San Diego County Municipal Copermittees Sediment Monitoring Plan-Final

Prepared For:

County of San Diego Municipal Copermittees

November 2014

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ACRONYMS AND ABBREVIATIONS

ASTM	American Society for Testing and Materials
AVS:SEM	acid-volatile sulfides and simultaneously extracted metals
Bight	Southern California Bight Regional Monitoring Program
BRI	Benthic Response Index
CA EPA	California Environmental Protection Agency
CA LRM	California Logistic Regression Model
CEDEN	California Environmental Data Exchange Network
CDFW	California Department of Fish and Wildlife
COC	chain-of-custody
Copermittees	San Diego Regional Copermittees
CSI	Chemical Score Index
DDE	dichlorodiphenyldichloroethylene
DDT	dichlorodiphenyltrichloroethane
DGPS	Differential Global Positioning System
DO	dissolved oxygen
DTCS	Department of Toxic Substances Control
EC_{50}	median effective concentration
IBI	Index of Biotic Integrity
ID	inner diameter
LC_{50}	median lethal concentration
LOE	line of evidence
$MgSO_4$	magnesium sulfate
MLOE	multiple lines of evidence
MS4	Municipal Separate Storm Sewer System
MW	molecular weight
NPDES	National Pollutant Discharge Elimination System
OEHHA	Office of Environmental Health Hazard Assessment
PAHs	polycyclic aromatic hydrocarbons
PCBs	polychlorinated biphenyls
pH	hydrogen ion concentration
P_{MAX}	maximum probability model
QA	quality assurance
QA/QC	quality assurance/quality control
QAMP	Quality Assurance Management Plan
QAPP	Quality Assurance Project Plan
QC	quality control
RBI	Relative Benthic Index
RIVPACS	River Invertebrate Prediction and Classification System
RL	Reporting Limit
RWQCB	Regional Water Quality Control Board
SCAMIT	Southern California Association of Marine Invertebrate Taxonomists
SDRWQCB	San Diego Regional Water Quality Control Board
SOPs	Standard Operating Procedures
SPME	solid phase microextraction
SQOs	Sediment Quality Objectives

SWAMP	Surface Water Ambient Monitoring Program
SWRCB	State Water Resources Control Board
TIE	toxicity identification evaluation
TMDL	Total Maximum Daily Load
TOC	total organic carbon
USEPA	United States Environmental Protection Agency
WQIP	Water Quality Improvement Plan

UNITS OF MEASURE

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

1.0 INTRODUCTION

The San Diego County Regional Copermittees (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 MS4 discharges to enclosed bays and estuaries. 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).

Provision D.1.e.(1)(b) of the Permit also requires the Copermittees to participate in the Southern California Bight Regional Monitoring Program (Bight). The Bight Program occurs every five years and consists of a partnership of multiple local, state, and federal agencies collaborating to address management questions of regional importance regarding offshore, nearshore, and estuarine habitats from Point Conception to the US-Mexican border. The Bight Program, which is overseen by the Southern California Coastal Water Research Program (SCCWRP) and reports to the State Water Quality Control Board (SWQCB), focuses on water quality, coastal ecology, sediment quality, and shoreline microbiology. 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 sediment quality objectives (SQO) analyses are incorporated into the Bight Program to regionally assess the sediment quality of Southern California's enclosed bays, lagoons, and estuaries (herein referred to as waterbodies), including those waterbodies in San Diego County. 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.

The following Sediment Monitoring Plan describes the sediment quality sample collection and analysis activities that will be implemented by the Copermittees during the Permit term. As required by the Permit, this Sediment Monitoring Plan includes the elements listed in Sections VII.D and VII.E of the Sediment Control Plan (Receiving Water Limits Monitoring Frequency and Sediment Monitoring, respectively), a Sediment Monitoring Quality Assurance Project Plan (QAPP) (Appendix B), and a schedule for completion of monitoring and submission of the Sediment Monitoring Report. Once the sediment quality monitoring is complete, the Copermittees will incorporate a Sediment Monitoring Report into the WQIP Annual Report.

1.1 Background

In 2003, the SWRCB initiated a program to develop SQOs for enclosed bays and estuaries. The primary objective is to protect benthic communities and aquatic life from exposure to contaminants in sediment that have been directly discharged into the water body or indirectly discharged into waters draining into the water body. The SQOs, which are outlined in the

Sediment Control Plan, are based on a multiple lines of evidence (MLOE) approach in which the lines of evidence (LOE) are sediment toxicity, sediment chemistry, and benthic community condition, as described in the Sediment Control Plan (see Appendix A) and in Section 3.2. The MLOE approach evaluates the severity of biological effects and the potential for chemically mediated effects to provide a final station level assessment. The Sediment Control Plan was approved by the SWRCB and the Office of Administrative Law on September 16, 2008, and on January 5, 2009, respectively, and was subsequently approved by the United States Environmental Protection Agency (USEPA) on August 25, 2009.

