Public Utilities

QUALITY ASSURANCE PLAN

FOR
COASTAL RECEIVING WATERS MONITORING

Environmental Monitoring and Technical Services
2392 Kincaid Road • Mail Station 45A • San Diego, CA 92101
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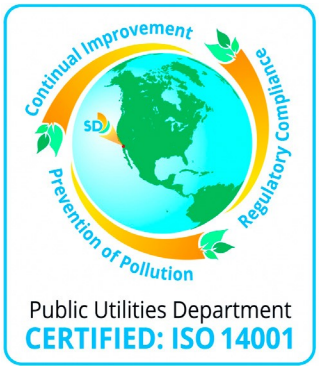

A. PROJECT MANAGEMENT

A.1 Title and Approval Sheet

The City of San Diego
Receiving Waters Monitoring Quality Assurance Plan

Organization:
City of San Diego, Public Utilities Department, Environmental Monitoring and Technical Services Division

Location:
2392 Kincaid Road, San Diego, CA 92101-0811

Approvals:
Approval history for revisions of this document is documented electronically and stored in Ideagen. Contact the division's Quality Manager if you need access to this information.

Approving Authorities:
Zoë Scott, MBOO Quality Assurance Officer
Dr. Ryan Kempster, Senior Marine Biologist
Maria Noller, EMTS Quality Manager
Dr. Peter S. Vroom, Deputy Public Utilities Department Director

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A.2 Table of Contents

A.3 Distribution List

In addition to internal distribution, copies of this Quality Assurance Plan (QAP), and any subsequent revisions, will be distributed to parties listed in the Distribution list (Table 1).

Table 1 Distribution list of the Quality Assurance Plan

Title	Affiliation	Contact Information
Executive Officer	California Regional Water Quality Control Board	San Diego Region, 2375 Northside Drive, Suite 100, San Diego, CA 92108
Regional Administrator	U.S. Environmental Protection Agency, Region 9	Attn: 65/MR, W-3, 75 Hawthorne Street, San Francisco, CA 94105-3901
Area Operations Manager	International Boundary and Water Commission	2995 Clearwater Way, San Diego, CA92154
Hydrogeologist	Department of Environmental Health, County of San Diego	5201 Ruffin Road, Suite C, San Diego, CA 92123
Regulatory Unit	Division of Water Quality, State Water Resources Control Board	P.O. Box 944213, Sacramento, CA 94244-2130
Deputy Director	Environmental Services, County of San Diego, Public Health Service	1255 Imperial Ave. Suite 400, San Diego, CA 92101
Assistant District Director	California Coastal Commission, San Diego Coast District	7575 Metropolitan Drive, Ste. 103, San Diego, CA 92108
	U.S. Dept. of Commerce, NOAA, Hazardous Materials Response & Assessment Division	7600 Sand Point Way NE, Bin C15700, Seattle, WA 98115

A.4 Program Organization

Ocean Monitoring Program

Monitoring of receiving waters by the City of San Diego's (City) Ocean Monitoring Program (OMP) are accomplished through the coordinated efforts of the Environmental Monitoring and Technical Services (EMTS) Division of the City's Public Utilities Department with support from various outside contractors (Figure 1). The EMTS Division includes laboratories from three sections that participate in the receiving waters monitoring and toxicity testing activities associated with the National Pollutant Discharge Elimination System (NPDES) permits. These sections include: (1) the Marine Biology and Ocean Operations (MBOO) section; (2) the Microbiology section (Marine Microbiology Laboratory, MML, and Toxicology Laboratory, TL); and (3) Environmental Chemistry Services section (Environmental Chemistry Lab, ECS).

