QUALITY ASSURANCE PROJECT PLAN

For

San Diego Regional Harbor Monitoring Program
Pilot Study

Prepared For:

Port of San Diego
City of San Diego
City of Oceanside
County of Orange

July 2005

2433 Impala Dr.
Carlsbad, CA 92010

GROUP A:

PROJECT MANAGEMENT

ELEMENT 1 TITLE AND APPROVAL SHEET

Quality Assurance Project Plan

For

San Diego
Regional Harbor Monitoring Program
Pilot Study

July 2005

APPROVAL SIGNATURES

Weston Solutions, Inc.

Title	Name	Signature	Date*
Principal-in-Charge	Lisa Kay		
Project Manager	Susie Watts		
QA Officer	Rosabel Dias		

Port of San Diego

Title	Name	Signature	Date*
Project Director	Eileen Maher		
Project Manager	Karen Helyer		

ELEMENT 2 TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ELEMENT 3 DISTRIBUTION LIST

Table 1 identifies those individuals who will receive one (1) copy of the approved Quality Assurance Project Plan (QAPP).

Table 1. QAPP Distribution List

Title:	Name (Affiliation):	Tel. No.:	QAPP No.:
Project Director	Eileen Maher	619-686-6254	01
Project Manager	Karen Heyler	619-686-6254	02
Contractor Principal-in-Charge	Lisa Kay (Weston Solutions, Inc.)	760-931-8081	03
Contractor Project Manager	Susie Watts (Weston Solutions, Inc.)	760-931-8081	04
Contractor QA Officer	Rosabel Dias (Weston Solutions, Inc.)	760-931-8081	05

ELEMENT 4 PROJECT/TASK ORGANIZATION

Involved Parties and Roles

Weston Solutions, Inc. (Weston) is a for-profit environmental consulting firm interested in the assessment and improvement of the regional harbors in the San Diego region. These harbors include San Diego Bay, Mission Bay, Oceanside Harbor, and Dana Point Harbor. As the lead firm, Weston will organize the maintenance of field sampling equipment, sample collection, field and in-house analysis of samples, and the initiation and maintenance of a contract with CRG Marine Laboratories, Inc.

Lisa Kay is Weston Solutions Principal in Charge. The Principal-in-Charge be responsible for project oversight and interactions with the involved parties and coordinating agencies (Table 2).

Susie Watts is Weston Solutions Project Manager. The Project Manager will be responsible for all aspects of the project including interactions with the involved parties, the organization of field staff, scheduling of sampling days, maintenance of field sampling equipment, reporting, and coordination with the contract analytical laboratories.

Larissa Aumand is Weston Solutions Microbiology Laboratory Manger. The Microbiology Laboratory Manager will ensure that submitted samples will be analyzed in accordance with all method and quality assurance requirements found in this QAPP. The Microbiology Laboratory Manager will act as a technical resource to the Project Manager.

Sheila Holt is Weston Solutions Benthic Laboratory Manager. The Benthic Laboratory Manager will ensure that submitted samples will be analyzed in accordance with all method and quality assurance requirements found in this QAPP. The Benthic Laboratory Manager will act as a technical resource to the Project Manager.

Bruce Ferguson is Weston Solutions Data Manager. The Data Manager will be responsible for maintaining a database of all project data and will also provide GIS support, as necessary.

CRG Marine Laboratories (CRG) will be the contract laboratory for all analyses not conducted in the field or at Weston Solutions' in-house microbiology laboratory. The contract analytical laboratories will analyze submitted samples in accordance with all method and quality assurance requirements found in this QAPP. The contract analytical laboratories will act as a technical resource to the Project Manager.

Quality Assurance Officer Role

The Quality Assurance (QA) Officers are responsible for guaranteeing the overall quality of the data produced and reported throughout the project. Specific duties of the QA Officers include conducting audits of ongoing tests, data packages, and completed reports, conducting audits of the routine quality control documentation of laboratory procedures, communicating potential quality control problems to the staff, and assuring that any problems are resolved. They are responsible for issuing Quality Assurance Reports to Management, maintaining a current Quality Assurance Manual, and issuing QAPPs as required. The QA Officers also ensure that data reported have been generated in compliance with the Quality Assurance Manual and the appropriate protocols. The QA Officers are knowledgeable in the quality system standard defined under ELAP. The QA Officers report to the Laboratory Director.

The QA Officer will work directly with each contract analytical laboratory's QA Officer by communicating all quality assurance and quality control issues contained in this QAPP to the respective laboratory.

Rosabel Dias is Weston Solutions QA officer.

The QA Officer will also review and assess all procedures during the life of the contract against QAPP requirements. The QA Officer will report all findings to the Project Manager, including all requests for corrective action. The QA Officer, or the Project Manager under the QA Officer's direction, may stop all actions, including those conducted by contracted analytical laboratories if there are significant deviations from required practices or if there is evidence of a systematic failure.

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 Principal-in-Charge, Project Manager and QA Officer, and with the concurrence of both the Port's Project Director and Project Manager. The QA Officer or Project Manager, under the direction, supervision and review of the QA Officer, will be responsible for making the changes, submitting drafts for review, preparing a final copy, and submitting the final for signature.

Table 2. Personnel Responsibilities.

Name	Organizational Affiliation	Title	Contact Information (Telephone number, fax number, email address.)
Lisa Kay	Weston Solutions	Principal-in-Charge	760-931-8081 (tel) 760-931-1580 (fax) lisa.kay@westonsolutions.com
Susie Watts	Weston Solutions	Project Manager	760-931-8081 (tel) 760-931-1580 (fax) susie.watts@westonsolutions.com
Rosabel Dias	Weston Solutions	Quality Assurance Officer	760-931-8081 (tel) 760-931-1580 (fax) rosabel.dias@westonsolutions.com
Sheila Holt	Weston Solutions	Benthic Laboratory Manager	760-931-8081 (tel) 760-931-1580 (fax) sheila.holt@westonsolutions.com
Larissa Aumand	Weston Solutions	Microbiology Laboratory Manager	760-931-8081 (tel) 760-931-1580 (fax) larissa.aumand@westonsolutions.com
Rosabel Dias	Weston Solutions	Microbiology Laboratory Quality Assurance Officer	760-931-8081 (tel) 760-931-1580 (fax) rosabel.dias@westonsolutions.com
Chris Osuch	Weston Solutions	Bioassay Laboratory Manager	760-931-8081 (tel) 760-931-1580 (fax) chris.osuch@westonsolutions.com
Lin Craft	Weston Solutions	Bioassay Laboratory Quality Assurance Officer	760-931-8081 (tel) 760-931-1580 (fax) lin.craft@westonsolutions.com
Satomi Yonemasu	Weston Solutions	Benthic Laboratory Quality Assurance Officer	760-931-8081 (tel) 760-931-1580 (fax) satomi.yonemasu@westonsolutions.com
Bruce Ferguson	Weston Solutions	Data Manager/GIS	760-931-8081 (tel) 760-931-1580 (fax) bruce.ferguson@westonsolutions.com
Misty Mercier	CRG Marine Laboratories	Contract Laboratory Project Manager	310-533-5190 x 106 (tel) 310-618-9630 (fax) mmercier@crglabs.com
Rich Gossett	CRG Marine Laboratories	Contract Laboratory Quality Assurance Officer	310-533-5190 x 105 (tel) 310-618-9630 (fax) crglabs@sbcglobal.net

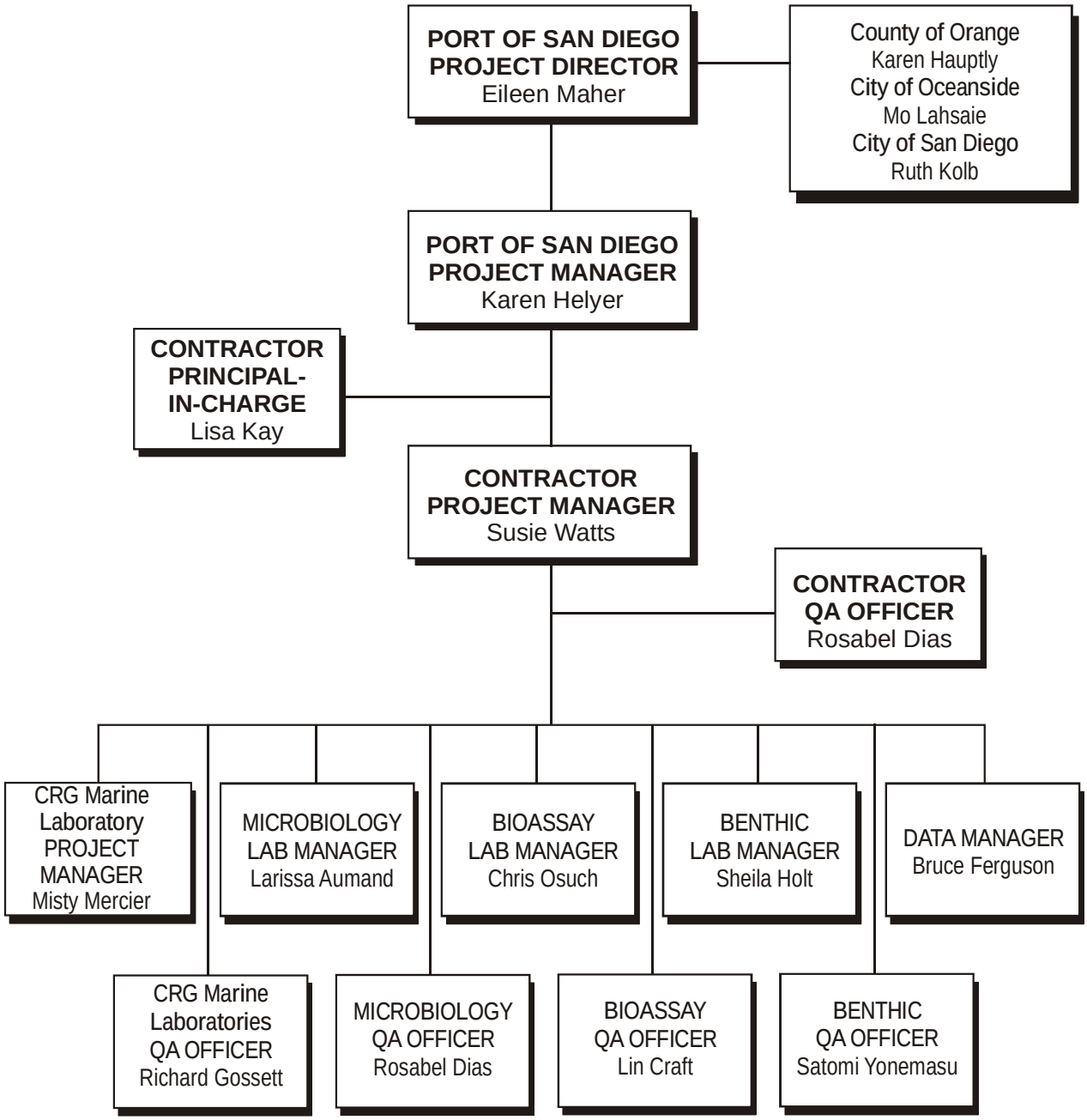

Figure 1. Project organization chart.

ELEMENT 5 PROBLEM DEFINITION/BACKGROUND

Problem Statement

The County of Orange, the City of Oceanside, the City of San Diego, and Port of San Diego have developed a San Diego Regional Harbor Monitoring Program (RHMP) in response to the July 24, 2003 request by the San Diego Regional Water Quality Control Board (RWQCB) under §13225 of the California Water Code. The intent of this coordinated program design is to develop a proposed coordinated monitoring effort of harbors in the San Diego Region to provide water quality status and trends information, as well as, assess the surface water's abilities to support designated beneficial uses.

The largest single component of the RHMP is the ambient monitoring program, because it provides the status and trends information on a broad scale for the San Diego Region harbors. In addition to the ambient monitoring program, special focused studies will address specific questions related to beneficial uses.

Program Goals

The overall goal of the RHMP is to assess water quality status and trends in the local harbors. The RHMP is focused on collecting information on baseline conditions and the effects of pollution sources. Monitoring will focus on the condition of beneficial uses. This program employs different types of monitoring efforts to address the various questions posed by the RWQCB. The program is designed to integrate with existing monitoring that is regularly conducted in the region, including storm water monitoring, other permit compliance monitoring, regional Bight monitoring, and special focused studies. This program is designed to both meet the requirements of RWQCB's letter and integrate with the State's SWAMP.

The County of Orange, the City of Oceanside, the City of San Diego, and Port of San Diego are also interested in establishing a closer link between state-mandated water quality program activities and the impact those activities have on protecting and improving water quality. The ability of both the RWQCB and the County of Orange, the City of Oceanside, the City of San Diego, and Port of San Diego to relate the performance of their programs directly to water quality outcomes has been hampered by limited coordinated data management and evaluation efforts.

The program goals outlined above are designed to address the purpose stated in the RWQCB's request. RWQCB July 24, 2003 §13225 Request:

> *The purpose of a coordinated regional monitoring program for San Diego Region harbors is to identify the water quality status and trends and the ability of surface waters to support beneficial uses over the long term.*

The proposed RHMP core monitoring program is a comprehensive effort to survey the general water quality and condition of aquatic life in the harbors and to determine whether beneficial

uses are being met. Core monitoring is the collection of information about the status of the physical, chemical, and biological indicators. This information can be used through time to compare trends in those indicators, as well as, status of those indicators. The monitoring typically provides trend information by being repeated at a specified frequency to obtain statistical trend data for the indicators.

In developing the proposed RHMP monitoring objectives, the County of Orange, the City of Oceanside, the City of San Diego, and Port of San Diego used the State Water Resources Control Board's November 30, 2000 Report to the Legislature, entitled "Proposal for a Comprehensive Ambient Surface Water Quality Monitoring Program," as guidance for developing clear monitoring objectives. The objectives of the RHMP are based on and directed at the five major questions and seven issues presented in the RWQCB's July 24, 2003 request. The questions and issues are identified below:

Question 1 What are the contributions and spatial distributions of inputs of pollutants to harbors in the San Diego Region and how do these inputs vary over time?

Question 2 Are the waters in harbors safe for body contact activities?

Question 3 Are fish in harbors safe to eat?

Question 4 Do the waters and sediments in the harbors sustain healthy biota?

Question 5 What are the long-term trends in water quality for each harbor?

Issue A Identification of significant contributors of waste loading. Example: Loading from boat hulls due to passive copper leaching.

Issue B Develop ambient sampling approach for water and sediment capable of identifying water quality status and trends.

Issue C Develop focused monitoring approaches in designated portions of water bodies.

Issue D Coordination and integration with Southern California Coastal Waters Research Project's Regional Bight Monitoring Program.

Issue E Consider existing permit monitoring programs and ways to eliminate duplication.

Issue F Electronic data storage and retrieval.

Issue G Public availability of reports.

A pilot study has been recommended to ensure that the core monitoring program design is appropriate prior to the investment or resources and commitment to full scale implementation. This document is the QAPP for the RHMP Core Monitoring Program's Pilot Study.

RHMP Core Monitoring Pilot Study

Problem Statement

The implementation of a collaborative regional approach to harbors will require an extensive commitment of resources. It is crucial that any regional program implemented is scientifically sustainable, provides technically valid answers to specific questions, is reasonably economical to implement, and allows for direct integration into other large scale monitoring programs (such as Bight Monitoring). To ensure that these objectives are met by the RHMP Core Monitoring Program, this pilot study is an approach to implement the monitoring and ensure that the design is appropriate prior to investment of resources and commitment to full scale implementation. The use of a pilot study allows the design to be verified (i.e., will it answer the refined questions?). The pilot study provides an opportunity to implement any necessary design modifications to ensure the RHMP answers the original and refined questions prior to full resource investment. Many regional scale monitoring programs utilized a limited scope approach in their initial phase of monitoring to verify program design, including the Bight program.

Program Goals

The objectives of the pilot study are to implement the RHMP Core Monitoring Program on a limited scale to verify the study design. The pilot study will result in data which will be statistically evaluated to set the appropriate frequency of RHMP Core Monitoring needed to determine trend analysis. Further, the concept of using a pilot study to verify design elements and understand trend development is supported by the Stormwater Monitoring Coalition's Model Monitoring Technical Committee (SMC).

ELEMENT 6 PROJECT/TASK DESCRIPTION

RHMP Core Monitoring Pilot Study

Work Statement and Produced Products

Samples will be collected during the summer months. The summer months were selected for the monitoring period because there will be stabilization of the benthic community following winter storms and spring generation of organisms. This timing allows for integration with the Bight program, as Bight monitoring is conducted in the summer months.

The pilot study would only include a limited number of indicators and be conducted at ten stations in two strata. The two strata recommended for the pilot study are fresh water input and marinas. These strata are recommended because they are reasonably anticipated to provide more variability and will provide the most conservative estimate of the number of years needed for monitoring to detect trends.

Data and metadata will be managed electronically to allow for easy integration with similar datasets and statistical assessment. A standardized data transfer format will be developed similar to the SMC and Bight data transfer formats to allow for sharing of data among agencies.

Information collected in the pilot study will be assessed to verify the statistical study design and determine the frequency of monitoring needed (i.e. every year, every three years, every five years) to develop trend data. Power analyses and other statistical tools will be used to assess the pilot study information and determine the ability to detect trends in each indicator category. It is expected that not all indicators will necessarily follow the same pattern; however, this information can provide an indication of the value of long-term monitoring in the San Diego Harbor areas for trend information. How long will it take (years) for trend information to be obtained? What proportion difference will be detectable? This will allow for refinement of the RHMP Core Monitoring Program.

Constituents to be monitored and measurement techniques

The indicators recommended for analysis during the RHMP pilot study are included in Table 3:

Table 3. RHMP Indicators to be Monitored and Corresponding Analytical Methods.

Constituent	Methods	Notes
Water Samples		
pH	Collected in Field	Seabird Electronics CTD
Specific Conductance	Collected in Field	Seabird Electronics CTD
Dissolved Oxygen	Collected in Field	Seabird Electronics CTD
Temperature	Collected in Field	Seabird Electronics CTD
Transmissivity	Collected in Field	Seabird Electronics CTD
Total Organic Carbon	EPA 415.1	By combustion or Oxidation

Dissolved Organic Carbon	EPA 415.1	By Combustion or Oxidation
Total and Dissolved Trace Metals	EPA 200.8 and EPA 1640	ELAN 6000 Inductively Couple Plasma (ICP) – Mass Spectrometry (MS)
Total Hardness as $CaCO_3$	SM 2340-B	By Calculation
PAHs	EPA 625	GCMS
Enterococcus	SM 9223 B	Chromogenic Substrate Method (IDEXX Enterolert)
Sediment Samples		
Total Organic Carbon (TOC)	EPA 415.1	By Combustion or Oxidation
Grain Size Analysis	Plumb 1981	Settling Tube
Trace Metals	EPA 6020	ELAN 6000 Inductively Couple Plasma (ICP) – Mass Spectrometry (MS)
PAHs	EPA 625	GCMS
Acute Toxicity		10-day *E. estuaries*
Benthic Infauna		BRI and other metrics

Project Schedule

Table 4 details the project's schedule, including start and end dates of major tasks, required deliverable(s) and the deliverable(s) due date.

Table 4. Project Schedule.

Activity	Date (MM/DD/YY)		Deliverable	Deliverable Due Date
	Anticipated Date of Initiation	Anticipated Date of Completion		
Field Sampling – Year 1	8/15/2005	9/15/2005	Progress Report	10/15/2005
Laboratory Analyses – Year 1	9/1/2005	3/1/2006	Progress Report	4/15/2006
Summary Report – Year 1	1/1/2006	5/1/2006	Report	5/1/2006
Field Sampling – Year 2	8/15/2006	9/15/2006	Progress Report	10/15/2006
Laboratory Analyses - Year 2	9/1/2006	3/1/2007	Progress Report	4/15/2007
Summary Report – Year 2	1/1/2007	5/1/2007	Report	5/1/2007
Field Sampling – Year 3	8/15/2007	9/15/2007	Progress Report	10/15/2007
Laboratory Analyses - Year 3	9/1/2007	3/1/2008	Progress Report	4/15/2008
Summary Report – Year 3	1/1/2008	5/1/2008	Report	5/1/2008
Final Report	3/1/2008	6/1/2008	Report	6/1/2008

Geographical Setting

The San Diego RHMP addresses four harbors in southern Orange and San Diego Counties. These include Dana Point Harbor, Oceanside Harbor, Mission Bay and San Diego Bay. Dana Point Harbor is located in the City of Dana Point in southern Orange County. It has berths for up to 2500 pleasure craft in two separate marinas. The harbor is protected by a single jetty that parallels the coast. There are no significant freshwater inputs to Dana Point Harbor other than storm drains servicing the local area. A variety of land uses occur around the harbor, including commercial (retail and restaurants), marina-related industry (fueling and dry-dock) and recreation.

Oceanside Harbor is located in the City of Oceanside in northern San Diego County. The Oceanside Harbor has berths for 950 pleasure craft and additional anchorage for U.S. Coast

Guard vessels, commercial and sport fishing vessels. There are no significant freshwater inputs to Oceanside Harbor other than storm drains servicing the local area. Retail shops and restaurants are located around the harbor and there is one fuel station. There are also residential units and recreational opportunities adjacent to the harbor. Separated from Oceanside Harbor, but protected by the same jetties, another harbor approximately ¼ mile north supports U.S. Navy vessels operating at Camp Pendleton. The Regional Harbor Monitoring Program does not include the military harbor.

Mission Bay is located in the City of San Diego in central San Diego County. Mission Bay is one of the largest man-made recreation aquatic parks in the world, encompassing 4,235 acres that used to be predominantly marshland until the mid-twentieth century. Tecolote and Rose Creeks discharge into the eastern side of the Bay. Storm drains and groundwater discharge also enter the Bay at numerous points. There are several marinas and anchorages in Mission Bay, located primarily in the southwest corner, near the entrance to the Bay. Sandy beaches surround most of the bay, with the majority of adjacent land uses being parks and residential areas. Mission Bay and the surrounding parks are used year-round for walking, jogging, picnicking, and a variety of water contact sports, including swimming, sailing, water-skiing and fishing.

San Diego Bay is located primarily in the City of San Diego. The entrance to San Diego Bay is between Point Loma on the west and North Island to the east. The bay curves around North Island and extends to the south, bound by the Silver Strand on the west and the Cities of San Diego, National City and Chula Vista to the east. Otay River, Sweetwater River and Chollas Creek discharge to the Bay. Other drainages discharge through storm drains into San Diego Bay, including Switzer Creek and the Downtown Anchorage Drainage. San Diego Bay is a deep water harbor, with the majority of shipping traffic related to military operations, tourist industry and fishing. Small boat marinas are located throughout the Bay. Land uses adjacent to San Diego Bay include commercial, industrial, military, residential and parks and recreation.

Constraints

Sampling will be conducted during the summer months. Summer months (July, August, or September) were selected because there will be stabilization of the benthic community following winter storms and spring generation. Additionally, this timing allows for integrating with the Bight program.

