FINAL
APPENDIX B

SAN DIEGO COUNTY MUNICIPAL COPERMITTEES
SEDIMENT MONITORING
QUALITY ASSURANCE PROJECT PLAN

Prepared for:

County of San Diego Municipal Copermittees

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November 2014

GROUP A:
PROJECT MANAGEMENT

ELEMENT 1 TITLE AND APPROVAL SHEET

Final

Appendix B

San Diego County Municipal Copermittees
Sediment Monitoring
Quality Assurance Project Plan

November 2014

APPROVAL SIGNATURES

San Diego County Copermittee:

Title	Name	Signature	Date
Senior Project Manager			
Project Manager			

Contractor:

Title	Name	Signature	Date
Contractor Sr. Project Manager			
Contractor Project Manager			
Contractor Quality Assurance Officer			

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LIST OF ACRONYMS

ASTM	American Society for Testing and Materials
Bight	Southern California Bight Regional Monitoring Program
BPJ	best professional judgement
CA EPA	California Environmental Protection Agency
CA LRM	California Logistic Regression Model
CEDEN	California Environmental Data Exchange Network
COC	chain of custody
Copermittees	San Diego County Regional Copermittees
CRM	certified reference materials
CSI	Chemical Score Index
CVAA	cold vapor atomic absorption
DDD	dichlorodiphenyldichloroethane
DDE	dichlorodiphenyldichloroethylene
DDT	dichlorodiphenyltrichloroethane
DGPS	Differential Global Positioning System
DQO	data quality objective
DTSC	Department of Toxic Substances Control
EC_{50}	median effect concentration
EPA	Environmental Protection Agency
GC/ECD	gas chromatography/ electron capture detector
GC/MS	gas chromatography/ mass spectrometry
HDPE	high density polyethylene
ICP/MS	inductively coupled mass spectrometry
ID	inner diameter
LC_{50}	median lethal concentration
LCS	laboratory control sample
LOE	line(s) of evidence
$MgSO_4$	magnesium sulfate
MLOE	multiple lines of evidence
MS/MSD	matrix spike/matrix spike duplicate
MS4	municipal separate storm sewer system
OEHHA	Office of Environmental Health Hazard Assessment
PAHs	polynuclear aromatic hydrocarbons
PCBs	polychlorinated biphenyls
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
RL	reporting limit
RPD	relative percent difference
RWQCB	Regional Water Quality Control Board
SCAMIT	Southern California Association of Marine Invertebrate Taxonomists
SRM	standard reference material
SWAMP	Surface Water Ambient Monitoring Program
SWRCB	State Water Resources Control Board
SIM	selective ion capture
SM	Standard Method

SOP	standard operating procedure
SP	solid phase
SQO	sediment quality objective
SWI	sediment water interface
TBD	to be determined
TOC	total organic carbon
USEPA	United States Environmental Protection Agency
WQIP	Water Quality Improvement Plan

Units of Measure

ppt	parts per thousand
ft	feet
m^2	square meters
L	liter
cm	centimeter
mm	millimeter
%	percent
mL	milliliter
^oC	degrees Celsius
kg	kilogram
mg	milligram
µg	microgram

ELEMENT 3 DISTRIBUTION LIST

Table 1 identifies those individuals who will receive one copy of the approved Sediment Monitoring Quality Assurance Project Plan (QAPP). (**NOTE:** This table should be completed by each San Diego County Regional Copermittee (Copermittee). The Titles and roles listed in the table can be expanded based on the monitoring and team assembled.)

Table 1. Quality Assurance Project Plan Distribution List

Title	Name (Affiliation)	Telephone No.	QAPP No.
San Diego County Copermittee Project Manager			01
Contractor Project Manager			02
Contractor Project Quality Assurance (QA) Officer			03
Contractor Field Task Manager			04
Laboratory Contractor Quality Assurance (QA) Officer			05

ELEMENT 4 PROJECT/TASK ORGANIZATION

Involved Parties and Roles

NOTE: This section detailing the specific roles of key individuals who will be conducting and managing the sediment monitoring project will have to be completed by each Copermittee. Text describing the roles played by key personnel should be followed by the contact information for these key individuals in a tabular format as shown in Table 2, and by an organizational chart. The Titles and roles listed in the table can be expanded based on the monitoring and team assembled.

Table 2. Key Personnel Responsibilities and Contact Information

Name	Organizational Affiliation	Title	Contact Information (telephone number, fax number and email address)
	San Diego County Copermittee	Project Manager	
	Contractor	Project Manager	
	Contractor	Field Task Manager	
	Contractor	QA Officer	
	Laboratory Contractor	QA Officer	

NOTE: Each Copermittee should complete an Organizational Chart to be placed here in Figure 1. An example is provided below. This chart should reflect the key individuals listed in Table 2.

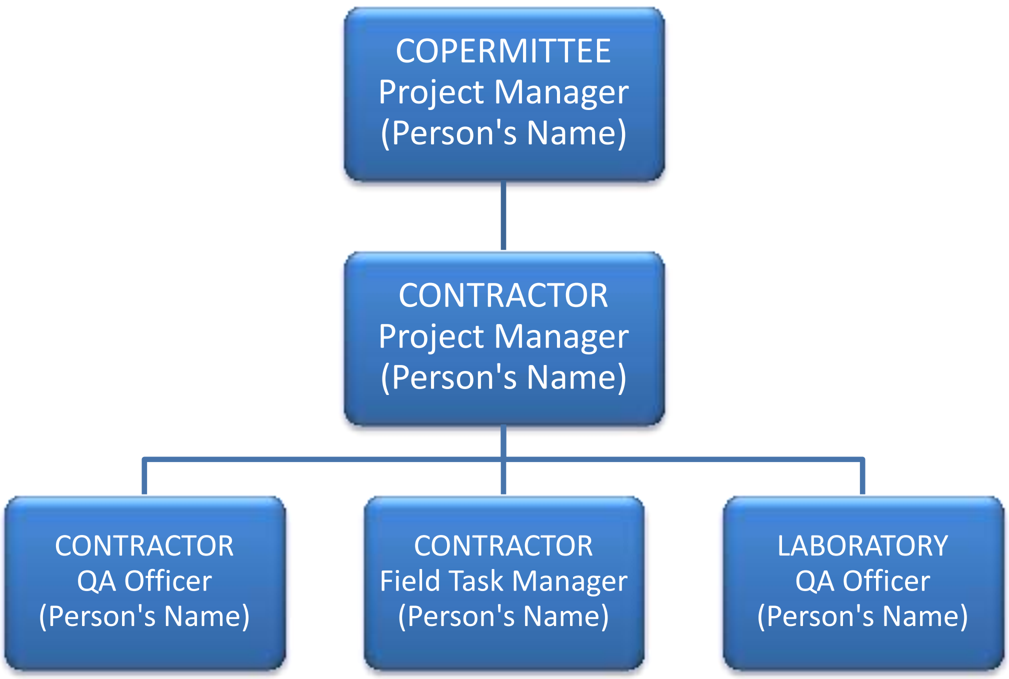

Figure 1. Organizational Chart

Quality Assurance Officer Role

The project Quality Assurance (QA) Officer will be responsible for the overall QA and quality control (QC) procedures found in this plan as part of the sampling and field analyses, laboratory analysis, and the overall quality of the data.

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 Contractor Project Manager and QA Officer with the concurrence of Copermittee Project Manager. The Contractor Project Manager, with input from the QA Officer, will be responsible for making the changes, submitting drafts for review by the Copermittee Project Manager, preparing a final amended copy, and submitting the final for signature. Project work must be halted while revisions to the QAPP are made, unless authorized by the Copermittee Project Manager.

ELEMENT 5 PROBLEM DEFINITION/BACKGROUND

Problem Statement

The Copermittees are required to conduct sediment quality monitoring in accordance with the requirements of the San Diego Regional Water Quality Control Board (RWQCB) Order No. R9-2013-0001 (Permit), effective June 27, 2013. The Copermittees are required, either individually, in association with multiple Copermittees, or through participation in a water body monitoring coalition to perform sediment quality monitoring to assess compliance with the sediment quality receiving water limits applicable to municipal separate storm sewer system (MS4) discharges to enclosed bays and estuaries. Urban runoff from the MS4 poses a risk to beneficial uses in receiving waterbodies. An understanding of the quality of sediments in relation to MS4 discharges is needed to direct and prioritize management actions.

Provision D.1.e.(2) of the Permit requires the Copermittees to develop a Sediment Monitoring Plan for incorporation into the Water Quality Improvement Plan (WQIP) which satisfies the requirements of the *Water Quality Control Plan for Enclosed Bays and Estuaries of California – Part I Sediment Quality* (Sediment Control Plan; State Water Quality Control Board [SWRCB] and California Environmental Protection Agency [CA EPA], 2009; see Appendix A). This QAPP supports the Sediment Monitoring Plan by describing the sampling, analysis, and quality assurance procedures that are needed to comply with Permit-required sediment quality monitoring.

Decisions or Outcomes

The primary objective of the sediment monitoring program is to assess compliance with the sediment quality receiving water limits applicable to MS4 discharges to enclosed bays and estuaries of San Diego County. Sediment toxicity, chemistry, and benthic community condition will be assessed using SQOs as described in the Sediment Monitoring Plan. The goals of the SQOs are to determine whether pollutants in sediments are present in quantities that are toxic to benthic organisms and/or will bioaccumulate in marine organisms to levels that may be harmful.

The goal of the Sediment Monitoring Plan and Sediment Monitoring QAPP is to provide the key elements that are required to successfully conduct field sediment sampling, processing, testing, and analysis of the results in accordance with SQO guidelines. Analyses of chemistry, toxicity, and benthic community condition require that samples be collected, preserved, processed, and analyzed using proper field and laboratory equipment, methods, and techniques. The Sediment Monitoring Plan and Sediment Monitoring QAPP describe the collection and analysis of surface sediment samples necessary to provide representative assessments of in-situ conditions for the enclosed bays and estuaries of San Diego County. By adhering to SQO protocols, sediment quality in subtidal marine and estuarine habitats can be assessed as to whether it is protective of aquatic life and human health.

