of 5 points per curve (one of them at or below the RL)
Calibration Verification	Per 12 hours	• Expected response or expected concentration ±20% • RF for SPCCs=initial calibration[4]
Laboratory Blank	Per 20 samples or per analytical batch, whichever is more frequent	<RL for target analytes
Reference Material	Per 20 samples or per analytical batch (preferably blind)	70-130% recovery if certified; otherwise, 50-150% recovery
Matrix Spike	Per 20 samples or per analytical batch, whichever is more frequent	50-150% or based on historical laboratory control limits (average±3SD)
Matrix Spike Duplicate	Per 20 samples or per analytical batch, whichever is more frequent	50-150% or based on historical laboratory control limits (average±3SD); RPD<25%
Surrogate	Included in all samples and all QC samples	Based on historical laboratory control limits (50-150% or better)
Internal Standard	Included in all samples and all QC samples (as available)	Per laboratory procedure
Field Quality Control	**Frequency of Analysis**	**Measurement Quality Objective**
Field Duplicate	5% of total project sample count	Per method
Field Blank, Travel Blank, Equipment Blank	Per method	<RL for target analytes

[1] Unless method specifies more stringent requirements; ELISA results must be assessed against kit requirements

[2] Pyrethroid quality control guidelines are presented in Table 2 immediately below

[3] All detected analytes must be confirmed with a second column, second technique, or mass spectrometry

[4] Mass spectrometry only

Consistent with SWAMP QAPP and as applicable, percent moisture should be reported with each batch of sediment samples. Sediment (and tissue) data must be reported on a dry weight basis.

Table 26-8. Quality Control[1]: Chronic Marine Water Toxicity Testing

Negative Controls	Frequency of Analysis	Control Limits
Laboratory Control Water	Laboratory control water consistent with Section 7 of the appropriate EPA method/manual must be tested with each analytical batch.	Laboratory control water must meet all test acceptability criteria (please refer to Section 7 of the appropriate EPA method/manual) for the species of interest.
Conductivity/Salinity Control Water	A conductivity or salinity control must be tested when these parameters are above or below the species tolerance.	Follow EPA guidance on interpreting data and refer to tables below for tolerance ranges.
Additional Control Water	Additional method blanks are required whenever manipulations are performed on one or more of the ambient samples within each analytical batch (e.g., pH adjustments, continuous aeration).	There must be no statistical difference between the laboratory control water and each additional control water within an analytical batch.
Sediment Control	Sediment control consistent with Section 7 of the appropriate EPA method/manual must be tested with each analytical batch of sediment toxicity tests.	Sediment control must meet all data acceptability criteria (please refer to Section 7 of the appropriate EPA method/manual) for the species of interest.
Positive Controls	**Frequency of Analysis**	**Control Limits**
Reference Toxicant Tests	Reference toxicant tests must be conducted monthly for species that are raised within a laboratory, or per analytical batch for commercially-supplied or field-collected species.	Last plotted data point (LC50 or EC50) must be within 2 SD of the cumulative mean (n=20). Reference toxicant tests that fall outside of recommended control chart limits are evaluated to determine the validity of associated tests. An out of control reference toxicant test result does not necessarily invalidate associated test results. More frequent and/or concurrent reference toxicant testing may be advantageous if recent problems have been identified in testing.
Field Quality Control	**Frequency of Analysis**	**Control Limits**
Sample Duplicate	5% of total project sample count	Recommended acceptable RPD<20%
Field Blanks	Based on project requirements	No statistical difference between the laboratory control water (or sediment control) and the field blank within an analytical batch
Bottle Blanks	Based on project requirements	No statistical difference between the laboratory control water and the equipment blank within an analytical batch

[1]Unless method specifies more stringent requirements.

In special cases where the criteria listed in the above tables cannot be met, EPA minimum criteria may be followed. The affected data should be flagged accordingly.

Test data are reviewed to verify that the test acceptability criteria for a valid test have been met. Any test not meeting the minimum test acceptability criteria is considered invalid. All invalid tests should be repeated with the newly collected sample. If this is not possible, the test should be repeated with an archived sample and all tests must be properly flagged.

Deviations from the summary of recommended test conditions must be evaluated on a project-specific basis to determine the validity of test results. Depending on the degree of the departure and the objective of the test, deviations from recommended conditions may or may not invalidate a test result. Before rejecting or accepting a test result as valid, the reviewer should consider the degree of the deviation and the potential or observed impact of the deviation on the test result. For example, if dissolved oxygen is measured below 4.0 mg/L in one test chamber, the reviewer should consider whether any observed mortality in that test chamber corresponded with the drop in dissolved oxygen.