ELEMENT 7 QUALITY OBJECTIVES AND CRITERIA FOR MEASUREMENT DATA

Table 5. Summary of Data Quality Objectives

Measurement or Analyses Type	Applicable Data Quality Objective
Water Samples	
Field Testing pH Specific Conductance Dissolved Oxygen Temperature Transmissivity	Accuracy, Precision, Completeness
Chemical Laboratory Analyses Total Organic Carbon Dissolved Organic Carbon Total and Dissolved Trace Metals Total Hardness as $CaCO_3$ PAHs	Accuracy, Precision, Recovery, Completeness
Microbiology Laboratory Analyses Enterococcus	Accuracy, Precision, Completeness
Sediment Samples	
Chemical Laboratory Analyses Total Organic Carbon (TOC) Grain Size Analyses Trace Metals PAHs	Accuracy, Precision, Recovery, Completeness
Benthic Laboratory Analyses Benthic Infauna	Accuracy, Precision, Completeness
Bioassay Laboratory Analyses Acute Toxicity	Accuracy, Precision, Completeness

Table 6. Data Quality Objectives for Field Measurements.

Group	Parameter	Accuracy	Precision	Recovery	Target Reporting Limits	Completeness
Field Testing	pH	± 0.1 units	No SWAMP requirement; will use ± 0.5	NA	NA	No SWAMP requirement; will use 90%.
Field Testing	Specific Conductance	± 0.0003 S/m	No SWAMP requirement; will use ± 5%	NA	NA	No SWAMP requirement; will use 90%
Field Testing	Dissolved Oxygen	± 2% of saturation	No SWAMP requirement; will use ± 0.5	NA	NA	No SWAMP requirement; will use 90%
Field Testing	Temperature	± 0.001 °C	No SWAMP requirement; will use ± 0.5	NA	NA	No SWAMP requirement; will use 90%
Field Testing	Transmissivity	± 0.02% / deg C	No SWAMP requirement; will use ± 0.5	NA	NA	No SWAMP requirement; will use 90%

Table 7. Data Quality Objectives for Laboratory Measurements.

Group	Parameter	Accuracy	Precision	Recovery	Target Reporting Limits	Completeness
Water Samples						
Laboratory Analyses	Total Organic Carbon	Standard Reference Materials (SRM, CRM, PT) within 95% CI stated by provider of material or Laboratory Control Standard (LCS) with 80% to 120% of true value	Laboratory duplicate, blind field duplicate, or MS/MSD ±30% RPD Laboratory duplicate minimum	Matrix spike 80% to 120% or control limits at ±3 standard deviations based on actual lab data	0.032 mg/L	No SWAMP requirement; will use 90%
Laboratory Analyses	Dissolved Organic Carbon	Standard Reference Materials (SRM, CRM, PT) within 95% CI stated by provider of material or Laboratory Control Standard (LCS) with 80% to 120% of true value	Laboratory duplicate, blind field duplicate, or MS/MSD ±30% RPD Laboratory duplicate minimum	Matrix spike 80% to 120% or control limits at ±3 standard deviations based on actual lab data	0.03 mg/L	No SWAMP requirement; will use 90%
Laboratory Analyses	Total and Dissolved Trace Metals	Standard Reference Materials (SRM, CRM, PT) 70% to 130%	Field replicate, laboratory duplicate, or MS/MSD ±30% RSD. Laboratory duplicate minimum	Matrix spike 70% to 130%	0.1 - 0.5 µg/L	No SWAMP requirement; will use 90%
Laboratory Analyses	PAHs	Standard Reference Materials (SRM, CRM, PT) within 95% CI stated by provider of material. If not available, then with 50% to 150% of true value	Field replicate of MS/MSD ±25% RPD. Field replicate minimum	Matrix spike 50% to 150% or control limits at ±3 standard deviations based on actual lab data	5 ng/L	No SWAMP requirement; will use 90%.
Laboratory Analyses	*Enterococcus*	Laboratory positive and negative cultures-proper positive and negative response. Bacterial PT sample-within the stated acceptance criteria.	R_{log} within 3.27* mean R_{log}	NA	10 MPN	SWAMP Requirement 90%

Table 7 (cont).

Group	Parameter	Accuracy	Precision	Recovery	Target Reporting Limits	Completeness
Sediment Samples						
Laboratory Analyses	Total Organic Carbon (TOC)	Standard Reference Materials (SRM, CRM, PT) within 95% CI stated by provider of material or Laboratory Control Standard (LCS) with 80% to 120% of true value	Laboratory duplicate, blind field duplicate, or MS/MSD ±25% RPD Laboratory duplicate minimum	Matrix spike 80% to 120% or control limits at ±3 standard deviations based on actual lab data	0.05 % DW	No SWAMP requirement; will use 90%
Laboratory Analyses	Grain Size	NA.	Laboratory duplicate, blind field duplicate, or MS/MSD ±25% RPD Laboratory duplicate minimum	A reference standard is analyzed with each batch of samples.	16 standard sieve sizes 0.001mm to 2 mm	No SWAMP requirement; will use 90%
Laboratory Analyses	Trace Metals	Standard Reference Materials (SRM, CRM, PT) 70% to 130%	Field replicate, laboratory duplicate, or MS/MSD ±30% RSD. Laboratory duplicate minimum	Matrix spike 70% to 130%	0.01 – 0.05 µg/g	No SWAMP requirement; will use 90%
Laboratory Analyses	PAHs	Standard Reference Materials (SRM, CRM, PT) within 95% CI stated by provider of material. If not available, then with 50% to 150% of true value	Field replicate of MS/MSD ±25% RPD. Field replicate minimum	Matrix spike 50% to 150% or control limits at ±3 standard deviations based on actual lab data	5 ng/g	No SWAMP requirement; will use 90%.
Laboratory Analyses	Acute Toxicity	Control samples using native sediment for test animals must have ≥90% survival	Reference toxicant tests within ±2 standard deviations of last 20 samples	NA	NA	No SWAMP requirement; will use 90%.
Laboratory Analyses	Benthic Invertebrates	≤ 5% difference	≤ 5% difference	NA	NA	SWAMP Requirement 100%

ELEMENT 8 SPECIAL TRAINING NEEDS/CERTIFICATION

Specialized Training or Certifications

Field Sampling

All field personnel shall be trained and have experience in proper field sampling and sample handling techniques, including chain of custody procedures prior to sampling. These techniques shall be reviewed prior to each sampling event.

Microbiology Laboratory

At a minimum, the microbiology laboratory shall be certified by the California Environmental Laboratory Accreditation Program (ELAP). All laboratory and field staffs shall be thoroughly trained on the requirements for sterile handling and processing. Laboratory staffs shall be trained, certified technicians and work closely with the laboratory manager. If an ELAP requirement is not met, justification will be provided in the report.

Benthic Laboratory

Currently, there is no state or national accreditation program for benthic infaunal analyses. However, all laboratory staff shall be thoroughly trained on all laboratory methods and test procedures.

Analytical Laboratory

At a minimum, the chemistry analytical laboratory shall be certified by ELAP for the analyses of inorganics, toxic chemical elements and organics in water and sediment. All laboratory and field staffs shall be thoroughly trained on the requirements for sterile handling and processing. If an ELAP requirement is not met, justification will be provided in the report.

Training and Certification Documentation

All personnel are responsible for complying with all quality assurance/quality control (QA/QC) requirements that pertain to their organizational and 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, quality assurance/quality control procedures, and records management.

Field Sampling

Field personnel will be trained in proper sampling techniques, sample handling, sample preservation and storage, sample transport, and chain of custody procedures.

Microbiology Laboratory

The Microbiology Laboratory training program begins with reviewing the Standard Operating Procedure (SOP) for a new task. The Laboratory Manager or a Senior Laboratory Technician demonstrates the procedure to the trainee, shows the appropriate steps in the SOP, and explains the significance of each step. The trainee later performs the procedure under the supervision of the Laboratory Manager or Senior Laboratory Technician. At this time, questions are answered and parts of the procedure may be demonstrated again to the trainee. The trainee continues to work under direct supervision until he/she can demonstrate the procedure with competence and full understanding. This process may be short or long depending on the procedure. Once the trainee has demonstrated competence, the Laboratory Manager completes a Training form. At this time the employee can work without supervision. This documentation is kept in files organized by individual with a separate form for each task. On an annual basis, the analyst is requalified, and this requalification is documented on the training form as well.

Benthic Laboratory

The Benthic Laboratory training program begins with reviewing the Standard Operating Procedure (SOP) for a new task. The Laboratory Manager or a Senior Laboratory Technician demonstrates the procedure to the trainee, shows the appropriate steps in the SOP, and explains the significance of each step. The trainee later performs the procedure under the supervision of the Laboratory Manager or Senior Laboratory Technician. At this time, questions are answered and parts of the procedure may be demonstrated again to the trainee. The trainee continues to work under direct supervision until he/she can demonstrate the procedure with competence and full understanding. This process may be short or long depending on the procedure. Once the trainee has demonstrated competence, the Laboratory Manager completes a Training form. At this time the employee can work without supervision. This documentation is kept in files organized by individual with a separate form for each task.

Analytical Laboratory

The Chemistry Analytical Laboratory training program begins with reviewing the Standard Operating Procedure (SOP) for a new task. The Laboratory Manager or a Senior Laboratory Technician demonstrates the procedure to the trainee, shows the appropriate steps in the SOP, and explains the significance of each step. The trainee later performs the procedure under the supervision of the Laboratory Manager or Senior Laboratory Technician. At this time, questions are answered and parts of the procedure may be demonstrated again to the trainee. The trainee continues to work under direct supervision until he/she can demonstrate the procedure with competence and full understanding. This process may be short or long depending on the procedure. Once the trainee has demonstrated competence, the Laboratory Manager completes a Training form. At this time the employee can work without supervision. This documentation is kept in files organized by individual with a separate form for each task. On an annual basis, the analyst is requalified, and this requalification is documented on the training form as well.

Training Personnel

The Project Manager will ensure training is provided for field personnel in proper field sampling techniques prior to work initiation to ensure consistent and appropriate sampling, sampling handling/storage, and chain of custody procedures.

ELEMENT 9 DOCUMENTS AND RECORDS

All aspects of the sample collection process, including generating field logs at each site and chain of custody forms for all samples, will be documented and tracked. Chain of custody forms will accompany water and sediment samples to the appropriate laboratory for analysis. The Project Manager will retain a copy of all COC's. Each laboratory will document and track all aspects of sample receipt and storage, analyses and reporting.

A database of information collected in this project will be maintained. The Data Manager will maintain this database.

After verification and final database establishment, the raw data files and databases shall be copied onto diskette for long-term electronic storage. All original data sheets, all statistical worksheets, and all reports produced shall be accumulated into project specific files that are maintained in locked file cabinets after the report has been submitted. Final report text and tables shall also be stored on disk. After data submissions, directories shall be archived electronically for storage offsite. In-house copies of data files shall be made on diskette when submitted. Records shall be maintained for at least five years or transferred according to agreement between the company and the client, should the laboratory transfer ownership. All records and analyses pertaining to accreditation shall be kept for a minimum of five years. If there is a change in company ownership, accreditation records for at least the last five years must be transferred to the new owner.

Laboratory results will be stored in a database system at each laboratories office and will be provided to the Project Manager either electronically or by hard copy. Data received from outside contractors shall be kept exactly as received (on original diskette); data shall be copied onto hard disk for editing as needed based on error checking and verification procedures.

Persons responsible for maintaining records for this project are as follows: the Project Manager will oversee the operations of the project and will arbitrate any issues relative to records retention and any decisions to discard records and will maintain all sample collection, sample transport, chain of custody and field analyses forms; the Data Manager will maintain the data; the Benthic Laboratory Manager will maintain the benthic infaunal data; the Microbiology Laboratory Manager will maintain the microbiology records; and the Chemistry Analytical Laboratory Manager will maintain the chemistry records.

Copies of this QAPP will be distributed to all parties involved with the project, including the County of Orange, the City of Oceanside, the City of San Diego, and the Port of San Diego. Updates to this QAPP will be distributed in like manner, and all previous versions will be discarded from the project file.

Copies of the final report, including laboratory results and field records will be maintained for a minimum of 5 years after project completion.

GROUP B:

DATA GENERATION AND ACQUISITION

ELEMENT 10 SAMPLING PROCESS DESIGN (EXPERIMENTAL DESIGN)

RHMP Core Monitoring Pilot Program

Station Locations

The Core Monitoring Pilot Program will be conducted at ten stations in each of two strata: freshwater input and marinas. These strata are expected to provide more variability than the other strata and provide the most conservative estimate of the number of years/samples needed for monitoring to detect trends. Stations are randomly selected each year from each of the strata. To randomly select the stations, maps of each of the bays are overlaid with uniformly sized hexagons; the size of the hexagons is determined by the smallest potential sampling area. In the case of this program, the size was determined by the smallest freshwater input area that was determined could be safely sampled. Hexagons were set at 100 ft (~65m) per side with the nominal sampling site at the center of the hexagon. Ten hexagons were selected randomly in each stratum with the stipulation that at least one station was set in each harbor. Replacement stations were drawn in case a station can not be sampled for logistical or safety reasons. Target station locations for sampling in 2005 are shown on Figures 2-6.

Sample Frequency

Samples will be collected annually during the summer months (July, August, or September).

Table 8. Number and Frequency of Water and Sediment Samples.

Sample Location	Total Number of Samples	Type of Sample	Frequency of Samples
Water Samples			
Freshwater Stratum	10	CTD Profiles	Annually
	10	Chemistry surface water grab	Annually
	10	Enterococcus	Annually
Marina Stratum	10	CTD Profiles	Annually
	10	Chemistry surface water grab	Annually
	10	*Enterococcus*	Annually
Sediment Samples			
Freshwater Stratum	10	Grain size	Annually
	10	Chemistry	Annually
	10	Amphipod toxicity	Annually
	10	Benthic infauna	Annually
Marina Stratum	10	Grain size	Annually
	10	Chemistry	Annually
	10	Amphipod toxicity	Annually
	10	Benthic infauna	Annually

Figure 2. Target station locations in Dana Point Harbor for 2005.

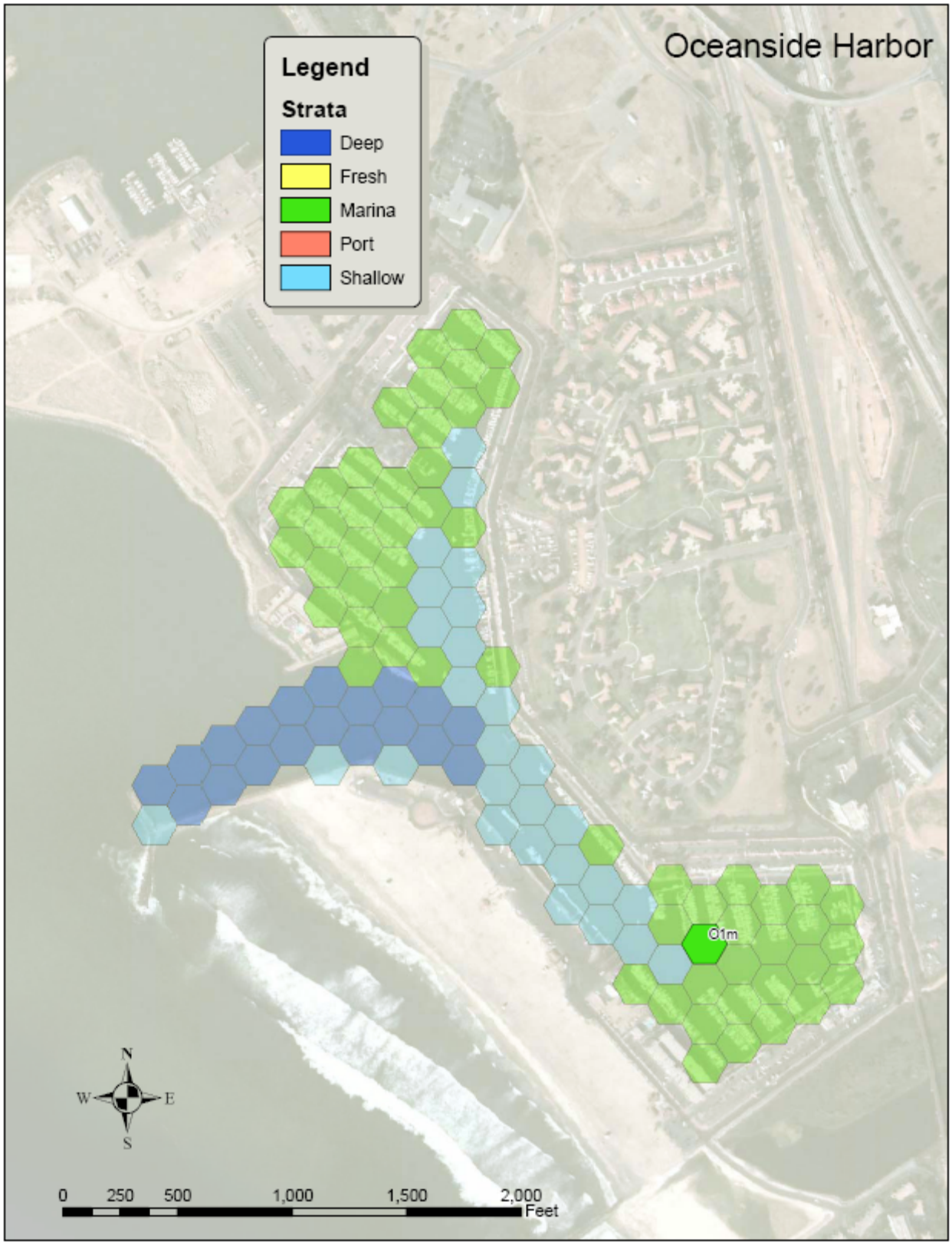

Figure 3. Target station locations in Oceanside Harbor for 2005.

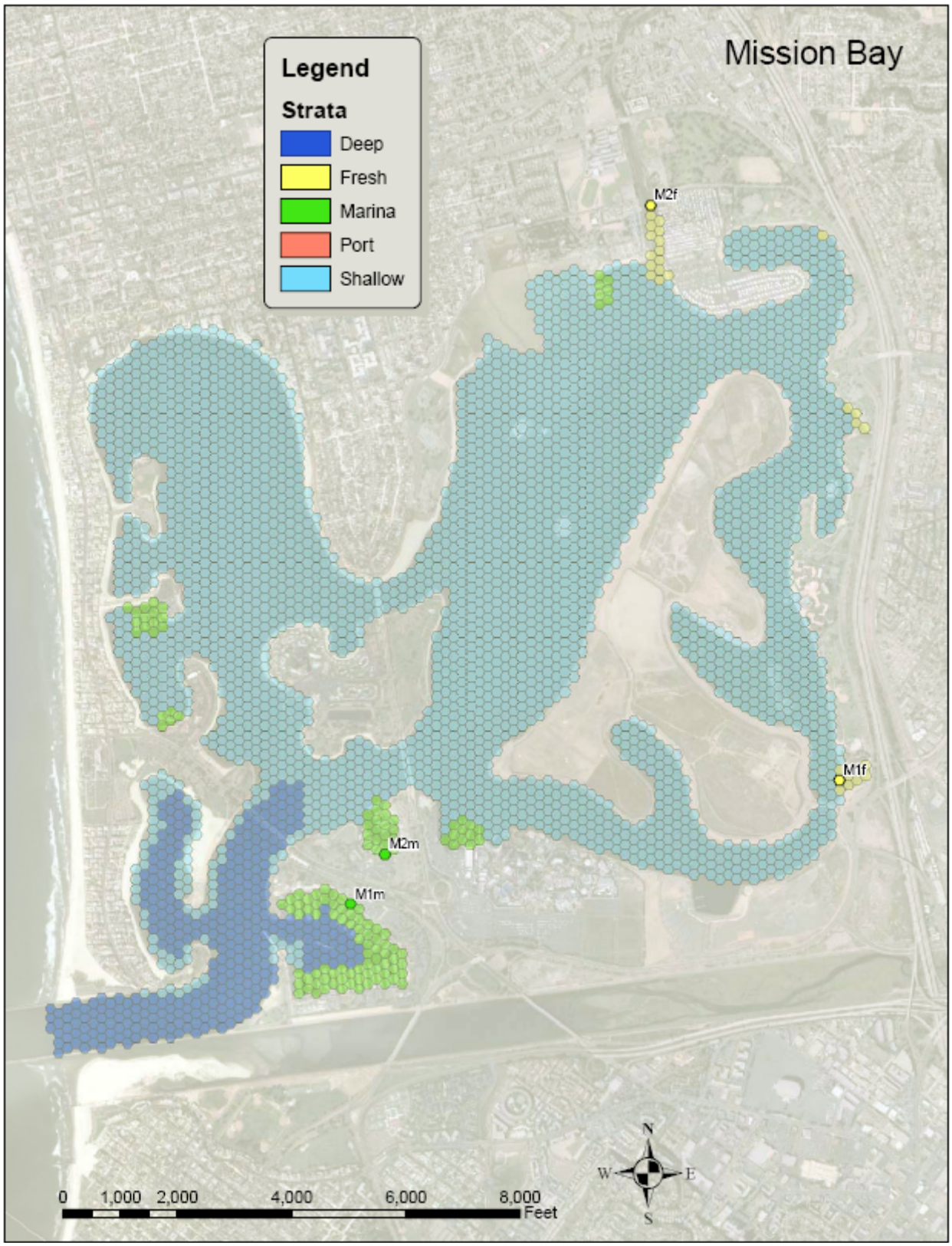

Figure 4. Target station locations in Mission Bay for 2005.

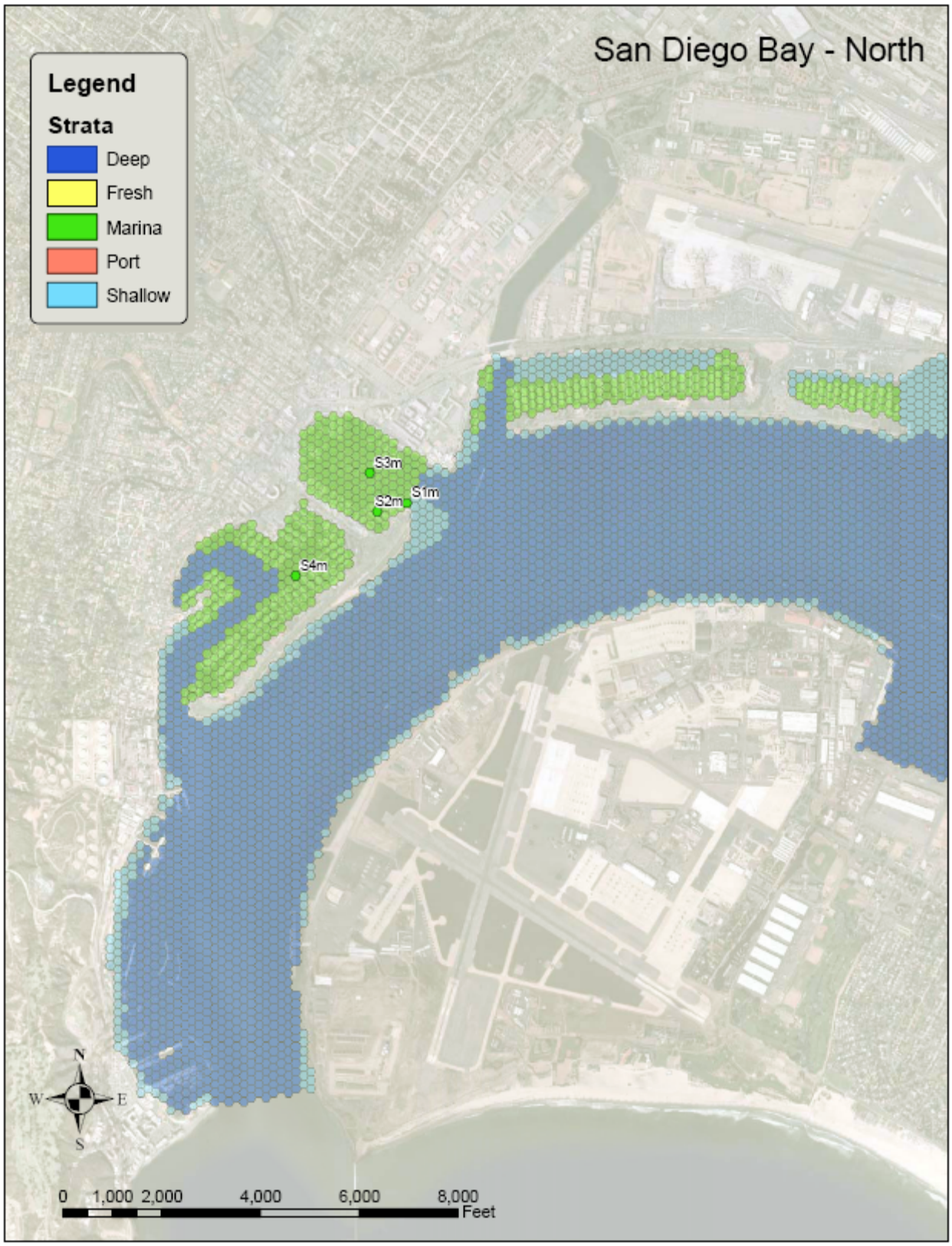

Figure 5. Target station locations in northern San Diego Bay for 2005.