ELEMENT 6 PROJECT/TASK DESCRIPTION

Work Statement and Produced Products

The San Diego County Regional Copermittees (Copermittees) are required to conduct sediment quality monitoring in accordance with the requirements of the *Water Quality Control Plan for Enclosed Bays and Estuaries of California – Part I Sediment Quality* (Sediment Control Plan; SWRCB and CA EPA, 2009; see Appendix A). The Sediment Control Plan outlines a multiple lines of evidence (MLOE) approach to determine whether pollutants in sediments are present in quantities that are toxic to benthic organisms and/or will bioaccumulate in marine organisms to levels that may be harmful to humans. Sediment monitoring will be conducted at least twice during the Permit cycle except at stations that have consistently been classified as Unimpacted or Likely Unimpacted using the MLOE approach. At the Unimpacted or Likely Unimpacted stations, monitoring may be reduced to a frequency of once during the Permit cycle. Sediment samples will be analyzed for toxicity, chemistry, and benthic infauna at a designated number of stations (station selection is outlined in ELEMENT 10) within a waterbody. An SQO analysis will be conducted on each station to determine a final station assessment that indicates whether the aquatic life SQO has been met. Depending on the outcome of the SQO assessments at the designated stations located in San Diego County waterbodies, follow-up monitoring may be necessary to meet all of the Permit requirements. Upon completion of the sediment quality monitoring, a Sediment Monitoring Report will be incorporated into the WQIP Annual Report. An additional stressor identification study may be required by the San Diego RWQCB for stations not meeting SQOs.

Provision D.1.e.(1)(a) of the Permit also requires the Copermittees to participate in the Southern California Bight Regional Monitoring Program. Participation in the Bight Program can be used to simultaneously fulfill all or part of the sediment quality monitoring requirement (Provision D.1.e[2]) because sediment monitoring and SQO analyses are incorporated into the Bight Program to regionally assess the sediment quality of Southern California's waterbodies. The Copermittees can also decide to conduct the initial sediment quality monitoring of San Diego County's water bodies independently of the Bight Program. Depending upon the outcome of the initial SQO assessments, the Copermittees may need to perform follow-up monitoring to meet all of the Permit requirements.

Constituents to be Monitored and Measurement Techniques

Chemical and toxicity analyses of all sediment samples collected as part of the SQO assessment must be tested in accordance with United States Environmental Protection Agency (USEPA) or American Society for Testing and Materials (ASTM) protocols. If appropriate protocols do not exist, the SWRCB or San Diego RWQCB may approve the use of other methods. All analytical laboratories must be certified by the California Department of Health Services in accordance with Water Code 13176.

Physical and chemical measurements of sediment were selected to comply with the Sediment Control Plan and to provide data on chemicals of potential concern in bays and estuaries located in San Diego County. The physical and chemical analyses of sediments will include, at a minimum, grain size, percent solids, total organic carbon (TOC), trace metals, organochlorine pesticides, polychlorinated biphenyl (PCBs) congeners, and polynuclear aromatic hydrocarbons (PAHs). Chemical analyses of these constituents are necessary in order to compare to the California Logistic Regression Model (CA LRM) and the Chemical Score Index (CSI) for SQO analyses. Additional physical or chemical analyses may be included in order to aid in the interpretation of the individual lines of evidence (LOEs) (e.g. pyrethroids or ammonia).

Sediment toxicity testing will be performed for each station using a minimum of one short-term survival toxicity test and one sublethal toxicity test. Acceptable short-term sediment survival tests include the *Eohaustorius estuarius* 10-day survival test, the *Leptocheirus plumulosus* 10-day survival test, or the *Rhepoxynius abronius* 10-day survival test. Acceptable sublethal sediment toxicity tests include the the *Mytilus galloprovincialis* sediment-water interface (SWI) 48-hour embryo development test or the *Neanthes arenaceodentata* whole sediment 28-day growth test. The *E. estuarius* short-term survival test and the *M. galloprovincialis* sublethal toxicity test have been the test methods used in previous San Diego County bay and estuary monitoring programs including the Bight program where the SQO analytical tool was used to assess aquatic health.

Benthic community condition samples will be screened by field personnel and then sorted and identified to the lowest possible taxon by qualified taxonomists in accordance with the most recent version of the Southern California Association of Marine Invertebrate Taxonomists (SCAMIT) taxonomic listing for nomenclature and orthography.

For the purposes of this QAPP, the constituent list for chemical analyses includes only those analytes that are required for compliance with SQO analyses and physical analyses that will aid in the interpretation of the SQO data. Analytical physical and chemistry methods provided in Table 3 are suggested methods that have been used in previous sediment monitoring programs within San Diego County's waterbodies (e.g. Bight), but are not the only acceptable methods. A detailed list of individual analytes is provided in Element 13.

Table 3. Analyte list and Suggested Testing Methods for SQO analyses

Analyte/ Test	Method
Physical Analyses	
Grain size	Plumb 1981 or use of a Horiba LA920 (Laser Particle Analyzer)
Percent solids	SM 2540B
TOC	USEPA 9060A
Chemical Analyses	
Trace Metals	USEPA 6020A (Mercury- 7471B)
Oganochlorine pesticides	USEPA 8081B
PCB congeners	USEPA 8082A
PAHs	USEPA 8270D
Toxicity	
Short-term amphipod survival using *Eohaustorius estuarius*	USEPA (1994) *Methods for Assessing Toxicity of Sediment-Associated Contaminants with Estuarine and Marine Amphipods*, ASTM E1367-03
Sublethal testing using *Mytilus galloprovincialis*	USEPA (1995) *Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to West Coast Marine and Estuarine Organisms;* Anderson et al. (1996) *Assessment of Sediment Toxicity at the Sediment-Water Interface*
Sublethal testing using *Neanthes arenaceodentata*	ASTM E1562 with modifications described in Farrar and Bridges (2011)
Benthic Infauna	
Benthic Community Condition	See Element 13

Short-term survival toxicity testing will be performed in accordance with procedures for amphipod testing outlined in *Methods for Assessing Toxicity of Sediment-Associated Contaminants with Estuarine and Marine Amphipods* (USEPA, 1994) and ASTM method E1367-03 (ASTM, 2006). Sublethal sediment toxicity testing for *Mytilus galloprovincialis* should follow procedures outlined in *Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to West Coast Marine and Estuarine Organisms* (USEPA, 1995) and *Assessment of Sediment Toxicity at the Sediment-Water Interface* (Anderson et al., 1996), whereas sublethal sediment toxicity testing for *Neanthes arenaceodentata* should follow ASTM method E1562 (ASTM, 2002) with modifications described in Farrar and Bridges (2011) that have been found to contribute manageability and precision to the ASTM procedure.

SQO Analyses

Protocols for assessing sediment chemistry, toxicity, and benthic community conditions for San Diego County waterbodies using California's SQOs are described in Section 3.2 of the Sediment Monitoring Plan.

Project Schedule

The schedule for completing the sediment quality monitoring requirements of the Permit and for submitting the Sediment Monitoring Report is shown in Table 4.

Table 4. Sediment Monitoring Program Schedule

Activity/Deliverable	Dates(s)*
San Diego RWQCB Order No. R9-2013-0001	Adopted May 8, 2013 and effective June 27, 2013
Southern California Bight Regional Monitoring Program	August-September 2013
Follow-up confirmation monitoring	August-September 2014
Final Sediment Monitoring Plan and Sediment Monitoring QAPP incorporated into WQIPs	December 2014
Draft Sediment Monitoring Report	December 2014
Final Sediment Monitoring Report incorporated into Transitional Monitoring and Assessment Report	January 31, 2015
Potential Stressor ID Studies	TBD

*Table does not include future permit cycles

The Sediment Monitoring Plan and Sediment Monitoring QAPP will be incorporated into the WQIPs in December of 2014. The San Diego County Regional Copermittees participated in the 2013 Bight Program and conducted follow-up monitoring in 2014 to satisfy Provisions D.1.e.(1)(b) and D.1.e.(2) of the Permit prior to the Sediment Monitoring Plan. Monitoring was conducted in accordance with *San Diego County Municipal Copermittees Bight 2013 Workplan* (WESTON, 2013) and data were collected using methods consistent with previous Bight surveys and the current SQO guidelines as described in with Sediment Control Plan. Follow-up confirmation monitoring was conducted in 2014 in accordance with the *San Diego County Municipal Copermittees 2014 Sampling and Analysis Plan for Bight '13 Follow-up Investigations* (WESTON, 2014). Since the WQIPs are still in development and there will be no WQIP Annual Reports in 2015, the Copermittees will include the Sediment Monitoring Report with the Transitional Monitoring and Assessment Report due to the San Diego RWQCB on January 31, 2015. The Sediment Monitoring Report will include the results from the 2013 Bight Program and any follow-up monitoring collected in 2014. Additional sediment quality monitoring or stressor identification studies conducted after 2014 will be included in the WQIP Annual Reports.

Constraints

Sediment monitoring must occur in subtidal areas located within a waterbody between the months of June through September. SQOs have been fully developed for only two of California's six enclosed bay habitats: euhaline (salinity = 25 to 32 parts per thousand [ppt]) bays and estuaries south of Point Conception and polyhaline (18 to 25 ppt) central San Francisco Bay. The benthic species assemblage used to calculate the benthic LOE in San Diego bays and estuaries is Habitat C- Southern California Marine Bays, which requires a salinity greater than 27 ppt (Bay et al 2014; Ranasinghe et al 2008). In order to select a sampling station applicable to the SQO assessment using Habitat C for the benthic LOE, it is recommended to verify that a proposed sampling station is both subtidal and has salinity greater than 27 ppt. Salinity measurements should be taken near the sediment-water interface. Sediment samples will be collected with a 0.1 m^2 Van Veen grab sampler or other similar device. Certain types of benthic habitat such as hard clay, cobble, coarse sand, and areas with thick eel grass may be difficult to sample using this type of device. A slight relocation of the target sampling location may be necessary to avoid areas in which obtaining acceptable grab samples is not achievable.