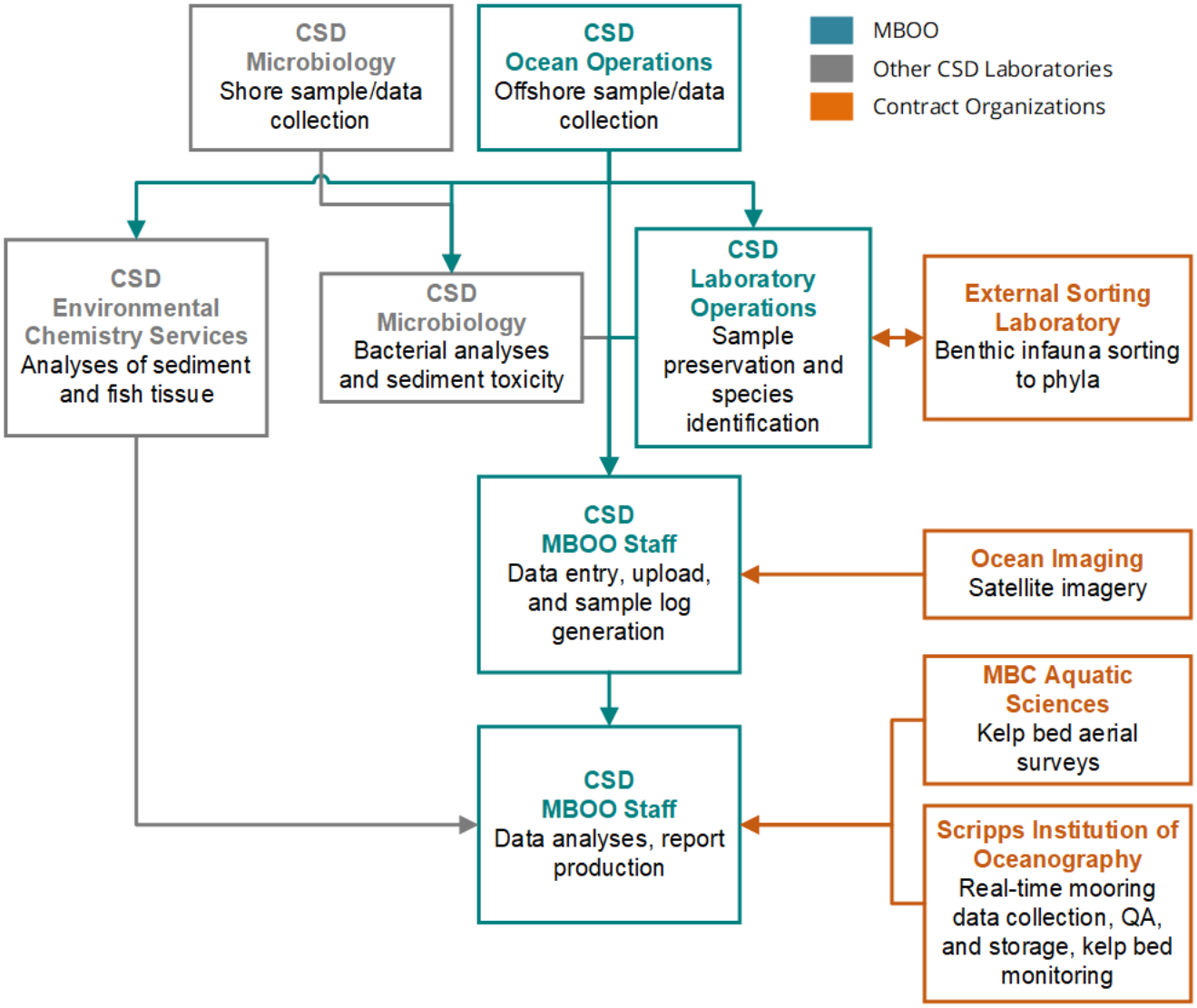

Figure 1 Overview of receiving waters data flow through EMTS and affiliates.

The MBOO section, and Marine Microbiology and Toxicology Labs are located at the EMTS Division's laboratory facility at 2392 Kincaid Road, San Diego, CA 92101. Staff scientists from these three labs are responsible for conducting most field sampling operations and subsequent laboratory assessments associated with the City's OMP such as water quality, benthic sediments and infauna, trawl-caught fishes and invertebrates, and contaminant bioaccumulation in marine fishes. The Environmental Chemistry Lab is located at another City facility and is responsible for performing chemical analyses of the various sediment and fish tissue samples collected by marine biologists. The Marine Microbiology, Toxicology, and Environmental Chemistry Labs have Quality Assurance (QA) Plans unique to each laboratory that supplement the EMTS Division QA Manual, therefore descriptions of the Quality Assurance/Quality Control (QA/QC) practices pertaining to the tasks performed by those three labs are not repeated herein.

Marine Biology and Ocean Operations

Marine Biology and Ocean Operations staff scientists are responsible for conducting most of the field sampling operations, some laboratory analyses, and subsequent biological and oceanographic assessments associated with the City's OMP. Staff in this section are organized into different work groups based on main responsibilities and areas of expertise. Brief descriptions of the areas of emphasis and responsibilities for each work group are provided here.