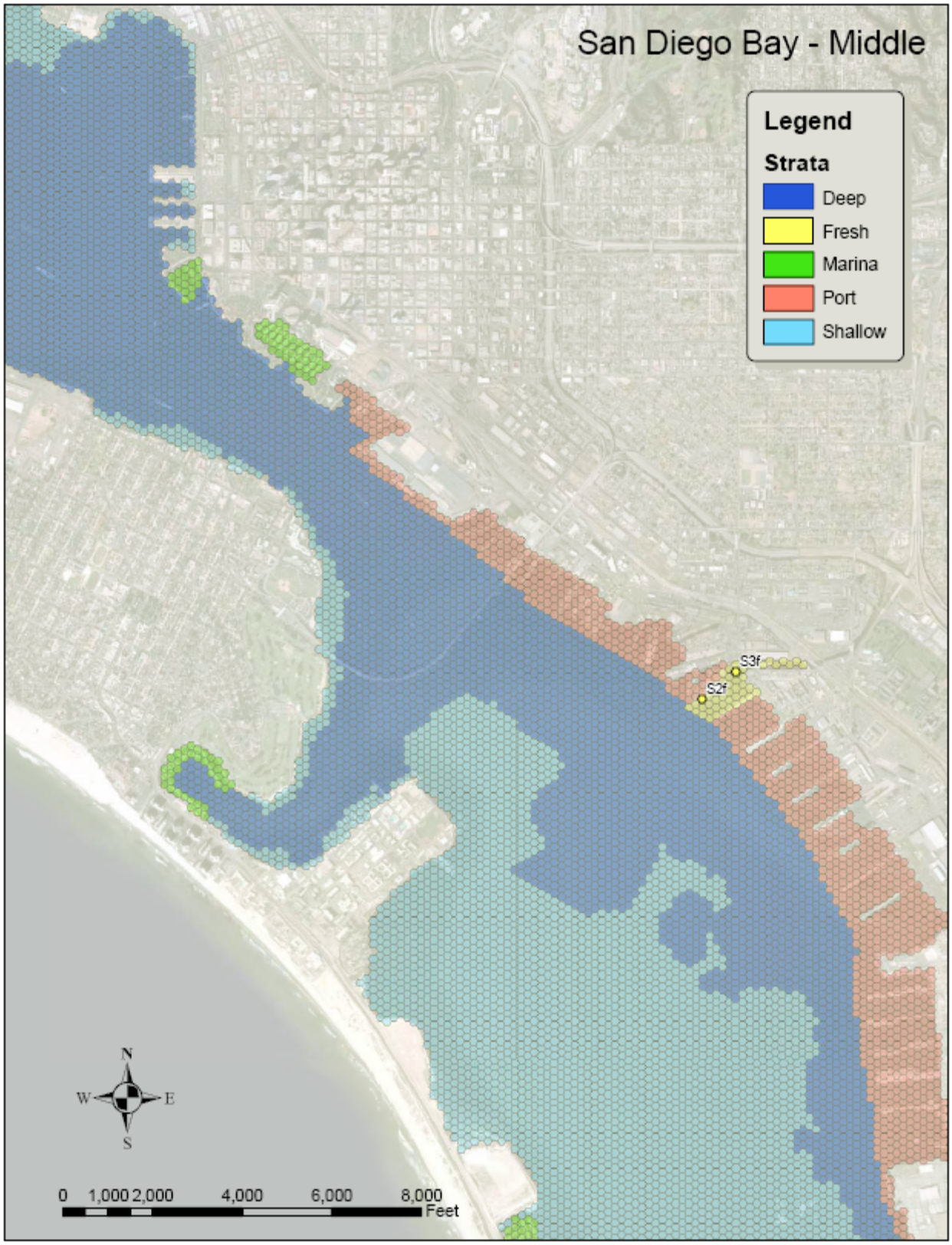

Figure 6. Target station locations in central San Diego Bay for 2005.

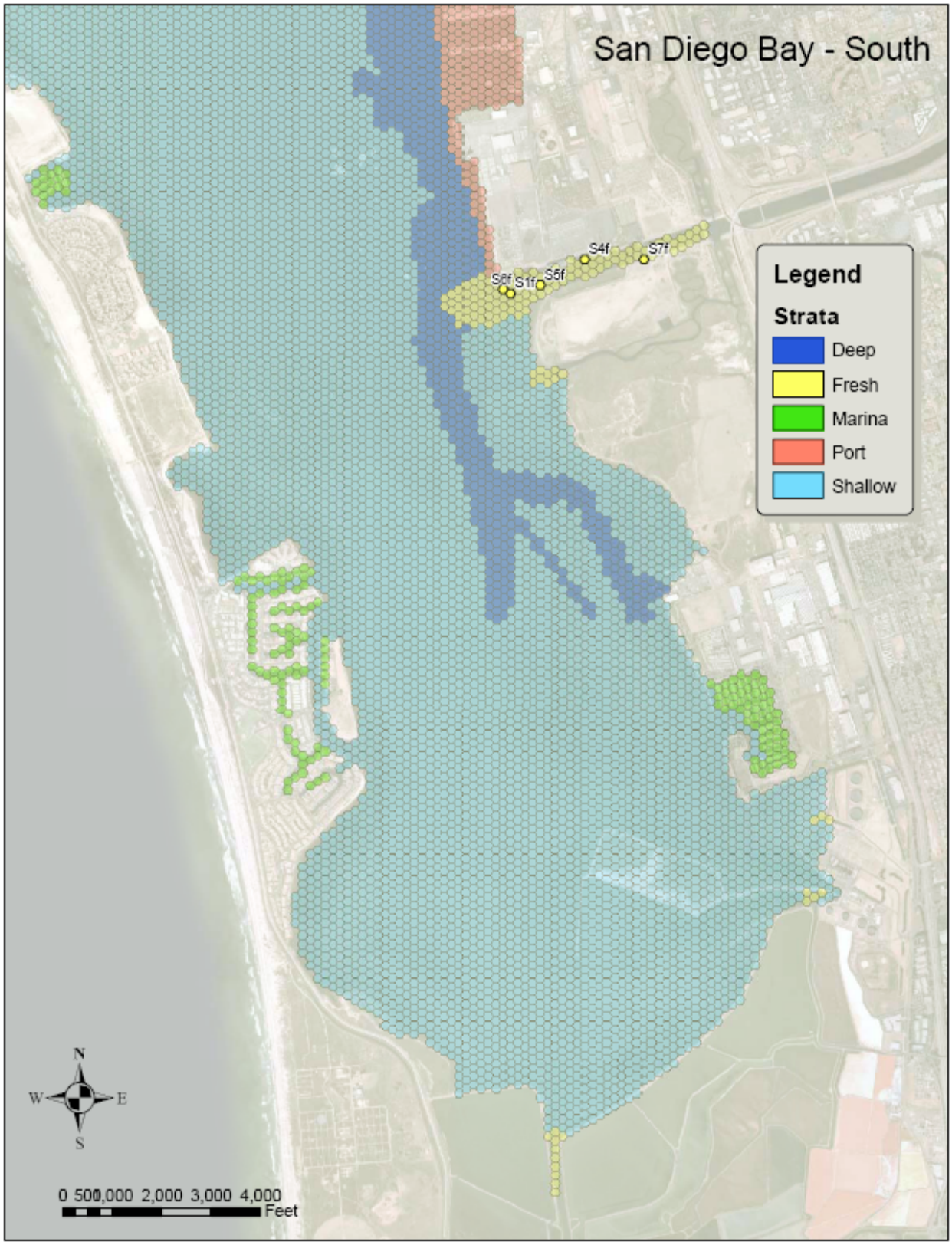

Figure 7. Target station locations in southern San Diego Bay for 2005.

ELEMENT 11 SAMPLING METHODS

Vessel Operations

All vessels shall be piloted by Coast Guard licensed operators and be covered by requested insurance limits ($1,000,000). All vessels shall have the required Coast Guard safety equipment. At a minimum, each vessel shall have cellular telephone as well as radio communication, depth finder and a Differential GPS navigation system. All sampling locations will be plotted on NAD 1983 Datum charts. Each vessel will have the necessary space for sampling equipment and for holding samples. If the vessel cannot provide refrigerated space, coolers with wet ice, blue ice, and/or dry ice will be utilized as appropriate.

Water Sampling

Water quality sampling will characterize depth-related gradients in general descriptive oceanographic properties. Water-column profiling using conductivity-temperature-depth profilers (CTDs) will describe gradients in hydrogen ion content (pH), specific conductance, dissolved oxygen, temperature, and transmissivity. In addition, a discrete water sample will be collected from one meter below the surface at each site for more thorough chemistry analyses. Discrete water samples will be analyzed for TOC, DOC, total and dissolved metals, total hardness (as $CaCO_3$), PAHs and the indicator bacteria, *Enterococcus*.

Differential global positioning system (dGPS) will be used to determine station locations. Water column sampling will be performed with a SBE-25 CTD equipped with sensors that measure temperature, conductivity, pressure, dissolved oxygen, pH, and light transmission (Sea Tech). Discrete water samples will be collected with Niskin bottles attached to a cable and triggered to close by a messenger sent down the cable.

A pre-cruise equipment checkout will be conducted within 24 hours prior to the survey. This includes a visual inspection of the equipment (e.g., plugs are secure and waterproof, computer output test for CTD sensors, and checking battery status). During the survey, routine visual inspection of cast profiles will be performed so immediate action can be taken to resample sites with bad data. Before beginning a cast, a 3 minute equilibration upon initial start up and 90 second at each station thereafter will be performed to bring the CTD sensors to thermal equilibration with the ambient sea water. The CTD will be lowered to within 1m of bottom with a descent rate within 0.25-0.50 m/sec. The instrument will operate at a scan rate of 8 scans/sec. A post cruise calibration will be performed within 24 hours of the last sampling for the survey.

Preservation and storage protocols will be performed as specified in Table 9.

Samples will be shipped under the appropriate conditions for each sample within 2 days of collection to the appropriate laboratory for immediate analysis.

Hard copies of all sensor and equipment factory maintenance, pre-and post-cruise calibration sheets and CTD field data sheets will be maintained and made available upon request.

Table 9. Water Sample Volume, Container, and Preservation

Analytical Parameter	Sample Volume	Containers (#, size, type)	Preservation (chemical, temperature, light protected)
Water Samples			
pH	N/A	Analyzed in Field	N/A
Specific Conductance	N/A	Analyzed in Field	N/A
Dissolved Oxygen	N/A	Analyzed in Field	N/A
Temperature	N/A	Analyzed in Field	N/A
Transmissivity	N/A	Analyzed in Field	N/A
Total Organic Carbon	250 mL	1, 500 mL Amber Glass	Store Cool at <4ºC
Dissolved Organic Carbon	250 mL	1, 500 mL Amber Glass	Store Cool at <4ºC
Total and Dissolved Trace Metals	100 mL	1, 1 L Plastic	Store Cool at <4ºC
Total Hardness	100 mL	1, 100 mL Plastic	HNO_3; Store Cool at <4ºC
PAH's	2 L	2, 1 L Amber Glass	Store Cool at <4ºC
Enterococcus	100 mL	1, 100 mL Plastic	Store Cool at <4^{o}C

Sediment Sampling

Sediment sampling will collect samples for benthic infaunal analysis, sediment chemistry, grain size, and sediment toxicity.

Differential global positioning system (dGPS) will be used to determine station locations. All sampling will be conducted within a 30 m radius of the nominal site coordinates. Prior to the survey, the planned sampling locations within each harbor will be mapped to make sure they are accessible for sediment sampling. The actual position of the vessel at the point at which samples are collected (i.e. the point at which the grab contacts the seafloor) will be recorded for each benthic grab. Field sampling will be conducted between sunrise and sunset. A 0.1 m^2 Van Veen grab sampler made of stainless steel will be used. A minimum of four successful benthic grabs will be required: 1 for benthic infauna, 1 for sediment chemistry, and 2 for sediment toxicity.

The grab sampler will be lowered at 2 m/sec until it is 5 m above the bottom; then lowered at 1 m/sec. Upon retrieval of the grab, the surface of the grab will be inspected for acceptability. To be acceptable, the surface of the grab must be even, with minimal surface disturbance and little or no leakage of overlying water. If the grab is acceptable, the overlying water will be carefully drained. For infaunal samples, the overlying water will be screened; any organisms captured on the screen will be added to the infaunal sample. The depth of the sediment in the grab will then measured to ensure acceptable penetration depth of at least 5 cm. If a grab is found not to be

acceptable, additional grab samples will be taken. If successful grabs cannot be collected from two successive sites within 30 m, the site will be repositioned. Samples for benthic infaunal analysis will be screened onboard the vessel through a 1.0 mm mesh screen with filtered wash water. The material retained on the screen will be placed in a jar and solution of relaxant will be added. After 30 minutes, buffered formalin will be added to obtain approximately 10% formalin solution.

Samples for sediment chemistry will be collected from the top 2 cm of the grab. Sediment within 1 cm of the sides of the grab will be avoided. Sediment grain size and total organic carbon will each require one quart sized Ziploc™ bag (Table 10). Trace metals and organics will each require one 8 oz jar of sample. Samples for sediment grain size will be stored at 4°C on ice. Other samples will be stored at 4°C, and frozen within 24 hr. Samples for toxicity will also be collected from the top 2 cm of the grab with a total of 2 L of sample collected in two 1-L jars. Toxicity samples will be maintained in the dark at 4°C on ice. Samples for chemistry will be delivered to the appropriate laboratory within a week of collection along with associated chain-of-custody forms.

Field observations and sampling positions will be recorded on cruise logs and sediment sampling data forms.

Table 10. Sediment Sample Volume, Container, and Preservation.

Analytical Parameter	Sample Volume	Containers (#, size, type)	Preservation (chemical, temperature, light protected)
Sediment Samples			
Total Organic Carbon (TOC)	100 g	1, qt Ziploc™ bag or 1, 4 oz glass jar	Store Cool at <4°C; Frozen within 24 hr
Grain Size	100 g	1, qt Ziploc™ bag	Store Cool at <4°C
Trace Metals	50 g	1, 8 oz Glass Jar	Store Cool at <4°C; Frozen within 24 hr
PAHs	50 g	1, 8 oz Glass Jar	Store Cool at <4°C; Frozen within 24 hr
Acute Toxicity	2 liters	2, 1-liter jar	Store Cool at <4°C
Benthic Infauna	-	1-liter Clear Glass	10% formalin

ELEMENT 12 SAMPLE HANDLING CUSTODY

Water Quality Samples

Chemistry and bacterial samples will be labeled with the project name, sample identification number, site location, date and time collected, analyses to be performed, and sample preservatives (if any). Samples will then be stored and transported on ice (4 °C) to the proper analytical laboratory. Samples will be delivered to the appropriate laboratory and analyses initiated within specified holding times (Table 11).

Table 11. Sample Holding Times

Parameter	Holding Time
Water Samples	
pH	-
Specific Conductance	-
Dissolved Oxygen	-
Temperature	-
Transmissivity	-
Total Organic Carbon	28 Days
Dissolved Organic Carbon	28 Days
Total and Dissolved Trace Metals	48 Hours
Total Hardness	48 Hours
PAHs	Extraction: 7 Days, Analysis: 40 Days
Enterococcus	6 Hours
Sediment Samples	
TOC	28 Days
Grain Size	6 Months
Trace Metals	6 Months
PAHs	40 Days
Acute Toxicity	36 hours
Benthic Infauna	Fix to 70% Ethanol: 7 Days; Analysis: 2 Years

Sediment Quality Samples

Sample bottles will be properly labeled with the project name, sample identification number, site location, date and time collected, analyses to be performed, and sample preservatives (if any). Samples will then be stored and transported on ice (4°C) to the proper analytical laboratory.

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 (Appendix A), field logbooks and field tracking forms. COC procedures will be used for all samples throughout the collection, transport and analytical process.

COC procedures will be initiated during sample collection. A COC record was 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 container 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 (i.e., confirming all samples are accounted for and properly labeled, the temperature of the sample and integrity of the sample jar) 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.

ELEMENT 13 ANALYTICAL METHODS

Table 12 lists the analytical methods for constituents analyzed in a laboratory.

Table 12. Laboratory Analytical Methods.

Analyte	Analytical Method		Achievable Laboratory Limits	
	Analytical Method/SOP	Modified for Method yes/no	Method Detection Limit	Laboratory Reporting Limit
Water Samples				
Conventionals – CRG Marine Laboratories, Inc.				
Total Organic Carbon	EPA 415.1	No	0.1 mg/L	1.0 mg/L
Dissolved Organic Carbon	EPA 415.1	No	0.1 mg/L	1.0 mg/L
Total Hardness	SM 2340B	No	1 mg $CaCO_3$/L	5 mg $CaCO_3$/L
Total and Dissolved Metals – CRG Marine Laboratories, Inc.				
Arsenic	EPA 200.8	No	0.1 µg/L	0.5 µg/L
Cadmium	EPA 1640	No	0.1 µg/L	0.2 µg/L
Chromium	EPA 200.8	No	0.1 µg/L	0.5 µg/L
Copper	EPA 1640	No	0.1 µg/L	0.5 µg/L
Lead	EPA 1640	No	0.1 µg/L	0.5 µg/L
Mercury	EPA 200.8	No	0.05 µg/L	0.1 µg/L
Nickel	EPA 1640	No	0.1 µg/L	0.5 µg/L
Selenium	EPA 200.8	No	0.1 µg/L	0.5 µg/L
Silver	EPA 200.8	No	0.1 µg/L	0.5 µg/L
Zinc	EPA 200.8	No	0.1 µg/L	0.5 µg/L
Polynuclear Aromatic Hydrocarbons (PAHs) – CRG Marine Laboratories, Inc.				
1-Methylnaphthalene	EPA 625	No	1 ng/L	5 ng/L
1-Methylphenanthrene	EPA 625	No	1 ng/L	5 ng/L
2,3,5-Trimethylnaphthalene	EPA 625	No	1 ng/L	5 ng/L
2,6-Dimethylnaphthalene	EPA 625	No	1 ng/L	5 ng/L
2-Methylnaphthalene	EPA 625	No	1 ng/L	5 ng/L
Acenaphthene	EPA 625	No	1 ng/L	5 ng/L
Acenaphthylene	EPA 625	No	1 ng/L	5 ng/L
Anthracene	EPA 625	No	1 ng/L	5 ng/L
Benz[a]anthracene	EPA 625	No	1 ng/L	5 ng/L
Benzo[a]pyrene	EPA 625	No	1 ng/L	5 ng/L
Benzo[b]fluoranthene	EPA 625	No	1 ng/L	5 ng/L

Analyte	Analytical Method		Achievable Laboratory Limits	
	Analytical Method/SOP	Modified for Method yes/no	Method Detection Limit	Laboratory Reporting Limit
Benzo[e]pyrene	EPA 625	No	1 ng/L	5 ng/L
Benzo[g,h,i]perylene	EPA 625	No	1 ng/L	5 ng/L
Benzo[k]fluoranthene	EPA 625	No	1 ng/L	5 ng/L
Biphenyl	EPA 625	No	1 ng/L	5 ng/L
Chrysene	EPA 625	No	1 ng/L	5 ng/L
Dibenz[a,h]anthracene	EPA 625	No	1 ng/L	5 ng/L
Fluoranthene	EPA 625	No	1 ng/L	5 ng/L
Fluorene	EPA 625	No	1 ng/L	5 ng/L
Indeno[1,2,3-c,d] pyrene	EPA 625	No	1 ng/L	5 ng/L
Naphthalene	EPA 625	No	1 ng/L	5 ng/L
Perylene	EPA 625	No	1 ng/L	5 ng/L
Phenanthrene	EPA 625	No	1 ng/L	5 ng/L
Pyrene	EPA 625	No	1 ng/L	5 ng/L
Bacterial Indicators – Weston Solutions, Inc.				
Enterococcus	SM 9230B	No	1 MPN	10 MPN
Sediment Samples				
Conventionals - Weston Solutions, Inc.				
Total Organic Carbon (TOC)	EPA 415.1	No	0.01 % Dry Wt	0.05 % Dry Wt
Grain Size	Plumb 1981	No		
Total Metals – CRG Marine Laboratories, Inc.				
Arsenic	EPA 6020	No	0.025 µg/g	0.05 µg/g
Cadmium	EPA 6020	No	0.025 µg/g	0.05 µg/g
Chromium	EPA 6020	No	0.025 µg/g	0.05 µg/g
Copper	EPA 6020	No	0.025 µg/g	0.05 µg/g
Lead	EPA 6020	No	0.025 µg/g	0.05 µg/g
Mercury	EPA 6020	No	0.005 µg/g	0.01 µg/g
Nickel	EPA 6020	No	0.025 µg/g	0.05 µg/g
Selenium	EPA 6020	No	0.025 µg/g	0.05 µg/g
Silver	EPA 6020	No	0.025 µg/g	0.05 µg/g
Zinc	EPA 6020	No	0.025 µg/g	0.05 µg/g

Analyte	Analytical Method		Achievable Laboratory Limits	
	Analytical Method/SOP	Modified for Method yes/no	Method Detection Limit	Laboratory Reporting Limit
PAHs – CRG Marine Laboratories, Inc.				
1-Methylnaphthalene	EPA 8270C	No	1 ng/g	5 ng/g
1-Methylphenanthrene	EPA 8270C	No	1 ng/g	5 ng/g
2,3,5-Trimethylnaphthalene	EPA 8270C	No	1 ng/g	5 ng/g
2,6-Dimethylnaphthalene	EPA 8270C	No	1 ng/g	5 ng/g
2-Methylnaphthalene	EPA 8270C	No	1 ng/g	5 ng/g
Acenaphthene	EPA 8270C	No	1 ng/g	5 ng/g
Acenaphthylene	EPA 8270C	No	1 ng/g	5 ng/g
Anthracene	EPA 8270C	No	1 ng/g	5 ng/g
Benz[a]anthracene	EPA 8270C	No	1 ng/g	5 ng/g
Benzo[a]pyrene	EPA 8270C	No	1 ng/g	5 ng/g
Benzo[b]fluoranthene	EPA 8270C	No	1 ng/g	5 ng/g
Benzo[e]pyrene	EPA 8270C	No	1 ng/g	5 ng/g
Benzo[g,h,i]perylene	EPA 8270C	No	1 ng/g	5 ng/g
Benzo[k]fluoranthene	EPA 8270C	No	1 ng/g	5 ng/g
Biphenyl	EPA 8270C	No	1 ng/g	5 ng/g
Chrysene	EPA 8270C	No	1 ng/g	5 ng/g
Dibenz[a,h]anthracene	EPA 8270C	No	1 ng/g	5 ng/g
Fluoranthene	EPA 8270C	No	1 ng/g	5 ng/g
Fluorene	EPA 8270C	No	1 ng/g	5 ng/g
Indeno[1,2,3-c,d] pyrene	EPA 8270C	No	1 ng/g	5 ng/g
Naphthalene	EPA 8270C	No	1 ng/g	5 ng/g
Perylene	EPA 8270C	No	1 ng/g	5 ng/g
Phenanthrene	EPA 8270C	No	1 ng/g	5 ng/g
Pyrene	EPA 8270C	No	1 ng/g	5 ng/g
Other - Weston Solutions, Inc.				
Acute Toxicity	EPA/600/R-94/025		na	na
Benthic Infauna	-	na	na	na

ELEMENT 14 QUALITY CONTROL

Field Measurements

Water Quality Samples

All field measurements for pH, specific conductance, dissolved oxygen, temperature and transmissivity will be made using a Seabird Electronics SBE 25 CTD profiler according to manufacturer's specifications. Calibration will be conducted prior to each sampling event. Proper storage and maintenance procedures for the CTD will be followed.