Nesting periods for threatened or endangered bird species inhabiting coastal water bodies may prevent or delay sampling during certain summer months. Species of particular concern include least terns, snowy plovers, California clapper rails, and Belding's savannah sparrows. Permission from California Fish and Wildlife may be required to enter restricted areas that are known to contain these species. Additionally permission from private land owners may be necessary to gain access to private property and/or private boat launches.

ELEMENT 7 QUALITY OBJECTIVES AND CRITERIA FOR MEASUREMENT DATA

All quality assurance/quality control (QA/QC) data for chemistry and toxicity samples must be conducted in accordance with the QAPP for the State of California's Surface Water Ambient Monitoring Program (SWAMP) (SWAMP Quality Assurance Team, 2008). The data quality objectives (DQOs) are summarized by category in Table 5. If sediment quality monitoring is conducted as part of the Bight Program (i.e. SQO analysis as stated in the Sediment Control Plan), the work plans and associated QA/QC documents pertaining to the Bight Program should be followed in conjunction with this QAPP.

Table 5. Summary of Data Quality Objectives

Measurement or Analysis Type	Applicable Data Quality Objective
Chemistry Laboratory Analyses	Accuracy, precision, and completeness
Toxicity Laboratory Analyses	Precision and completeness
Benthic Infauna Analyses	Accuracy and completeness

Acceptance criteria will be based on the implementation of acceptable and recognized QA/QC procedures. Acceptable data must have proper sample collection and handling methods, sample preparation and analytical procedures, holding times, stability issues, and QA protocols.

Accuracy is a measure of how closely the analytical result or field measurement represents the true quantity found in the sample. Evaluation of the accuracy of laboratory samples will be achieved through the preparation and analysis of either reference materials (e.g. certified or standard reference materials [CRM/SRM]) or laboratory control samples [LCS]) with each analytical batch. For sediment toxicity samples, the accuracy of sediment toxicity tests cannot be determined since a reference material of known toxicity is not available. The accuracy of benthic infaunal sorting will be evaluated via a QA/QC procedure that ensures a 95% sorting efficiency of each sample.

Precision is the measure of agreement among repeated measurements of the same property under identical or substantially similar conditions calculated as either the range or as the standard deviation. The precision of chemistry laboratory measurements will be controlled by comparison of the sample to either a laboratory duplicate or a laboratory matrix spike/matrix spike duplicate (MS/MSD). For toxicity samples, a water only reference toxicant test will be run with every batch of test samples in order to document organism relative sensitivity and test precision. Reference toxicant test results that fall outside of control chart limits (2 standard deviations of the mean) will trigger a review of test procedures and a possible retest of the corresponding sediment samples. A negative control will be run with each test batch for both the short term survival and sublethal toxicity tests.

Completeness is a measure of the percentage of sample results that are collected and analyzed and determined to be valid. A goal of 90% completeness exists for each measurement process.

Completeness will be assessed in all chemistry samples with qualifiers indicating the reasons for any samples that did not meet acceptance criteria. All toxicity tests will be run with toxicity control tests to assess validity of the toxicity test results. Benthic infauna samples that do not meet acceptance criteria will be re-sorted.

"Representative" is a qualitative term that expresses "the degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition" (ANSI/ASQC, 1994). Best professional judgement (BPJ) will be used in the field to evaluate whether measurements are made and physical samples collected in such a manner that the resulting data appropriately reflect the environment or condition being measured or studied. Sample selection and use of approved/documented analytical methods will control to the best extent possible that the measurement data represent the conditions at the investigation site.

Quality control samples and data quality objectives for analyzing chemistry and toxicity samples collected as part of the sediment monitoring program must be conducted in accordance with the QAPP for the State of California's SWAMP (SWAMP Quality Assurance Team, 2008) if SWAMP quality objectives are available. The quality objectives are outlined in Table 6 through Table 8. Depending on the physical or chemical analysis of the sediment samples, the following QA/QC sample types may be required to be included in the analytical run:

- A laboratory blank to determine the likelihood of contamination in the samples.
- A laboratory duplicate sample to estimate the precision of the results through the calculation of the relative percent difference (RPD) between the sample and the duplicate sample.
- A certified or standard reference material to determine the accuracy of the analyses.
- A matrix spike to determine if interference has occurred between the sample matrix and the analysis of the target analyte.
- A surrogate compound to estimate losses of the target analyte during the sample extraction phase and analysis of the sample (for organic measurements only).

SWAMP quality control measurements for toxicity testing of marine sediments are provided in Table 7. It should be noted that these SWAMP measurements currently only apply for the short term 10-day survival test using *Eohaustorius estuarius*. SWAMP is developing quality guidelines for *Mytilus galloprovincialis*; however, they are not currently available. It is recommended that quality control measurements for the other test species use the same guidelines listed in Table 7. For the SQO analysis, quality assurance recommendations for toxicity testing are also provided in the Sediment Quality Assessment Technical Support Manual (Bay et al., 2014).

Table 6. Frequency of Chemistry Analysis for Laboratory Quality Assurance/Quality Control Samples

Analysis Type	Laboratory Blanks	Laboratory Duplicate	SRM or LCS[1]	Matrix Spikes	Matrix Spike Duplicates	Surrogate
Total solids	1 per analytical batch	1 per analytical batch	N/A	N/A	N/A	N/A
Total organic carbon	1 per analytical batch	1 per analytical batch	1 per 20 samples or 1 per analytical batch, whichever is more frequent	N/A	N/A	N/A
Grain size	N/A	1 per analytical batch	N/A	N/A	N/A	N/A
Trace Metals	1 per 20 samples or 1 per analytical batch, whichever is more frequent	1 per 20 samples or 1 per analytical batch, whichever is more frequent	1 per 20 samples or 1 per analytical batch, whichever is more frequent	1 per 20 samples or 1 per analytical batch, whichever is more frequent	1 per 20 samples or 1 per analytical batch, whichever is more frequent	N/A
Organochlorine Pesticides	1 per 20 samples or 1 per analytical batch, whichever is more frequent	N/A	1 per 20 samples or 1 per analytical batch	1 per 20 samples or 1 per analytical batch, whichever is more frequent	1 per 20 samples or 1 per analytical batch, whichever is more frequent	Included in all samples and all QC samples
PCB Congeners	1 per 20 samples or 1 per analytical batch, whichever is more frequent	N/A	1 per 20 samples or 1 per analytical batch	1 per 20 samples or 1 per analytical batch, whichever is more frequent	1 per 20 samples or 1 per analytical batch, whichever is more frequent	Included in all samples and all QC samples
PAHs	1 per 20 samples or 1 per analytical batch, whichever is more frequent	N/A	1 per 20 samples or 1 per analytical batch	1 per 20 samples or 1 per analytical batch, whichever is more frequent	1 per 20 samples or 1 per analytical batch, whichever is more frequent	Included in all samples and all QC samples

LCS = Laboratory control sample

N/A = not applicable

SRM = standard reference material

[1] When a Standard Reference Material is not available, an LCS will be analyzed.

Table 7. Quality Control Measurements for Sediment Toxicity Testing

QC Control	Frequency of Analysis and Control Limits
Negative Controls Laboratory Control Water	Laboratory Control water consistent with Section 7 of appropriate EPA method/manual must be tested with each analytical batch/ Laboratory control water must meet all test acceptability criteria for the species of interest.
Negative Controls 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.
Negative Controls Additional Control Water	Additional method blanks are required whenever manipulations are performed on one or more of the ambient samples within each analytical batch/ There must be no statistical difference between the laboratory control water and each additional control water within an analytical batch.
Negative Controls 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 for the species of interest.
Positive Controls 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.
Sample Duplicate	5% of total project sample count/ Recommended acceptable RPD<20%

[1] SWAMP quality control measurements currently only apply for marine sediment toxicity testing for the 10-day survival *Eohaustorius estuarius* test. SWAMP is in the process of developing guidelines for the *Mytilus galloprovincialis* 48-hr SWI test.