1.2 Monitoring Objective

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 Control Plan (Appendix A). 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 is to provide the key elements that are required to successfully conduct field sediment sampling, processing, testing, and analysis of the results. 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. Additionally, the selection of representative station locations is necessary to ensure proper characterization of benthic conditions. The Sediment Monitoring Plan and Sediment Monitoring QAPP (Appendix B) 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.

2.0 MATERIALS AND METHODS

The materials and methods described in this section are designed to meet the requirements of the Sediment Control Plan, Sections VII.D and VII.E, as required by Permit Provision D.1.e.(2)(a). The methodology is outlined in Section V of the Sediment Control Plan. If sediment quality monitoring is conducted as part of the Bight Program, the work plans and associated QA/QC documents pertaining to the Bight Program should be followed.

Quality assurance methods and procedures needed to maintain consistency in sample collection, processing, and analysis to produce scientifically defensible data are provided in the Sediment Monitoring Quality Assurance Project Plan (QAPP) (Appendix B). The QAPP provides acceptability criteria for the collection and analysis of duplicate field samples, field or equipment rinse blanks, laboratory methods, and laboratory spikes. The QAPP should be used as a reference to ensure proper methods are used consistently throughout the monitoring program.

2.1 Field Collection Program

2.1.1 Station Selection

The Sediment Control Plan applies to subtidal surficial sediments located seaward of the intertidal zone in enclosed bays and estuaries. It does not apply to ocean waters, inland surface waters, sediments consisting of less than 5 percent (%) fines or substrates composed of gravel, cobble, or consolidated rock, or to sediment classified as a pollutant due to physical processes such as burial or sedimentation. 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 SQQ 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 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, since it is likely that some areas of the enclosed bays and estuaries in San Diego will not meet the criteria under certain conditions. This monitoring can be accomplished by deploying a continuous monitoring device such as an YSI water quality data sonde. 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.

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. For example, in the 2008 Bight Program, five stations were analyzed per lagoon; however, in the 2013 Bight Program the number of stations per lagoon varied from one to three stations. If a stressor identification study becomes necessary following the original SQO assessment of a waterbody (see Section 4.0), then the number of stations will be based on what suspected pollutants are driving the impacted scores (e.g. algae, physical factors, or chemical factors) and to have enough samples to statistically support meaningful findings.

2.1.2 Permitting

Scientific collecting permits from the California Department of Fish and Wildlife will need to be obtained in order to collect benthic infaunal samples containing invertebrate specimens. At a minimum, it can take up to three weeks to obtain the permit; however, at times it can take several months to receive a scientific collecting permit so applications should be submitted well in advance of the desired sampling dates. A minimum of 24 hours (business day only) prior to collecting benthic infaunal samples in the field, a copy of the Notification of Intent to Collect for Scientific Purposes form should be faxed or emailed to the Marine Region (Monterey, CA) office of the CDFW. Additionally, written authorization may be required from state agencies or private landowners in order to gain access to water bodies that are surrounded by private land, have locked fences or gates, contain threatened or endangered species, or require the use of a private boat launch. Nesting seasons of threatened and endangered bird species may prevent sampling from being conducted or may restrict access around nesting areas during certain times of year, typically mid to late summer months.

2.1.3 Monitoring Season and Frequency

Section VII.E.6 of the Sediment Control Plan requires that samples for SQO programs be collected during the "index period" occurring between June and September. Physical environments and benthic community composition and abundance within enclosed bays and estuaries are generally stable and most similar from year to year during this time (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. 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.

2.1.4 Sampling Vessels

Vessels used to collect sediment samples will be both stable and maneuverable and will have a sufficiently shallow draft to navigate into shallow waters (e.g. large inflatable boat). The vessels will be equipped with a side or rear davit from which to deploy and retrieve surface sampling equipment, and will accommodate a minimum of two persons in addition to all appropriate sampling and safety equipment. The vessel should be anchored in one or more directions with the motor turned off during sampling.

2.1.5 Navigation

All station locations will be selected using a stratified random design approach (where possible) and pre-plotted prior to sampling activities. Stations will be identified using a Differential Global Positioning System (DGPS). The system uses U.S. Coast Guard differential correction data, and is accurate within 10 feet (ft). Pre-plotted stations are defined by a specific latitude and longitude; however, occupation within a radius limit of 100 m of the target coordinate will be considered acceptable. This site acceptability criteria is similar to the criteria adhered to in the Bight Program. If a pre-plotted sample station is deemed to be unsuitable for collecting sediment (due to factors such as inaccessibility, 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 will be recorded on field data sheets. All final station locations will be recorded in the field using positions from the DGPS.

2.1.6 Sediment Sampling and Handling

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 square meter (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 sediment-water interface toxicity tests (see Section 2.2.2.2) 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 sediment-water interface 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. Minimum sample volumes and types of sample containers to be used in the sediment collection are provided in the Sediment Monitoring QAPP (see Appendix B).