Chemistry Analyses

Water Quality Samples

Quality assurance and quality control for sampling processes begin with proper collection of the samples in order to minimize the possibility of contamination. All water samples are collected in laboratory supplied laboratory-certified, contaminant free sample bottles.

The chemistry, analysis of the water samples will be performed under the guidelines of the quality assurance and quality control programs established by CRG Marine Laboratories, Inc. CRG Marine Laboratories' QAPP is provided in Appendix B.

Sediment Quality Samples

The chemistry analysis of the sediment samples will be performed under the guidelines of the quality assurance and quality control programs established by CRG Marine Laboratories, Inc.

Microbiology Laboratory Quality Control

The microbiological analysis of the water samples will be performed under the guidelines of the quality assurance and quality control programs established by the analytical laboratory. These guidelines The Weston Microbiology Laboratory adheres to strict ELAP and NELAP quality control guidelines. Appendix C contains the Weston Microbiology Laboratory quality control procedures. Any deviation from theses procedures is reported.

Benthic Laboratory Quality Control

The Weston Benthic Laboratory adheres to strict NELAP quality control guidelines. Appendix D contains the Weston Benthic Laboratory quality control procedures. Any deviation from theses procedures is reported.

Bioassay Laboratory Quality Control

The Weston Bioassay Laboratory adheres to strict NELAP quality control guidelines. Appendix E contains the Weston Benthic Laboratory quality control procedures. Any deviation from theses procedures is reported.

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, chain of custody forms, sample labels, sampling bottles, decontamination equipment and tools. Field measurement equipment will be checked for operation in accordance with the manufacturer's specifications. Equipment will be inspected prior to use and when returned from use for damage. The Project Manager will be responsible for implementing the field maintenance program.

Microbiology Laboratory

Each type of equipment/instrument has a written SOP that describes the methods for routine inspection, cleaning, maintenance, testing, calibration, and/or standardization of the equipment. Instrument operating manuals are kept near the instrument or where analysts have easy access.

Analysts using the instruments are properly trained and have developed troubleshooting skills that will enable them to recognize problems, their causes, and appropriate corrective actions, quickly and accurately to reduce equipment failure and reduce dependence upon outside servicing agencies. In complicated cases, the servicing agency or supplier is called to solve the problem.

Written equipment records are kept to document all inspection, maintenance, troubleshooting, calibration, or modifications. The records contain the date, description of the maintenance done, the actual findings, and the name of the person doing the maintenance.

Performance criteria are established for judging when data from instrument performance checks indicate the need to make adjustments in the instrument operating conditions.

Benthic Laboratory

Each type of equipment/instrument has a written SOP that describes the methods for routine inspection, cleaning, maintenance, testing, calibration, and/or standardization of the equipment. Instrument operating manuals are kept near the instrument or where analysts have easy access.

Analysts using the instruments are properly trained and have developed troubleshooting skills that will enable them to recognize problems, their causes, and appropriate corrective actions, quickly and accurately to reduce equipment failure and reduce dependence upon outside servicing agencies. In complicated cases, the servicing agency or supplier is called to solve the problem.

Written equipment records are kept to document all inspection, maintenance, troubleshooting, calibration, or modifications. The records contain the date, description of the maintenance done, the actual findings, and the name of the person doing the maintenance.

Performance criteria are established for judging when data from instrument performance checks indicate the need to make adjustments in the instrument operating conditions.

Analytical Laboratory

CRG maintains its equipment in accordance with its SOP's, which include those specified by the manufacturer and those specified by the method. Section 11 of CRGs QAPP specifies equipment and system evaluations (Appendix B). This QAPP has been reviewed by Weston's Quality Assurance Officer and found to be in compliance with SWAMP criteria.

ELEMENT 16 INSTRUMENT/EQUIPMENT CALIBRATION AND FREQUENCY

All equipment and instruments used at Weston are operated and calibrated according to the manufacturer's recommendations as well as by criteria defined in individual SOPs. Operation and calibration are performed by personnel properly trained in these procedures. Documentation of all routine and special calibration information is recorded in appropriate log books 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

The water quality instruments will be calibrated per manufacturer's specifications prior to and following each survey. Complete records of calibration are maintained for all instruments.

Microbiology Laboratory

All equipment and instruments used at Weston are operated and calibrated according to the manufacturer's recommendations as well as by criteria defined in individual SOPs. Operation and calibration are performed by personnel properly trained in these procedures. Documentation of all routine and special calibration information is recorded in appropriate log books 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.

Benthic Laboratory

All equipment and instruments used at Weston are operated and calibrated according to the manufacturer's recommendations as well as by criteria defined in individual SOPs. Operation and calibration are performed by personnel properly trained in these procedures. Documentation of all routine and special calibration information is recorded in appropriate log books 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.

Bioassay Laboratory

All equipment and instruments used at Weston are operated and calibrated according to the manufacturer's recommendations as well as by criteria defined in individual SOPs. Operation and calibration are performed by personnel properly trained in these procedures. Documentation of all routine and special calibration information is recorded in appropriate log books 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.

Analytical Laboratory

CRG calibrates its instrumentation at a frequency that ensures the validity of the results. CRG's calibration procedures follow USEPA guidelines and the recommendations of the instrument manufacturer. Section 7 of CRG's QAPP (Appendix B) provides detailed information on their calibration procedure.

ELEMENT 17 INSPECTION/ACCEPTANCE OF SUPPLIES AND CONSUMABLES

All 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.

Microbiology Laboratory

Supplies purchased from outside sources must be of adequate quality to sustain confidence in the laboratory's tests. If no independent assurance of the quality of outside supplies is available, the laboratory will first perform tests with the new supplies to be sure that they comply with specified requirements.

Benthic Laboratory

Supplies purchased from outside sources must be of adequate quality to sustain confidence in the laboratory's tests. If no independent assurance of the quality of outside supplies is available, the laboratory will first perform tests with the new supplies to be sure that they comply with specified requirements.

Bioassay Laboratory

Supplies purchased from outside sources must be of adequate quality to sustain confidence in the laboratory's tests. If no independent assurance of the quality of outside supplies is available, the laboratory will first perform tests with the new supplies to be sure that they comply with specified requirements.

ELEMENT 18 NON-DIRECT MEASUREMENTS

The program will also incorporate existing monitoring efforts where appropriate in order to make effective use of resources and bridge data gaps, where necessary.

ELEMENT 19 DATA MANAGEMENT

Data will be maintained as established in Element 9. All original data sheets, statistical worksheets and reports produced will be accumulated into project specific files that are maintained at Weston's Carlsbad, CA office in locked file cabinets. Data files, databases, final report text and tables are copied onto diskette for storage onsite. Directories are archived on tape for storage offsite. Records will be maintained for a minimum of five years after project completion. Results will be transmitted to clients by telephone, facsimile or electronically.

GROUP C:

ASSESSMENT AND OVERSIGHT

ELEMENT 20 ASSESSMENTS AND RESPONSE ACTIONS

Corrective Action Plans

An out-of-control event is defined as any occurrence failing to meet pre-established criteria. A nonconformance is a deficiency in characteristic, documentation, or procedure sufficient to make the quality indeterminate or unacceptable. An out-of-control event is a subcategory of nonconformance.

When either situation is identified, it will be categorized as:

Deficiency: Recognition of a specific requirement (e.g., program, process, or procedure) that has been violated.

Observation: Recognition of an activity or action that might be improved but is not in violation of a specific requirement. Left alone, the activity or action may develop into a deficiency.

Criteria Used for Determination of an Out-of-Control Event

Factors that affect data quality (failure to meet calibration criteria, inadequate recordkeeping, improper storage, or preservation of samples) require investigation and corrective action.

When a nonconformance is recognized, each individual involved with the analysis in question has an interactive role and responsibility. These are as follows:

- **Technician:** He/She must be able to recognize non-conformances and immediately notify the Laboratory Manager and work with the Quality Assurance Officer to solve the problem. Each technician is responsible for documenting and correcting problems that might affect quality.

- **Laboratory Manager:** He/She must review all analytical and QC data for reasonableness, accuracy, and clerical errors. In an out-of-control event, the Laboratory Manager works with the analyst and Quality Assurance Officer to solve the problem and prevents the reporting of suspect data by stopping work on the analysis in question and insuring that all results that are suspect are repeated, if possible, after the source of the error is determined and remedied. Clients are notified in writing when their work is affected by an out-of-control event or results of an internal audit. 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.

- **Quality Assurance Officer:** In the event that an out-of-control situation occurs that is unnoticed at the bench or supervisory level, the Quality Assurance Officer will notify the Laboratory Manager; help identify and solve the problem where applicable; ensure the work is stopped on the analysis; and verify that no suspect

data are reported. The Quality Assurance Officer must review and approve all corrective action reports and submit them to the Laboratory Manager for review. The Quality Assurance Officer is responsible for reviewing nonconformance report forms, recommending or approving proposed corrective actions, maintaining an up-to-date nonconformance log, and verifying that corrective actions have been completed.

Procedures for Stopping Analysis

Whenever the analytical system is out-of-control, investigation and correction efforts are initiated by all concerned personnel as outlined in Table 13.

If the problem is instrumental or specific only to preparation of a sample batch, samples are reprocessed after the instrument is repaired and recalibrated.

Corrective Action

The need for corrective action comes from several sources: equipment malfunction; failure of internal QA/QC checks; failure of follow-up on performance or system audit findings; and noncompliance with QA requirements.

When measurement equipment or analytical methods fail QA/QC requirements, the problems will immediately be brought to the attention of the Laboratory Manager and Quality Assurance Officer. Corrective measures to be taken will depend entirely on the type of analysis, the extent of the error, and whether the error is determinant or not. The corrective action to be taken is determined by either the Laboratory Manager, technicians, the Project Manager, and the Quality Assurance Officer or by all of them in conference, if necessary; but final approval is the responsibility of the Quality Assurance 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. All attempts will be made to reanalyze all 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 problems and implement corrective actions immediately. A step-by-step analysis and investigation to determine the cause of the problem shall take place as part of the corrective action program. If the problem cannot be controlled, the laboratory will analyze the impact on the data. Clients will be notified if their data are affected.

When a system audit reveals an unacceptable performance, work shall be suspended until corrective action has been implemented and performance has been proven to be acceptable.

Table 13. Laboratory Corrective Action Plan for Potential Analytical Problems

Problems in Lab Area		Actions to be Taken
A.	**Sample Receipt, Log-in, and Labeling**	
1.	Sample containers received broken	Notify Laboratory Manager
2.	Sample cannot be located	Notify Laboratory Manager
3.	Samples received without proper refrigeration of preservation	Notify Project Manager
4.	Illegible sample numbers or label missing from sample containers	Notify Project Manager
5.	No instructions received with samples	Notify Project Manager
6.	Shipment container received damaged upon arrival	Notify Laboratory Manager
7.	Chain-of-custody document does not match information indicated on sample label and containers received	Notify Laboratory and Project Managers
8.	Samples received past the holding time requirement	Notify Project Manager
B.	**Sample Refrigeration and Preservation**	
1.	No indication on the chain-of-custody or sample container that the sample was preserved	Notify Project Manager
2.	Discovery of sample storage (i.e., refrigeration) malfunction	Notify Laboratory and Project Managers
C.	**Analytical Method**	
1.	If at anytime you are not in agreement with the method to be used or some portion of the method	Notify Laboratory Manager
D.	**Sample Preparation**	
1.	Loss of sample	Notify Laboratory Manager
2.	Knowledge of making a mistake in analysis	Notify Laboratory Manager
3.	Calibration mistake	Notify Laboratory Manager
E.	**Storage**	
1.	Label or labels have come off of the storage container	Notify Laboratory Manager
F.	**Standard Preparation**	
1.	Doubt as to the purity of the standard material	Notify Laboratory Manager
2.	Question whether standard (stock or working) is “too old” (expired)	a. Check expiration of the standard if available; if not, check SOP on standard expiration. b. Notify Laboratory Manager
G.	**Instrument Analysis**	
1.	Blank or reference are out-of-compliance	a. Check instrument operating condition b. Do corrective maintenance c. Reanalyze affected samples as necessary
H.	**Data Review**	
1.	The recovery of material from spiked sample is not within the limits set prior to analysis (e.g., outside control chart limits)	a. Notify Laboratory Manager b. Check standard solutions c. Check instrument performance d. If no explanation, re-prepare and reanalyze QC and affected samples
2.	The data are contrary to that expected (historical background does not agree)	Notify Laboratory and Project Manager

If an external audit (system or performance) report identifies deficiencies that require corrective action, the Quality Assurance Officer shall notify the responsible supervisor and log the pertinent information. The Quality Assurance Officer and the responsible supervisor shall assure that corrective action is taken. The Quality Assurance Officer shall verify that the problem has been corrected. The Laboratory Manager shall transmit the response to the external organization, with copies to the Quality Assurance file.

All incidents of QA failure and corrective action tasks will be documented and reports will be placed in the appropriate contract file. Also, corrective action will be taken promptly for deficiencies noted during the visual inspection of raw data. When corrective actions are implemented, evidence of correction of deficiencies will be presented. Corrective action documentation will be forwarded to the Quality Assurance Officer and the Project Manager for evaluation and approval.

Documenting Corrective Action

If, at any time during analyses, a process is out-of-control, corrective action shall be taken, and documented, with regard to:

- What actions were taken to bring the process back into control
- What actions were taken to prevent recurrence of the out-of-control situation
- What was done with the data obtained while the process was out-of-control

This is accomplished by filling out a corrective actions form (Appendix F). This form is initiated either by the Laboratory Manager or the Quality Assurance Officer depending on where the problem is recognized. The report will include the following information:

- Nature of the problem
- Sample lot affected
- Corrective action measure(s) taken and final resolution of the problem
- Dates (date recognized, date occurred, date corrected)
- Signature of the Quality Assurance Officer, Project Manager, Reporter, and Laboratory Manager.

Field Corrective Action

The initial responsibility for monitoring the quality of field measurements lies with the field personnel. The Field Supervisor is responsible for verifying that all QC procedures are followed. This requires that the Field Supervisor assess the correctness of the field methods and the ability to meet QA objectives and make a value judgment regarding the impact a procedure has upon the field objectives and subsequent data quality. If a problem occurs that might jeopardize the integrity of the project, cause a QA objective not to be met, or impact data quality, the Field Supervisor will immediately notify the Project Manager. Corrective action measures are then decided upon and implemented. The Field Supervisor 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 Project Manager and the Quality Assurance Officer.

Complaints

Following submission of reports, it is Weston's policy to follow-up with clients to be certain they have received all deliverables and their expectations have been met. If a complaint is received that concerns the quality of data received, the Quality Assurance Office shall promptly audit that area of the laboratory. Documentation of the complaint, the audit, and subsequent activities shall be maintained.

ELEMENT 21 REPORTS TO MANAGEMENT

Table 14 outlines the schedule of reports due to the Project Director.

Table 14. Management Reports.

Type of Report	Frequency (daily, weekly, monthly, quarterly, annually, etc.)	Projected Delivery Dates(s)	Person(s) Responsible for Report Preparation	Report Recipients
Sampling and Analysis Plan	Once	July 2005	Project Manager	Ports' Project Director
Quality Assurance Project Plan	Once	July 2005	Project Manager	
Progress Reports	Semi-Annually	October and April 2006, 2007, 2008	Project Manager	
Summary Report	Annually	May 2006, 2007, 2008	Project Manager	
Final Project Report	Once	June 2008	Project Manager	

GROUP D:

DATA VALIDATION AND USABILITY

ELEMENT 22 DATA REVIEW, VERIFICATION AND VALIDATION

Data validation is the process whereby data are filtered and accepted or rejected, based on a set of criteria. It is a systematic procedure of reviewing a body of data against a set of criteria to provide assurance of its validity prior to its intended use. All data are checked for accuracy and completeness. The data validation process consists of data generation, reduction, and review (Element 23). Requirements of the NELAC Standards and Good Automated Laboratory Practices (EPA Document 2185, 1995) are followed for computer processing, manipulation, reporting, storage, and retrieval of data.

Data reduction, validation, and reporting are on-going processes which involve the technicians, Laboratory Managers, and QA personnel.

ELEMENT 23 VERIFICATION AND VALIDATION METHODS

Database Generation

After each survey, the field data sheets are removed from the field log books and all sheets are checked for completeness and accuracy by the QA Officer or Project Manager. All appropriate field sheets must be present. If there are any questions, clarification from the Field Supervisor is obtained as soon as possible. Field data sheets and the field logbook are placed into folders by data type, labeled with the data type and survey number, and filed in the appropriate filing cabinet.

In the laboratory, technicians document sample preparation activities 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 all samples; the use of sample tracking and numbering systems to track the progress of samples through the laboratory; and the use of quality control criteria to reject or accept specific data.

The data for all laboratory analyses are entered directly onto data sheets. All data sheets should be filled-in in non-fallible ink and signed by the technician, who is responsible for scanning the sheet to be sure it is complete and accurate.

The technician who generates the data has the prime responsibility for the accuracy and completeness of the data. Each technician reviews the data to ensure that:

- Sample description information is correct and complete
- Analysis information is correct and complete
- Results are correct and complete
- Documentation is complete

Data sheets are turned into the QA Officer. (For small jobs, the project manager may enter the data directly.) A Tracking Sheet is initialed when the data are ready for transmittal to a data entry operator. All data sheets are copied before transmittal to the data entry operator. The copies are kept by the QA Officer; the originals are delivered to the data entry operator. Copies are checked for legibility; these must be used for data entry should the originals be lost or destroyed.

Data files are assigned a job number, and given a file name, which will be used when the file is put on diskette. Data sheets destined for data entry are logged out with the QA Officer or designee.

Data are entered by double-entry. A comparison is automatically made by the data entry system, which signals the operator if there is a discrepancy between the two files; this discrepancy is then resolved. In the event that a discrepancy cannot be resolved, the project manager will be notified.

When data return from data entry, they are logged back in with the QA Officer, who checks to be sure all the files have been returned; date of return is recorded. The data files are copied onto the hard disk and titled appropriately.

Error Checking and Verification

For large projects, the database establishment program is run. Standard database reduction occurs on the computer during the database establishment program (see SOPs for program names and specifics). The establishment programs run a number of checks. Error files and a listing of the raw data are printed.

The QA Officer resolves and corrects on data sheets and in raw data file any errors reported in the files; the printout is notated with corrections, initialed and dated.

The raw data file is printed. 10% of the stations are selected randomly, and the raw data file is checked against the original data by the QA Officer or designee. If any errors are found in this 10%, they are corrected and another 10% is checked. Any errors found are corrected on the raw data printout and the data entry sheets. If no errors are found, the station checked is marked 'OK'. The process is continued until no errors are found in the check. After the raw data is checked, the top sheet is marked with the date the checking was completed, percentage of data checked, and the initials of the QA Officer or designee. The raw data printout used for error checking is saved and filed with the data entry sheets. Any errors in the raw data file are corrected, and the establishment program is rerun.

After the database has been established, the data entry copies may be discarded, and the original data entry sheets and raw data printouts filed.

Further chemistry 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.

Data validation includes dated and signed entries by the technicians and Laboratory Manager on the bench sheets and notebooks used for all samples; the use of sample tracking and numbering systems to track the progress of samples through the laboratory; and the use of quality control criteria to reject or accept specific data.

The minimum requirements for each analytical run area:

- Matrix spike and duplicate analyses per concentration level and per matrix for every sample batch analyzed (where appropriate).

- Reference materials analyses are compared with "true" values and acceptable ranges. Values outside the acceptable ranges indicate that the sample values are invalid. Following correction of the problem, the reference material should be reanalyzed.

For microbiological data, the integrity of the results is determined after review of positive and negative controls, sterility checks, verification samples, and duplicate samples. The Weston microbiology laboratory Quality Assurance officer, Rosabel Dias, will do all reviews at the lab.

For data produced from the Weston benthic laboratory the integrity of the data is assessed through the use of a variety of measures. Test results and adequate fulfillment of environmental testing parameters are taken into consideration during the data validation process. Any deviations of test protocol are reported with test results. The Weston benthic laboratory Quality Assurance officer, Satomi Yonemasu, will do all reviews at the lab.

For all Weston laboratories, in the data review process, the data are compared to information such as the sample's history, sample preparation, and QC sample data to evaluate the validity of the results. Corrective action is 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.

Data Reporting

Data tables are created and printed. Tables are reviewed for any errors or irregularities; if any are found it may be necessary to correct and re-establish the databases or the dictionaries. Tables are submitted to Project Manager for review. The tables and report are edited by at least two of the following three people; the QA Officer, the Project Manager, and the Laboratory Director. The report returns to the office staff for any corrections, and then the final draft is reviewed once again by the QA Officer. The Project Manager signs the letter of transmittal.

ELEMENT 24 RECONCILIATION WITH USER REQUIREMENTS

The quality assurance personnel will review data after each survey to determine if data quality objectives (DQOs) have been met. If data do not meet the project's specifications, the quality assurance personnel will review the errors and determine if the problem is due to calibration/maintenance, sampling techniques, or other factors. They will suggest corrective action. It is expected that the problem would be able to be corrected by retraining, revision of techniques, or replacement of supplies/equipment. If not, then the DQOs will be reviewed for feasibility. If specific DQOs are not achievable, the quality assurance personnel will recommend appropriate modifications. Any revisions would need approval by the Weston Project Manager and the Port of San Diego Project Manager.