Table 8. Data Quality Objectives for Laboratory Measurements

Group	Parameter	Accuracy	Precision	Completeness
Sediment Samples				
Laboratory analyses	Total Solids	N/A	Laboratory duplicate RPD < 25%	90%
Laboratory analyses	TOC	Laboratory Blank <RL or <30% of lowest sample; SRM or LCS with 80–120% recovery of true value	Laboratory duplicate RPD < 25%	90%
Laboratory analyses	Grain Size	N/A	Laboratory duplicate RPD < 25%	90%
Laboratory Analyses	Trace Metals	Laboratory Blank< RL for target analyte; SRM or LCS 75-125% recovery	Laboratory duplicate, MSD RPD < 25%; MS/MSD 75-125% recovery	90%
Laboratory Analyses	Organochlorine Pesticides	Laboratory Blank< RL for target analyte; SRM 70-130% recovery if certified, otherwise 50-150% recovery; if using LCS 70-130% recovery	MSD RPD < 25%; MS/MSD 50-150% recovery or based on historical laboratory control limits (average ±3SD); surrogates based on historical lab control limits (50-150% or better)	90%
Laboratory Analyses	PCB Congeners	Laboratory Blank< RL for target analyte; SRM 70-130% recovery if certified, otherwise 50-150% recovery; if using LCS 70-130% recovery	MSD RPD < 25%; MS/MSD 50-150% recovery or based on historical laboratory control limits (average ±3SD); surrogates based on historical lab control limits (50-150% or better)	90%
Laboratory Analyses	PAHs	Laboratory Blank< RL for target analyte; SRM 70-130% recovery if certified, otherwise 50-150% recovery; if using LCS 70-130% recovery	MSD RPD < 25%; MS/MSD 50-150% recovery or based on historical laboratory control limits (average ±3SD); surrogates based on historical lab control limits (50-150% or better)	90%

Table 8. Data Quality Objectives for Laboratory Measurements

Group	Parameter	Accuracy	Precision	Completeness
Toxicity Samples				
Toxcity Testing	Short-term 10-day Amphipod Survival Tests	N/A	Reference toxicity testing; test results within 2 standard deviations of the mean are re-evaluated.	90%
Toxicity Testing	Sublethal Sediment Toxicity Tests	N/A	Reference toxicity testing; test results within 2 standard deviations of the mean are re-evaluated.	90%
Benthic Infauna Samples				
Benthic Infauna	Benthic Infaunal Sorting	95% sorting efficiency	N/A	90%

ELEMENT 8 SPECIAL TRAINING NEEDS/CERTIFICATION

Specialized Training or Certifications

Field Sampling

Field personnel will have current and relevant experience in the aspects of standard field monitoring, including use of relevant field equipment such as boats, field instruments, and monitoring equipment. Field personnel will also have been trained and have experience in the collection and handling of samples, and chain-of-custody (COC) procedures. Training will be reviewed in proper field sampling and sample-handling techniques prior to sampling and only those staff with proficiency will be permitted to conduct field work.

Analytical Laboratory

All analytical tests including chemistry and toxicity will be conducted by laboratories certified by the California Department of Health Services in accordance with Water Code Section 13176.

Training and Certification Documentation

Personnel are responsible for complying with QA/QC requirements that pertain to their organizational/technical function. Each technical staff member must have a combination of experience and education to adequately demonstrate a specific knowledge of their particular function and a general knowledge of laboratory operations, test methods, QA/QC procedures, and records management.

Field Sampling

Field personnel training will be documented and records kept in the project files at each organization’s offices.

Analytical Laboratory

Training documents for each subcontracting laboratory will be detailed in the individual QAPPs for each laboratory.

Training Personnel

The Project Manager and/or Field Task Manager will provide training for field personnel in proper field sampling techniques prior to work initiation to ensure consistent and appropriate sampling, sample handling/storage, and COC procedures.

ELEMENT 9 DOCUMENTS AND RECORDS

Each Copermittee or their subcontractor(s) will document and track the aspects of the sample collection process, including generating field logs at each site and COC forms for the samples collected. COC forms will accompany samples to the appropriate laboratory for analysis. Each laboratory will document and track the aspects of receipt and storage, analyses, and reporting related to their respective samples.

A database of information collected during the sediment monitoring will be maintained by each Copermittee or their subcontractor(s). The database will include field observations, data sheets, COC records, and analytical results. The original data sheets, statistical worksheets, and reports produced will be accumulated into project-specific files maintained in file cabinets following submittal of the draft report. Data from outside contractors will be kept exactly as received. Monitoring data and analytical results will be uploaded into California Environmental Data Exchange Network (CEDEN).

Persons responsible for maintaining records for this project will be specified by the project manager and will be tasked with overseeing the operations of the project, and maintaining the sample collection, sample transport, COC, field analysis forms, and laboratory data. They will also be responsible for arbitrating any issues relative to records retention and any decisions to discard records.

Copies of this QAPP will be distributed to all parties identified previously in Element 3. Updates to this QAPP will be distributed in like manner, and previous versions will be discarded from the project file. The Project Manager under the direction, supervision, and review of the QA Officer, will be responsible for distributing an updated version of the QAPP.

Copies of the final report, including laboratory results and field records, will be maintained for a minimum of five years after project completion.

GROUP B:
DATA GENERATION AND ACQUISITION

ELEMENT 10 SAMPLE PROCESS DESIGN

Station Selection

NOTE: It is recommended that each Copermittee list under this section the waterbodies they are responsible for by WMA.

The selection of suitable station locations is critical to assessing benthic conditions. Justification for selecting locations for sediment sampling is provided in Section 2.1.1 of the Sediment Monitoring Plan. The Sediment Control Plan does not give guidance as to how many stations should be sampled in each waterbody. The number of sampling stations will vary within each San Diego County waterbody based on the spatial extent of the area likely to be impacted. If the Bight Program is utilized to fulfill the Sediment Quality Monitoring requirement of the Permit, then the number of stations within each San Diego County waterbody will be dictated by the Bight Program. If a stressor identification study becomes necessary following the original SQO assessment of a waterbody, then the number of stations will be based upon the drivers of the impacted scores (e.g. algae, physical factors, or chemical factors) and statistical power (i.e., having enough samples to statistically support meaningful findings).

All station locations will be pre-plotted prior to sampling activities. Locations will be identified in the field using a Differential Global Positioning System (DGPS). The system uses U.S. Coast Guard differential correction data, and is accurate within 10 feet (ft). All final station locations will be recorded in the field using positions from the DGPS.

In the event that a pre-plotted sample location is found to be unsuitable for collecting sediment, because of factors such as inaccessibility, the salinity does not meet the SQO criteria, disturbance to wildlife, or safety considerations, the station may be abandoned and an alternate station may be selected. Reasons for abandonment should be recorded on field data sheets.

Monitoring Season and Frequency

Sediment for SQO programs must be collected between June and September. Physical environments and benthic community composition and abundance within enclosed bays and estuaries are generally most stable during this time of year (Bay et al., 2014).

According to Section VII.D of the Sediment Control Plan, sediment monitoring associated with Phase I stormwater discharges and major discharges shall be conducted at least twice during the Permit cycle except at stations that have consistently been classified as Unimpacted or Likely Unimpacted using the MLOE approach described in Section 3.2 of the Sediment Monitoring Plan. At the Unimpacted or Likely Unimpacted stations, monitoring may be reduced to a frequency of once during the Permit cycle. The San Diego RWQCB may also limit receiving water monitoring to a subset of outfalls to focus where the risk to sediment quality is greatest.

ELEMENT 11 SAMPLING METHODS

Sediment Sampling

Information regarding the sampling vessel and site acceptability are provided in Sections 2.1.4 and 2.1.5 of the Sediment Monitoring Plan. Benthic sediments will be collected as surface grabs using an appropriate sampler, such as a stainless steel Van Veen grab sampler. The size of the grab sampler to be used for sediment programs in Southern California should be 0.1 m^2 across the top of the sampler. An appropriate sampler for the collection of benthic sediments will have the following characteristics:

- Constructed of a material that does not introduce contaminants.
- Causes minimal surface sediment disturbance.
- Does not leak or mix during sample retrieval.
- Has a design that enables safe/easy sample verification that samples meet all applicable sampling criteria (e.g., collects sediments to at least 5 centimeters (cm) below the sediment surface, has access doors allowing visual inspection and removal of undisturbed surface sediment).

Sediment grabs will be collected for the following analyses: benthic infauna, chemistry, grain size, and toxicity. A sample will be considered acceptable if the surface of the grab is even, there is minimal surface disturbance, and there is a penetration depth of at least 7 cm. Rejected grabs will be discarded, and the station will be re-sampled. Acceptable sediment grabs to be utilized for chemistry, grain size, and toxicity analyses will have the overlying water carefully drained from the sediment surface prior to removing the sediment to be placed in the appropriate sample containers. Overlying water will not be drained from sediment samples collected for benthic infaunal analysis. Station location and grab event data will be recorded on pre-formatted field data sheets (hard copies or via computer). At a minimum, field data will include station identification, station location, date, time of sample collection, depth of water, depth of penetration of grab in sediment (e.g. 5 cm), sediment composition, sediment odor and color, and sample type (e.g. sediment chemistry). It is recommended that photographs of each sediment sample be taken and stored.

The entire contents of one grab sample will be utilized for benthic community analyses with a minimum penetration depth of 7 cm. Samples collected for benthic infaunal analysis will be rinsed through a 1.0-millimeter (mm) mesh screen. The material retained on the screen will be transferred to a labeled glass or plastic sample container. A 7% magnesium sulfate ($MgSO_4$) seawater solution will be added to the sample container to 85-90% of its volume to relax the collected specimens. The sample container will be inverted several times to distribute the relaxant solution. After 30 minutes, add enough sodium borate buffered formaldehyde to top off the sample container and gently invert the container several times to ensure the sample is mixed. This will make a 10% formalin solution.

Sediment samples for chemistry and toxicity testing will be collected from the top 5 cm of a grab sample using a pre-cleaned stainless steel scoop. Sediment within 1 cm of the sides of the grab will be avoided to prevent interaction of any contaminants and the steel sampling device. For chemistry and grain size analysis, equal portions of sediment will be aliquoted from a single grab and placed into the appropriate samples containers. The sediment aliquots will be representative of the entire 5 cm depth of the surface sediment. According to the Sediment Control Plan, the preferred method of collection for SWI toxicity tests is to collect intact cores directly from the sediment sampler by pressing polycarbonate core tubes (7.3-cm inner diameter [ID] and 16 cm in length) into the top 5 cm of sediment. However, homogenizing sediment for SWI testing is also acceptable according to the Sediment Control Plan. This method is more practical to implement in the field and is consistent with previous sediment quality objective methodology (e.g., Bight protocols and previous lagoon monitoring implemented by the Copermittees). A stainless steel scoop will be used to remove aliquots of the top 5 cm of surface sediment from two grab samples and evenly distributed into the appropriate toxicity sample container(s) until the necessary volume is reached.