All sampling equipment will be cleaned prior to sampling. Between sampling stations, the grab sampler will be rinsed with station water. Stainless steel scoops will be rinsed with seawater and rinsed with de-ionized water between stations. All sediment samples will be logged on a chain-of-custody (COC) form (see Section 2.1.7). Sediment chemistry and toxicity samples will be placed in a cooler on ice until delivered or shipped to the appropriate laboratories. Prior to shipping, sample containers will be placed in sealable plastic bags and securely packed inside the cooler with ice. The original signed COC forms will remain with the samples during shipment. Sediment samples will be shipped or delivered to the analytical laboratory within appropriate holding times (refer to Sediment Monitoring QAPP in Appendix B).

2.1.7 Documentation of Chain-of-Custody

This section describes the program requirements for sample handling and COC procedures. Samples are 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 secured container. The principal documents used to identify samples and to document possession are COC records, field log books, and field tracking forms. COC procedures will be used for all samples throughout the collection, transport, and analytical process, and for all data and data documentation, whether in hard copy or electronic format.

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

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

The completed COC form will be placed in a sealable plastic envelope that will travel inside the ice chest containing the listed samples. The COC form will be signed by the person transferring custody of the samples. The condition of the samples will be recorded by the receiver. COC records will be included in the final analytical report prepared by the laboratory and will be considered an integral part of the report.

2.2 Laboratory Testing

All samples will be tested in accordance with USEPA or American Society for Testing and Materials (ASTM) protocols. If appropriate protocols do not exist, the Copermittees should use other methods approved by the SWRCB or San Diego RWQCB. Analytical laboratories will be certified by the California Department of Health Services in accordance with Water Code 13176. Additional information pertaining to laboratory testing is presented in the Sediment Monitoring QAPP (see Appendix B).

2.2.1 Physical and Chemical Analysis

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. In accordance with the Sediment Control Plan, the physical and chemical analyses of sediments will include, at a minimum, the constituents outlined in Table 2-1. If sediment quality monitoring is conducted as part of the Bight Program, additional chemical analyses may be included and will be provided in Bight Workplans. Reporting limits (RLs) must be equal to or less than those listed in Table 2-1 in order to generate the chemistry LOE outlined in Section 2.3.3.1. Concentrations associated with the RLs in Table 2-1 are expressed in dry-weight. Physical analyses of sediment will include grain size and percent solids. Grain size will be analyzed to determine the general size classes that make up the sediment (e.g., gravel, sand, silt, and clay), whereas percent solids will be measured to convert chemical concentrations from a wet-weight to a dry-weight basis. Chemical analyses of sediment will include total organic carbon (TOC), and the select trace metals, chlorinated pesticides, polychlorinated biphenyls (PCBs), and polycyclic aromatic hydrocarbons (PAHs) shown in Table 2-1.

Table 2-1. Chemical and Physical Parameters for Sediment Samples

Parameter	Reporting Limit
Physical/Conventional Tests	
Grain Size	1.00 %
Percent Solids	0.10 %
Total Organic Carbon (TOC)	0.01 %
Metals	
Cadmium (Cd)	0.09 mg/kg
Copper (Cu)	52.8 mg/kg
Lead (Pb)	25.0 mg/kg
Mercury (Hg)	0.09 mg/kg
Zinc (Zn)	60.0 mg/kg
Organochlorine Pesticides	
2,4′-DDD	0.50 µg/kg
2,4′-DDE	0.50 µg/kg
2,4′-DDT	0.50 µg/kg
4,4′-DDD	0.50 µg/kg
4,4′-DDE	0.50 µg/kg
4,4′-DDT	0.50 µg/kg
Chlordane-alpha	0.50 µg/kg
Chlordane-gamma	0.54 µg/kg
Dieldrin	2.5 µg/kg
trans-Nonachlor	4.6 µg/kg
PCB Congeners	
2,4'-Dichlorobiphenyl	3.0 µg/kg
2,2',5-Trichlorobiphenyl	3.0 µg/kg
2,4,4'-Trichlorobiphenyl	3.0 µg/kg
2,2',3,5'-Tetrachlorobiphenyl	3.0 µg/kg
2,2',5,5'-Tetrachlorobiphenyl	3.0 µg/kg
2,3',4,4'-Tetrachlorobiphenyl	3.0 µg/kg
2,2',4,5,5'-Pentachlorobiphenyl	3.0 µg/kg
2,3,3',4,4'-Pentachlorobiphenyl	3.0 µg/kg
2,3',4,4',5-Pentachlorobiphenyl	3.0 µg/kg
2,2',3,3',4,4'-Hexachlorobiphenyl	3.0 µg/kg
2,2',3,4,4',5'-Hexachlorobiphenyl	3.0 µg/kg
2,2',4,4',5,5'-Hexachlorobiphenyl	3.0 µg/kg
2,2',3,3',4,4',5-Heptachlorobiphenyl	3.0 µg/kg
2,2',3,4,4',5,5'-Heptachlorobiphenyl	3.0 µg/kg
2,2',3,4',5,5',6-Heptachlorobiphenyl	3.0 µg/kg
2,2',3,3',4,4',5,6-Octachlorobiphenyl	3.0 µg/kg
2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl	3.0 µg/kg
Decachlorobiphenyl	3.0 µg/kg
PAHs (low molecular weight)	
Acenaphthene	20.0 µg/kg
Anthracene	20.0 µg/kg
Phenanthrene	20.0 µg/kg
Biphenyl	20.0 µg/kg
Naphthalene	20.0 µg/kg
2,6-Dimethylnaphthalene	20.0 µg/kg