Appendix A

Chain of Custody Form

☐ 2433 Impala Drive • Carlsbad, CA 92008 • (760) 931-8081, FAX 931-1580
☐ 98 Main St., Ste. #428 • Tiburon, CA 94920 • (415) 435-1847, FAX 435-0479
☐ 1440 Broadway, Ste. 908 • Oakland, CA 94612 • (510) 808-0302, FAX 891-9710
☐ 152 Sunset View Lane • Sequim, WA 98382 • (360) 582-1758, FAX 582-1679
☐ 4729 NE View Drive • Port Gamble, WA 98364 • (360) 297-6903, FAX 297-6905

CHAIN OF CUSTODY

№ 10150

DATE_____ PAGE_____ OF_____

PROJECT NAME / SURVEY / PROJECT NUMBER					NUMBER &TYPE OF CONTAINERS	ANALYSIS/TEST REQUESTED						FOR WESTON USE ONLY	
PROJECT MANAGER													
COMPANY													
ADDRESS													
PHONE/FAX													
SAMPLE I.D.	DATE	TIME	MATRIX	INITIALS							PRESERVED HOW/ COMMENTS	SAMPLE TEMP. UPON RECEIPT	WESTON LAB ID

SPECIAL INSTRUCTIONS/COMMENTS:

SHIPPING:

Shipping VIA: Airbill No:

SAMPLE CONDITION UPON RECEIPT (FOR WESTON USE ONLY):

RELINQUISHED BY	RECEIVED BY	RELINQUISHED BY	RECEIVED BY	RELINQUISHED BY	RECEIVED BY
Signature	Signature	Signature	Signature	Signature	Signature
Firm	Firm	Firm	Firm	Firm	Firm
Date/Time	Date/Time	Date/Time	Date/Time	Date/Time	Date/Time

WHITE – return to originator • YELLOW – lab • PINK – retained by originator

Appendix B

CRG Marine Laboratories, Inc.
QAPP

CRG MARINE LABORATORIES
2020 Del Amo Blvd, Torrance, California 90501, (310) 533-5190

QUALITY ASSURANCE PROGRAM DOCUMENT

Approved by:

_____ _____

Richard Gossett, Laboratory Director Date

1.0 TABLE OF CONTENTS

2.0 INTRODUCTION

2.1 CRG Marine Laboratories, Inc., Torrance, CA (CRG) is committed to providing quality environmental analytical services to all of its clients. To maintain this high level of quality, an extensive Quality Assurance Program (QA) has been implemented within CRG. The purpose of this manual is to document the QA practices utilized by CRG. It describes the applications and concepts employed to assure that results generated by CRG are in control, scientifically valid, of known highest possible quality, and can be used with a high degree of confidence by the client or user.

2.2 CRG is certified by the California Environmental Laboratory Accreditation Program (ELAP) for the analyses of inorganics, toxic chemical elements and organics in wastewater, Certificate No. 2261.

2.3 The format of this manual is patterned after that outlined in the California Department of Health Services Application for Environmental Laboratory Accreditation.

2.4 This document is intended for use as a reference document to CRG's Quality Assurance Program. It is designed to assist all staff members to perform the operations necessary to comply with all client and contractual requirements and to ensure that data produced by CRG conforms to the highest standards set by state and/or federal regulations.

3.0 ORGANIZATIONS AND RESPONSIBILITY

3.1 CRG operates two environmental laboratories at the following locations:

2020 Del Amo Blvd, Suite 200
Torrance, CA 90501

355 Van Ness, Suite 115
Torrance, California 90501

3.2 Quality Assurance Staff Responsibilities

The Laboratory Director is ultimately responsible and accountable for all activities related to the generation of technical data by or for CRG. In order to carry out these QA responsibilities and facilitate

the integration of QA into all data generation activities, certain responsibilities have been delegated to other CRG employees.

3.2.1 The **Laboratory Director** is responsible for the following activities:

A. Provides leadership and technical direction for the organization

B. Removes barriers that limit the ability of individuals to obtain their goals and introduces change as a positive opportunity for the growth of the individual and CRG

C. Ensures that adequate QA/QC provisions are developed and incorporated into all laboratory data generation activities

D. Ensure that adequate resources are provided to meet these objectives

E. Ensure that specific QC procedures conform to the requirements specified by the client or project manager

F. Participates in appropriate certification programs and audit programs to establish credibility and demonstrate proficiency

G. Ensure that deficiencies or problems identified through audits are corrected as expeditiously as possible

H. Ensure that all routinely used analytical and administrative procedures are covered by well-written Laboratory Operating Procedures (LOP)

I. Ensure that all staff members are adequately qualified and trained to perform assigned tasks

J. Ensure that equipment is adequately maintained for the intended use

K. Ensure that the laboratory is a safe, efficient, and productive work environment.

3.2.2 The **Quality Assurance Specialist** is responsible for the following activities:

A. Maintain and update the Quality Assurance Program and this QA Manual

B. Serve as a QA liaison with clients and project managers

C. Coordinate accreditation/certification and auditing activities

D. Assess the adequacy of QC activities within the laboratory and keep the Laboratory Director informed of their effectiveness

E. Ensure that data is validated with respect to QC criteria

F. Ensure that all chain-of-custody requirements are met

G. Issue and evaluate the analyses of performance evaluation samples

H. Ensure that audit results are communicated with the appropriate staff and corrective actions are taken when needed

I. Identify and recommend staff training needs

J Work with the various laboratory staff to assure that LOPs are documented and meet the established quality standards

3.2.3 The **Organics Supervisor** is responsible for the following activities:

A. Develop, update, and implement modern state-of-the-art instrumental analysis techniques to cost-effectively meet CRG's requirements

B. Provide organic analytical testing services including priority pollutants and other regulated organic chemicals to CRG's clients

C. Validate data generated by the Organic Chemistry Section to assure that all quality objectives are met

D. Responsible for financial performance of the Organic Chemistry Section

E. Provide necessary training for all subordinates

F. Provide a safe working environment.

3.2.4 The **Inorganics Supervisor** is responsible for the following activities:

A. Develop, update, and implement modern state-of-the-art instrumental analysis techniques to cost-effectively meet CRG's requirements

B. Provide inorganic analytical testing services including metals and wet chemistry to CRG's clients

C. Validate data generated by the Inorganic Chemistry Section to assure that all quality objectives are met

D. Responsible for financial performance of the Inorganic Chemistry Section

E. Provide necessary training for all subordinates

F. Provide a safe working environment.

3.2.5 The **Microbiology Supervisor** is responsible for the following activities:

A. Develop, update, and implement modern state-of-the-art analytical techniques to cost-effectively meet CRG's requirements

B. Provide Microbiology analytical testing services including indicator bacteria, bacterial viruses and other microorganisms CRG's clients

C. Validate data generated by the Microbiology Section to assure that all quality objectives are met

D. Responsible for financial performance of the Microbiology Section

E. Provide necessary training for all subordinates

F. Provide a safe working environment.

3.2.5 The **Sample Custodian** is responsible for the following activities:

A. Receipt, login, and storage of all analytical chemistry samples

B. Review all chain-of-custody forms, record sample condition, and resolve inconsistencies and problems

C. Serve as liaison between Project Managers and Analysts with respect to handling rush orders

D. Purchase, label, preserve, pack, and ship all appropriate sample containers provided to clients

E. Ensure that all laboratory samples are ultimately disposed of according to the laboratory guidelines.

4.0 QA OBJECTIVES FOR MEASUREMENT DATA

4.1 Data Quality Objectives (DQOs) for the data collection activity describe the overall level of uncertainty that a decision-maker is willing to accept in results derived from environmental analyses. The objective of CRG's Quality Assurance Program is to ensure that the validity and reliability of the data meets client's requirements in terms of DQOs. The program follows the guidelines established by the California Department of Health Services and the U.S. EPA.

Since DQOs often vary with individual projects, CRG sets internal specifications that are strict enough to meet a majority of client's requirements. Project-specific DQO's can be found in the Quality Assurance Project Plans (QAPPs) for that project.

4.2 DQOs for analytical determinations are expressed in terms of accuracy, precision, detection limits, completeness, and comparability. Section 11 of this manual describes the types of quality control checks used to measure these objectives and the procedures used to derive them. Table 1 outlines typical accuracy, precision, and method detection limit objectives for each field of

testing. Specific DQOs for each parameter are contained within the LOP used for anlaysis.

5.0 SAMPLING PROCEDURES

CRG provides trained staff for sample collection purposes. Proper sampling includes using appropriate equipment, containers, and preservation as well as following strict procedures for collection, storage, and transport to prevent cross contamination and loss of sample integrity.

CRG provides appropriate containers and sampling procedures to those clients who choose to perform their own sampling. CRG staff refers to EPA guidelines published in the Federal Register, 40 CFR Part 136.3 and Standard Methods for the Examination of Water and Wastewater, 20th Ed, for container selection and preservation.

6.0 SAMPLE CUSTODY

To produce legally defensible data, CRG maintains and demonstrates custody control of all samples. Two components of custody are addressed: physical possession and documentation.

6.1 Documentation begins with field records, including a chain-of-custody (COC) form, which follows the physical sample from the field to the laboratory. The Sample Custodian checks to insure that:

A. The sample container is clearly marked and agrees with the information provided on the chain-of-custody sheet

B. The evidence tape is unaltered and the container is intact

C. The sample was supplied in the proper type of container

D. The sample has not exceeded its maximum holding time

E. Sufficient sample volume exists to perform the requested analyses

F. Samples requiring analysis by a contract laboratory are packaged with an ice substitute and dunnage, and are shipped in an ice chest to the contract laboratory. A chain-of-custody sheet accompanies all samples shipped from CRG.

6.2 If samples are delivered without a COC, one is completed at the laboratory prior to acceptance of the samples. The Sample Custodian shall note on the COC any discrepancies between the physical sample and the custody record.

6.3 Once received, each sample is assigned a unique laboratory ID number and logged into a bound Sample Receiving Logbook. Key characteristics are recorded into the logbook, the COC is filed with the project file, and the sample is placed in the appropriate storage location until analysis.

7.0 CALIBRATION PROCEDURES AND FREQUENCY

7.1 All instrumentation is calibrated at a frequency that ensures the validity of the results. These procedures are carried out following USEPA guidelines and the recommendations of the instrument manufacturer.

7.2 Calibration standards are prepared either from purchased stock standards or from stock standards prepared in-house utilizing reagents suitable for the preparation of standards. When available, calibration standards are prepared from starting materials that are certified traceable to the National Institute of Standards Technology (NIST).

7.3 The following is a brief summary of the instrumentation calibration procedures employed at CRG. Detailed descriptions of these procedures are contained with the appropriate method.

7.3.1 The gas chromatograph or gas chromatograph mass spectrometer is calibrated using either an external calibration procedure or internal standard. For each parameter of interest, at least three to five different concentrations of standards are employed. One of the concentrations is near the Method Detection Limit (MDL) for each parameter. Concentrations of the remaining standards correspond to the expected range of concentrations found in the samples analyzed. Calibration standards are prepared by utilizing secondary dilution standards and/or stock solutions. Calibration standards may include a set of internal standards at a known constant amount. The base peak m/z shall be used as the primary m/z for quantification of the standards. Sensitivity of the instrument is checked every 10 samples by analyzing the external reference samples. If the result is not within a predetermined range, the problem is corrected, and

the samples immediately following the last acceptable check are reanalyzed

7.3.2 The Inductively Coupled Mass Spectrometer (ICPMS) is calibrated before each use. For each parameter of interest, at least three to five different concentrations of standards are employed. One of the concentrations is near the Method Detection Limit (MDL) for each parameter. Concentrations of the remaining standards correspond to the expected range of concentrations found in the samples analyzed. Calibration standards are prepared by utilizing secondary dilution standards and/or stock solutions. Calibration standards may include a set of internal standards at a known constant amount. Sensitivity of the instrument is checked every 10 samples by analyzing the external reference samples. If the result is not within a predetermined range, the problem is corrected, and the samples immediately following the last acceptable check are reanalyzed

7.3.3 The performance of the balances is monitored against a set of calibration weights that are traceable to NIST (a log is maintained of these inspections)

7.3.4 Temperature records are maintained for all refrigerators, incubators, water baths, ovens. The temperatures are monitored at a frequency determined by how often the equipment is placed in service.

8.0 ANALYTICAL PROCEDURES

Analytical procedures are determined by current environmental regulations set forth by both state and federal guidelines. Analytical methods are published in CRG's Laboratory Operating Procedures Manual (LOPM). Revisions and updates of the LOPMs are developed as required. The LOPMs are numbered to correspond with their standard reference method.

8.1 The manual includes the methods employed by CRG for the analyses required to support CRG's clients

8.2 The format of the LOPM is patterned after those listed in the Code of Federal Regulations.

8.3 The LOPMs are prepared by senior members of the technical staff and approved by the Laboratory Director.

8.4 The LOPM is a controlled document. Each manual is assigned to an individual who has custodial responsibilities. Revised LOPMs are issued with a new revision letter. The custodian updates the manual and is responsible for replacing the previous section(s) with the revised section(s). This insures that the analyst is always working to the latest revision of test procedures and protocols. A history file is maintained of all revisions to the LOPM. A memorandum is attached to each revision in the history file summarizing the reason for the change.

8.5 Research and development projects and methods development projects are documented in bound laboratory notebooks.

9.0 DATA REDUCTION, VALIDATION, AND REPORTING

Laboratory results are communicated to CRG's clients through the analytical report delivered either electronically or by mail. This document is based on the client's laboratory order or by group of related samples.

9.1 Data reduction- Data reduction is the process by which the analyst translates raw data into a reported result that is reviewed by a second party then approved by the section supervisor before being released in the final report. Specific calculations and verification processes are summarized in the respective LOPMs.

All determinations are performed by dedicated instrumentation equipped with a microcomputer. Results are stored in a computer file, reported in a printed report and then electronically transferred to the database. A sequence logs containing the sample position, and order of analysis is kept both electronically and hardcopy. Sample results are tracked by the computer filename cross-referenced to the unique sample ID number.

9.2 Data validation - Data validation involves ensuring the correct assignment of sample labels before instrument operation, checking the performance of the instrument, verification of successful completion of all quality-control checks, and fitness of the calculations performed by the computer.

9.3 Data Management **-** Sample analytical data including ID, date and time of collection and analyses, type of requested field and laboratory analyses, and results are entered into a Laboratory Information Management System (LIMS), which is a Microsoft Access-based database system. After data entry, all results from

sample analyses and QA/QC are reviewed for accuracy and completeness and any reporting of laboratory results are based on queries from the LIMS.

9.4 Reports **-** Electronic and/or hard copy reports are provided based on client's need. The basic report includes a header containing the CRG sample ID number, date collected, date received, date processed, prepared, date analyzed, client sample information, batch ID number, replicate number, and instrument identification. Electronic data deliverables can be designed to meet any client requests and based upon queries of the LIMS database. The section supervisor prior to release to the client reviews the final report.

9.5 Records Storage - CRG archives all client final reports and instrument files in electronic format (pdf and/or Excel) for a period of 7 years following completion of project. CRG archives all laboratory records including raw data, charts, printouts and data books in hard copy format for a period of 7 years following completion of project.

10.0 INTERNAL QUALITY CONTROL CHECKS

Quality control measurements verify the integrity of the analytical results. While the goal of all quality control procedures remains constant, specific quality control procedures vary from method to method. Every analyst is responsible for a thorough understanding of the goals of each quality control measurements and the control analyses as required per method.

10.1 A batch is defined as a group of 20 or fewer samples of similar matrix, processed together under the same conditions and with the same reagents. Quality control samples are associated with each batch and are used to assess the validity of the sample analyses. Control limits can be found in Table 4.1 of this document. Each batch must include the following QC checks:

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

10.1.2 Laboratory Control Material (LCM) or Certified Reference Material (CRM)- A LCM or CRM is a sample with a matrix similar to the client samples that contains analytes of interest at known or certified concentrations. It is used to determine

the accuracy of the results based on the comparison of the measured concentration with the true value. For analytes that are greater than 10 times the MDL, the acceptable percent recovery is presented in Table 4.1.

10.1.3 Duplicate Analyses- Duplicate analyses are samples that have been split and processed within a single batch. They are used to determine the precision of the results based on the percent relative difference (%RSD) between the two sets of results. Control limits for %RSD are presented in Table 4.1.

10.1.4 Matrix Spike/Matrix Spike Duplicates (MS/MSD)- MS/MSD are samples of similar matrix to the client's samples that are spiked with a known amount of analyte. Spike recovery measures the effect of interferences caused by the sample matrix and reflects the accuracy of the determination. The spike level should be at least ten times the MDL. The duplicate spike may be used to determine the precision of the analytical results similar to Section 10.1.3.

10.1.5 Tuning Check- The tuning of the mass spectrometer is checked at the beginning of each run to insure that it is providing adequate spectra.

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

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

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

10.1.9 Recovery Surrogate- A recovery surrogate is a non-target analyte or analytes that are added to the sample prior to

processing. It is used to indicate the extraction efficiency and instrument variation from sample to sample.

11.0 PERFORMANCE AND SYSTEM EVALUATIONS

CRG is dedicated to the continuous improvement of all of its operational systems. This is an essential part of everyone's job within CRG. Internal evaluations are conducted by staff from the Laboratory and are performed on a periodic basis.

11.1 CRG employs the philosophy of Continuous Measurable Improvement systems to evaluate its process performance and to identify opportunities for improvement on a continual basis. Five key elements are essential for the Continuous Measurable Improvement system to work efficiently. The first is to establish open and honest communication among all personnel. The second is to encourage decision making by delegating responsibility to the lowest appropriate levels of the work force. The third is to provide positive recognition for achievements and to strive continuously to identify and strengthen areas needing improvements. The fourth is to provide employees with the knowledge, skills, motivation, and working environment to meet their full potential and find personal satisfaction in their work. The fifth is to accept the concept of change as a positive opportunity for growth for both the individual and the organization.

11.2 With the five key elements of this philosophy in place, all levels of personnel can develop a true quantitative measurement system for assessing the status of meeting target goals in a wide variety of processes (i.e. improved accuracy, precision, training, safety, working environment, etc.). The system begins with a quantitative evaluation of the process based on a review of both historical and current capability and performance. Individual processes are selected as proposed projects based on whether they are in statistical control, predictable, and have attained target goals. CRG then prioritizes the selected projects based on frequency and magnitude of problem recurrence. Root-cause analysis is employed to establish control and eliminate the true sources of problems. Corrective actions are taken and the process is rerun to verify stability, capability and quality. If necessary, new target goals are set for the process and the system is repeated until the acceptable goal is achieved.

12.0 PREVENTIVE MAINTENANCE

12.1 Service contracts may be maintained for the major instrumentation and equipment that are no longer under warranty. The gas chromatographs, ICPMS instrumentation, and balances are typical examples of equipment that might be covered by a maintenance contract. Records of maintenance are kept by the person responsible for the equipment. Specific examples of routine preventive maintenance are further discussed in the following sections:

A. Hewlett Packard 5972 Gas Chromatograph/Mass Spectrometer System

1. Every six months, replace the MSD foreline pump oil and foreline trap pellets. During the fluid exchange, replace the outlet mist filter

2. Every year, check and if necessary replace the diffusion pump fluid

3. As needed, clean the ion source of the MSD (typically every six months)

4. As needed, the glass injector sleeve and injector septum for the split-splitless injector is replaced (typically once per month)

5. As needed, the gas purifiers and filters for the carrier gas are replaced

B. Hewlett Packard 4500 ICPMS System

1. Every six months, replace the oil and foreline trap pellets for the rough pumps. During the fluid exchange, replace the outlet mist filter

2. Every year check and replace the turbo molecular pump fluid

3. Once per month, clean the sample and skimmer cones

4. Once per week, replace the peripump tubing

5. As needed, clean the ion source of the mass spectrometer

6. Every three months, clean the nebulizer

13.0 ASSESSMENT OF PRECISION AND ACCURACY

13.1 CRG utilizes several methods to monitor precision and accuracy. These are designed to determine the reproducibility of the analysis (precision) or agreement of the result to the actual value of the analyte (accuracy). CRG routinely performs analysis of blind samples. This procedure is explained in section 14. The following definitions describe the types of analyses performed to assess precision and accuracy:

A. Duplicate analyses involve performing two separate analyses of a particular parameter on the same sample. Precision is measured by the degree of agreement between the two sample results. Duplicate analyses are designed to measure the precision of a determination when the sample contains detectable amounts of the constituent

B. Laboratory control material or certified reference material are samples that have known concentrations of the target analytes. These concentrations are either based on a series of analyses or are certified by an external laboratory such as NIST. Accuracy is determined by comparing the measured amount of analyte recovered during analysis to the known value

C. Sample spikes are samples that a known amount of the analyte has been added. Accuracy is determined by the amount of the added material recovered during analysis

D. Blank spikes or water spikes are used if poor recovery from a spiked sample occurs, analysis of blank spikes is useful to determine if the poor performance is a function of the sample matrix or the analytical process. These consist of the usual sample portion of deionized water spiked with the constituent at a concentration equivalent to that of the sample spike

E. Replicate spike analyses are employed to determine the precision and accuracy of an analysis when some or all of the parameters being determined are below the detection limit. The replicate spike procedure involves analyzing the sample and two portions of the sample spiked with a measured portion of the same analyte. Relative precision of

the spikes can be determined as well as the accuracy of the analysis. Spike concentrations are sufficient to eliminate the bias that would be created by the undetectable quantity of the parameter being determined

13.2 One set of duplicate samples or spike duplicates, a LCM or CRM sample, and a method blank are analyzed with each batch of samples.

13.3 The ongoing evaluation of relative precision and accuracy performance is accomplished by the generation of control charts. Employing a minimum of 20 results, control limits are generated utilizing the mean and standard deviation of the data set. Upper and lower “warning" limits are twice the standard deviation from the mean of the set of results for accuracy charts and twice the standard deviation from the origin for precision charts. Upper and lower "out of control" limits are three times the standard deviation from the mean for accuracy charts and three times the standard deviation from the origin for precision charts. When relative precision or accuracy results suggest atypical performance, an investigation into the problem is initiated. If a sample result is outside the out-of-control limits, the sample is reanalyzed. If samples cannot be reanalyzed, the result is flagged.

14.0 CORRECTIVE ACTIONS AND TRAINING

14.1 Corrective Actions

14.1.1 Corrective action is the process of defining- root-cause, identifying and implementing corrective action plans, educating - and training to provide system-wide solutions, and verifying that the improved system is being followed. Corrective action responses are divided into three separate categories based on the time required to complete the-corrective action. An immediate corrective action occurs when a response that fully meets closure criteria can be carried out in the same time frame that the observation of the discrepancy occurs. An intermediate corrective action is one that will require a maximum of 30 days to complete the response satisfactorily. A long-term corrective action requires a time period greater than 30 days to provide a complete response. Long-term corrective actions typically involve cooperation of additional organizational elements.