Table 26-9. Chronic Marine Water Testing: 48-Hour Germination and Germ-Tube Length *Macrocystis pyrifera* Test

Method Recommendation	
EPA/600/R-95/136 (Test Method 1009.0) or validated and SWAMP-approved alternative method	
Data Acceptability Requirements	
Parameter	*Criteria*
Test Acceptability Criteria[1]	≥70% germination in the controls, ≥10 µm germ-tube length in the controls
Data Qualification	
Test Conditions	*Required*
Test Type	Static non-renewal
Age at Test Initiation	n/a
Replication at Test Initiation	5
Organisms/Replicate	Add 7500 spores/mL of test solution
Food Source	Do not feed
Renewal Frequency	None
Test Duration	48 h
Endpoints	Germination and germ-tube length
Test Conditions	*Recommended* [2]
Salinity	34 ± 2‰
Temperature Range	15 ± 1.0 °C (±3 °C required)
Light Intensity	50 ± 10 µE/m^2/s
Photoperiod	16 hours of ambient laboratory light, 8 hours dark
Test Chamber Size	600 mL
Replicate Volume	200 mL
Feeding Regime	Do not feed
Laboratory Control Water	Dilution water should be 1-µm filtered natural seawater or hyper-saline brine prepared from uncontaminated natural seawater plus reagent water
Minimum Sample Volume	2 L for one-time grab sample
Sensitivity	*Performance Criteria*
Reference Toxicant Testing	If the LC50 exceeds +/- two standard deviations of the running mean of the last 20 reference toxicant tests, the test should be flagged.
Water Chemistry	
Test Parameter	*Required Frequency*
Initial Water Chemistry	One DO, pH, salinity, ammonia, and temperature measurement per sample
Final Water Chemistry	One DO, pH, salinity, and temperature measurement per sample
Test Parameter	*Recommended Criteria*
Initial DO Range	4.0 mg/L - 100% Saturation
Salinity Control	Include appropriate controls if salinity is less than 32 or greater than 36 ppt.
Sample Handling/Collection	
Test Parameter	*Recommended Conditions*
Relevant Media	Water column
Sample Container Type	Amber glass
Sample Preservation	Wet or blue ice in field, 0 - 6 °C refrigeration in laboratory, dark at all times
Sample Receipt Temperature	0 - 6 °C
Holding Time	< 48 hours@ 0 - 6 °C; dark

[1]Test data are reviewed to verify that test acceptability criteria (TAC) requirements for a valid test have been met. Any test not meeting these criteria is considered invalid. All invalid tests must be repeated with a newly collected sample.

[2]Deviations from the summary of recommended test conditions must be evaluated on a project-specific basis to determine the validity of test results. Depending on the degree of the departure and the objective of the test, deviations from recommended conditions may or may not invalidate a test result.

Table 26-10. Chronic Marine Water Testing: 48-hour Embryo-Larval Development *Mytilus galloprovincialis* and *M. spp.* Test

Method Recommendation	
EPA/600/R-95/136 or validated and SWAMP-approved alternative method	
Data Acceptability Requirements	
Parameter	*Criteria*
Test Acceptability Criteria[1]	≥50% survival, ≥90% of those must have normal shell development
Data Qualification	
Test Conditions	*Required*
Test Type	Static non-renewal
Age at Test Initiation	Within 4hours of fertilization
Replication at Test Initiation	4 (minimum)
Organisms/Replicate	150 – 300 (15-30/mL)
Food Source	Do not feed
Renewal Frequency	None
Test Duration	48 h
Endpoints	Survival of normal live prossidoconch larvae
Test Conditions	*Recommended* [2]
Salinity	28 - 34 ± 2‰
Temperature Range	15 ± 1.5 °C (±3 °C required)
Light Intensity	10 – 20 µE/m^2/s or 50 – 100 ft-c
Photoperiod	16 hours of ambient laboratory light, 8 hours dark
Test Chamber Size	20 mL
Replicate Volume	10 mL
Feeding Regime	Do not feed
Laboratory Control Water	Dilution water should be 1-µm filtered natural seawater or hyper-saline brine prepared from uncontaminated natural seawater plus reagent water
Minimum Sample Volume	1L for one-time grab sample
Sensitivity	*Performance Criteria*
Reference Toxicant Testing	If the LC50 exceeds +/- two standard deviations of the running mean of the last 20 reference toxicant tests, the test should be flagged.
Water Chemistry	
Test Parameter	*Required Frequency*
Initial Water Chemistry	One DO, pH, salinity, ammonia, and temperature measurement per sample
Final Water Chemistry	One DO, pH, salinity, and temperature measurement per sample
Test Parameter	*Recommended Criteria*
Initial DO Range	4.0 mg/L - 100% Saturation
Salinity Control	Include appropriate controls if salinity is less than 28 or greater than 36 ppt.
Sample Handling/Collection	
Test Parameter	*Recommended Conditions*
Relevant Media	Water column, pore water
Sample Container Type	Amber glass
Sample Preservation	Wet or blue ice in field, 0 - 6 °C refrigeration in laboratory, dark at all times
Sample Receipt Temperature	0 - 6 °C
Holding Time	<48 hours@ 0 - 6 °C; dark

[1]Test data are reviewed to verify that test acceptability criteria (TAC) requirements for a valid test have been met. Any test not meeting these criteria is considered invalid. All invalid tests must be repeated with a newly collected sample.