Ocean Operations: This work group comprises two subsections, Ocean Operations and Vessel Operations. Ocean Operations staff oversee and conduct water quality sampling, benthic sediment and infauna sampling, trawling and rig-fishing, and ocean outfall inspections, including data collection and QA. These staff members maintain and calibrate all oceanographic instrumentation, including the laboratory's remotely operated vehicle (ROV), remotely operated towed vehicle (ROTV), and static/real-time oceanographic moorings. Vessel Operations staff (i.e., Boat Operators) are primarily responsible for the operation and maintenance of the City's two ocean monitoring vessels, the Oceanus, and the Monitor III. When the vessels are in port, the boat operators schedule and oversee all regular vessel maintenance as well as any modifications that may become necessary. While at sea, they are responsible for ensuring the safety of the crew, locating, and maintaining position at monitoring stations, and assisting with various deck activities during field operations, as appropriate. Members of this and other work groups participate in and are members of the Southern California Association of Ichthyological Taxonomists and Ecologists (SCAITE).

Laboratory Operations: The Laboratory Operations work group coordinates processing of all benthic infauna, trawl-caught fish and megabenthic invertebrates, and rig fishing samples including label preparation, sample login, and data entry. In addition, they maintain the taxonomic literature and voucher collections, produce in-house identification/voucher sheets and keys, and conduct taxonomic training. This group also oversees fish dissections as part of the analysis of contaminant accumulation in marine fishes. Staff participate in regional taxonomic standardization programs and perform all QA/QC procedures to ensure the accuracy of the taxonomic identifications made by laboratory staff. Members of this and other work groups are members of the Southern California Association of Marine Invertebrate Taxonomists (SCAMIT).

Program Coordination: One of the primary responsibilities of the Program Coordination (PC) supervisor is to support the Ocean Monitoring Program manager by facilitating collaborations with external entities such as Scripps Institution of Oceanography, Southern California Coastal Water Research Project (SCCWRP), regulatory agencies, and other POTWs. Examples include managing contracts for supplemental monitoring (satellite imagery, aerial kelp surveys, kelp forest underwater surveys) as well as serving as Bight Coordinator, Commission's Technical Advisory Group (CTAG) alternate, and Region Nine Kelp Survey Consortium chair. The PC supervisor also works closely with City staff and contract vendors to ensure data collection efforts meet permit requirements. In addition, they help with compliance report management, production and submission, manage data requests, manage OMP data available via the City's Open Data Portal, and help maintain the City's Ocean Monitoring Program Reports and Data webpages.

Environmental Management: This work group oversees MBOO compliance with environmental and laboratory management standards such as International Organization for Standardization (ISO) 14001. Oversight includes document control and maintenance of the QAP, Standard Operating Procedures, Work Instructions, and ISO 14001 documentation using the division's compliance software, Ideagen. Staff in this work group coordinate with members of other work groups and sections to produce an annual report of quality assurance activities. Furthermore, this group promotes lab and field safety through trainings, and environmental systems through hazardous materials and universal waste management. Environmental Management seeks to reduce resource use and exceed regulatory expectations by supporting process development and improvement, data management, and staff training, and to engage the public by supporting MBOO's and the division's outreach efforts.

Key Personnel

Key personnel involved with the Receiving Waters Monitoring Quality Assurance Plan and their primary responsibilities are listed in Table 2, and each role is described below.

Table 2 Key Project Personnel and Primary Responsibilities

Name	Title	Contact Information	Group/Section
Maria Noller	EMTS Quality Manager	619-668-3256 MNoller@sandiego.gov	Data Management and Quality Services Section
Dr. Ryan Kempster	OMP Manager; Senior Marine Biologist	619-758-2329 RKempster@sandiego.gov	Marine Biology and Ocean Operations Section
Zoë Scott	MBOO QA Officer Marine Biologist III	619-758-2347 ZScott@sandiego.gov	Environmental Management
Ami Latker	Marine Biologist III	619-758-2324 ALatker@sandiego.gov	Program Coordination
Wendy Enright	Marine Biologist III	619-758-2378 WEnright@sandiego.gov	Laboratory Operations
Adriano Feit	Marine Biologist III	619-758-2377 AFeit@sandiego.gov	Ocean Operations and Vessel Operations

Ocean Monitoring Program (OMP) Manager: The Senior Marine Biologist, who also serves as the OMP Manager, is responsible for overseeing implementation of the OMP. The OMP Manager is the primary contact for all receiving waters monitoring activities, both in-house and contracted, and has overall responsibility for contracts, scheduling, staffing, and resource allocations. Additionally, they are responsible for ensuring that necessary staff orientation and training occurs, providing final approval of all procedures, plans, and reports, and notifying the EMTS Deputy Director, Technical Services Program Manager, and Quality Manager, as well as regulatory agencies, of any program nonconformance or change.