14.1.2 Both intermediate and long-term corrective actions require a detailed corrective action plan showing clearly defined

milestones, task descriptions, and responsibilities. CRG's Quality Assurance Specialist must approve all intermediate and long-term corrective action plans. Closure of corrective actions require verifiable, objective evidence that the corrective action be thorough, comprehensive, and will permanently prevent the problem from reoccurring. Corrective actions result from a wide variety of situations including:

A. Inspection of the sample indicates the: samples are 1) not representative of their source, 2) deteriorated, 3) improperly labeled, 4) damaged in transport, or 5) collected in an inappropriate container. In this case, the CRG Sample Custodian or Quality Assurance Specialist will notify the sample collector of the problem(s) and request a new sample(s) to be collected following proper sample collection and handling methods

B. Samples that are not properly preserved, stored at incorrect temperatures, or exhibit deficiencies in the chain-of-custody records are not analyzed. The CRG Sample Custodian or Quality Assurance Specialist reviews the discrepancy with appropriate personnel and new samples are collected employing correct methods

C. The required LOPM has not been followed correctly. The supervisor reviews the Method with the analyst and requests the analyst to rerun the analysis, per the method, under the supervisor's direct observation. The analyst repeats the procedure until it is correctly performed. The analyst's performance of the method's protocol and results are evaluated randomly over a minimum of a two week period to ensure adherence to all requirements of the method

D. Instrumentation malfunctions are immediately noted in the instrument logbook and the supervisor is notified. Senior technical staff with specific in-depth knowledge of the particular instrument reviews the problem and attempt to fix the instrument. Major problems may require trained field service personnel from the manufacturer to be brought in to fix the problem. If the projected downtime will extend beyond the samples required holding time, the sample will be

either analyzed on another instrument or sent to an approved contract laboratory for analysis

E. When duplicate results, spike recovery results, or Quality Assurance reference samples are outside their acceptance limits, the supervisor is notified and the complete analytical procedure is reviewed with the analyst. The data entry and calculations are reviewed for transcription errors. Reagents and standards are checked to see if they were properly prepared and whether they are within their shelf life. The equipment is examined for proper performance. The calibration and maintenance record is reviewed to ensure the instrumentation is performing optimally. The methodology is reviewed to make sure that it is properly applied. Sampling and sample handling protocols are verified to ensure that the sample was collected properly and the recommended preservation and holding times were observed. If the cause of the problem is found, the Quality Assurance Specialist sends a Quality Assurance reference sample to the analyst for analysis. If the Quality Assurance check sample is acceptable, the duplicate or spike analysis is reanalyzed. However, if the same result is obtained in the repeat analysis, the problem is probably due to matrix interference effect. The results of the sample batch are reported with an accompanying explanation of possible matrix interference. If the precision of duplicate spike analyses improves and are in control, the sample batch run with the initial duplicate spike analysis sample is reanalyzed. A different scenario must be followed in circumstances such as insufficient sample or analysis of the sample after the prescribed holding time exists. In these situations, the original result is reported and accompanied by a failure report stating the circumstances that occurred in the initial and repeat analysis. If the results for the Quality Assurance reference sample are not satisfactory, a team will be formed to identify and correct the problem. The analysis will not be resumed until the system is in control

F. CRG's internal evaluation and corrective action program and external agency audits can result in corrective actions. The response to these evaluation studies requires a written corrective action plan that

has been accepted by the Quality Assurance Specialist. Closure requires objective evidence that the corrective action be thorough, complete, and will permanently solve the problem

G. CRG's Continuous Measurable Improvement program is designed to identify opportunities for improvements systematically. This program leads to specific corrective actions initiated by either a combination of senior technical staff and analysts or a team established to address the specific problem. A quantitative measurement is applied to ensure that the corrective action has had a positive impact on eliminating the problem.

14.2 Training

14.2.1 Educational background- the minimum qualification for conducting analyses in the laboratory is two years of college-level course work in science and two years of related analytical work experience or an equivalent combination of education and experience. These education and experience requirements provide the analysts with a proper background in the fundamentals of chemistry to assist in understanding the principles behind work that they perform.

14.2.2 Orientation- CRG provides a general orientation to working in an environmental chemistry laboratory. CRG also provides a basic safety orientation, which includes lab coats, specific safety instructions, approved footwear, location of first aid supplies, location of eyewash stations, location of emergency showers, and location of fire extinguishers.

14.2.3 Ongoing Training- CRG maintains a technical library of key journals and books for staff's use. Staffs are encouraged to join professional societies, attend conferences, and receive additional training in their technical fields.

14.2.4 Discrete Job Training- CRG Provides:

A. On-the-job training to new analysts or analysts assuming additional responsibilities.

B. Maintains a file for each employee which contains all information relating to the analysts education and training including:

Resume
Certificates from training classes and courses
Completed Training Documentation Forms
Related data

C. The following approach is used for providing staff on-the-job training:

1. Read the appropriate Laboratory Operating Procedures Method which details the analytical procedure

2. Review the associated material safety data sheets if you are not knowledgeable of the

safety hazards of the reagents used in the analysis

3. Observe the procedure in use by an analyst who is approved for performing this analysis

4. Perform the analysis under the direct supervision of a qualified analyst who will certify the successful completion of training

5. Demonstrate proficiency using the method by analyzing blind check samples

6. Document the successful completion of your training using the following Training Documentation Form:

CRG Marine Laboratories, Inc.
2020 Del Amo Boulevard, Suite 2020
Torrance, California 90501-1206

TRAINING DOCUMENTATION FORM

EMPLOYEE NAME _____

METHOD NUMBER	DATE COMPLETED	CERTIFIED BY
COMMENTS:		

15.0 QA REPORTS

Numerical results of quality control analyses are delivered as part of the analytical report package. Reports that discuss corrective actions, Quality accomplishments, control charts, and ad-hoc inquiries are generated internally on a regular basis and made available to clients upon request.

Table 1. Metals, Organic Chemistry and Inorganic Chemistry

EPA METHOD	ANALYSIS	PRECISION (% RSD)	ACCURACY (% Recovery)	MDL
	TOTAL & DISSOLVED METALS BY ICPMS- LIQUID MATRIX			
200.8	Aluminum (Al)	0-30	75-125	1.0 µg/L
	Antimony (Sb)	0-30	75-125	0.1 µg/L
	Arsenic (As)	0-30	75-125	0.1 µg/L
	Barium (Ba)	0-30	75-125	0.1 µg/L
	Beryllium (Be)	0-30	75-125	0.1 µg/L
	Bizmuth (Bi)	0-30	75-125	5.0 µg/L
	Boron (B)	0-30	75-125	1.0 µg/L
	Bromine (Br)	0-30	75-125	0.5 µg/L
	Cadmium (Cd)	0-30	75-125	0.1 µg/L
	Calcium (Ca)	0-30	75-125	0.1 µg/L
	Cesium (Cs)	0-30	75-125	0.1 µg/L
	Chromium (Cr)	0-30	75-125	0.1 µg/L
	Cobalt (Co)	0-30	75-125	0.1 µg/L
	Copper (Cu)	0-30	75-125	0.1 µg/L
	Iodine (I)	0-30	75-125	0.1 µg/L
	Iron (Fe)	0-30	75-125	1.0 µg/L
	Lead (Pb)	0-30	75-125	0.1 µg/L
	Lithium (Li)	0-30	75-125	0.1 µg/L
	Magnesium (Mg)	0-30	75-125	1.0 µg/L
	Manganese (Mn)	0-30	75-125	0.1 µg/L
	Mercury (Hg)	0-30	75-125	0.05 µg/L
	Molybdenum (Mo)	0-30	75-125	0.1 µg/L
	Nickel (Ni)	0-30	75-125	0.1 µg/L
	Phosphorus (P)	0-30	75-125	5.0 µg/L
	Potassium (K)	0-30	75-125	5.0 µg/L
	Selenium (Se)	0-30	75-125	0.1 µg/L
	Silicon (Si)	0-30	75-125	1.0 µg/L
	Silver (Ag)	0-30	75-125	0.1 µg/L
	Sodium (Na)	0-30	75-125	5.0 µg/L
	Strontium (Sr)	0-30	75-125	0.5 µg/L
	Thallium (Tl)	0-30	75-125	0.1 µg/L
	Titanium (Ti)	0-30	75-125	0.1 µg/L
	Vanadium (V)	0-30	75-125	0.1 µg/L
	Zinc (Zn)	0-30	75-125	0.1 µg/L
	TOTAL & DISSOLVED METALS BY ICPMS- LIQUID MATRIX			
1640	Aluminum (Al)	0-30	70-130	0.01 µg/L
	Antimony (Sb)	0-30	70-130	0.01 µg/L
	Arsenic (As)	0-30	70-130	0.01 µg/L
	Barium (Ba)	0-30	70-130	0.5 µg/L

Table 1. (Continued)

METHOD	ANALYSIS	PRECISION (% RSD)	ACCURACY (% Recovery)	MDL
	Beryllium (Be)	0-30	70-130	0.005 µg/L
	Boron (B)	0-30	70-130	0.5 µg/L
	Cadmium (Cd)	0-30	70-130	0.005 µg/L
	Calcium (Ca)	0-30	70-130	0.05 µg/L
	Chromium (Cr)	0-30	70-130	0.005 µg/L
	Cobalt (Co)	0-30	70-130	0.005 µg/L
	Copper (Cu)	0-30	70-130	0.005 µg/L
	Iodine (I)	0-30	70-130	0.5 µg/L
	Iron (Fe)	0-30	70-130	0.01 µg/L
	Lead (Pb)	0-30	70-130	0.005 µg/L
	Lithium (Li)	0-30	70-130	0.01 µg/L
	Magnesium (Mg)	0-30	70-130	5.0 µg/L
	Manganese (Mn)	0-30	70-130	0.005 µg/L
	Mercury (Hg)	0-30	70-130	0.005 µg/L
	Molybdenum (Mo)	0-30	70-130	0.005 µg/L
	Nickel (Ni)	0-30	70-130	0.005 µg/L
	Potassium (K)	0-30	70-130	5.0 µg/L
	Selenium (Se)	0-30	70-130	0.01 µg/L
	Silver (Ag)	0-30	70-130	0.005 µg/L
	Sodium (Na)	0-30	70-130	5.0 µg/L
	Strontium (Sr)	0-30	70-130	0.01 µg/L
	Thallium (Tl)	0-30	70-130	0.005 µg/L
	Tin (Sn)	0-30	70-130	0.005 µg/L
	Titanium (Ti)	0-30	70-130	0.005 µg/L
	Vanadium (V)	0-30	70-130	0.005 µg/L
	Zinc (Zn)	0-30	70-130	0.005 µg/L
	TOTAL METALS BY ICPMS- SOLID MATRIX			
6020	Aluminum (Al)	0-30	75-125	1.0 mg/kg
	Antimony (Sb)	0-30	75-125	0.025mg/kg
	Arsenic (As)	0-30	75-125	0.025mg/kg
	Barium (Ba)	0-30	75-125	0.025mg/kg
	Beryllium (Be)	0-30	75-125	0.025mg/kg
	Bismuth (Bi)	0-30	75-125	0.5mg/kg
	Boron (B)	0-30	75-125	0.025mg/k
	Cadmium (Cd)	0-30	75-125	0.025mg/kg
	Calcium (Ca)	0-30	75-125	1.0 mg/kg
	Cesium (Cs)	0-30	75-125	0.05mg/kg
	Chromium (Cr)	0-30	75-125	0.025mg/kg
	Cobalt (Co)	0-30	75-125	0.025mg/kg
	Copper (Cu)	0-30	75-125	0.025mg/kg

Table 1. (Continued)

METHOD	ANALYSIS	PRECISION (% RSD)	ACCURACY (% Recovery)	MDL
	Iodine (I)	0-30	75-125	0.05mg/kg
	Iron (Fe)	0-30	75-125	1.0 mg/kg
	Lead (Pb)	0-30	75-125	0.025mg/kg
	Lithium (Li)	0-30	75-125	0.05mg/kg
	Magnesium (Mg)	0-30	75-125	1.0 mg/kg
	Manganese (Mn)	0-30	75-125	0.025mg/kg
	Mercury (Hg)	0-30	75-125	0.005mg/kg
	Molybdenum (Mo)	0-30	75-125	0.025mg/kg
	Nickel (Ni)	0-30	75-125	0.025mg/kg
	Phosphorus (P)	0-30	75-125	0.5mg/kg
	Potassium (K)	0-30	75-125	1.0 mg/kg
	Selenium (Se)	0-30	75-125	0.025mg/kg
	Silicon (Si)	0-30	75-125	0.1 mg/kg
	Silver (Ag)	0-30	75-125	0.025mg/kg
	Sodium (Na)	0-30	75-125	1.0 mg/kg
	Strontium (Sr)	0-30	75-125	0.025mg/kg
	Thallium (Tl)	0-30	75-125	0.025mg/kg
	Tin (Sn)	0-30	75-125	0.025mg/kg
	Titanium (Ti)	0-30	75-125	0.025mg/kg
	Vanadium (V)	0-30	75-125	0.025mg/kg
	Zinc (Zn)	0-30	75-125	0.025mg/kg
	SEMI-VOLATILE ORGANICS BY GC/MS- LIQUID MATRIX			
	Polynuclear Aromatic Hydrocarbons			
625,	1-Methylnaphthalene	0-30	70-130	1 ng/L
8270	1-Methylphenanthrene	0-30	70-130	1 ng/L
	2,3,5-Trimethylnaphthalene	0-30	70-130	1 ng/L
	2,6-Dimethylnaphthalene	0-30	70-130	1 ng/L
	2-Methylnaphthalene	0-30	70-130	1 ng/L
	Acenaphthene	0-30	70-130	1 ng/L
	Acenaphthylene	0-30	70-130	1 ng/L
	Anthracene	0-30	70-130	1 ng/L
	Benz[a]anthracene	0-30	70-130	1 ng/L
	Benzo[a]pyrene	0-30	70-130	1 ng/L
	Benzo[b]fluoranthene	0-30	70-130	1 ng/L
	Benzo[e]pyrene	0-30	70-130	1 ng/L
	Benzo[g,h,i]perylene	0-30	70-130	1 ng/L
	Benzo[k]fluoranthene	0-30	70-130	1 ng/L
	Biphenyl	0-30	70-130	1 ng/L
	Chrysene	0-30	70-130	1 ng/L
	Dibenz[a,h]anthracene	0-30	70-130	1 ng/L

Table 1. (continued)

METHOD	ANALYSIS	PRECISION (% RSD)	ACCURACY (% Recovery)	MDL
	Fluoranthene	0-30	70-130	1 ng/L
	Fluorene	0-30	70-130	1 ng/L
	Indeno[1,2,3-c,d]pyrene	0-30	70-130	1 ng/L
	Naphthalene	0-30	70-130	1 ng/L
	Perylene	0-30	70-130	1 ng/L
	Phenanthrene	0-30	70-130	1 ng/L
	Pyrene	0-30	70-130	1 ng/L
	Base Neutrals			
625,	1,2,4-Trichlorobenzene	0-30	70-130	10 ng/L
8270	1,2-Dichlorobenzene	0-30	70-130	10 ng/L
	1,2-Diphenylhydrazine	0-30	70-130	50 ng/L
	1,3-Dichlorobenzene	0-30	70-130	10 ng/L
	1,4-Dichlorobenzene	0-30	70-130	10 ng/L
	1,4-Dioxane	0-30	70-130	50 ng/L
	2,3,7,8-TCDD	0-30	70-130	1 ng/L
	2,4-Dinitrotoluene	0-30	70-130	50 ng/L
	2,6-Dinitrotoluene	0-30	70-130	50 ng/L
	2-Chloronaphthalene	0-30	70-130	50 ng/L
	2-Nitroaniline	0-30	70-130	50 ng/L
	3,3’-Dichlorobenzidine	0-30	70-130	50 ng/L
	3-Nitroaniline	0-30	70-130	50 ng/L
	4-Bromophenyl phenyl ether	0-30	70-130	50 ng/L
	4-Chloroaniline	0-30	70-130	50 ng/L
	4-Chlorophenyl phenyl ether	0-30	70-130	50 ng/L
	4-Nitroaniline	0-30	70-130	50 ng/L
	Aniline	0-30	70-130	50 ng/L
	Azobenzene	0-30	70-130	50 ng/L
	Benzidine	0-30	70-130	50 ng/L
	bis(2-Ethylhexyl) phthalate	0-30	70-130	5 ng/L
	bis(2-Chloroethoxy) methane	0-30	70-130	50 ng/L
	bis(2-Chloroethyl) ether	0-30	70-130	50 ng/L
	bis(2-Chloroisopropyl) ether	0-30	70-130	50 ng/L
	Butylbenzyl phthalate	0-30	70-130	5 ng/L
	Caffeine	0-30	70-130	10 ng/L
	Carbazole	0-30	70-130	50 ng/L
	Dibenzofuran	0-30	70-130	50 ng/L
	Dibutyl phthalate	0-30	70-130	5 ng/L
	Diethyl phthalate	0-30	70-130	5 ng/L
	Dimethyl phthalate	0-30	70-130	5 ng/L
	Di-n-butyl phthalate	0-30	70-130	5 ng/L

Table 1. (continued)

METHOD	ANALYSIS	PRECISION (% RSD)	ACCURACY (% Recovery)	MDL
	Di-n-octyl phthalate	0-30	70-130	5 ng/L
	Hexachlorobenzene	0-30	70-130	1 ng/L
	Hexachlorobutadiene	0-30	70-130	50 ng/L
	Hexachlorocyclopentadiene	0-30	70-130	50 ng/L
	Hexachloroethane	0-30	70-130	50 ng/L
	Isophorone	0-30	70-130	50 ng/L
	Nitrobenzene	0-30	70-130	50 ng/L
	N-Nitrosodimethylamine	0-30	70-130	50 ng/L
	N-Nitrosodi-n-propylamine	0-30	70-130	50 ng/L
	N-Nitrosodiphenylamine	0-30	70-130	50 ng/L
	ACID EXTRACTABLE ORGANICS BY GC/MS- LIQUID MATRIX			
625,	2,4,5-Trichlorophenol	0-30	70-130	50 ng/L
8270	2,4,6-Tribromophenol	0-30	70-130	50 ng/L
	2,4,6-Trichlorophenol	0-30	70-130	50 ng/L
	2,4-Dichlorophenol	0-30	70-130	50 ng/L
	2,4-Dimethylphenol	0-30	70-130	100 ng/L
	2,4-Dinitrophenol	0-30	70-130	100 ng/L
	2-Chlorophenol	0-30	70-130	50 ng/L
	2-Fluorophenol	0-30	70-130	50 ng/L
	2-Methyl-4,6-dinitrophenol	0-30	70-130	100 ng/L
	2-Methylphenol	0-30	70-130	100 ng/L
	2-Nitrophenol	0-30	70-130	100 ng/L
	3-Methylphenol	0-30	70-130	100 ng/L
	4-Chloro-3-methylphenol	0-30	70-130	100 ng/L
	4-Methylphenol	0-30	70-130	100 ng/L
	4-Nitrophenol	0-30	70-130	100 ng/L
	Benzoic Acid	0-30	70-130	100 ng/L
	Benzyl Alcohol	0-30	70-130	100 ng/L
	Nonylphenol	0-30	70-130	100 ng/L
	Pentacholorophenol	0-30	70-130	50 ng/L
	Phenol	0-30	70-130	100 ng/L
	SEMI-VOLATILE ORGANICS BY GC/MS- SOLID MATRIX			
	Polynuclear Aromatic Hydrocarbons			
8270	1-Methylnaphthalene	0-30	70-130	1 µg/kg
	1-Methylphenanthrene	0-30	70-130	1 µg/kg
	2,3,5-Trimethylnaphthalene	0-30	70-130	1 µg/kg
	2,6-Dimethylnaphthalene	0-30	70-130	1 µg/kg
	2-Methylnaphthalene	0-30	70-130	1 µg/kg
	Acenaphthene	0-30	70-130	1 µg/kg

Table 1. (continued)

METHOD	ANALYSIS	PRECISION (% RSD)	ACCURACY (% Recovery)	MDL
	Acenaphthylene	0-30	70-130	1 µg/kg
	Anthracene	0-30	70-130	1 µg/kg
	Benz[a]anthracene	0-30	70-130	1 µg/kg
	Benzo[a]pyrene	0-30	70-130	1 µg/kg
	Benzo[b]fluoranthene	0-30	70-130	1 µg/kg
	Benzo[e]pyrene	0-30	70-130	1 µg/kg
	Benzo[g,h,i]perylene	0-30	70-130	1 µg/kg
	Benzo[k]fluoranthene	0-30	70-130	1 µg/kg
	Biphenyl	0-30	70-130	1 µg/kg
	Chrysene	0-30	70-130	1 µg/kg
	Dibenz[a,h]anthracene	0-30	70-130	1 µg/kg
	Fluoranthene	0-30	70-130	1 µg/kg
	Fluorene	0-30	70-130	1 µg/kg
	Indeno[1,2,3-c,d]pyrene	0-30	70-130	1 µg/kg
	Naphthalene	0-30	70-130	1 µg/kg
	Perylene	0-30	70-130	1 µg/kg
	Phenanthrene	0-30	70-130	1 µg/kg
	Pyrene	0-30	70-130	1 µg/kg
	Base Neutrals			
8270	1,2,4-Trichlorobenzene	0-30	70-130	10 µg/kg
	1,2-Dichlorobenzene	0-30	70-130	10 µg/kg
	1,2-Diphenylhydrazine	0-30	70-130	50 µg/kg
	1,3-Dichlorobenzene	0-30	70-130	10 µg/kg
	1,4-Dichlorobenzene	0-30	70-130	10 µg/kg
	1,4-Dioxane	0-30	70-130	50 µg/kg
	2,3,7,8-TCDD	0-30	70-130	1 µg/kg
	2,4-Dinitrotoluene	0-30	70-130	50 µg/kg
	2,6-Dinitrotoluene	0-30	70-130	50 µg/kg
	2-Chloronaphthalene	0-30	70-130	50 µg/kg
	2-Nitroaniline	0-30	70-130	50 µg/kg
	3,3'-Dichlorobenzidine	0-30	70-130	50 µg/kg
	3-Nitroaniline	0-30	70-130	50 µg/kg
	4-Bromophenyl phenyl ether	0-30	70-130	50 µg/kg
	4-Chloroaniline	0-30	70-130	50 µg/kg
	4-Chlorophenyl phenyl ether	0-30	70-130	50 µg/kg
	4-Nitroaniline	0-30	70-130	50 µg/kg
	Aniline	0-30	70-130	50 µg/kg
	Azobenzene	0-30	70-130	50 µg/kg
	Benzidine	0-30	70-130	50 µg/kg
	bis(2-Ethylhexyl) phthalate	0-30	70-130	5 µg/kg

Table 1. (continued)