All sampling equipment will be cleaned prior to sampling. Between sampling locations, grab sampling equipment will be scrubbed with a brush and rinsed with site water. Stainless steel scoops will be rinsed with seawater and rinsed with de-ionized water between stations. Clean gloves will be worn by sampling personnel at each new station.

ELEMENT 12 SAMPLE HANDLING CUSTODY

Sediment samples will be uniquely identified with sample labels in indelible ink. All sample containers will be identified with the project title, appropriate identification number, date and time of sample collection, and preservation method. All samples will be kept on wet ice from the time of sample collection until delivery or transport to the analytical laboratory. All samples will be transferred to the appropriate laboratory and analyses initiated within the method specified holding time (Table 9). Sample volumes required for each analysis will be dictated by the analytical laboratory conducting the analyses.

Table 9. List of Analytes with Container Type, Holding Time, and Preservation Method

Analyte	Recommended Container Type	Required Holding Time	Recommended Preservation
Field Measurements			
Salinity (conductivity & temperature if using a YSI sonde)	*In situ*		
Depth			
Sediment Chemistry			
Total Solids	Glass jar	7 days	Cool to ≤6 °C
Total Organic Carbon	Glass jar	28 days at ≤6 °C; 1 year at ≤- 20°C	Cool to ≤6 °C or freeze to ≤ -20°C
Grain Size	HDPE, Glass jar, or plastic bag	1 year	Wet ice to ≤6 °C in the field, then refrigerate at ≤6 °C
Trace Metals	Glass jar	1 year; samples must be analyzed within 14 days of collection or thawing	Cool to ≤6 °C within 24 hours, then freeze to ≤-20°C
Organochlorine Pesticides	Glass jar	1 year; samples must be extracted within 14 days of collection or thawing and analyzed within 40 days of extraction	Cool to ≤6 °C within 24 hours, then freeze to ≤-20°C
PCB Congeners	Glass jar	None	Cool to ≤6 °C within 24 hours, then freeze to ≤-20°C
PAHs	Glass jar	1 year; samples must be extracted within 14 days of collection or thawing and analyzed within 40 days of extraction	Cool to ≤6 °C within 24 hours, then freeze to ≤-20°C
Sediment Toxicity			
Toxicity Testing	10L Polyethylene bag or 1-L glass jar	1 month	Wet ice then 4°C for transport; 4°C for storage
Benthic Infauna			
Benthic Community Condition	1-L HDPE or 1-L Glass jar – sample volume will vary so may need multiple jars per sample	Formalin: 2-5 days 70% Ethanol: Indefinite- sample jars should be periodically checked for evaporation of ethanol	Initially samples are placed in 10% Buffered Formalin for 2-5 days; samples are then transferred to 70% ethanol

Chain-of-Custody Procedures

Samples will be considered to be in custody if they are (1) in the custodian's possession or view, (2) retained in a secured place (under lock) with restricted access, or (3) placed in a container and secured with an official seal such that the sample could not be reached without breaking the seal. The principal documents used to identify samples and to document possession will be COC records, field logbooks, and field tracking forms. COC procedures will be used for samples throughout the collection, transport, and analytical process.

COC procedures will be initiated during sample collection. A COC record will be provided with each sample or group of samples. Each person who will have custody of the samples will sign the form and ensure the samples will not be left unattended unless properly secured. Documentation of sample handling and custody includes the following:

- Sample identifier.
- Sample collection date and time.
- Any special notations on sample characteristics or analysis.
- Initials of the person collecting the sample.
- Date the sample was sent to the analytical laboratory.
- Shipping company and waybill information.

Completed COC forms will be placed in a plastic envelope and kept inside the cooler containing the samples. Once delivered to the analytical laboratory, the COC form will be signed by the person receiving the samples. The condition of the samples will be noted and recorded by the receiver. COC records will be included in the final reports prepared by the analytical laboratories and are considered an integral part of the report.

Sampling Transport, Shipping, and Storage Procedures

Sediment samples collected in the field for chemistry and toxicity analyses will initially be placed on ice and stored in the dark. Prior to shipping or transport, sample containers will be packed inside coolers with ice. COC forms will be filled out, and the original signed COC forms will be inserted in a sealable plastic bag and placed inside the coolers. The cooler lids will be securely taped shut and then samples will be delivered or shipped on ice to the appropriate analytical laboratory for analysis. Sediment designated for benthic infauna analysis will be screened on location by field personnel. The material and organisms retained on the screen will be put into appropriate 1-L containers, treated with magnesium sulfate relaxant, and preserved with formalin. Once preserved, benthic infauna samples will be delivered with accompanying COC forms to the laboratory tasked with sorting macroinvertebrates into broad taxonomic groupings. Following sorting, taxonomic samples will be shipped/ delivered to specialized taxonomists who will identify benthic macroinvertebrates to the lowest possible taxon.

ELEMENT 13 ANALYTICAL METHODS

Field Analytical Methods

A YSI water quality data sonde (e.g. YSI 6600 Multiparameter Sonde) or similar device can be utilized to take salinity measurements at each station location. Salinity measurements should be taken approximately six inches above the SWI. At a minimum, it is recommended that salinity measurements should be taken at a spring high and low tide to get an estimate of the salinity range for a proposed station. If feasible, it is recommended that salinity should be monitored throughout an entire spring tidal cycle to ensure it meets the salinity criteria prior to sampling. Water depth should also be measured when visiting the station at a spring low tide or deploying a continuous monitoring device over a spring tidal cycle to ensure the station is subtidal. Operation of field equipment will be conducted as per manufacturer instructions. Calibrations will be performed and recorded to ensure accurate functionality.

Laboratory Analytical Methods

Chemistry Samples

A list of sediment chemical constituents and maxiumum reporting limits (RLs) for analytes that are required for SQO analysis are provided in Table 10. Additional physical parameters including grain size and TOC are also listed. While these physical parameters are not required to calculate the chemistry LOE, they should be analyzed in order to provide additional information to aid in the interpretation of the toxicity and benthic LOEs. Percent solids must be measured to convert concentrations of the chemical parameters from a wet-weight to a dry-weight basis.

Target RLs listed in Table 10 are those that are provided in the Sediment Quality Assessment Technical Support Manual (Bay et al., 2014) for SQO analyses. The maximum RLs provided in Table 10 are based on the CSI classification ranges and are expressed on a dry weight basis. Lower RLs may be achievable depending on available analytical methods. As stated in Element 6, the analytical methods listed in Table 8 are suggested methods that have been used in previous sediment monitoring programs within San Diego County's waterbodies (e.g. Bight), but are not the only acceptable methods. Chemical analyses of all sediment samples collected as part of the SQO assessment must be tested in accordance with USEPA or ASTM protocols. If appropriate protocols do not exist, the SWRCB or San Diego RWQCB may approve the use of other methods.

Table 10. Physical and Chemical Parameters, Suggested Methods, and Maximum Reporting Limits for SQO Analysis

Parameter	Method	Procedure	Maximum Reporting Limit (dry weight)
Physical/ Conventional			
Grain Size	Plumb 1981	Wet sieving	1.00 %
Percent Solids	SM 2540B	Gravimetric	0.10 %
Total Organic Carbon (TOC)	USEPA 9060A	Combustion/ oxidation	0.01 %

Table 10. Physical and Chemical Parameters, Suggested Methods, and Maximum Reporting Limits for SQO Analysis

Parameter	Method	Procedure	Maximum Reporting Limit (dry weight)
Chemistry			
Trace Metals			
Cadmium (Cd)	USEPA 6020A	ICP/MS	0.09 mg/kg
Copper (Cu)	USEPA 6020A	ICP/MS	52.8 mg/kg
Lead (Pb)	USEPA 6020A	ICP/MS	25.0 mg/kg
Mercury (Hg)	USEPA 7471B	CVAA	0.09 mg/kg
Zinc (Zn)	USEPA 6020A	ICP/MS	60.0 mg/kg
Organochlorine Pesticides			
2,4′-DDD	USEPA 8081B	GC/MS	0.50 µg/kg
2,4′-DDE	USEPA 8081B	GC/MS	0.50 µg/kg
2,4′-DDT	USEPA 8081B	GC/MS	0.50 µg/kg
4,4′-DDD	USEPA 8081B	GC/MS	0.50 µg/kg
4,4′-DDE	USEPA 8081B	GC/MS	0.50 µg/kg
4,4′-DDT	USEPA 8081B	GC/MS	0.50 µg/kg
Chlordane-alpha	USEPA 8081B	GC/MS	0.50 µg/kg
Chlordane-gamma	USEPA 8081B	GC/MS	0.54 µg/kg
Dieldrin	USEPA 8081B	GC/MS	2.5 µg/kg
trans-Nonachlor	USEPA 8081B	GC/MS	4.6 µg/kg
PCB Congeners			
2,4'-Dichlorobiphenyl (8)	USEPA 8082A	GC/MS ECD	3.0 µg/kg
2,2',5-Trichlorobiphenyl (18)	USEPA 8082A	GC/MS ECD	3.0 µg/kg
2,4,4'-Trichlorobiphenyl (28)	USEPA 8082A	GC/MS ECD	3.0 µg/kg
2,2',3,5'-Tetrachlorobiphenyl (44)	USEPA 8082A	GC/MS ECD	3.0 µg/kg
2,2',5,5'-Tetrachlorobiphenyl (52)	USEPA 8082A	GC/MS ECD	3.0 µg/kg
2,3',4,4'-Tetrachlorobiphenyl (66)	USEPA 8082A	GC/MS ECD	3.0 µg/kg
2,2',4,5,5'-Pentachlorobiphenyl (101)	USEPA 8082A	GC/MS ECD	3.0 µg/kg
2,3,3',4,4'-Pentachlorobiphenyl (105)	USEPA 8082A	GC/MS ECD	3.0 µg/kg
2,3',4,4',5-Pentachlorobiphenyl (118)	USEPA 8082A	GC/MS ECD	3.0 µg/kg
2,2',3,3',4,4'-Hexachlorobiphenyl (128)	USEPA 8082A	GC/MS ECD	3.0 µg/kg
2,2',3,4,4',5'-Hexachlorobiphenyl (138)	USEPA 8082A	GC/MS ECD	3.0 µg/kg
2,2',4,4',5,5'-Hexachlorobiphenyl (153)	USEPA 8082A	GC/MS ECD	3.0 µg/kg
2,2',3,3',4,4',5-Heptachlorobiphenyl (170)	USEPA 8082A	GC/MS ECD	3.0 µg/kg
2,2',3,4,4',5,5'-Heptachlorobiphenyl (180)	USEPA 8082A	GC/MS ECD	3.0 µg/kg
2,2',3,4',5,5',6-Heptachlorobiphenyl (187)	USEPA 8082A	GC/MS ECD	3.0 µg/kg
2,2',3,3',4,4',5,6-Octachlorobiphenyl (195)	USEPA 8082A	GC/MS ECD	3.0 µg/kg
2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl (206)	USEPA 8082A	GC/MS ECD	3.0 µg/kg
Decachlorobiphenyl (209)	USEPA 8082A	GC/MS ECD	3.0 µg/kg
Low Molecular Weight PAHs			
Acenaphthene	USEPA 8270D	GC/MS SIM	20 µg/kg
Anthracene	USEPA 8270D	GC/MS SIM	20 µg/kg
Phenanthrene	USEPA 8270D	GC/MS SIM	20 µg/kg