Parameter	Reporting Limit
Fluorene	20.0 µg/kg
1-Methylnaphthalene	20.0 µg/kg
2-Methylnaphthalene	20.0 µg/kg
1-Methylphenanthrene	20.0 µg/kg
PAHs (high molecular weight)	
Benzo(a)anthracene	80.0 µg/kg
Benzo(a)pyrene	80.0 µg/kg
Benzo(e)pyrene	80.0 µg/kg
Chrysene	80.0 µg/kg
Dibenzo(a,h)anthracene	80.0 µg/kg
Fluoranthene	80.0 µg/kg
Perylene	80.0 µg/kg
Pyrene	80.0 µg/kg

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

2.2.2 Toxicity Testing

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, if sediment monitoring is conducted as part of the Bight Program, the species selection will be listed in the Bight Workplans. If significant toxicity is observed in the solid phase or sediment-water interface test, a toxicity identification evaluation (TIE) may be conducted as part of stressor identification studies described in Section 4.0. Further descriptions of the test species used in both the short-term survival test and the sublethal endpoint test are provided below.

2.2.2.1 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 bay and lagoon 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 2-2. 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 2-2. 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

2.2.2.2 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 2-3 and Table 2-4, respectively. The *M. galloprovincialis* sediment-water interface test has been the sublethal test method used in previous San Diego County bay and lagoon monitoring programs, including the Bight Program, where the SQO analytical tool was used to assess aquatic health.

Mytilus galloprovincialis Sediment-Water Interface Development Sublethal Test

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.

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 2-3. 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
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 2-4. 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

2.2.3 Benthic Infauna Analysis

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, as described in the following paragraph. 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.

A QA/QC procedure will be performed on each of the sorted samples to ensure a 95% sorting efficiency. 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.

2.2.3.1 Quality Assurance/Quality Control

All quality assurance/quality control (QA/QC) samples must be conducted in accordance with the Quality Assurance Management Plan (QAMP) for the State of California's Surface Water Ambient Monitoring Program (SWAMP). The data quality objectives for all analyses conducted by the participating analytical laboratories will be detailed in the Sediment Monitoring QAPP (see Appendix B). The results of the laboratory quality control (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 Sediment Monitoring QAPP will be identified, and the corresponding data will be appropriately qualified in the final report. All QA/QC records for the various testing programs will be kept on file for review by regulatory agency personnel.

3.0 DATA REVIEW, MANAGEMENT, AND ANALYSIS

3.1 Data Review and Management

All QA/QC data must be conducted in accordance with the QAMP for the State of California's SWAMP and the data quality objectives as outlined in the Sediment Monitoring QAPP (see Appendix B). Data will be reviewed to determine if appropriate corrective actions have been taken, when necessary. Corrective actions taken by the laboratories will be noted in the laboratory report and affected data will be flagged or qualified as appropriate. The laboratories will supply analytical results in both hard copy and electronic formats. Laboratories will have the responsibility of ensuring that both formats are accurate. Monitoring data and analytical results will be uploaded into California Environmental Data Exchange Network (CEDEN).

3.2 Data Analysis

Sediment toxicity, chemistry, and benthic community condition will be assessed using California's SQOs as described in the Sediment Control Plan (Appendix A). 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 to humans. SQOs have been fully developed for only one of Southern California's enclosed bay habitats: euhaline (salinity = 25 to 32 ppt) bays and estuaries south of Point Conception. 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). The data analysis methods described below should be limited to the subtidal areas of the waterbodies where the SQO salinity criteria can be met.

The SQOs are based on a MLOE approach in which sediment toxicity, sediment chemistry, and benthic community condition are the LOE. The MLOE approach evaluates the severity of biological effects and the potential for chemically mediated effects to provide a final station level assessment. Brief descriptions of the specific methods associated with each LOE are described below. Detailed calculations and descriptions of each LOE are provided in the Sediment Control Plan (SWRCB and CA EPA, 2009) (see Appendix A).