METHOD	ANALYSIS	PRECISION (% RSD)	ACCURACY (% Recovery)	MDL
	bis(2-Chloroethoxy) methane	0-30	70-130	50 µg/kg
	bis(2-Chloroethyl) ether	0-30	70-130	50 µg/kg
	bis(2-Chloroisopropyl) ether	0-30	70-130	50 µg/kg
	Butylbenzyl phthalate	0-30	70-130	5 µg/kg
	Caffeine	0-30	70-130	10 µg/kg
	Carbazole	0-30	70-130	50 µg/kg
	Dibenzofuran	0-30	70-130	50 µg/kg
	Dibutyl phthalate	0-30	70-130	5 µg/kg
	Diethyl phthalate	0-30	70-130	5 µg/kg
	Dimethyl phthalate	0-30	70-130	5 µg/kg
	Di-n-butyl phthalate	0-30	70-130	5 µg/kg
	Di-n-octyl phthalate	0-30	70-130	5 µg/kg
	Hexachlorobenzene	0-30	70-130	1 µg/kg
	Hexachlorobutadiene	0-30	70-130	50 µg/kg
	Hexachlorocyclopentadiene	0-30	70-130	50 µg/kg
	Hexachloroethane	0-30	70-130	50 µg/kg
	Isophorone	0-30	70-130	50 µg/kg
	Nitrobenzene	0-30	70-130	50 µg/kg
	N-Nitrosodimethylamine	0-30	70-130	50 µg/kg
	N-Nitrosodi-n-propylamine	0-30	70-130	50 µg/kg
	N-Nitrosodiphenylamine	0-30	70-130	50 µg/kg
	ACID EXTRACTABLE ORGANICS BY GC/MS- SOLID MATRIX			
8270	2,4,5-Trichlorophenol	0-30	70-130	50 µg/kg
	2,4,6-Tribromophenol	0-30	70-130	50 µg/kg
	2,4,6-Trichlorophenol	0-30	70-130	50 µg/kg
	2,4-Dichlorophenol	0-30	70-130	50 µg/kg
	2,4-Dimethylphenol	0-30	70-130	100 µg/kg
	2,4-Dinitrophenol	0-30	70-130	100 µg/kg
	2-Chlorophenol	0-30	70-130	50 µg/kg
	2-Fluorophenol	0-30	70-130	50 µg/kg
	2-Methyl-4,6-dinitrophenol	0-30	70-130	100 µg/kg
	2-Methylphenol	0-30	70-130	100 µg/kg
	2-Nitrophenol	0-30	70-130	100 µg/kg
	3-Methylphenol	0-30	70-130	100 µg/kg
	4-Chloro-3-methylphenol	0-30	70-130	100 µg/kg
	4-Methylphenol	0-30	70-130	100 µg/kg
	4-Nitrophenol	0-30	70-130	100 µg/kg
	Benzoic Acid	0-30	70-130	100 µg/kg
	Benzyl Alcohol	0-30	70-130	100 µg/kg
	Nonylphenol	0-30	70-130	100 µg/kg

Table 1. (continued)

METHOD	ANALYSIS	PRECISION (% RSD)	ACCURACY (% Recovery)	MDL
	Pentacholorophenol	0-30	70-130	50 µg/kg
	Phenol	0-30	70-130	100 µg/kg
	CHLORINATED HYDROCARBONS BY GC/MS- LIQUID MATRIX			
625, 8270	α-BHC	0-30	70-130	1 ng/L
	β-BHC	0-30	70-130	1 ng/L
	γ-BHC (Lindane)	0-30	70-130	1 ng/L
	δ-BHC	0-30	70-130	1 ng/L
	α-Chlordane	0-30	70-130	1 ng/L
	γ-Chlordane	0-30	70-130	1 ng/L
	2,4-DDD	0-30	70-130	1 ng/L
	2,4-DDE	0-30	70-130	1 ng/L
	2,4-DDT	0-30	70-130	1 ng/L
	4,4-DDD	0-30	70-130	1 ng/L
	4,4-DDE	0-30	70-130	1 ng/L
	4,4-DDT	0-30	70-130	1 ng/L
	Alachlor	0-30	70-130	2 ng/L
	Aldrin	0-30	70-130	1 ng/L
	cis-Nonachlor	0-30	70-130	1 ng/L
	DCPA (Dacthal)	0-30	70-130	5 ng/L
	Dicofol	0-30	70-130	1 ng/L
	Dieldrin	0-30	70-130	1 ng/L
	Endosulfan sulfate	0-30	70-130	1 ng/L
	Endosulfan I	0-30	70-130	1 ng/L
	Endosulfan II	0-30	70-130	1 ng/L
	Endrin	0-30	70-130	1 ng/L
	Endrin Aldehyde	0-30	70-130	1 ng/L
	Endrin Ketone	0-30	70-130	1 ng/L
	Heptachlor	0-30	70-130	1 ng/L
	Heptachlor Epoxide	0-30	70-130	1 ng/L
	Hexachlorobenzene	0-30	70-130	1 ng/L
	Methoxychlor	0-30	70-130	1 ng/L
	Mirex	0-30	70-130	1 ng/L
	Oxychlordane	0-30	70-130	1 ng/L
	Toxaphene	0-30	70-130	10 ng/L
	Trans-Nonachlor	0-30	70-130	1 ng/L
	Trifluralin	0-30	70-130	1 ng/L
	PCB Aroclor 1016	0-30	70-130	10 ng/L
	PCB Aroclor 1221	0-30	70-130	10 ng/L
	PCB Aroclor 1232	0-30	70-130	10 ng/L

Table 1. (continued)

METHOD	ANALYSIS	PRECISION (% RSD)	ACCURACY (% Recovery)	MDL
	PCB Aroclor 1242	0-30	70-130	10 ng/L
	PCB Aroclor 1248	0-30	70-130	10 ng/L
	PCB Aroclor 1254	0-30	70-130	10 ng/L
	PCB Aroclor 1260	0-30	70-130	10 ng/L
	PCB Congener 001	0-30	70-130	1 ng/L
	PCB Congener 002	0-30	70-130	1 ng/L
	PCB Congener 003	0-30	70-130	1 ng/L
	PCB Congener 004	0-30	70-130	1 ng/L
	PCB Congener 006	0-30	70-130	1 ng/L
	PCB Congener 008	0-30	70-130	1 ng/L
	PCB Congener 009	0-30	70-130	1 ng/L
	PCB Congener 016	0-30	70-130	1 ng/L
	PCB Congener 018	0-30	70-130	1 ng/L
	PCB Congener 019	0-30	70-130	1 ng/L
	PCB Congener 022	0-30	70-130	1 ng/L
	PCB Congener 025	0-30	70-130	1 ng/L
	PCB Congener 028	0-30	70-130	1 ng/L
	PCB Congener 031	0-30	70-130	1 ng/L
	PCB Congener 033	0-30	70-130	1 ng/L
	PCB Congener 037	0-30	70-130	1 ng/L
	PCB Congener 044	0-30	70-130	1 ng/L
	PCB Congener 049	0-30	70-130	1 ng/L
	PCB Congener 052	0-30	70-130	1 ng/L
	PCB Congener 056	0-30	70-130	1 ng/L
	PCB Congener 065	0-30	70-130	1 ng/L
	PCB Congener 066	0-30	70-130	1 ng/L
	PCB Congener 067	0-30	70-130	1 ng/L
	PCB Congener 070	0-30	70-130	1 ng/L
	PCB Congener 071	0-30	70-130	1 ng/L
	PCB Congener 074	0-30	70-130	1 ng/L
	PCB Congener 077	0-30	70-130	1 ng/L
	PCB Congener 081	0-30	70-130	1 ng/L
	PCB Congener 082	0-30	70-130	1 ng/L
	PCB Congener 087	0-30	70-130	1 ng/L
	PCB Congener 095	0-30	70-130	1 ng/L
	PCB Congener 097	0-30	70-130	1 ng/L
	PCB Congener 099	0-30	70-130	1 ng/L
	PCB Congener 101	0-30	70-130	1 ng/L
	PCB Congener 105	0-30	70-130	1 ng/L
	PCB Congener 110	0-30	70-130	1 ng/L
	PCB Congener 114	0-30	70-130	1 ng/L

Table 1. (continued)

METHOD	ANALYSIS	PRECISION (% RSD)	ACCURACY (% Recovery)	MDL
	PCB Congener 118	0-30	70-130	1 ng/L
	PCB Congener 119	0-30	70-130	1 ng/L
	PCB Congener 123	0-30	70-130	1 ng/L
	PCB Congener 126	0-30	70-130	1 ng/L
	PCB Congener 128	0-30	70-130	1 ng/L
	PCB Congener 128+167	0-30	70-130	1 ng/L
	PCB Congener 132	0-30	70-130	1 ng/L
	PCB Congener 138	0-30	70-130	1 ng/L
	PCB Congener 141	0-30	70-130	1 ng/L
	PCB Congener 146	0-30	70-130	1 ng/L
	PCB Congener 147	0-30	70-130	1 ng/L
	PCB Congener 149	0-30	70-130	1 ng/L
	PCB Congener 151	0-30	70-130	1 ng/L
	PCB Congener 153	0-30	70-130	1 ng/L
	PCB Congener 156	0-30	70-130	1 ng/L
	PCB Congener 157	0-30	70-130	1 ng/L
	PCB Congener 158	0-30	70-130	1 ng/L
	PCB Congener 167	0-30	70-130	1 ng/L
	PCB Congener 168	0-30	70-130	1 ng/L
	PCB Congener 168+132	0-30	70-130	1 ng/L
	PCB Congener 169	0-30	70-130	1 ng/L
	PCB Congener 170	0-30	70-130	1 ng/L
	PCB Congener 173	0-30	70-130	1 ng/L
	PCB Congener 174	0-30	70-130	1 ng/L
	PCB Congener 177	0-30	70-130	1 ng/L
	PCB Congener 179	0-30	70-130	1 ng/L
	PCB Congener 180	0-30	70-130	1 ng/L
	PCB Congener 183	0-30	70-130	1 ng/L
	PCB Congener 187	0-30	70-130	1 ng/L
	PCB Congener 189	0-30	70-130	1 ng/L
	PCB Congener 194	0-30	70-130	1 ng/L
	PCB Congener 195	0-30	70-130	1 ng/L
	PCB Congener 200	0-30	70-130	1 ng/L
	PCB Congener 201	0-30	70-130	1 ng/L
	PCB Congener 203	0-30	70-130	1 ng/L
	PCB Congener 205	0-30	70-130	1 ng/L
	PCB Congener 206	0-30	70-130	1 ng/L
	PCB Congener 209	0-30	70-130	1 ng/L

Table 1. (continued)

METHOD	ANALYSIS	PRECISION (% RSD)	ACCURACY (% Recovery)	MDL
	CHLORINATED HYDROCARBONS BY GC/MS- SOLID MATRIX			
8270	α-BHC	0-30	70-130	1 µg/kg
	β-BHC	0-30	70-130	1 µg/kg
	γ-BHC (Lindane)	0-30	70-130	1 µg/kg
	δ-BHC	0-30	70-130	1 µg/kg
	α-Chlordane	0-30	70-130	1 µg/kg
	γ-Chlordane	0-30	70-130	1 µg/kg
	2,4-DDD	0-30	70-130	1 µg/kg
	2,4-DDE	0-30	70-130	1 µg/kg
	2,4-DDT	0-30	70-130	1 µg/kg
	4,4-DDD	0-30	70-130	1 µg/kg
	4,4-DDE	0-30	70-130	1 µg/kg
	4,4-DDT	0-30	70-130	1 µg/kg
	Alachlor	0-30	70-130	2 µg/kg
	Aldrin	0-30	70-130	1 µg/kg
	cis-Nonachlor	0-30	70-130	1 µg/kg
	DCPA (Dacthal)	0-30	70-130	5 µg/kg
	Dicofol	0-30	70-130	1 µg/kg
	Dieldrin	0-30	70-130	1 µg/kg
	Endosulfan sulfate	0-30	70-130	1 µg/kg
	Endosulfan I	0-30	70-130	1 µg/kg
	Endosulfan II	0-30	70-130	1 µg/kg
	Endrin	0-30	70-130	1 µg/kg
	Endrin Aldehyde	0-30	70-130	1 µg/kg
	Endrin Ketone	0-30	70-130	1 µg/kg
	Heptachlor	0-30	70-130	1 µg/kg
	Heptachlor Epoxide	0-30	70-130	1 µg/kg
	Hexachlorobenzene	0-30	70-130	1 µg/kg
	Methoxychlor	0-30	70-130	1 µg/kg
	Mirex	0-30	70-130	1 µg/kg
	Oxychlordane	0-30	70-130	1 µg/kg
	Toxaphene	0-30	70-130	10 µg/kg
	Trans-Nonachlor	0-30	70-130	1 µg/kg
	Trifluralin	0-30	70-130	1 µg/kg
	PCB Aroclor 1016	0-30	70-130	10 µg/kg
	PCB Aroclor 1221	0-30	70-130	10 µg/kg
	PCB Aroclor 1232	0-30	70-130	10 µg/kg
	PCB Aroclor 1242	0-30	70-130	10 µg/kg
	PCB Aroclor 1248	0-30	70-130	10 µg/kg
	PCB Aroclor 1254	0-30	70-130	10 µg/kg

Table 1. (continued)

METHOD	ANALYSIS	PRECISION (% RSD)	ACCURACY (% Recovery)	MDL
	PCB Aroclor 1260	0-30	70-130	10 µg/kg
	PCB Congener 001	0-30	70-130	1 µg/kg
	PCB Congener 002	0-30	70-130	1 µg/kg
	PCB Congener 003	0-30	70-130	1 µg/kg
	PCB Congener 004	0-30	70-130	1 µg/kg
	PCB Congener 006	0-30	70-130	1 µg/kg
	PCB Congener 008	0-30	70-130	1 µg/kg
	PCB Congener 009	0-30	70-130	1 µg/kg
	PCB Congener 016	0-30	70-130	1 µg/kg
	PCB Congener 018	0-30	70-130	1 µg/kg
	PCB Congener 019	0-30	70-130	1 µg/kg
	PCB Congener 022	0-30	70-130	1 µg/kg
	PCB Congener 025	0-30	70-130	1 µg/kg
	PCB Congener 028	0-30	70-130	1 µg/kg
	PCB Congener 031	0-30	70-130	1 µg/kg
	PCB Congener 033	0-30	70-130	1 µg/kg
	PCB Congener 037	0-30	70-130	1 µg/kg
	PCB Congener 044	0-30	70-130	1 µg/kg
	PCB Congener 049	0-30	70-130	1 µg/kg
	PCB Congener 052	0-30	70-130	1 µg/kg
	PCB Congener 056	0-30	70-130	1 µg/kg
	PCB Congener 065	0-30	70-130	1 µg/kg
	PCB Congener 066	0-30	70-130	1 µg/kg
	PCB Congener 067	0-30	70-130	1 µg/kg
	PCB Congener 070	0-30	70-130	1 µg/kg
	PCB Congener 071	0-30	70-130	1 µg/kg
	PCB Congener 074	0-30	70-130	1 µg/kg
	PCB Congener 077	0-30	70-130	1 µg/kg
	PCB Congener 081	0-30	70-130	1 µg/kg
	PCB Congener 082	0-30	70-130	1 µg/kg
	PCB Congener 087	0-30	70-130	1 µg/kg
	PCB Congener 095	0-30	70-130	1 µg/kg
	PCB Congener 097	0-30	70-130	1 µg/kg
	PCB Congener 099	0-30	70-130	1 µg/kg
	PCB Congener 101	0-30	70-130	1 µg/kg
	PCB Congener 105	0-30	70-130	1 µg/kg
	PCB Congener 110	0-30	70-130	1 µg/kg
	PCB Congener 114	0-30	70-130	1 µg/kg
	PCB Congener 118	0-30	70-130	1 µg/kg
	PCB Congener 119	0-30	70-130	1 µg/kg

	PCB Congener 123	0-30	70-130	1 µg/kg

Table 1. (continued)

METHOD	ANALYSIS	PRECISION (% RSD)	ACCURACY (% Recovery)	MDL
	PCB Congener 126	0-30	70-130	1 µg/kg
	PCB Congener 128	0-30	70-130	1 µg/kg
	PCB Congener 128+167	0-30	70-130	1 µg/kg
	PCB Congener 132	0-30	70-130	1 µg/kg
	PCB Congener 138	0-30	70-130	1 µg/kg
	PCB Congener 141	0-30	70-130	1 µg/kg
	PCB Congener 146	0-30	70-130	1 µg/kg
	PCB Congener 147	0-30	70-130	1 µg/kg
	PCB Congener 149	0-30	70-130	1 µg/kg
	PCB Congener 151	0-30	70-130	1 µg/kg
	PCB Congener 153	0-30	70-130	1 µg/kg
	PCB Congener 156	0-30	70-130	1 µg/kg
	PCB Congener 157	0-30	70-130	1 µg/kg
	PCB Congener 158	0-30	70-130	1 µg/kg
	PCB Congener 167	0-30	70-130	1 µg/kg
	PCB Congener 168	0-30	70-130	1 µg/kg
	PCB Congener 168+132	0-30	70-130	1 µg/kg
	PCB Congener 169	0-30	70-130	1 µg/kg
	PCB Congener 170	0-30	70-130	1 µg/kg
	PCB Congener 173	0-30	70-130	1 µg/kg
	PCB Congener 174	0-30	70-130	1 µg/kg
	PCB Congener 177	0-30	70-130	1 µg/kg
	PCB Congener 179	0-30	70-130	1 µg/kg
	PCB Congener 180	0-30	70-130	1 µg/kg
	PCB Congener 183	0-30	70-130	1 µg/kg
	PCB Congener 187	0-30	70-130	1 µg/kg
	PCB Congener 189	0-30	70-130	1 µg/kg
	PCB Congener 194	0-30	70-130	1 µg/kg
	PCB Congener 195	0-30	70-130	1 µg/kg
	PCB Congener 200	0-30	70-130	1 µg/kg
	PCB Congener 201	0-30	70-130	1 µg/kg
	PCB Congener 203	0-30	70-130	1 µg/kg
	PCB Congener 205	0-30	70-130	1 µg/kg
	PCB Congener 206	0-30	70-130	1 µg/kg
	PCB Congener 209	0-30	70-130	1 µg/kg
	ORGANOPHOSPHORUS PESTICIDES BY GC/MS- LIQUID MATRIX			
625,	Bolstar (Sulprofos)	0-30	70-130	10 ng/L
8270	Chlorpyrifos	0-30	70-130	5 ng/L
	Demeton	0-30	70-130	10 ng/L

	Diazinon	0-30	70-130	5 ng/L

Table 1. (continued)

METHOD	ANALYSIS	PRECISION (% RSD)	ACCURACY (% Recovery)	MDL
	Dichlorvos	0-30	70-130	10 ng/L
	Dimethoate	0-30	70-130	5 ng/L
	Disulfoton	0-30	70-130	10 ng/L
	Ethoprop (Ethoprofos)	0-30	70-130	10 ng/L
	Fencholorphos (Ronnel)	0-30	70-130	10 ng/L
	Fensulfothion	0-30	70-130	10 ng/L
	Fenthion	0-30	70-130	10 ng/L
	Malathion	0-30	70-130	5 ng/L
	Merphos	0-30	70-130	10 ng/L
	Methyl Parathion	0-30	70-130	10 ng/L
	Mevinphos (Phosdrin)	0-30	70-130	10 ng/L
	Phorate	0-30	70-130	10 ng/L
	Methyl Parathion	0-30	70-130	10 ng/L
	Tetrachlorvinphos	0-30	70-130	10 ng/L
	Tokuthion	0-30	70-130	10 ng/L
	Trichloronate	0-30	70-130	10 ng/L
	Mevinphos (Phosdrin)	0-30	70-130	10 ng/L
	ORGANOPHOSPHORUS PESTICIDES BY GC/MS- SOLID MATRIX			
8270	Bolstar (Sulprofos)	0-30	70-130	10 µg/kg
	Chlorpyrifos	0-30	70-130	5 µg/kg
	Demeton	0-30	70-130	10 µg/kg
	Diazinon	0-30	70-130	5 µg/kg
	Dichlorvos	0-30	70-130	10 µg/kg
	Dimethoate	0-30	70-130	5 µg/kg
	Disulfoton	0-30	70-130	10 µg/kg
	Ethoprop (Ethoprofos)	0-30	70-130	10 µg/kg
	Fencholorphos (Ronnel)	0-30	70-130	10 µg/kg
	Fensulfothion	0-30	70-130	10 µg/kg
	Fenthion	0-30	70-130	10 µg/kg
	Malathion	0-30	70-130	5 µg/kg
	Merphos	0-30	70-130	10 µg/kg
	Methyl Parathion	0-30	70-130	10 µg/kg
	Mevinphos (Phosdrin)	0-30	70-130	10 µg/kg
	Phorate	0-30	70-130	10 µg/kg
	Methyl Parathion	0-30	70-130	10 µg/kg
	Tetrachlorvinphos	0-30	70-130	10 µg/kg
	Tokuthion	0-30	70-130	10 µg/kg
	Trichloronate	0-30	70-130	10 µg/kg
	Mevinphos (Phosdrin)	0-30	70-130	10 µg/kg

Table 1. (continued)

METHOD	ANALYSIS	PRECISION (% RSD)	ACCURACY (% Recovery)	MDL
	PYRETHROID PESTICIDES BY GC/MS- LIQUID MATRIX			
625, 8270	Allethrin	0-30	70-130	5 ng/L
	Bifenthrin	0-30	70-130	5 ng/L
	Cyfluthrin	0-30	70-130	5 ng/L
	Cypermethrin	0-30	70-130	5 ng/L
	Deltamethrin	0-30	70-130	5 ng/L
	L-Cyhalothrin	0-30	70-130	5 ng/L
	Permethrin	0-30	70-130	5 ng/L
	Prallethrin	0-30	70-130	5 ng/L
	PYRETHROID PESTICIDES BY GC/MS- SOLID MATRIX			
8270	Allethrin	0-30	70-130	5 µg/kg
	Bifenthrin	0-30	70-130	5 µg/kg
	Cyfluthrin	0-30	70-130	5 µg/kg
	Cypermethrin	0-30	70-130	5 µg/kg
	Deltamethrin	0-30	70-130	5 µg/kg
	L-Cyhalothrin	0-30	70-130	5 µg/kg
	Permethrin	0-30	70-130	5 µg/kg
	Prallethrin	0-30	70-130	5 µg/kg
	INORGANIC CHEMISTRY – CONVENTIONAL CONSTITUENTS			
SM4500NH3 F	Ammonia (as N)	0-30	70-130	0.01 mg/L
SM4500CL E	Dissolved Chloride	0-30	70-130	0.01 mg/L
SM10200H	Chlorophyl-a	0-30	70-130	0.005mg/m^3
SM2510	Conductivity	0-30	70-130	0.1 µS/cm
SM4500NO3 E	Nitrate (as N)	0-30	70-130	0.01 mg/L
SM4500NO3 E	Nitrite (as N)	0-30	70-130	0.01 mg/L
SM4500P C	Orthophosphate (as P)	0-30	70-130	0.01 mg/L
EPA 150.1	pH	0-30	70-130	0.1 pH Unit
SM4500P C	Soluble Reactive Phosphorus	0-30	70-130	0.01 mg/L
SM2540 C	Total Dissolved Solids	0-30	70-130	0.1 mg/L
SM2340 B	Total Hardness	0-30	70-130	1.0 mg/L
SM4500P C	Total Phosphate (as P)	0-30	70-130	0.01 mg/L
SM4500P C	Total Phosphorus	0-30	70-130	0.01 mg/L
SM2540 C	Total Dissolved Solids	0-30	70-130	0.1 mg/L
SM2540 D	Total Suspended Solids	0-30	70-130	0.1 mg/L
180.1	Turbidity	0-30	70-130	0.5 NTU

MDL: Method Detection Limits

Table 2. Microbiology

METHOD	ANALYSIS	MAXIMUM HOLDING TIME	MDL
	INDICATOR BACTERIA- STORM, SEA & RECREATIONAL WATER		
SM9221B	Total Coliform	6 hrs	2 MPN/100 mL
SM9222B	Total Coliform	6 hrs	2 CFU/100 mL
SM9223B	Total Coliform	6 hrs	2 MPN/100 Ml
SM9221E	Fecal Coliform	6 hrs	2 MPN/100 mL
SM9222D	Fecal Coliform	6 hrs	2 CFU/100 mL
SM9223B	*E. coli*	6 hrs	2 MPN/100 mL
EPA1600	Enterococci	6 hrs	1 CFU/100 mL
SM9230C	Enterococci	6 hrs	1 CFU/100 mL
Enterolert	Enterococci	6 hrs	1 MPN/100 mL
SM9215B/C	Heterotrophic Plate Count	6 hrs	1 CFU/1mL
	INDICATOR BACTERIA- DRINKING WATER		
SM9223B	Total Coliform	24 hrs	Presence/Absence
SM9223B	*E. coli*	24 hrs	Presence/Absence
EPA1600	Enterococci	6 hrs	1 CFU/100 mL
SM9215B/C	Heterotrophic Plate Count	6 hrs	1 CFU/1mL
	BACTERIOPHAGE		
Adams	Coliphage	6 hrs	1 PFU/100 mL

MPN: Most Probable Number
CFU: Colony Forming Unit
PFU: Plaque Forming Unit

Appendix C

Microbiology Laboratory QAPP Excerpts

Microbiology Laboratory Quality Control

The following are excerpts from the microbiology QAPP.