Quality Manager: The EMTS Quality Manager is a member of the Division's Senior Staff responsible to the Deputy Director and Technical Services Program Manager for the continuous implementation of the quality system (QS) via the EMTS Division QA Manual. The Quality Manager has direct access to

the EMTS Division Deputy Director, and the necessary resources to ensure the continuous implementation of the QS throughout the division. The Quality Manager evaluates data objectively and independently and performs assessments without outside (laboratory director or OMP Manager) influence. The Quality Manager coordinates with the MBOO QA Officer to ensure sample requirements and analyses meet permit, project, and regulatory requirements, and that all staff are appropriately trained.

MBOO QA Officer: Appointed by the Senior Marine Biologist, the MBOO QA Officer is responsible for maintaining and distributing amended versions of this QAP to the appropriate parties, and to work with the Senior Marine Biologist to ensure that all members of the Marine Biology Laboratory are familiar with its contents. This person supervises the Environmental Management work group mentioned previously.

Marine Biologist III: Supervisors are responsible for all functions of their work group. Duties include supervision, coordination with other groups, QA, and oversight of all phases of field and laboratory operations. All MBIIIs report directly to the Senior Marine Biologist.

A.5 Program Definition and Background

The QA/QC practices described herein ensure the quality of field sampling, laboratory analysis, records and documentation, data entry, and electronic data collection/transfer, as well as data assessment, analysis, and reporting. This QAP has been prepared to ensure compliance with the United States Environmental Protection Agency (USEPA) QAP format outline (USEPA 2002) and serves to supplement the EMTS Division QA Manual (City of San Diego 2020), which provides an outline of the quality management system for the EMTS Division and its associated laboratories.

Ocean monitoring within the Point Loma and South Bay outfall regions is conducted by the City in accordance with requirements set forth in National Pollutant Discharge Elimination System (NPDES) permit Attachment E – Monitoring and Reporting Program for the City's Point Loma Wastewater Treatment Plant (PLWTP) and South Bay Water Reclamation Plant (SBWRP), as well as the South Bay International Wastewater Treatment Plant (SBIWTP) that is owned and operated by the U.S. International Boundary and Water Commission, U.S. Section (Table 3). This QAP fulfils Attachment E Section I.G in the PLWTP permit and Attachment E Section 1.6 in the SBWRP and SBIWTP permits.

Table 3 NPDES permits, and associated Orders issued by the San Diego Regional Water Quality Control Board for the Point Loma Wastewater Treatment Plant (PLWTP), South Bay Water Reclamation Plant (SBWRP), and the South Bay International Wastewater Treatment Plant

Facility	Outfall	NPDES Permit No.	Order No.	Effective Dates
PLWTP	PLOO	CA0107409	R9-2017-0007[a]	October 1, 2017 – September 30, 2022
SBWRP	SBOO	CA0109045	R9-2021-0011	July 1, 2021 – June 30, 2026
SBIWTP	SBOO	CA0108928	R9-2021-0001	July 1, 2021 – June 30, 2026

[a] Amended by R9-2022-0078 effective on September 25, 2022

These permits specify the terms and conditions that allow treated effluent to be discharged to the Pacific Ocean via the Point Loma Ocean Outfall (PLOO) and South Bay Ocean Outfall (SBOO); effluent from the PLWTP is discharged to the ocean through the PLOO, whereas commingled effluents from the SBWRP and SBIWTP are discharged through the SBOO. In addition, the Monitoring and Reporting Program (MRP) included within each of these permits defines the requirements for monitoring ocean (receiving) waters surrounding the two outfalls, including sampling design, frequency of sampling, field operations and equipment, regulatory compliance criteria, types of laboratory tests and analyses, data management and analysis, statistical methods and procedures, environmental assessment, and reporting guidelines. Principal objectives of the combined MRPs for both outfall regions include: (1) measure and document compliance with NPDES permit requirements (see Table 3) and the California Ocean Plan water quality objectives and standards (SWRCB 2015, SWRCB 2019); (2) assess any impact of wastewater discharge or other anthropogenic inputs on the local marine ecosystem, including effects on coastal water quality, seafloor sediments, and marine life; (3) monitor natural spatial and temporal fluctuations of key oceanographic and community parameters, and evaluate the overall health and status of the San Diego marine environment.