3.2.1 Sediment Toxicity

Sediment toxicity will be assessed using two tests: a short-term survival test using one of three species of marine amphipods (*E. estuarius*, *L. plumulosus*, or *R. abronius*) and a sublethal test using either *N. arenaceodentata* (a species of polychaete worm) or *M. galloprovincialis* (a species of marine bivalve). Sediment toxicity test results from each station will be statistically compared to control test results; normalized to the control survival; and categorized as nontoxic, low, moderate, or high toxicity according to Table 3-1. The average of the two test response categories (nontoxic, low toxicity, moderate toxicity, and high toxicity) will be calculated to determine the final toxicity LOE category. If the average falls midway between the two categories, it will be rounded up to the higher of the two. For example, if the test response category for the short-term survival test is low toxicity, and the test response category for the sublethal test is moderate toxicity, the final category for sediment toxicity would be moderate toxicity.

Table 3-1. Sediment Toxicity Categorization Values

Test Type	Endpoint	Statistical Significance	Nontoxic[1]	Low Toxicity[2]	Moderate Toxicity[2]	High Toxicity[2]
Short-Term Survival Tests	*E. estuarius* Survival	Significant	90 to 100	82 to 89	59 to 81	<59
		Not significant	82 to 100	59 to 81	-	<59
	L. plumulosus Survival	Significant	90 to 100	78 to 89	56 to 77	<56
		Not significant	78 to 100	56 to 77	-	<56
	R. abronius Survival	Significant	90 to 100	83 to 89	70 to 82	<70
		Not significant	83 to 100	70 to 82	-	<70
Sublethal Tests	*N. arenaceodentata* Growth	Significant	90 to 100[2]	68 to 90	46 to 67	<46
		Not significant	68 to 100	46 to 67	-	<46
	M. galloprovincialis Normal-Alive	Significant	80 to 100	77 to 79	42 to 76	<42
		Not significant	77 to 79	72 to 76	-	<42

[1] Expressed as percent.
[2] Expressed as percent of control.

3.2.2 Sediment Chemistry

Sediment chemistry will be assessed using the analyte list presented in Table 2-1. Concentrations of chemicals detected in sediments will be compared to the California Logistic Regression Model (CA LRM) and the Chemical Score Index (CSI). The CA LRM is a maximum probability model (P_{max}) that uses logistic regression to predict the probability of sediment toxicity. The CSI is calculated independently of the CA LRM and is a predictive index that relates sediment chemical concentration to benthic community disturbance. Sediment chemistry results according to CA LRM and CSI are categorized as having minimal, low, moderate, and high exposure to pollutants (Table 3-2). The final sediment LOE category is the average of the two chemistry exposure categories. If the average falls midway between the two categories, it is rounded up to the higher of the two. For example, if the CA LRM is low exposure and the CSI is moderate exposure, then the final sediment LOE category is moderate exposure.

Table 3-2. Sediment Chemistry Guideline Categorization

Sediment Chemistry Guideline		Sediment LOE Category
CA LRM	CSI	
<0.33	<1.69	**Minimal Exposure**
0.33 - 0.49	1.69 - 2.33	**Low Exposure**
0.50 - 0.66	2.34 - 2.99	**Moderate Exposure**
>0.66	>2.99	**High Exposure**

3.2.3 Benthic Community Condition

Benthic community condition will be assessed using a combination of four benthic indices: the Benthic Response Index (BRI; abundance-weighted average pollution tolerance of sample organisms), the Relative Benthic Index (RBI; the weighted sum of community parameters and abundance of indicator species), the Index of Biotic Integrity (IBI; a measure that identifies benthic community characteristics outside of reference ranges), and a predictive model based on the River Invertebrate Prediction and Classification System (RIVPACS; a comparison of assemblages in a sample to expected species composition). The four indices will be calculated following the January 21, 2008, guidance provided by Southern California Coastal Water Research Project (SCCWRP) entitled *Determining Benthic Invertebrate Community Condition in Embayments* for Southern California marine bays. Each benthic index result is categorized according to four levels of disturbance, including reference, low, moderate, and high disturbance.

- Reference: Equivalent to a least affected or unaffected station.
- Low Disturbance: Some indication of stress is present, but is within measurement error of unaffected condition.
- Moderate Disturbance: Clear evidence of physical, chemical, natural, or anthropogenic stress.
- High Disturbance: High magnitude of stress.

Specific categorization values, which are tailored to southern California marine bays, are assigned for each index (Table 3-3), and are based on the specific taxa found within a given sample. To determine the benthic community condition, the four indices will be integrated into a single category. The median of the four benthic index response categories are computed to determine the benthic condition. If the median falls between two categories, the value is rounded to the next higher category to provide the most conservative estimate of benthic community condition.

Table 3-3. Benthic Index Categorization Values for Southern California Marine Bays

Benthic Community Guideline				Index
BRI	IBI	RBI	RIVPACS	
<39.96	0	>0.27	>0.90 to <1.10	**Reference**
39.96 - 49.14	1	0.17 - 0.27	0.75 - 0.90 or 1.10 - 1.25	**Low Disturbance**
49.15 - 73.26	2	0.09 - 0.16	0.33 - 0.74 or >1.25	**Moderate Disturbance**
>73.26	3 or 4	<0.09	<0.33	**High Disturbance**

3.2.4 Integration of Multiple Lines of Evidence

The station level assessment that indicates whether the aquatic life SQO at a station has been met will be determined by the combination of the three LOE categories to assess the severity of biological effects and the potential for chemically mediated effects. The severity of biological effects will be determined by combining the toxicity and benthic community condition LOEs (Table 3-4). The potential for chemically mediated effects will be determined by combining the toxicity and chemistry LOEs (Table 3-5).