IDEXX Chromogenic Substrate Procedure for Enterococci

For the enumeration of enterococci, 100 mL of sample is allowed to reach room temperature. One packet of Enterolert reagent is aseptically added to the sample and shaken vigorously or vortexed until reagent dissolves. If dilutions are performed, the reagent is added to sterile deionized water first and shaken until dissolved. The sample is added last, and shaken or vortexed until completely mixed. The quantitray is pinched/pushed in from either side to open it and the entire sample with reagent is aseptically poured in. A rubber sealer pad is placed facing the front of the quantitray so that all the holes in the pad match the wells in the tray and the tray with pad are fed into the sealer. When the tray and pad exit the back of the sealer, the tray is separated from the sealer pad and placed in an incubator at 41°C ± 0.5°C for 24-28 hours. Upon completion of incubation, the quantitray is counted for enterococci by using a 365λ fluorescent lamp to check for fluorescence. The numbers of large and small fluorescent wells are counted and the results inserted into the IDEXX - MPN program or are interpolated from the IDEXX - MPN chart. Results are recorded and reported as MPN/100 mL.

Water Supply

Water used in the preparation of media solutions and buffers is E-pure water from System II, described in Table 14. System II water is filtered through a 0.2-µm filter to remove bacterial contamination.

Water quality is monitored continuously for conductivity. A continuously-lit LED indicates that the water has a minimum resistance of 1 mega-ohm. Records are maintained for all water quality monitoring.

Table 14 Quality of Water Used in Media Preparation

Test	Monitoring Frequency	Limit
Chemical tests:		
Heavy metals, single (Cd, Cr, Cu, Ni, Pb, and Zn)	Annually*	< 0.05 mg/L
Heavy metals, total	Annually*	≤ 0.1 mg/L
Conductivity	Daily	< 0.5 megohms resist.
Heterotrophic plate count	Monthly	< 1,000 CFU/mL
pH	With each use	5.5-7.5
Total chlorine residual	Monthly	< detection limit
Ammonia/organic nitrogen	Monthly	<0.1 mg/L
Water suitability test	Annually	0.8-3.0 ratio
Inhibitory Residue Test	Annually	Pass/Fail

*Or more frequently if there is a problem

Appendix D

Benthic Laboratory QAPP Excerpts

Benthic Laboratory Quality Control

The following are excerpts from the Benthic Laboratory QAPP.

Grain Size Analysis

Initial Treatment

The wet sample is mixed thoroughly in its container and 40 gm wet sediment is weighed immediately (while still homogeneous) into 8-oz. deflocculent bottles. Sample identification and analyzed by, date, sieve size for sand/silt-clay separation, and deflocculent bottle number are recorded. Approximately 150 mL of sodium hexametaphosphate (deflocculent) is added to the sediment in the deflocculent bottle, which is shaken and left overnight.

The sample is transferred from the bottle to a 63-µm sieve using a squirt bottle with deflocculent solution. The remaining silt and clay are washed through the sieve (using light finger pressure and squirt bottle). Remaining sand is washed with deionized water to remove excess sodium hexametaphosphate and salts. Sand is washed into a numbered Coors dish, and the sand dish number is recorded.

Sand is dried in the oven between 50 and 65°C. The silt/clay solution is transferred from evaporating dish to a numbered 1,000 mL graduated cylinder, filled to 1,000 mL with deflocculent solution. The cylinder numbers are recorded.

Sieve Analysis for Sand

The Coors dish with sample is weighed, and the weight is recorded. The sand from the Coors dish is transferred to the top sieve in the sieve stack. The weight of the dish is recorded.

The sieve stack is placed in the sieve shaker and is shaken for 10 minutes. Sand is transferred to tared plastic dish on balance, and the cumulative weight is recorded for each successive sieve.

Pipette Analysis for Silt-Clay Fraction

Numbered graduated cylinders are placed in a water bath approximately 24°C. Each sample is agitated for one minute with the plunger, and six, 25-mL aliquots are taken from each cylinder at different depths and different times. Plunging times, withdrawal times, and withdrawal depths are provided on a chart. Aliquots are transferred to numbered 50-mL beakers. Beakers are dried overnight in oven set between 95 and 105°C. Beaker weight with dried sediment and empty beaker weight are recorded.

Calculations

1. Total Sand = (weight of Coors dish + sand) - weight of Coors dish.

2. Weight of silt and clay fractions = (weight of silt and clay + beaker) - weight of beaker.
   Multiply this weight by 40.08 to obtain the total weight in 1000 mL.
   ($\frac{25\ mL}{1000\ mL}$ = 1/40;
   .08 is a correct factor because the pipette does not deliver exactly 25 mL at 24^{o}C). From this subtract .3825 grams (the weight of sodium hexametaphosphate in 150 mL of a .025N solution).

   Total weight of silt and clay - ([wt. of beaker containing dry silt-clay - wt. of beaker] x 40.08) - .3825 gms.

3. Total sand + total silt-clay = total sample weight.

4. $\frac{\text{Total sand}}{\text{Total sample weight}}$ = % sand

5. $\frac{\text{Total silt-clay}}{\text{Total sample weight}}$ = % silt and clay

6. Data are entered into a computer to calculate individual and cumulative percents, median and mean grain size, and grain size distribution moments.

Quality Assurance Requirements

Quality control procedures for grain size analyses will consist of visual inspection of all screens and equipment prior to analysis and strictly following the standard grain size protocol. In addition,

1. Duplicate analyses are conducted for 10% of the samples. Percentages are plotted for all phi values. Outliers are checked (for presence of large shells, etc.). Analyses will be re-run when values vary significantly.

2. A reference standard is routinely analyzed with each batch of 1-7 samples. Percentages are plotted for all phi values; results are compared against a cumulative plot of previous values. Outliers are checked, and analyses will be re-run when values fall out of the expected range.

Any defect in a screen or piece of equipment will be reported to the laboratory manager, and a corrective action report will be filed.

Raw data will be reviewed before entering into grain size analysis program. Any errors in recording or calculations will be reported, and appropriate corrective action will be taken.

Total Organic Carbon Analysis

Sample Preparation

Samples are homogenized using a clean, stainless steel spatula, and a small amount of sample is placed into a numbered porcelain coors dish. Six to ten drops of concentrated phosphoric acid are added to the sample so that the sediment is completely submerged. The dish is gently swirled to ensure mixing and left for 1 hour. Every 15 minutes it is mixed to remove residual inorganic carbon. Samples are dried at 70 to 75°C for at least 12 hours. A portion of dried sample is ground to a homogeneous powder using a clean porcelain mortar and pestle and then discarded.

Routine Operation

The following system conditions are verified:

- All gas connections are secure.
- The inorganic carbon sparger and the mist trap are dry.
- The tin/copper scrubber is free of water.
- The printer is on and contains sufficient paper.
- The "furnace" light on the DC-190 is green.
- The "temperature ok" light on the DC-183 Boat Sampler is green.
- The baseline located in the bottom right corner of the DC-190 TOC Analyzer control panel is stable.

Sample Analysis

0.010-0.030 grams of sample are weighed in a platinum boat, and the weight is recorded. The platinum boat is placed into the boat vessel within the sample port. The port hatch is closed, and the baseline stabilizes. After the sound, the platinum boat is slowly moved into the boat furnace by moving the magnetic sample boat drive to the left. The baseline will increase and then steadily decrease over the next few minutes.

When the baseline has decreased to 100-300 mV, the magnetic sample boat drive is slid to the right until the platinum boat is within the sample port. A sound indicates that analysis is complete, and the result will be displayed on the screen in µg/g. The platinum boat is removed, and sample remains are discarded by scraping any material adhering to the sides of the boat.

Quality Assurance Requirements

A minimum of 10% duplicates will be analyzed. A blank will be run after every 10 samples. For the standard curve fit, a coefficient of correlation of $\geq$ 0.995 will be considered acceptable. Every set of samples will include external reference standards, one of which will be analyzed after every 20 samples. Results will be compared against

previous values, and samples will be re-run when these standards fall out of the expected range. An organic carbon standard followed by a blank will be run every 10 samples and at the end of each run. Analysis will be re-run when organic carbon standard values exceed 20% precision RPD.

Initial Calibration and Continuing Calibration Checks

A five-point response factor calibration curve is established to demonstrate the linear range of the analysis with a coefficient of correlation ≥ 0.995.

After every 10 sample analyses, a continuing calibration verification (CCV) sample is analyzed. The CCV must be the same concentration as one of the standard calibration samples. Relative percent difference (RPD) between the CCV and the standard calibration sample is calculated using the following equation:

$$RPD = \frac{RFI - RFC \times 100}{RFI}$$

where:

RFI = Average response factor from initial calibration.
RFC = Response factor from continuing verification sample.

The instrument response for the CCV must be within ± 10 percent of the initial calibration standard, or the five-point calibration curve must be repeated prior to further sample analysis.

After every CCV sample, a continuing calibration blank (CCB) is analyzed to verify that contamination from previous samples is not being introduced. The CCB must be 3 times the response factor produced for the method blank (Section 7.2). If the CCB response is greater than 3 times the method blank, the analytical procedure is out of control, and the source of contamination must be investigated and corrective measures taken and documented before further sample analysis proceeds.

Method Blank Analysis

A laboratory method blank sample of appropriate matrix is analyzed at the beginning of each analytical batch. An acceptable method blank analysis must not produce measurable TOC at concentrations 3 times greater than the method detection limit (MDL). If the method blank exceeds this criterion, the analytical procedure is out of control, and the source of contamination must be investigated and corrective measures taken and documented before further sample analysis proceeds.

Reference Material

When available, a standard reference material (SRM) is analyzed with each analytical batch of samples. The SRM is either a laboratory generated sample or material obtained from a reputable source (e.g., U.S. EPA or NIST). Laboratory control charts are established for the TOC concentration in the SRM. The average percent difference for

measured TOC should not differ by more than 20 percent of the mean of all previous values.

Method Detection Limit

The actual analytical method detection limit (MDL) is determined following procedures outlined in Federal Register (1984), Vol. 49, No. 209: 198-199. In brief, five to seven samples of known concentration are chosen at the target MDL and analyzed. A mean concentration and standard deviation are calculated. The MDL is the mean concentration plus 3 standard deviations.

Laboratory Duplicate Analyses

A laboratory duplicate will be analyzed at a frequency of 10 percent. Relative percent difference for the sample and sample duplicate should not exceed ± 10 percent. Sample analysis may proceed with an RPD greater than 10 percent; however, an out of control event will be flagged and reported.

Infauna Sample Analysis

Infauna Sample Transfer

The sample is poured over a sieve of appropriate mesh size and then gently rinsed with tap water from a spray nozzle. The sample is returned to the container; which is filled with 70% ETOH. The sample volume is measured by comparison with a calibrated jar of the same total volume as the sample container. The date of transfer, technician's initials, and sample volume are recorded on infaunal sample tracking sheets, and the sample is returned to the proper storage area.

Quality Assurance Requirements

If a sample container is broken during the sample transfer process, the sample contents will be picked-up and placed in a new container. A corrective action form is filed, and documentation of possible sample loss will accompany data subsequently obtained. The laboratory manager is responsible for this documentation.

Infauna Sample Sorting

Sorting

A sample is logged out of the storage location on the infaunal sample tracking sheet. The sample is poured over a 0.5-mm mesh sieve, and gently rinsed with tap water using a spray nozzle. The sample is transferred to a finger bowl, and tap water is added to the finger bowl so that the sample is completely covered.

A small portion of the sample is placed in a sorting tray and sorted carefully and systematically using a dissection microscope. Each tray is examined 3-4 times, and organisms are placed in 70% ETOH according to designated major taxonomic groups. Appropriate labels are used for each vial, and the sort sheet is completed. Grunge material is returned to 70% ETOH for storage. Grunge material is logged back into storage location, and vials and jars are organized for taxonomy. The number of vials and jars containing specimens is recorded on sort sheets.

Quality Assurance Requirements

Quality assurance of the sorting process begins with the personnel assigned to perform the sorting. Weston assigns only trained sorters to programs with high quality assurance requirements. In addition, all sorters are trained at Weston, and all sorting is done at our corporate headquarters laboratory.

Sorters do a rough count of animals during initial sorting (F*). This number shall become the basis for evaluating sorting efficiency on the table of quality control limits for benthos. This table was generated for 95% sorting efficiency with 95% confidence limits

on the C values. The grunge of every sample will be examined by a senior technician who has been trained in the QA/QC procedure.

A grunge sample is signed out on the infaunal sample tracking sheet. Any large shells, calcareous tubes, etc. are removed from the sample by hand after careful washing. The well-mixed sample is placed onto a 0.5-mm screen so that material will be evenly distributed over the screen. The material is divided into 50% aliquots – 1-50% aliquot is removed and returned to grunge jar. The remaining 50% is redistributed evenly on screen. This material is divided into 30% + 20% aliquots. The 20% aliquot is removed and returned to the grunge jar. The remaining 30% is redistributed evenly on the screen. The material is divided into 3-10% aliquots and placed into 3 small jars.

The first 10% portion is resorted, and the number of animals removed is recorded on the QA/QC tracking sheet. Refer to QA/QC table. The C value for the closest F value without exceeding the total animals sorted (F*) is recorded on the QA/QC tracking sheet. If the number of animals removed in 10% is less than or equal to the C value, then the sample has passed. The animals for this 10% aliquot are added to the previously sorted animals for taxonomy, and the 10% grunge is recombined with the rest of the grunge sample. A QA/QC "Pass" is recorded on the QA/QC tracking sheet.

If the number of animals removed in 10% is greater than the C value, then the second 10% fraction is re-sorted, and the animals from both 10%'s are added together (refer to the QA/QC chart in the 20% section). The C value for the largest F value without exceeding the F* value is recorded on the QA/QC tracking sheet. If the total animals in 20% is less than or equal to C, the sample has passed; if not, the sample will have failed, and the third 10% must be sorted. This stepped procedure continues until the sample passes or 30% of the entire sample is re-sorted for QA/QC. If the sample fails at the 30% level, the original sorter re-sorts the remainder (70%) of the grunge sample. By utilizing this stepped QA/QC procedure every sample processed is assessed for sorting efficiency.

The sample is logged back into the storage location on the infauna sample tracking sheet.

If a technician repeatedly fails the QA/QC procedure for sorting, his or her sorting technique will be reviewed by the laboratory manager, and appropriate corrective action will be taken. A corrective action form is filed.

The sorting QA/QC procedure provides statistical guidelines for the removal of at least 95% of the animals in a sample. Because it is based on 95% confidence limits and sensitive to subsample bias, there is a probability that a given sample will pass when 95% of the organisms have not been removed, particularly when the number of animals in the sample is small. Therefore, the following protocol describes steps taken when a sample that has passed the sorting QA/QC check undergoes additional QA (i.e., external QA) and does not pass. At this point, it is necessary to determine if the problem is statistical in nature or requires corrective action.

Recent performance of the technician who originally sorted the sample that did not pass the second QA/QC check is evaluated.

1. If there were fewer than 170 animals in the sample, two additional samples will be resorted by a senior technician. If both samples pass, no further action is taken. If one (or both) samples does not pass, all samples sorted by that technician for that survey will be resorted, and corrective action will be taken.

2. If there were 170 or more animals in the sample, four additional samples originally sorted by the same technician will be resorted by a senior technician. If all four samples pass, no further action is taken. If one (or more) of the four does not pass, all samples sorted by that technician for that survey will be resorted, and corrective action will be taken.

Infauna Taxonomy

All organisms are identified using the most recent taxonomic references, literature, and keys. Species names and counts are recorded on taxonomic keypunch sheets, and species are coded using the NODC code system.

Quality Assurance Requirements

Weston's taxonomic QA/QC protocol consists of the following series of steps to ensure the proper taxonomic designation of each specimen examined:

Senior taxonomists for each taxonomic group will review identifications of questionable species. All specimens with questionable identifications will be compared with organisms in Weston's reference collection and/or archived specimens in museums (e.g., Allan Hancock Foundation, Los Angeles County Museum, Santa Barbara Museum of Natural History, California Academy of Sciences).

Depending on the project, at least ten percent of the samples will be re-identified and counted by independent taxonomists.

Taxonomic intercalibration will be assured by conferring, when necessary, on voucher specimens with other taxonomists. This intercalibration will be achieved at the monthly Southern California Association of Marine Invertebrate Taxonomists (SCAMIT) meetings and other select meetings between taxonomists.

An in-house voucher collection of all taxa identified for various geographic regions has been established. Where possible, the collection includes a size series of specimens (juveniles and adults) and/or males and females. This collection forms the basis for maintaining the continuity of taxonomic identifications in future sample examinations.

As further quality assurance for taxonomy, Weston will consult recognized authorities on the taxonomy of particular taxonomic groups for discussion of questionable or new taxa.

These authorities are members of SCAMIT or the Allan Hancock Foundation at the University of Southern California or other recognized experts in their field.

Weston taxonomists attend SCAMIT meetings pertaining to the animal groups on which they work. Many taxonomic problems are worked out this way on an ad hoc basis.

Appendix E

Bioassay Laboratory QAPP Excerpts

Bioassay Laboratory

The following are excerpts from the Bioassay Laboratory QAPP.

The Weston bioassay laboratories include facilities for freshwater, marine, and estuarine bioassay testing. Toxicity testing of fish, invertebrates, and algae is performed in controlled environments in the laboratories. Both static and flow-through tests are performed on fresh and saltwater species. Test media include fresh or saltwater, and marine sediments.

Water Supply

Seawater

Fresh seawater typically is used for marine bioassay testing. Seawater is collected once a month or more often if needed by Weston personnel from a coastal seawater source located at Scripps Institution of Oceanography, San Diego, California. Water is dispensed into a pre-cleaned, 1200-L polyethylene carboy and is transported to Weston, where it is filtered to 3 or 4.5 microns, ultra-violet sterilized, and stored in a constantly recirculating polypropylene container. This system includes a four-cartridge filtration unit (two 10µm and two 3µm), an activated carbon and paper filtration unit, and two ultra-violet units. Semi-annual analyses for priority pollutants are performed on seawater that has passed through the system.

When specified for a specific project, artificial seawater is used for some static and static-renewal bioassays. Bioassay Grade Crystal Sea® Marine Mix (formerly Forty Fathoms®) is prepared with E-Pure™ deionized water for larval organisms (prepared with deionized water for juvenile organisms) to the salinity required for testing.

Test Organisms

Test organisms used in bioassays are collected from sources known to be generally free from pollutants, purchased from reputable suppliers, or obtained from laboratory cultures. Every effort is made to ensure that the test organisms are in good health prior to use. Records of the date and location of collection, as well as water quality measurements of the water in which test organisms arrive, are maintained. The health and maintenance of organisms cultured in-house are recorded two to three times per week. Test organisms are acclimated with regard to temperature, salinity, and other water quality criteria, as specified in test protocols. Propagules (sperm, egg, spores, or embryos) used in tests are obtained from several adults and examined to determine viability prior to testing.

Weston maintains cultures of the following test organisms in the laboratory for use in bioassay testing:

<u>Invertebrates</u>

- Freshwater Water Flea, *Ceriodaphnia dubia*
- Freshwater Amphipod, *Hyalella azteca*

Test Procedures

For all bioassay test procedures, specific protocols or SOPs either exist or are written prior to the start of the test. All personnel involved with bioassay testing must have a copy of the protocol and adhere to the testing procedures.

In addition to protocols, SOPs for instrument use, reagent preparation, culture, test organism manipulation, and any other activities associated with bioassay testing are maintained by the appropriate staff members. Personnel responsible for tasks outlined in SOPs are trained and tested. Training files are maintained for all Weston personnel.

Quality Assurance Requirements

Studies will be conducted according to the Standard Operating Procedures of Weston which are in effect during the time the study is being performed. In the case where there is a conflict between the SOPs and a specific protocol, the protocol will be the definitive procedure.

Usually tests would be unacceptable if one or more of the following occurred:

- More than 10% of the control organisms die or show signs of disease or stress, or if mortality in an individual control test chamber exceeds 20%.
- All test chambers were not identical.
- Treatments were not randomly assigned to test chambers.
- Test organisms were not randomly or impartially distributed to test chambers.
- All test animals were not from the same population, were not all of the same species, or were not of acceptable quality.
- Reference sediment and controls were not included in the test.
- Amphipods from a wild population were maintained in the laboratory for more than two weeks, unless the effects of prolonged maintenance in the laboratory has been shown to have no significant effect on sensitivity.
- The test organisms were not acclimated at the test temperature and salinity at least 48 hours before they were placed in the test chambers.
- Temperature, DO, salinity, and concentration of test substance were not measured, or were not within acceptable range.
- Aeration to the test chamber was off for an extended time such that the DO levels dropped to less than 90% of saturation.
- The analytical method used to measure the concentration of toxicant in the test chamber was not validated before beginning the test.
- Response criteria were not monitored in a blind fashion.

Any deviation from test specifications will be noted as a protocol deviation when reporting data from a test. Depending on the degree of the deviation, a test may still be conditionally acceptable. This decision is made on a test-specific basis and depends on the experience and judgment of the project manager.

Appendix F

Corrective Action Form

CORRECTIVE ACTION

Job Number/Project: _____

Procedure: _____ Reporter: _____

Description of problem encountered:

Samples affected (Sample ID):

Date Recognized: _____ By: _____

Date Occurred: _____ By: _____

Date Corrected: _____ By: _____

Reported To: _____

Description of corrective/preventive action taken to remedy problem:

Notification and approval of final corrective action (signatures):

Reporter: _____ Date: _____

Lab Manager: _____ Date: _____

QA Officer: _____ Date: _____

Program Manager: _____ Date: _____