[2]Deviations from the summary of recommended test conditions must be evaluated on a project-specific basis to determine the validity of test results. Depending on the degree of the departure and the objective of the test, deviations from recommended conditions may or may not invalidate a test result.

Table 26-11. Chronic Marine Water Testing: 20-Minute Fertilization *Strongylocentrotus purpuratus* Test

Method Recommendation	
EPA/600/R-95/136 or validated and SWAMP-approved alternative method	
Data Acceptability Requirements	
Parameter	*Criteria*
Test Acceptability Criteria[1]	≥70% egg fertilization and appropriate sperm counts in controls
Data Qualification	
Test Conditions	*Required*
Test Type	Static non-renewal
Age at Test Initiation	n/a
Replication at Test Initiation	4 (minimum)
Organisms/Replicate	~1,120 eggs
Food Source	Do not feed
Renewal Frequency	None
Test Duration	40 min (20 min plus 20 min)
Endpoints	Fertilization of egg
Test Conditions	*Recommended* [2]
Salinity	34 ± 2‰
Temperature Range	12 - 15 ± 1.0 °C (±3 °C required)
Light Intensity	10 – 20 µE/m^2/s or 50 – 100 ft-c
Photoperiod	16 hours of ambient laboratory light, 8 hours dark
Test Chamber Size	20-30 mL
Replicate Volume	5 mL
Feeding Regime	Do not feed
Laboratory Control Water	Dilution water should be 1-µm filtered natural seawater or hyper-saline brine prepared from uncontaminated natural seawater plus reagent water
Minimum Sample Volume	250 m L for one-time grab sample
Sensitivity	*Performance Criteria*
Reference Toxicant Testing	If the LC50 exceeds +/- two standard deviations of the running mean of the last 20 reference toxicant tests, the test should be flagged.
Water Chemistry	
Test Parameter	*Required Frequency*
Initial Water Chemistry	One DO, pH, salinity, ammonia, and temperature measurement per sample
Test Parameter	*Recommended Criteria*
Initial DO Range	4.0 mg/L - 100% Saturation
Salinity Control	Include appropriate controls if salinity is less than 32 or greater than 36 ppt.
Sample Handling/Collection	
Test Parameter	*Recommended Conditions*
Relevant Media	Water column, interstitial water
Sample Container Type	Amber glass
Sample Preservation	Wet or blue ice in field, 0 - 6 °C refrigeration in laboratory, dark at all times
Sample Receipt Temperature	0 - 6 °C
Holding Time	<48 hours@ 0 - 6 °C; dark

[1]Test data are reviewed to verify that test acceptability criteria (TAC) requirements for a valid test have been met. Any test not meeting these criteria is considered invalid. All invalid tests must be repeated with a newly collected sample.

[2]Deviations from the summary of recommended test conditions must be evaluated on a project-specific basis to determine the validity of test results. Depending on the degree of the departure and the objective of the test, deviations from recommended conditions may or may not invalidate a test result.

Table 26-12. Quality Control[1]: Marine Sediment Toxicity Testing

Negative Controls	Frequency of Analysis	Control Limits
Laboratory Control Water	Laboratory control water consistent with Section 7 of the appropriate EPA method/manual must be tested with each analytical batch.	Laboratory control water must meet all test acceptability criteria (please refer to Section 7 of the appropriate EPA method/manual) for the species of interest.
Conductivity/Salinity Control Water	A conductivity or salinity control must be tested when these parameters are above or below the species tolerance.	Follow EPA guidance on interpreting data and refer to tables below for tolerance ranges.
Additional Control Water	Additional method blanks are required whenever manipulations are performed on one or more of the ambient samples within each analytical batch (e.g., pH adjustments, continuous aeration).	There must be no statistical difference between the laboratory control water and each additional control water within an analytical batch.
Sediment Control	Sediment control consistent with Section 7 of the appropriate EPA method/manual must be tested with each analytical batch of sediment toxicity tests.	Sediment control must meet all data acceptability criteria (please refer to Section 7 of the appropriate EPA method/manual) for the species of interest.
Positive Controls	**Frequency of Analysis**	**Control Limits**
Reference Toxicant Tests	Reference toxicant tests must be conducted monthly for species that are raised within a laboratory, or per analytical batch for commercially-supplied or field-collected species.	Last plotted data point (LC50 or EC50) must be within 2 SD of the cumulative mean (n=20). Reference toxicant tests that fall outside of recommended control chart limits are evaluated to determine the validity of associated tests. An out of control reference toxicant test result does not necessarily invalidate associated test results. More frequent and/or concurrent reference toxicant testing may be advantageous if recent problems have been identified in testing.

[1]Unless method specifies more stringent requirements.

In special cases where the criteria listed in the above tables cannot be met, EPA minimum criteria may be followed. The affected data should be flagged accordingly.