Table 3-4. Determination of Severity of Biological Effects

Combination of Toxicity LOE and Benthic Condition LOE		Toxicity LOE			
		Non-toxic	Low Toxicity	Moderate Toxicity	High Toxicity
Benthic Community Condition LOE	Reference	Unaffected	Unaffected	Unaffected	Low Effect
	Low Disturbance	Unaffected	Low Effect	Low Effect	Low Effect
	Moderate Disturbance	Moderate Effect	Moderate Effect	Moderate Effect	Moderate Effect
	High Disturbance	Moderate Effect	High Effect	High Effect	High Effect

Table 3-5. Determination of Potential for Chemically Mediated Effects

Combination of Toxicity LOE and Sediment Chemistry LOE		Toxicity LOE			
		Non-toxic	Low Toxicity	Moderate Toxicity	High Toxicity
Sediment Chemistry LOE	Minimal Exposure	Minimum Potential	Minimum Potential	Low Potential	Moderate Potential
	Low Exposure	Minimum Potential	Low Potential	Moderate Potential	Moderate Potential
	Moderate Exposure	Low Potential	Moderate Potential	Moderate Potential	Moderate Potential
	High Exposure	Moderate Potential	Moderate Potential	High Potential	High Potential

Based on the determinations of the severity of biological effects and the potential for chemically mediated effects, a station level assessment (Table 3-6) will be made that categorizes the station as one of the following:

- Unimpacted: Confident that sediment contamination is not causing significant adverse impacts to aquatic life living in station sediments.
- Likely Unimpacted: Sediment contamination at the station is not expected to cause adverse impacts to aquatic life, but some disagreement among the LOE reduces the certainty that the station is unimpacted.
- Possibly Impacted: Sediment contamination at the station may be causing adverse impacts to aquatic life, but the impacts are either small or uncertain due to disagreement among the LOE.
- Likely Impacted: Evidence for a contaminant-related impact to aquatic life at the station is persuasive, even if there is some disagreement among the LOE.
- Clearly Impacted: Sediment contamination at the station is causing clear and severe adverse impacts to aquatic life.
- Inconclusive: Disagreement among the LOE suggests that either the data are suspect or additional information is needed before a determination can be made.

Table 3-6. Determination of Final Station Assessment

Combination of Severity of Biological Effects and Potential for Chemically-Mediated Effects		Severity of Biological Effects			
		Unaffected	**Low Effect**	**Moderate Effect**	**High Effect**
Potential for Chemically-Mediated Effects	**Minimal Potential**	Unimpacted	Likely Unimpacted	Likely Unimpacted	Inconclusive
	Low Potential	Unimpacted	Likely Unimpacted	Possibly Impacted	Possibly Impacted
	Moderate Potential	Likely Unimpacted	Possibly Impacted or Inconclusive[1]	Likely Impacted	Likely Impacted
	High Potential	Inconclusive	Likely Impacted	Clearly Impacted	Clearly Impacted

[1] When chemistry classification is minimal exposure, benthic response is reference, and toxicity is high.

All 64 possible combinations are presented in Attachment B of the Sediment Control Plan. If a station is consistently classified as Unimpacted or Likely Unimpacted according to the SQO assessments, then the protective condition has been achieved. If the final station assessment result is Possibly Impacted, Likely Impacted or Clearly Impacted, the station is considered degraded and the Copermittees will need to coordinate with the San Diego RWQCB to determine if a stressor identification study will need to be conducted. Stations categorized as Inconclusive should not be used to evaluate whether the protective condition at a station has been met. Additional information should be gathered at stations classified as Inconclusive in order to understand why the LOE results show a level of disagreement.

If stations are categorized as Possibly Impacted within a monitored segment, reach, or water body that also contain stations that are not categorized as Clearly or Likely Impacted, then confirmation monitoring will be conducted in order to confirm the level of impact at these stations prior to initiating a stressor identification study. As stated in the *Sediment Quality Assessment Technical Support Manual* (Bay et al., 2014), "the *Possibly Impacted* station assessment is the least certain of all categorizations, and therefore requires the most caution during interpretation. Stations may be classified as *Possibly Impacted* due to low levels of effect for each LOE, indicating a low magnitude of impacts. Alternatively, a *Possibly Impacted* classification may be the result of a large disagreement between LOEs, potentially due to confounding factors or noncontaminant stressors." At a minimum, confirmation monitoring at a Possibly Impacted station will consist of re-sampling and recalculating the SQO to determine if the station results in the same SQO assessment (i.e. Possibly Impacted) or if the assessment is more conclusive as to whether the station is impacted or not (e.g. Unimpacted or Likely Impacted). If the results of the confirmation monitoring determine that the station is Unimpacted or Likely Unimpacted then the protective condition has been achieved at that location. If the station assessment is categorized as Possibly Impacted, Likely Impacted, or Clearly Impacted then the Copermittees will need to coordinate with the San Diego RWQCB to determine if a stressor identification study will need to be conducted. If additional monitoring or previous specialized studies at Possibly Impacted stations indicate that factors other than toxic pollutants in sediments are causing observed negative responses then it may be possible to coordinate with the RWQCB to designate the station as meeting the protective condition. A flow chart of actions to be taken following the initial station assessment is provided in Figure 3-1.