A.6 Program Description

The current core receiving waters monitoring requirements for the Point Loma and South Bay MRPs are summarized in Tables 4 and 5, respectively, and the permanent, fixed-position sampling sites for each aspect of the monitoring program are shown in Figures 2–5. These core monitoring activities include: (1) weekly sampling of ocean waters from recreational areas located along the shoreline and within the Point Loma and Imperial Beach kelp beds to assess nearshore water quality conditions; (2) quarterly sampling of ocean waters at offshore sites to document water quality conditions throughout the region; (3) semiannual benthic sampling to monitor sediment conditions and the status of resident benthic infauna communities; (4) semiannual trawl surveys to monitor the ecological health of demersal fish and megabenthic invertebrate communities; (5) annual collection of fish tissue samples to monitor levels of chemical constituents that may have ecological or human health implications. The results of the above monitoring activities are analyzed and presented in various regulatory reports that are submitted to the San Diego Regional Water Quality Control Board (SDRWQCB), the United States Environmental Protection Agency (USEPA), and the International Boundary and Water Commission, US Section (USIBWC) on an on-going basis (Table 6).

In addition to core monitoring efforts, the City conducts "strategic process studies" (i.e., special projects) and participates in regional monitoring activities (e.g., Southern California Bight 2023 Regional Monitoring Program) as part of its regulatory requirements outlined in each NPDES permit. An example of a special project or enhanced monitoring effort presently underway includes the Real-Time Oceanographic Mooring Systems (RTOMS) for the PLOO and SBOO. Special studies and regional monitoring efforts are typically subject to QA/QC procedures like those described in this document, although the analysis and reporting schedules may vary. Thus, full details of these non-core monitoring efforts are not included in this document. The planning documents for the current Bight project, including its Quality Assurance Plan, are available upon request or for download from SCCWRP's website (www.sccwrp.org).

A.7 Quality Objectives and Criteria

The overarching quality objectives for the City's OMP are to: (1) comply with all applicable federal, state, local, and contract quality assurance requirements; (2) ensure scientific data generated are of sufficient quality to withstand scientific and legal scrutiny; (3) ensure data are gathered or developed in accordance with procedures appropriate for the intended use of the data; (4) ensure data are of known and acceptable precision, bias, accuracy, representativeness, comparability, completeness, and sensitivity. The EPA (2002) defines these terms as follows:

Precision: The measure of agreement among repeated measurements of the same property under identical, or substantially similar conditions; calculated as either the range or as the standard deviation. May also be expressed as a percentage of the mean of the measurements, such as relative range or relative standard deviation (coefficient of variation).

Bias: The systematic or persistent distortion of a measurement process that causes errors in one direction.

Accuracy: A measure of the overall agreement of a measurement to a known value; includes a combination of random error (precision) and systematic error (bias) components of both sampling and analytical operations.

Representativeness: A qualitative term that expresses "the degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition" (ANSI/ASQC E4: 1994).

Comparability: A qualitative term that expresses the measure of confidence that one data set can be compared to another and can be combined for the decision(s) to be made.

Completeness: A measure of the amount of valid data needed to be obtained from a measurement system.

Sensitivity: The capability of a method or instrument to discriminate between measurement responses representing different levels of the variable of interest.

Performance criteria used to ensure that ocean monitoring data collected by the City comply with the EMTS Division QA Manual are described hereafter for field sampling and laboratory analyses conducted by Marine Biology Lab staff, with additional details provided in applicable Standard Operating Procedures (SOPs) (Appendix F.1) and Work Instructions (Appendix F.2). Performance criteria for bacteriological, sediment toxicity, sediment particle size and chemistry, and fish tissue chemistry analyses are provided in the QA Plans for Marine Microbiology, Toxicology, and ECS Labs, respectively.

Table 4 Core receiving waters monitoring requirements for the PLOO region. Sampling effort excludes FIB resamples, QA/QC activities, new plume tracking requirements, and/or special studies.