Table 10. Physical and Chemical Parameters, Suggested Methods, and Maximum Reporting Limits for SQO Analysis

Parameter	Method	Procedure	Maximum Reporting Limit (dry weight)
Biphenyl	USEPA 8270D	GC/MS SIM	20 µg/kg
Naphthalene	USEPA 8270D	GC/MS SIM	20 µg/kg
2,6-Dimethylnaphthalene	USEPA 8270D	GC/MS SIM	20 µg/kg
Fluorene	USEPA 8270D	GC/MS SIM	20 µg/kg
1-Methylnaphthalene	USEPA 8270D	GC/MS SIM	20 µg/kg
2-Methylnaphthalene	USEPA 8270D	GC/MS SIM	20 µg/kg
1-Methylphenanthrene	USEPA 8270D	GC/MS SIM	20 µg/kg
High Molecular Weight PAHs			
Benzo(a)anthracene	USEPA 8270D	GC/MS SIM	80 µg/kg
Benzo(a)pyrene	USEPA 8270D	GC/MS SIM	80 µg/kg
Benzo(e)pyrene	USEPA 8270D	GC/MS SIM	80 µg/kg
Chrysene	USEPA 8270D	GC/MS SIM	80 µg/kg
Dibenzo(a,h)anthracene	USEPA 8270D	GC/MS SIM	80 µg/kg
Fluoranthene	USEPA 8270D	GC/MS SIM	80 µg/kg
Perylene	USEPA 8270D	GC/MS SIM	80 µg/kg
Pyrene	USEPA 8270D	GC/MS SIM	80 µg/kg

DDD Dichlorodiphenyldichloroethane
DDE dichlorodiphenyldichloroethylene
DDT dichlorodiphenyltrichloroethane
mg/kg milligrams per kilogram
µg/kg micrograms per kilogram

Toxicity Samples

To evaluate the benthic condition of San Diego County's waterbodies, sediment toxicity testing will be conducted in accordance with ASTM and USEPA methods. Toxicity testing involves a short-term survival test, a sublethal endpoint test, and an assessment of sediment toxicity. For each test type, more than one specific test is acceptable. The appropriate species tested for a sample will depend on the characteristics of the sample such as grain size, salinity, and suspected toxic constituents, if any. When historical data are available for a sample location, it is recommended that the same species be used in order to make comparisons and to conduct trend analysis. In addition, when testing is conducted as part of a regional monitoring program such as the Bight program, the species selection will be dictated by the program.

Short-Term Survival Testing

SQO analysis requires that at least one short-term survival test be conducted. There are three acceptable short-term survival tests, each of which is a 10-day test exposing amphipods to whole sediment. The three acceptable test organisms are *Eohaustorius estuarius*, *Leptocheirus plumulosus*, and *Rhepoxynius abronius*. The *E. estuarius* short-term survival test has been the 10-day test method used in previous San Diego County enclosed bay and estuary monitoring programs, including the Bight Program, where the SQO analytical tool was used to assess aquatic health. These amphipod bioassays will be conducted in accordance with procedures outlined in *Methods for Assessing Toxicity of Sediment-Associated Contaminants with Estuarine and Marine Amphipods* (USEPA, 1994) and ASTM method E1367-03 (ASTM, 2006). Test conditions are summarized in Table 11. If sediment monitoring is conducted as part of the Bight Program, then procedures and test conditions should be in accordance with Bight Workplans.

A water-only reference toxicity test should be conducted concurrently with the whole sediment amphipod test to assess the relative sensitivity of test organisms used in the evaluation of project sediments. Amphipod reference toxicant tests are typically conducted using cadmium. However, using ammonia as the reference toxicant is preferable because the sensitivity of the test organisms to ammonia (often a confounding factor in sediment testing) can be evaluated along with the relative sensitivity of the batch of organisms used in testing. If ammonia is selected as the reference toxicant, pore water ammonia will be measured between sample receipt and test set-up, and again at test initiation. If the un-ionized pore water ammonia concentration in the test initiation sample is 0.8 mg/L or greater, then the ammonia reference toxicant test will be extended from 4 days to 10 days for better comparison to 10-day test sample results.

Table 11. Summary of Conditions for 10-Day Whole Sediment Amphipod Bioassay

Test Conditions 10-Day Whole Sediment Bioassay				
	Test Species	***E. estuarius***	***L. plumulosus***	***R. abronius***
	Test Procedures	USEPA (1994); ASTM E1367-03 (2006)		
	Test Type/Duration	Static - Acute Whole Sediment/10 days		
	Sample Storage Conditions	4 °C, dark, minimal head space		
	Age/Size Class	3-5 mm	2-4 mm; immature	3-5 mm
	Grain Size Tolerance	0.6-100% sand	0-100% sand	10-100% sand
Recommended Water Quality Parameters	Temperature	15 ± 1 °C	25 ± 1 °C	15 ± 1 °C
	Salinity	20 ± 2 ppt	20 ± 2 ppt	28 ± 2 ppt
	Dissolved Oxygen	Maintaining 90% saturation		
	Total Ammonia	< 60 mg/L	< 60 mg/L	< 30 mg/L
	Test Chamber	1 L glass		
	Exposure Volume	2 cm sediment, 800 mL seawater		
	Replicates/Sample	5		
	No. of Organisms/Replicate	20		
	Photoperiod	Continuous light		
	Feeding	None		
	Water Renewal	None		
	Aeration	Constant gentle aeration		
	Acceptability Criteria	Mean control survival ≥ 90%; ≥80% survival in each replicate		

mg/L milligram per liter

Sublethal Testing

The second type of testing required for SQO analysis is a sublethal test. Either a 48-hour development test exposing embryos of the bivalve *Mytilus galloprovincialis* to the sediment-water interface may be conducted or a 28-day survival and growth test exposing the polychaete worm *Neanthes arenaceodentata* to whole sediment. Test condition summaries for the bivalve and polychaete tests are presented in Table 12 and Table 13, respectively. The *M.*

galloprovincialis sediment-water interface test has been the sublethal test method used in previous San Diego County enclosed bay and estuary monitoring programs, including the Bight Program, where the SQO analytical tool was used to assess aquatic health.

<u>*Mytilus galloprovincialis* Sediment-Water Interface Development Sublethal Test</u>

Sediment-water interface bioassays are performed to estimate the potential toxicity of contaminants fluxing from test sediments into the overlying water. The sediments will be tested in a 48-hour sediment-water interface test using the bivalve *M. galloprovincialis* in accordance with procedures outlined in *Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to West Coast Marine and Estuarine Organisms* (USEPA, 1995) and Assessment of Sediment Toxicity at the Sediment-Water Interface (Anderson et al., 1996). If sediment monitoring is conducted as part of the Bight Program, then procedures and test conditions should be in accordance with Bight Workplans. Sediment-water interface bioassays will be tested on intact cores collected in the field or on homogenized sediment samples as described in Section 2.1.6 of the Sediment Monitoring Plan.

A water-only reference toxicity test should be conducted concurrently with the sediment-water interface bivalve test to assess the relative sensitivity of test organisms used in the evaluation of the project sediments. Bivalve reference toxicant tests are typically conducted using copper. However, using ammonia as the reference toxicant is preferable because the sensitivity of the test organisms to ammonia (often a confounding factor in sediment testing) can be evaluated along with the relative sensitivity of the batch of organisms used in testing. If ammonia is selected as the reference toxicant, pore water ammonia will be measured between sample receipt and test set-up, and again at test initiation. If the un-ionized pore water ammonia concentration in the test initiation sample is 0.8 mg/L or greater, then the ammonia reference toxicant test will be extended from 4 days to 10 days for better comparison to 10-day test sample results.