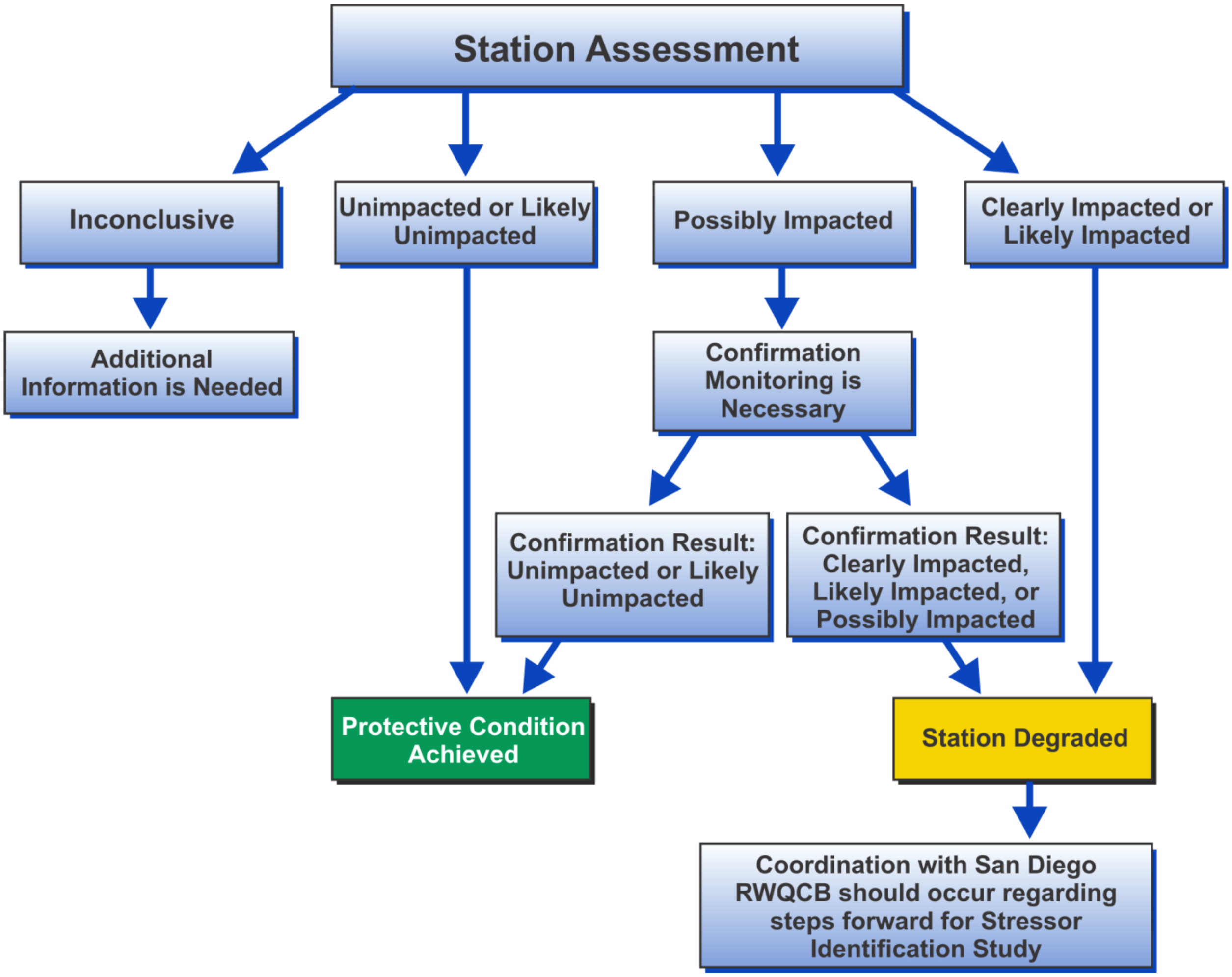

Figure 3-1. Flow Chart of Actions Following Station Assessment

4.0 STRESSOR IDENTIFICATION

The highest priority for stressor identification will be assigned to those water body segments with the highest percentage of Clearly Impacted or Likely Impacted stations. In cases where segments contain sediments categorized as Possibly Impacted but not Clearly Impacted or Likely Impacted, confirmation monitoring will be conducted prior to requiring stressor identification studies. By reviewing the available data sets, deductive reasoning can be used to narrow the focus of future actions. Based on the outcome of the additional data analysis, steps forward for stressor identification should be coordinated with the San Diego RWQCB. If a stressor identification study is required, the Copermittees will develop a clearly defined work plan that has met the approval of the San Diego RWQCB prior to beginning work. No formal guidance is given in the Sediment Control Plan on how to conduct a stressor identification study; however, the Sediment Control Plan does give some general guidance on types of stressor identification studies that can be implemented. These studies include confirmation and characterization of pollutant-related impacts, pollutant identification, and source identification and management actions. These types of studies are summarized in the following sections.