Monitoring Component	Location	No. of Stations/Zones	Sample Type	Discrete No. Samples/Site	Sampling Frequency	Sample Times/Yr	Discrete No. Samples/Yr	Parameters	No. "Samples" Analyzed/Yr	Notes
Water Quality, Microbiology	shore	8	Seawater - FIB	1	1/Week	52	416	T, F, E[a]	1248	1 sample/station
Oceanographic Conditions	kelp/ nearshore	8	Seawater - FIB	3	1/Week	52	1248	T, F, E[a]	3744	3 depths/station
		8	CTD	1	1/Week	52	416	CTD profile[c]	3744	1 cast/station (1-m batch avg samples)
	offshore	3	Seawater - FIB	3	1/Quarter	4	36	E[b]	36	3 depths/station (18-m stations)
		11	Seawater - FIB	3	1/Quarter	4	132	E[b]	132	3 depths/station (60-m stations)
		11	Seawater - FIB	4	1/Quarter	4	176	E[b]	176	4 depths/station (80-m stations)
		11	Seawater - FIB	5	1/Quarter	4	220	E[b]	220	5 depths/station (98-m stations)
		36	CTD	1	1/Quarter	4	144	CTD profile[c]	1296	1 cast/station (1-m batch avg samples)
Sediment Chemistry	offshore	22	Grab	1	2/Year	2	44	sed chem[d]	352	1° and 2° core stations (Jan, Jul)
	offshore	12	Grab	1	2/Year	2	24	sed chem[e]	24	1° core stations (Jan, Jul)
	offshore	40	Grab	1	1/Year	1	40	sed chem[d]	320	Randomized stations (Jul)[g]
Benthic Infauna	offshore	22	Grab	1	2/Year	2	44	community	44	1° and 2° core stations (Jan, Jul)
	offshore	40	Grab	1	1/Year	1	40	structure	40	Randomized stations (Jul)[g]
Sediment Toxicity	offshore	8-28	Grab	1	1/Year	1	8-28	acute toxicity	8-28	Rotating offshore stations[h]
Demersal Fishes & Invertebrates	offshore	6	Trawl	1	2/Year	2	12	community structure	12	1 trawl/station (Jan, Jul)
Bioaccumulation in Fish Tissues	offshore	4	Trawl/ Rig Fishing	3	1/Year	1	12	liver tissue[f]	60	3 composites/zone (Oct)
	offshore	2	Rig Fishing	3	1/Year	1	6	muscle tissue[f]	30	3 composites/zone (Oct)
Totals							**3038**		**11,506**	

[a] Fecal Indicator Bacteria (FIB) parameters = total coliform (T), fecal coliform (F), *Enterococcus* bacteria (E); n = 3 parameters required at shore and kelp water quality stations.

[b] *Enterococcus* = only FIB indicator required at offshore water quality stations.

[c] CTD profile = temperature, depth, pH, salinity, dissolved oxygen, light transmittance (transmissivity), chlorophyll *a* (n=7 required parameters), plus density and CDOM (n=9 parameters total)

[d] Sediment constituents = sediment particle size, total organic carbon, total nitrogen, sulfides, metals, PCBs, chlorinated pesticides, PAHs (n = 8 parameter categories; see NPDES permit for complete list of constituents).

[e] Sediment constituents = BODs at 12 primary core stations only (voluntary sampling per agreement with USEPA Region IX)

[f] Fish tissue constituents = lipids, metals, PCBs, chlorinated pesticides, and PAHs (n = 5 parameter categories; see NPDES permit for complete list of constituents)

[g] Random (regional) benthic survey = joint requirement of Point Loma and South Bay outfall monitoring programs (i.e., 40 stations/year total)

[h] Continued Sediment Toxicity Monitoring as recommended by the Final Project Report for the Sediment Toxicity Pilot Study for the San Diego Ocean Outfall Monitoring Regions (City of San Diego, 2019)

Table 5 Core receiving waters monitoring requirements for the SBOO region. Sampling effort excludes FIB resamples, QA/QC activities, new plume tracking requirements, and/or special studies.