Table 12. Test Conditions for the 48-Hour *M. galloprovincialis* Sediment-Water Interface Bioassay

Test Conditions **10-Day Whole Sediment Bioassay**		
	Test Species	***M. galloprovincialis***
	Test Procedures	USEPA (1995), Anderson et al. (1996)
	Test Type/Duration	Static - Acute sediment-water interface/48 hours
	Sample Storage Conditions	4 °C, dark, minimal head space
	Age/Size Class	< 4 hour old larvae
Recommended Water Quality Parameters	Temperature	15 ± 1 °C
	Salinity	32 ± 2 ppt
	Dissolved Oxygen	Maintaining 90% saturation
	Total Ammonia	< 4 mg/L
	Test Chamber	Polycarbonate core tube 7.3-cm inner diameter, 16 cm high
	Exposure Volume	5 cm sediment, 300 mL water
	Replicates/Sample	4
	No. of Organisms/Replicate	Approximately 250 larvae

Test Conditions **10-Day Whole Sediment Bioassay**	
Photoperiod	16 hours light: 8 hours dark
Feeding	None
Water Renewal	None
Aeration	Constant gentle aeration
Acceptability Criteria	Mean control normal-alive ≥ 80%

Neanthes arenaceodentata Whole Sediment Survival and Growth Sublethal Test

The *N. arenaceodentata* test will be conducted in accordance with ASTM method E1562 (ASTM, 2002) with modifications described in Farrar and Bridges (2011) that have been found to contribute manageability and precision to the ASTM procedure. If sediment monitoring is conducted as part of the Bight Program, then procedures and test conditions should be in accordance with Bight Workplans. A water-only reference toxicity test should be conducted concurrently with the whole sediment polychaete test to assess the relative sensitivity of test organisms used in the evaluation of the project sediments. Polychaete reference toxicant tests are typically conducted using cadmium. However, using ammonia as the reference toxicant is preferable because the sensitivity of the test organisms to ammonia (often a confounding factor in sediment testing) can be evaluated along with the relative sensitivity of the batch of organisms used in testing. If ammonia is selected as the reference toxicant, pore water ammonia will be measured between sample receipt and test set-up, and again at test initiation. If the un-ionized pore water ammonia concentration in the test initiation sample is 0.8 mg/L or greater, then the ammonia reference toxicant test will be extended from 4 days to 10 days for better comparison to 10-day test sample results.

Table 13. Test Conditions for the 28-Day Whole Sediment *N. arenaceodentata* Bioassay

Test Conditions 10-Day Whole Sediment Bioassay		
Test Species		***N. arenaceodentata***
Test Procedures		ASTM E1562 (2002), Farrar and Bridges (2011)
Test Type/Duration		Static - Acute Whole Sediment/28 days
Sample Storage Conditions		4 °C, dark, minimal head space
Age/Size Class		≤ 7 days post-emergence
Grain Size Tolerance		5-100% sand
Recommended Water Quality Parameters	Temperature	20 ± 1 °C
	Salinity	30 ± 2 ppt
	Dissolved Oxygen	Maintaining 90% saturation
	Total Ammonia	< 20 mg/L
Test Chamber		300 mL glass
Exposure Volume		2 cm sediment, 125 mL seawater
Replicates/Sample		10
No. of Organisms/Replicate		1
Photoperiod		12 hours light: 12 hours dark
Feeding		Twice per week
Water Renewal		Weekly
Aeration		Constant gentle aeration
Acceptability Criteria		Mean control survival ≥ 80%; positive growth in controls

Benthic Infauna Samples

The benthic infaunal samples will be transported from the field to the laboratory and stored in a formalin solution for a minimum of 48 hours and no longer than 5 days. The samples will then be transferred from formalin to 70% ethanol for laboratory processing. The organisms will initially be sorted using a dissecting microscope into five major phyletic groups: polychaetes, crustaceans, molluscs, echinoderms, and miscellaneous minor phyla. While sorting, technicians will keep a count for quality control purposes. After initial sorting, samples will be distributed to qualified taxonomists who will identify each organism to species or to the lowest possible taxon. Taxonomists will use the most recent version of the Southern California Association of Marine Invertebrate Taxonomists (SCAMIT) taxonomic listing for nomenclature and orthography. If sediment monitoring is conducted as part of the Bight Program, then procedures should be in accordance with Bight Workplans.

ELEMENT 14 QUALITY CONTROL

QA/QC Field Procedures

Field measurements for salinity will be made using a water quality probe, such as a YSI data sonde, that has been calibrated according to manufacturer specifications. Operation of field equipment will be conducted as per manufacturer instructions. Calibrations will be performed and recorded to ensure accurate functionality. Proper storage and maintenance procedures will be followed.

QA/QC for sampling processes begins with proper collection of the samples to minimize the possibility of contamination. Sediment samples will be collected in appropriate containers, kept on wet ice during the sampling event, and placed into coolers along with completed COC for transfer to the analytical laboratory. Field crews will ensure that sampling containers are being filled properly and the requirement to avoid contamination of samples at all times is met. The field data log sheets will include empirical observations of the site and water quality characteristics. Field duplicates will be collected at a minimum of 5% of total project sample count. A minimum of one equipment blank will be collected during the monitoring event. The equipment blank will be analyzed for the same target SQO analytes specified for the sediment samples (excluding grain size and percent solid analyses).

QA/QC Laboratory Analyses

Chemistry Analyses

The chemistry analysis of the samples will be performed under the guidelines of the analytical laboratories respective standard operationg procedures (SOPs) and QAPPs as well as meet the DQOs and quality objectives set forth in this QAPP. This includes analyzing the appropriate QC laboratory controls for each analysis in accordance with SWAMP criteria such as laboratory blanks and duplicates, MS/MSDs, certified or standard reference materials, and surrogates (see Element 7 for frequency of analysis and DQOs for QC laboratory controls).

Toxicity Analyses

A water-only reference toxicity test will be conducted concurrently with each batch of sediment tests to establish the sensitivity of the test organisms used in the evaluation of the sediments and to evaluate the potential influence of ammonia toxicity on the test organisms. Typically, amphipod and polychaete reference toxicant tests are conducted using cadmium and bivalve reference toxicant tests are typically conducted using copper. However, using ammonia as the reference toxicant is preferable because the sensitivity of the test organisms to ammonia (often a confounding factor in sediment testing) can be evaluated along with the relative sensitivity of the batch of organisms used in testing. The LC_{50} and/or EC_{50} values of the reference toxicant test will be compared to historical laboratory data for each respective test species. The results of these reference toxicant tests will be used in combination with the control mortality to assess the health of the test organisms.

Benthic Infauna Analyses

A QA/QC procedure will be performed on each of the sorted samples to ensure a 95% sorting efficiency. This procedure is the same one followed in the Bight programs. A 10% aliquot of a sample will be re-sorted by a senior technician trained in the QA/QC procedure. The number of organisms found in the aliquot will be divided by 10% and added to the total number found in the sample. The original total will be divided by the new total to calculate the percent sorting efficiency. When the sorting efficiency of the sample is below 95%, the remainder of the sample (90%) will be re-sorted.

ELEMENT 15 INSTRUMENT/EQUIPMENT TESTING, INSPECTION, AND MAINTENANCE

Field Sampling

Prior to conducting field sampling, field technicians will be responsible for preparing sampling kits that include field logs, COC forms, sample labels, sampling containers, decontamination equipment and tools. Field measurement equipment should be checked for operation in accordance with the manufacturer's specifications. Equipment should be inspected prior to use and when returned from use for damage.

Analytical Laboratories

All analytical laboratories including chemistry, toxicity, and benthic infaunal will maintain their equipment in accordance with their SOPs, which include those specified by the manufacturer and those specified by the method. Each laboratory's QAPP will specify equipment and system evaluations.

ELEMENT 16 INSTRUMENT/EQUIPMENT CALIBRATION AND FREQUENCY

The equipment and instruments used at each analytical laboratory will be operated and calibrated according to manufacturer recommendations as well as by criteria defined in each analytical laboratory's SOPs. Operation and calibration will be performed by properly trained personnel. Documentation of routine and special calibration information will be recorded in appropriate logbooks and reference files. If a critical measurement is found to be out of compliance during analysis, the results of that analysis will not be reported, corrective action will be taken and documented, and the analysis will be repeated.

Field Equipment

Water quality instruments used for salinity measurements will be calibrated per manufacturer's specifications prior to each monitoring event. Complete records of calibration will be maintained for each field instrument that requires periodic calibration.

Analytical Laboratories

All analytical labortatories including chemistry, toxicity, and benthic infaunal will calibrate their instrumentation at a frequency that ensures the validity of the results. Each laboratory's calibration procedures must follow EPA guidelines and the recommendations of the instrument manufacturer. Each laboratory's QAPP should provide detailed information on calibration procedures.

ELEMENT 17 INSPECTION/ACCEPTANCE OF SUPPLIES AND CONSUMABLES

It is the duty of each person who is responsible for equipment ordering to inspect equipment and materials for quality and report any equipment or materials that do not meet acceptance criteria to the Project Manager, Laboratory Manager, and/or QA Officer, as appropriate. Upon receipt of materials or equipment, a designated employee must receive and sign for the materials. The items will then be reviewed to ensure the shipment is complete, prior to delivery to the proper storage location. Chemicals must be dated upon receipt. Supplies will be stored appropriately and discarded on their expiration date. The equipment and supplies purchased for use in field sampling activities will be inspected for damage as they are received. Confirmation that sample bottles are laboratory-certified clean will be made when received.

Critical Supplies and Consumables

Chemistry Sample Bottles – Chemistry sample bottles will be provided by the analytical laboratory. They will be shipped from the laboratory and stored appropriately by the field sampling team prior to use in the field. Confirmation that sample bottles are laboratory-certified clean will be made when received from the analytical laboratories. Preservatives may be required for the analysis of certain analyte groups and the laboratory supplied bottles should already contain any required preservatives.

Toxicity Sample Containers – Clean, food-grade, heavy duty 0.004 gauge polyethylene bags capable of holding up to 20-L, or clean glass jars with Teflon-lined lids should be used as the sample container for sediment toxicity samples. If bags are used, samples should be double bagged, twisted at the top with excess air removed, and cable tied to ensure sample integrity.

Benthic Infauna Jars– Clean, 1-L HDPE or glass sample jars should be used as containers for benthic infauna samples following sediment processing in the field. Additionally, magnesium sulfate and 10% formalin solutions that are used for processing benthic infauna samples will need to be on hand during sampling events and should be provided by each Copermittee or their subcontractor(s).