Test data are reviewed to verify that the test acceptability criteria for a valid test have been met. Any test not meeting the minimum test acceptability criteria is considered invalid. All invalid tests should be repeated with the newly collected sample. If this is not possible, the test should be repeated with an archived sample and all tests must be properly flagged.

Deviations from the summary of recommended test conditions must be evaluated on a project-specific basis to determine the validity of test results. Depending on the degree of the departure and the objective of the test, deviations from recommended conditions may or may not invalidate a test result. Before rejecting or accepting a test result as valid, the reviewer should consider the degree of the deviation and the potential or observed impact of the deviation on the test result. For example, if dissolved oxygen is measured below 4.0 mg/L in one test chamber, the reviewer should consider whether any observed mortality in that test chamber corresponded with the drop in dissolved oxygen

Table 26-13. Marine Sediment Testing: 10-Day Survival *Eohaustorius estuarius* Sediment Toxicity Test

Method Recommendation	
EPA/600/R-94/025 or validated and SWAMP-approved alternative method	
Data Acceptability Requirements	
Parameter	*Criteria*
Test Acceptability Criteria[1]	≥90% survival in controls
Data Qualification	
Test Conditions	*Required*
Test Type	Whole sediment, static
Size at Test Initiation	3 – 5 mm (no mature males of females)
Replication at Test Initiation	4 (minimum)
Organisms/Replicate	20 (minimum)
Food Source	Do not feed
Renewal Frequency	None
Test Duration	10 days
Endpoints	Survival
Test Conditions	*Recommended* [2]
Salinity	20-34 ± 2‰
Temperature Range	15 ± 1.0 °C (±3 °C required)
Light Intensity	10 – 20 µE/m^2/s or 50 – 100 ft-c
Photoperiod	Continuous luminance
Test Chamber Size	1 L
Replicate Volume	Sediment volume 175 mL (~2 cm); Overlying water volume 800 mL
Feeding Regime	Do not feed
Laboratory Control Water	Clean natural seawater or reconstituted water
Sediment Control	Clean sediment from organism collection site (sieved through 500 µm screen)
Minimum Sample Volume	3L for one-time grab sample
Sensitivity	*Performance Criteria*
Reference Toxicant Testing	If the LC50 exceeds +/- two standard deviations of the running mean of the last 20 reference toxicant tests, the test should be flagged.
Water Chemistry	
Test Parameter	*Required Frequency*
Initial Overlying Water Chemistry	One DO, pH, salinity, ammonia, and temperature measurement per sample
Initial Interstitial Water Chemistry	One pH, ammonia, and salinity measurement per sample
Daily Water Chemistry	One temperature measurement per sample
Final Overlying Water Chemistry	One DO, pH, salinity, ammonia, and temperature measurement per sample
Final Interstitial Water Chemistry	One pH, ammonia, and salinity measurement per sample
Test Parameter	*Recommended Criteria*
Initial DO Range	90 - 100% Saturation
Sample Handling/Collection	
Test Parameter	*Recommended Conditions*
Relevant Media	Sediment
Sample Container Type	Amber glass recommended but clear glass or plastic (polyethylene or polycarbonate) acceptable
Sample Preservation	Wet or blue ice in field, 0 - 6 °C refrigeration in laboratory, dark at all times
Sample Receipt Temperature	0 - 6 °C
Holding Time	<14 days (recommended) or <8 weeks (required) @ 0 - 6 °C; dark; Do not freeze

[1]Test data are reviewed to verify that test acceptability criteria (TAC) requirements for a valid test have been met. Any test not meeting these criteria is considered invalid. All invalid tests must be repeated with a newly collected sample.

[2]Deviations from the summary of recommended test conditions must be evaluated on a project-specific basis to determine the validity of test results. Depending on the degree of the departure and the objective of the test, deviations from recommended conditions may or may not invalidate a test result.

27. Appendix B. Rocky Intertidal Monitoring Method Summary

Comprehensive sampling of ecological communities on rocky intertidal habitats will be done using protocols developed by the coastal biodiversity surveys (http://cbsurveys.ucsc.edu/). This approach was (and is being) used in Southern California in both phase 1 and 2 of rocky intertidal ASBS assessment (Raimondi, Schiff and Gregorio 2012). The general approach is described below.

Site selection: Discharge and Reference – Based on the operational definition of natural water quality described above, along with the regulations prohibiting discharge in ASBS, we select sites as follows. Sites are selected within ASBS that (1) have sufficient rocky intertidal habitat to be suited for sampling (as described below) and, (2) are located near to active discharge. Reference sites are selected following guideline (1) but instead of requiring proximity to an active discharge, we only used sites that are not near an active discharge. In addition we matched reference sites to discharge sites to control for spatial variance

The sampling procedure used is identical to that used by the coastal biodiversity survey (CBS) program housed at UCSC and administered by Peter Raimondi. In order to be cost-efficient, data from sites previously sampled by the CBS program are used in the analyses. New sampling will be done to supplement existing data.