4.1.1 Pollutant Confirmation and Characterization

When the analyses described in Section 3.2 indicate that pollutants are a likely cause of an SQO exceedance at a station, a variety of tools can be used to determine whether the reason for the narrative objective not being met is due to generic stressors other than toxic pollutants, such as physical alterations or other pollutant-related stressors. Physical disturbances, such as decreased salinity, dredging impacts, and grain size, are confounding factors that may produce conditions mimicking the effects of pollutants. In these cases, the benthic community LOE will indicate degradation, but the toxicity and chemistry LOEs may not. Pollutant-related stressors, such as ammonia, TOC, nutrients, and pathogens, may also be confounding factors. In these cases, the benthic community LOE will indicate degradation, toxicity may be indicated, and chemical concentrations will be low. To determine whether a station is impacted from toxic pollutants, one or more of the following tools may be included in the stressor identification analysis as part of the confirmation:

- Evaluate the spatial extent of the area of concern in relation to anthropogenic sources.
- Evaluate the body burden of the pollutants accumulated in the animals used for exposure testing.
- Evaluate the chemical constituent results in relation to chemical benchmark values.
- Compare chemistry and biology LOE to determine whether correlations exist.
- Alternative biological assessment, such as bioaccumulation experiments, pore water toxicity, or pore water chemistry analyses, may be conducted.
- Phase I TIEs, which are often useful in determining the causative agent or class of compounds causing toxicity may be conducted.

According to the SQO guidelines, "If there is compelling evidence that the SQO exceedances contributing to a receiving water limit exceedance are not due to toxic pollutants, then the assessment area shall be designated as having achieved the receiving water limit."

4.1.2 Pollutant Identification

Pollutant identification investigations may be conducted using one or more of the following types of data: statistical, biological, or chemical investigation data. These investigations should be station-specific and should be based on:

- Correlations between individual chemicals and biological endpoints.
- Gradient analysis of chemical concentrations and the biological responses in comparison to distance from a chemical hotspot.
- Additional TIE procedures.
- Sediment pore water investigations into the bioavailability of pollutants (e.g., acid-volatile sulfides and simultaneously extracted metals [AVS:SEM] analysis, solid phase microextraction [SPME], and/or laboratory desorption studies.
- Verification studies such as spiking or in situ toxicity and bioaccumulation studies.

In cases where stressor identification studies conducted on stations categorized as Possibly Impacted are inconclusive, the Copermittees may iplement a one-time augmentation to the study or suspend stressor identification studies in favor of additional routine SQO monitoring.

4.1.3 Pollutant Source Identification and Management

Stressor identification studies should include determinations of whether sources are ongoing or legacy and determinations of the number and nature of ongoing sources. If a single or multiple dischargers are responsible for stressor pollutant discharges, the discharger(s) may need to address the SQO exceedance and to reduce the pollutant loading.

According to Section VII.H of the Sediment Control Plan, the San Diego RWQCB may develop station-specific sediment management guidelines to estimate the level of the stressor pollutant in order to meet the SQOs. Guideline development should be initiated only following identification of the stressor, and should have an overall goal of establishing a relationship between the organism's exposure and the biological effect. Upon establishing this relationship, a pollutant-specific guideline may be designated that corresponds with minimum biological effects. Approaches that can be used to establish relationships between exposure and biological effect include the following: correspondence with sediment chemistry, correspondence with bioavailable pollutant concentration, correspondence with tissue residue, and literature review. Additionally, the Sediment Control Plan states that the chemistry LOE, "including the threshold values (e.g. CSI and CALRM) shall not be used for setting cleanup levels or numeric values for technical TMDLs."

5.0 REPORTING

Provision D.1.e.(2)(c) of the Permit requires incorporation of 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 required by the RWQCB. 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 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 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.

6.0 SCHEDULE

The schedule for completing the sediment quality monitoring requirements of the Permit and for submitting the Sediment Monitoring Report is shown in Table 6-1:

Table 6-1. Sediment Monitoring Plan 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 (Appendix B) 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 development of the Sediment Monitoring Plan. Monitoring was conducted in accordance with the *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.

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Appendix A

Water Quality Control Plan for Enclosed Bays and Estuaries - Part 1 Sediment Quality

Appendix B

Sediment Monitoring Plan QAPP