ELEMENT 18 NON-DIRECT MEASUREMENTS

Data will be reviewed against DQOs in Section 7 prior to SQO analysis. Only data meeting the DQOs will be used in the SQO analysis.

ELEMENT 19 DATA MANAGEMENT

Data will be maintained as described in Element 9. The original data sheets and reports produced will be accumulated into project-specific files that are kept by either the Copermittee or Contractor Project Manager.

The Copermittee or Contractor Project Manager will document and track the aspects of the sample collection process, including generating field logs at each site and COC forms for the samples collected. COC forms will accompany samples to the appropriate laboratories for analysis. Each analytical laboratory will document and track the aspects of sample receipt and storage, analyses, and reporting. Each analytical laboratory’s results will be stored in a database system at their office and will be provided to the Copermittee or Contractor Project Manager both electronically and by hard copy. Further details of each laboratory’s data management protocols can be found in each laboratory’s respective QAPP.

Field logs and analytical data will be entered into or transferred to the Copermittee or Contractor’s database. After the data is added to the database, the Contractor Project QA Officer will validate the data by checking for errors and ensure the data is complete. The database will be updated with finalized data. The results of the laboratory QC analyses will be reported with the final data. Any QC samples that fail to meet the specified QC criteria in the methodology or the DQOs described in Element 7 will be identified, and the corresponding data will be appropriately qualified in the final report. All QA/QC records will be kept on file for review by regulatory agency personnel. Once data is finalized, all monitoring data and analytical results will be formatted and uploaded into CEDEN. All records should be maintained for at least five years.

GROUP C:
ASSESSMENT AND OVERSIGHT

ELEMENT 20 ASSESSMENTS AND RESPONSE ACTIONS

Corrective Actions

The following sections identify the responsibilities of key project members and corrective actions to be taken if issues arise during field sampling or laboratory analyses that may result in noncompliance with protocols established in the Sediment Monitoring Plan.

Field Sampling

The initial responsibility for monitoring the quality of field measurements lies with the field personnel. The Field Task Manager is responsible for verifying that QC procedures are followed. This requires that the Field Task Manager assess the accuracy of the field methods as well as the ability to meet QA objectives and make a value judgment regarding the impact a procedure has on field objectives and subsequent data quality. If a problem occurs that might jeopardize the integrity of the project, hinder a QA objective, or impact data quality, the Field Task Manager will immediately (within 24 hours) notify the Copermittee or Contractor Project Manager. Corrective action measures are then decided upon and implemented. The Field Task Manager documents the situation, the field objective affected, the corrective action taken, and the results of that action. Copies of the documentation are provided to the Copermittee or Contractor Project Manager and the QA Officer.

Laboratory

The need for corrective action comes from several sources, including equipment malfunction, failure of internal QA/QC checks or to follow-up on performance or system audit findings, and noncompliance with QA requirements. All laboratory personnel are responsible for documenting and correcting problems that might affect quality. When measurement equipment or analytical methods fail QA/QC requirements, the problem(s) will be brought immediately to the attention of the Laboratory Manager and QA Officer. Corrective measures will depend entirely on the type of analysis, the extent of the error, and whether or not the error is determinant. The corrective action is determined by either the Laboratory Manager, technicians, the Copermittee or Contractor Project Manager, the QA Officer, or by all of them in conference, if necessary, but final approval is the responsibility of the Copermittee or Contractor QA Officer and/or Project Manager.

If failure is due to equipment malfunction, the equipment will not be used until repaired. Precision and accuracy will be reassessed, and the analysis will be rerun. Attempts will be made to reanalyze the affected parts of the analysis so that in the end, the product is not affected by failure of QC requirements. When a result in a performance audit is unacceptable, the laboratory will identify the problem(s) and implement corrective actions immediately. A step-by-step analysis and investigation to determine the cause of the problem will take place as part of the corrective action program. If the problem cannot be controlled, the laboratory will analyze the impact on data. If the data is affected, the problem will be documented and the Copermittee or Contractor QA Officer and/or Project Manager will be notified. When a system audit reveals an unacceptable performance, work will be suspended until corrective action has been implemented and performance has been proven acceptable. If the problem is instrumental or specific only to preparation of a sample batch, samples are reprocessed after the instrument is repaired and recalibrated. In the event that a QC measure is out-of-control and the data are to be reported, qualifiers are reported together with sample results.

ELEMENT 21 PROJECT REPORTS

The Project Manager is responsible for preparation and submittal of all project deliverables. Each analytical laboratory's QA Officer is responsible for the preparation of all data packages and laboratory reports originating from their laboratory. Provision D.1.e.(2)(c) of the Permit requires incorporation of a Sediment Monitoring Report into the WQIP Annual Report. The Sediment Monitoring Report will contain an evaluation, interpretation, and tabulation of monitoring data, including an assessment of whether receiving water limits outlined in the Permit were attained; a sample location map; and a statement of certification that monitoring data and results have been uploaded into CEDEN.

Based on the conclusions of the Sediment Monitoring Report, a human health risk assessment may be necessary in order to determine whether human health objectives have been obtained at each sample location. Provision A.2.a.(3)(b)(ii) states that "pollutants shall not be present in sediments at levels that will bioaccumulate in aquatic life to levels that are harmful to human health." The potential risk assessments must consider any relevant information, such as guidelines set forth in the CA EPA's Office of Environmental Health Hazard Assessment (OEHHA) fish consumption policies, CA EPA's Department of Toxic Substances Control (DTSC) risk assessment, and the USEPA human health risk assessment policies.

Since the WQIPs are still in development and there will be not WQIP Annual Reports in 2015, the Copermittees will include the Sediment Monitoring Report with the Transitional Monitoring and Assessment Report due to the San Diego RWQCB on January 31, 2015. The Sediment Monitoring Report will include the results from the 2013 Bight Program and any follow-up monitoring collected in 2014 to satisfy Provisions D.1.e.(1)(b) and D.1.e.(2) of the Permit. Additional sediment quality monitoring or stressor identification studies conducted after 2014 will be included in the WQIP Annual Reports.

The schedule for completing the sediment quality monitoring requirements of the Permit and for submitting the Sediment Monitoring Report is shown in Table 14.

Table 14. Sediment Monitoring Report Schedule

Activity/Deliverable	Dates(s)*
San Diego RWQCB Order No. R9-2013-0001	Adopted May 8, 2013 and effective June 27, 2013
Southern California Bight Regional Monitoring Program	August-September 2013
Follow-up confirmation monitoring	August-September 2014
Final Sediment Monitoring Plan and Sediment Monitoring QAPP incorporated into WQIPs	December 2014
Draft Sediment Monitoring Report	December 2014
Final Sediment Monitoring Report incorporated into Transitional Monitoring and Assessment Report	January 31, 2015
Potential Stressor ID Studies	TBD

*Table does not include future permit cycles

GROUP D:
DATA VALIDATION AND USABILITY

ELEMENT 22 DATA REVIEW, VERIFICATION, AND VALIDATION

Data reduction, verification, validation, and reporting are ongoing processes, which involve the field technicians, laboratory technicians, Laboratory Managers, and QA personnel. Data generated by the sediment monitoring activities including field sampling and laboratory analyses will be reviewed against the DQOs presented in Element 7 and the QA/QC practices cited in this QAPP. This includes field logbooks, COC forms, and all data related to laboratory analytical procedures (e.g., sample preparation logs, instrument logs, etc.). Data entry of field sampling data will be reviewed to check for accuracy and completeness. Analytical laboratory electronic data deliverables and hard copy reports will be reviewed to ensure that the proper QC elements are included (e.g., blanks, lab duplicates, etc.), all sample analyses are correct, holding times were met, and data failing to meet QC criteria are properly qualified. Data that does not meet the DQOs will be evaluated to determine the impact of the failure on the data quality. If sufficient evidence is found to support the use of the data, the data will be qualified, and entered into the database.

ELEMENT 23 VERIFICATION AND VALIDATION METHODS

After each sampling event, the field data sheets will be removed from the field logbooks, and the sheets will be checked for completeness and accuracy by the QA Officer or Project Manager. The appropriate field sheets must be present. If there are any questions, clarification from the Field Task Manager will be obtained as soon as possible.

In the laboratory, sample preparation activities will be documented in bound laboratory notebooks or on bench sheets. Data validation includes dated and signed entries by technicians on the data sheets and logbooks used for the samples, the use of sample tracking and numbering systems to track the progress of samples through the laboratory, and the use of QC criteria to reject or accept specific data. The laboratory generating the data will have the prime responsibility for the accuracy and completeness of the data. Each laboratory will review the data to ensure that the following information is correct and complete: sample description information, analysis information, results, and documentation of the data. Further data validation is performed by the Laboratory Manager. Validation is accomplished through routine audits of the data collection and flow procedures and by monitoring of QC sample results. In the data review process, the data will be compared to information such as the sample's history, sample preparation, and QC sample data to evaluate the validity of the results. Corrective action will be minimized through the development and implementation of routine internal system controls. Analysts are provided with specific criteria that must be met for each procedure, operation, or measurement system.

ELEMENT 24 RECONCILIATION WITH USER REQUIREMENTS

The QA personnel will review data after each survey to determine if DQOs have been met. If data do not meet project specifications, the QA personnel will review errors and determine if the problem is due to calibration/maintenance, sampling techniques, or other factors, and they will suggest corrective action. It is expected that the problem would be correctible through personnel re-training, technique revision, or supplies/equipment replacement. If not, the DQOs will be reviewed for feasibility. If specific DQOs are not achievable, the QA personnel will recommend appropriate modifications. Any revisions would need approval by the Copermittee or Contractor Project Manager.

ELEMENT 25 REFERENCES

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