Selecting an appropriate location within a site - Within a site, the ideal location to do a CBS is on a bench that 1) is at least 30m wide, 2) gently slopes from the high to low zone, and most importantly 3) contains a representative sample of the intertidal community of the entire site. If it is not possible to find a contiguous 30m stretch of coastline, the survey can be split between two adjacent benches. When this is done, the survey should be divided as evenly as possible between the two benches.

Set-Up - Once an appropriate area of shoreline is selected, it is sampled using a series of parallel transect lines extending from the high zone to the low zone. To facilitate the setup of these lines, two permanent 30m horizontal baselines (parallel to the ocean) are first established. The upper baseline is placed in the high zone above the upper limit of the organisms, while the lower baseline, which should be parallel to the upper baseline, is established farther down the shore. Depending on the amount of beach traffic or site regulations, the ends of these lines are permanently marked with either hex or carriage bolts.

Once these two baselines are established, parallel transect lines are run down the shore every three meters along the upper base line. To insure that these lines are parallel, they should intersect the appropriate meter mark on the lower baseline. In general the transect lines are allowed to follow the contours of the bench. When necessary, rocks are placed along the lines to prevent them from being shifted by heavy winds. It is noted where each transect crossed the lower baseline.

To facilitate resurveys of the site, a map is drawn of the site showing the location of the bolts relative to notable landmarks or other, pre-existing permanent plots. Photographs are also taken that include prominent visual reef characteristics for orientation (e.g. a large crack). The distance and bearing between the baseline endbolts are measured. When possible, measurements are also taken between the endbolts and any pre-existing permanent plots. Other pertinent information, such as the compass heading of the vertical transects, the sampling interval, weather conditions, site complications, and problems with

taxonomic identification, is also recorded. All such information is used to make the mapping of the site more spatially explicit.

In addition to the spatial information described above, we also collected information about the site including bench type, relief, slope, extent of habitat and characteristics of surrounding coast. This information can be used to provide a spatial context for the site.

Point-Contact Surveys **-** Each vertical transect is sampled using the point intercept method. An average of 100 points are sampled on each transect line. Hence, for example the interval between points would be 20cm for a 20m long transect, and 10cm for a 10m long transect. The basis of this design is to ensure that there is a similar density of sampled points per vertical unit of tidal elevation for all sites. For each point two types of data are collected: data that are used to determine relative abundance (% cover), and data that are used to describe spatial distributions. The relative abundance data are collected by identifying all taxa that fell directly under each point, including rock, sand, and tar. If there is layering of species, the taxa occupying the different layers are identified and assigned a letter; A for the top layer, B for the second layer, and C for the third. (Note: each layer must be a different taxa). If the point fell on an epibiont living on a host species, the epibiont is noted. Also recorded is whether the species under the point is in a pool, on cobble, or on boulders. A total of up to three taxa are identified under each point.

If fewer than three taxa are recorded under a point, then the next one or two species closest to that point are also noted. These 'nearby' species have to differ from those found under the point, and must fall within a circle centered over the point with a radius half the length of the sampling interval.

Mobile Invertebrate Surveys **-** Although point-contact surveys are good at determining the abundance of spatially common species, particularly sessile species, they do not sample rare or spatially uncommon species very well. Because most mobile species are not spatially common, their abundances are sampled in 50 x 50 cm quadrats placed at three locations along each transect. Each transect is first divided into three zones; the low zone, defined as the area below the mussel zone, the mid-zone (including mussels and rock weeds, and the high zone (usually dominated by barnacles and littorines). Within each zone a quadrat is randomly placed on the transect, and all mobile species found within the quadrat are identified and counted. Sub-sampling is used when there are more than one hundred individuals of one species in a quadrat. If a quadrat landed in a deep pool or in an area dominated by sand, a new location within the defined zone is selected.

Vouchers–We collect field vouchers for all species that could not be identified in the field. Voucher samples are labeled with the date, site, name of sampler, transect line on which it is found.

Specific hypotheses tested **-** The general goal of this project is to compare the ecological communities in discharge and reference locations. To do this we developed the following specific (null) hypotheses

1. Species richness will not vary as function of site type (Discharge, Reference)
2. Community composition of sessile species will not vary as a function of site type
3. Community composition of mobile species will not vary as a function of site type
4. An integrated assessment of both mobile and sessile species will not identify particular sites as being substantially different from the expectation based on all sites. This is a way to look at specific sites rather than site types.

For questions 1-3 two forcing (independent) variables are used in the statistical approaches. First – whether the sites is considered to be a discharge site or a reference site (that could also be in an ASBS). Second – we imposed a geographical group structure to match discharge sites with appropriate reference sites. Point contact (mainly sessile or sedentary organisms) and Quadrat data (mobile organisms) are evaluated using a PERMANOVA approach to compare communities between discharge and reference sites after accounting for geography. Species Richness is assessed using ANOVA. For hypotheses 1-3 we set the critical p-value at 0.05 (null hypothesis not rejected unless $p<0.05$).

For hypothesis 4 we generated site similarity matrices (using Bray Curtis values) then calculated Mahalanobis distances using values from the two matrices. Mahalanobis distances are the distance from a multivariate centroid accounting for the covariance structure among variables. Small values indicate that that sample is similar to a hypothetical typical sample, while large distances indicate samples very different from the hypothetical typical sample. Prediction limits (of the Mahalanobis distance) are used to assess the likelihood of inclusion of samples. For example, an 80% prediction limit would contain 80% of samples drawn from a pool of samples coming from the same population. This differs from confidence limits, which are used to assess the inclusion likelihood of means of samples from a population.

28. Appendix C. Target MRLs

Table 28-1. Project Target MRLs for Conventional Analytes.

Analyte	MRL (mg/L)
Ammonia (as N)	0.1
Nitrate (as N)	0.1
Orthophosphate (as P)	0.1
Oil & Grease	5.0
Total Suspended Solids (103-105 ˚C)	2.0
Urea (as N)	0.01

Table 28-2. Project Target MRLs for Inorganic Analyses.

Analyte	Saline Water (µg/L)	Fresh Water (µg/L)	Sediment (mg/kg) DW
Arsenic	0.3	0.06	0.3
Cadmium	0.16	0.03	0.1
Chromium	0.21	0.30	1.0
Copper	0.16	0.10	1.5
Lead	0.16	0.03	0.50
Mercury	0.0002	0.0002	0.012
Nickel	0.11	0.03	0.40
Selenium	0.66	1.00	1.0
Silver	0.02	0.04	0.20
Zinc	0.33	0.70	10.0

Table 28-3. Project Target MRLs for Pathogen Indicators.

Analyte	MRL (MPN/100 mL)
Pathogens –Fecal Coliform	2
Pathogens – Enterococcus	2

Table 28-4. Project Target MRLs for PAHs

Analyte	Water (µg/L)	Sediment ng/g DW
Acenaphthene	0.01	20
Acenaphthylene	0.01	20
Anthracene	0.01	20
Benz(a)anthracene	0.01	20
Benzo(a)pyrene	0.01	20
Benzo(b)fluoranthene	0.01	20
Benzo(e)pyrene	0.01	20
Benzo(g,h,i)perylene	0.01	20

Analyte	Water (µg/L)	Sediment ng/g DW
Benzo(k)fluoranthene	0.01	20
Biphenyl	0.01	20
Chrysene	0.01	20
Dibenz(a,h)anthracene	0.01	20
Dibenzothiophene	0.01	20
Dimethylnaphthalene, 2,6-	0.01	20
Dimethylphenanthrene, 3,6-	0.01	20
Fluoranthene	0.01	20
Fluorene	0.01	20
Indeno(1,2,3-c,d)pyrene	0.01	20
Methylnaphthalene, 1-	0.01	20
Methylnaphthalene, 2-	0.01	20
Methylphenanthrene, 1-	0.01	20
Methyldibenzothiophene, 4-	0.01	20
Methylfluoranthene, 2-	0.01	20
Methylfluorene, 1-	0.01	20
Naphthalene	0.01	20
Perylene	0.01	20
Phenanthrene	0.01	20
Pyrene	0.01	20
Trimethylnaphthalene, 2,3,5-	0.01	20

Table 28-5. Project Target MRLs for OP Pesticides

Analyte	Water (µg/L)
Chlorpyrifos	0.04
Chlorpyrifos methyl	0.04
Diazinon	0.04
Dichlofenthion	0.04
Ethion	0.04
Fenchlorphos	0.10
Fenitrothion	0.04
Fonofos	0.04
Malathion	0.10
Parathion, Ethyl	0.04
Parathion, Methyl	0.10
Ethoprop	0.10
Sulfotep	0.04
Thionazin	0.04
Tokuthion	0.10
Trichloronate	0.04

Table 28-6. Project Target MRLs for Pyrethroids

Analyte	Water (ng/L)
Bifenthrin	10
Cyfluthrin	10
Total Cypermethrin	10
Total Deltamethrin/Tralomethrin	10
Total Esfenvalerate/ Fenvalerate	10
Total Lambda-cyhalothrin	10
Total cis-Permethrin	10
trans-Permethrin	10
Fenpropathrin	10

Table 28-7. Project Target MRLs for Organotins

Analyte	Water (µg/L)	Sediment and Tissue (µg/kg)
Tributyltin as Sn	0.1	2

29. Appendix D. Corrective Actions

Table 29-1. Corrective Action – Laboratory Analysis of Conventional Analytes (Water)

Laboratory Quality Control	Corrective Action
Calibration Standard	Affected samples and associated quality control must be reanalyzed following successful instrument recalibration.
Initial/Continuing Calibration Verification	The analysis must be halted, the problem investigated, and the instrument recalibrated. All samples after the last calibration verification must be reanalyzed.
Laboratory Blank	The sample analysis must be halted, the source of the contamination investigated, the samples along with a new laboratory blank prepared and/or re-extracted, and the sample batch and fresh laboratory blank reanalyzed. If reanalysis is not possible due to sample volume, flag associated samples as estimated.
Reference Material	Affected samples and associated quality control must be reanalyzed following instrument recalibration.
Matrix Spike	The spiking level should be approximately 2-5 times the ambient concentration of the spiked sample. Appropriately spiked results should be compared to the matrix spike duplicate to investigate matrix interference. If matrix interference is suspected, the matrix spike result must be qualified.
Matrix Spike Duplicate	The spiking level should be approximately 2-5 times the ambient concentration of the spiked sample. Appropriately spiked results should be compared to the matrix spike duplicate to investigate matrix interference. If matrix interference is suspected and reference material recoveries are acceptable, the matrix spike duplicate result must be qualified.
Laboratory Duplicate	For duplicates with a heterogeneous matrix or ambient levels below the reporting limit, failed results may be qualified. Other failures should be reanalyzed as sample volume allows.
Internal Standard	As method requires. The instrument must be flushed with rinse blank. If, after flushing, the responses of the internal standards remain unacceptable, the analysis must be terminated and the cause of drift investigated.
Field Quality Control	**Corrective Action**
Field Duplicate	For duplicates with a heterogeneous matrix or ambient levels below the reporting limit, failed results may be qualified. All failures should be communicated to the project coordinator, who in turn will follow the process detailed in the method.
Field Blank, Travel Blank, Equipment Blank	If contamination of the field blanks and associated samples is known or suspected, the laboratory should qualify the affected data, and notify the project coordinator, who in turn will follow the process detailed in the method.

Table 29-2. Corrective Action - Conventional Analytes (Total Solids, Suspended Sediment Concentration, and Percent Lipids)

Laboratory Quality Control	Corrective Action
Calibration Standard	n/a
Initial/Continuing Calibration Verification	n/a
Laboratory Blank	Please refer to method requirements.
Reference Material	Please refer to method requirements.
Matrix Spike	n/a
Matrix Spike Duplicate	n/a
Laboratory Duplicate*	For duplicates with a heterogeneous matrix or ambient levels below the reporting limit, failed results may be qualified. Other failures should be reanalyzed as sample volume allows. A matrix spike duplicate may not be analyzed in place of a laboratory duplicate.
Internal Standard	n/a
Field Quality Control	**Corrective Action**
Field Duplicate	For duplicates with a heterogeneous matrix or ambient levels below the reporting limit, failed results may be qualified. All failures should be communicated to the project coordinator, who in turn will follow the process detailed in the method.
Field Blank, Travel Blank, Equipment Blank	n/a

*Not applicable to suspended sediment concentration analyses

Table 29-3. Corrective Action - Inorganic Chemistry

Laboratory Quality Control	Corrective Action
Calibration Standard	Affected samples and associated quality control must be reanalyzed following successful instrument recalibration
Initial/Continuing Calibration Verification	The analysis must be halted, the problem investigated, and the instrument recalibrated if necessary. If deemed appropriate, all samples after the last acceptable continuing calibration verification may be reanalyzed.
Laboratory Blank	The sample analysis must be halted, the source of the contamination investigated, the samples along with a new laboratory blank prepared and/or re-extracted, and the sample batch and fresh laboratory blank reanalyzed. If reanalysis is not possible due to sample volume, flag associated samples as estimated.
Reference Material	If deemed appropriate, affected samples and associated quality control may be reanalyzed following instrument recalibration.
Matrix Spike	The spiking level should be approximately 2-5 times the ambient concentration of the spiked sample. Appropriately spiked results should be compared to the matrix spike duplicate to investigate matrix interference. If matrix interference is suspected, the matrix spike result must be qualified.
Matrix Spike Duplicate	The spiking level should be approximately 2-5 times the ambient concentration of the spiked sample. Appropriately spiked results should be compared to the matrix spike duplicate to investigate matrix interference. If matrix interference is suspected and reference material recoveries are acceptable, the matrix spike duplicate result must be qualified.
Laboratory Duplicate	For duplicates with a heterogeneous matrix or ambient levels below the reporting limit, failed results may be qualified. Other failures should be reanalyzed as sample volume allows.
Internal Standard	As method requires. The instrument must be flushed with rinse blank. If, after flushing, the responses of the internal standards remain unacceptable, the analysis must be terminated and the cause of drift investigated.
Field Quality Control	**Corrective Action**
Field Duplicate	For duplicates with a heterogeneous matrix or ambient levels below the reporting limit, failed results may be qualified. All failures should be communicated to the project coordinator, who in turn will follow the process detailed in the method.
Field Blank, Equipment Blank	n/a

Table 29-4. Corrective Action - Organic Chemistry

Laboratory Quality Control	Corrective Action
Calibration Standard	Affected samples and associated quality control must be reanalyzed following successful instrument recalibration.
Initial/Continuing Calibration Verification	The analysis must be halted, the problem investigated, and the instrument recalibrated. All samples after the last acceptable continuing calibration verification must be reanalyzed.
Laboratory Blank	The sample analysis must be halted, the source of the contamination investigated, the samples along with a new laboratory blank prepared and/or re-extracted, and the sample batch and fresh laboratory blank reanalyzed. If reanalysis is not possible due to sample volume, flag associated samples as estimated.
Reference Material	Affected samples and associated quality control must be reanalyzed following instrument recalibration.
Matrix Spike	The spiking level should be approximately 2-5 times the ambient concentration of the spiked sample. Appropriately spiked results should be compared to the matrix spike duplicate to investigate matrix interference. If matrix interference is suspected, the matrix spike result must be qualified.
Matrix Spike Duplicate	The spiking level should be approximately 2-5 times the ambient concentration of the spiked sample. Appropriately spiked results should be compared to the matrix spike duplicate to investigate matrix interference. If matrix interference is suspected and reference material recoveries are acceptable, the matrix spike duplicate result must be qualified.
Laboratory Duplicate	For duplicates with a heterogeneous matrix or ambient levels below the reporting limit, failed results may be qualified. Other failures should be reanalyzed as sample volume allows.
Internal Standard	Analyze as appropriate per method. Troubleshoot as appropriate. If, after trouble-shooting, the responses of the internal standards remain unacceptable, the analysis must be terminated and the cause of drift investigated.
Surrogate	Analyze as appropriate per method. All affected results should be qualified. The analytical method or quality assurance project plan must detail procedures for updating surrogate measurement quality objectives.
Field Quality Control	**Corrective Action**
Field Duplicate	For duplicates with a heterogeneous matrix or ambient levels below the reporting limit, failed results may be qualified. All failures should be communicated to the project coordinator, who in turn will follow the process detailed in the method.
Field Blank, Travel Blank, Equipment Blank	n/a

Table 29-5. Corrective Action - Toxicity Testing

Negative Controls	Corrective Action
Laboratory Control Water	If tested with in-house cultures, affected samples and associated quality control must be retested as soon as is feasible after determination of test failure (dependent upon procurement of test species). If commercial cultures are used, they must be ordered within 16 hours of test failure for earliest possible receipt, and retests must be initiated within 8 hours of receipt. The laboratory should try to determine the source of contamination, document the investigation, and document steps taken to prevent recurrence.
Conductivity Control Water	Affected samples and associated quality control must be qualified.
Additional Control Water	A water sample that has similar qualities to the test sample may be used as an additional control based on the objectives of the study. Results that show statistical differences from the laboratory control should be qualified. The laboratory should try to determine the source of contamination, document the investigation, and document steps taken to prevent recurrence. This is not applicable for TIE method blanks.
Laboratory Control Sediment	Affected samples and associated quality control must be re-tested within 24 hours of test failure if tested with in-house cultures. If commercial cultures are used, they must be ordered within 16 hours of test failure for earliest possible receipt, and re-tests must be initiated within 8 hours of receipt. The laboratory should try to determine the source of contamination, document the investigation, and document steps taken to prevent recurrence.
Additional Control Sediment	A sediment sample that has similar qualities to the test sample may be used as an additional control based on the objectives of the study. Results that show statistical differences from the laboratory control should be qualified. The laboratory should try to determine the source of contamination, document the investigation, and document steps taken to prevent recurrence.
Positive Controls	**Corrective Action**
Reference Toxicant Tests	If LC50 exceeds +/- two standard deviations of the running mean of the last 20 reference toxicant tests, the test should be qualified.

Table 29-6. Corrective Action - Field Measurements

Field Quality Control	Corrective Action
Depth, Dissolved Oxygen, pH, Salinity, Specific Conductance, Temperature, Turbidity, Velocity	The instrument should be recalibrated following its manufacturer's cleaning and maintenance procedures. If measurements continue to fail measurement quality objectives, affected data should not be reported and the instrument should be returned to the manufacturer for maintenance. All troubleshooting and corrective actions should be recorded in the calibration and field data logbooks.

30. Appendix E – Laboratory Protocols, MPSL

31. Appendix F – Laboratory Protocols, UCD-GC

32. Appendix G – Laboratory Protocols, WPCL

33. Appendix H – Laboratory Protocols, MBAS

34. Appendix I – Laboratory Protocols, Alpha Analytical

35. Appendix J - ASBS RMP and Reference Site Monitoring SOPs

SOP #	SOP	Source
FS-1	Collection of Water Samples	RMP
FS-2	Field Equipment Cleaning Procedures	RMP
FS-3	Sample Container, Handling, and Chain of Custody Procedures	RMP
FS-4	Site and Sample Naming Convention	RMP
FS-5	Completion and Processing of Field Datasheets	RMP
FS-6	Collection of Sediment Samples	RMP