Monitoring Component	Location	No. of Stations /Zones	Sample Type	Discrete No. Samples/Site	Sampling Frequency	Sample Times/Yr	Discrete No. Samples/Yr	Parameters	No. "Samples" Analyzed/Yr	Notes
Water Quality, Microbiology	shore	11	Seawater - FIB	1	1/Week	52	572	T, F, E[a]	1716	1 sample/station
Oceanographic Conditions	kelp/ nearshore	7	Seawater - FIB	3	1/Week	52	1092	T, F, E[a]	3276	3 depths/station
		7	CTD	1	1/Week	52	364	CTD profile[b]	3276	1 cast/station (1-m batch avg samples)
	offshore	21	Seawater - FIB	3	1/Quarter	4	252	T, F, E[a]	756	3 depths/station
		33	CTD	1	1/Quarter	4	132	CTD profile[b]	1188	1 cast/station (1-m batch avg samples)
		3	Seawater - pH/TA	2-3	1/Quarter	4	32	pH, TA[c]	64	
Sediment Chemistry	offshore	27	Grab	1	2/Year	2	54	sed chem[d]	432	1° and 2° core stations (Jan, Jul)
	offshore	40	Grab	1	1/Year	1	40	sed chem[d]	320	Randomized stations (Jul)[f]
Benthic Infauna	offshore	27	Grab	1	2/Year	2	54	community	54	1° and 2° core stations (Jan, Jul)
	offshore	40	Grab	1	1/Year	1	40	structure	40	Randomized stations (Jul)[f]
Sediment Toxicity	offshore	8-28	Grab	1	1/Year	1	8-28	acute toxicity	8-28	Rotating offshore stations[g]
Demersal Fishes & Invertebrates	offshore	7	Trawl	1	2/Year	2	14	community structure	14	1 trawl/station (Jan, Jul)
Bioaccumulation in Fish Tissues	offshore	5	Trawl/ Rig Fishing	3	1/Year	1	15	liver tissue[e]	75	3 composites/zone (Oct)
	offshore	2	Rig Fishing	3	1/Year	1	6	muscle tissue[e]	30	3 composites/zone (Oct)
Totals							**2695**		**11,269**	

[a] Fecal Indicator Bacteria (FIB) = total coliform (T), fecal coliform (F), and *Enterococcus* bacteria (E); n = 3 parameters required at all shore, kelp nearshore and offshore water quality stations

[b] CTD profile = temperature, depth, pH, salinity, dissolved oxygen, light transmittance (transmissivity), chlorophyll *a* (n = 7 required parameters), plus density and CDOM (n = 9 parameters total)

[c] As of July 1, 2021, samples were collected and analyzed for pH/TA at offshore stations (see SBWRP and SBIWTP NPDES permits for details)

[d] Sediment constituents = sediment particle size, total organic carbon, total nitrogen, sulfides, metals, PCBs, chlorinated pesticides, PAHs (n = 8 parameter categories; see NPDES permit for complete list of constituents)

[e] Fish tissue constituents = lipids, metals, PCBs, chlorinated pesticides, and PAHs (n = 5 parameter categories; see NPDES permit for complete list of constituents)

[f] Random (regional) benthic survey = joint requirement of Point Loma and South Bay outfall monitoring programs (i.e., 40 stations/year total)

[g] Continued Sediment Toxicity Monitoring as recommended by the Final Project Report for the Sediment Toxicity Pilot Study for the San Diego Ocean Outfall Monitoring Regions (City of San Diego, 2019)

Table 6 Receiving waters monitoring reports generated by MBOO.

Report Title	Frequency	Receiving Agencies	Report Due
Monthly Receiving Waters Monitoring Report for the PointLoma Ocean Outfall (PLWTP)	1/Month	SDRWQCB, USEPA	1st day of second calendar month following sampling
Monthly Receiving Waters Monitoring Report for the SouthBay Ocean Outfall (SBWRP)	1/Month	SDRWQCB, USEPA	1st day of second calendar month following sampling
Monthly Receiving Waters Monitoring Report for the SouthBay Ocean Outfall (SBIWTP)	1/Month	USIBWC	1st day of second calendar month following sampling
Interim Receiving Waters Monitoring Report for the PLOOand SBOO	1x/2 Years	USIBWC, SDRWQCB, USEPA	July 1 following even years (i.e., due in 2019,2021, 2023); draft to USIBWC 10 working days prior to June 15; Final report due June 15
Biennial Receiving Waters Monitoring Report for the PLOOand SBOO	1x/2 Years	USIBWC, SDRWQCB, USEPA	July 1 following odd years (i.e., due in 2020,2022, 2024); draft to USIBWC 10 working days prior to June 15; Final report due June15
Biennial State of the Ocean Report	1x/2 Years	USIBWC, SDRWQCB, USEPA	December 31 following odd years (i.e., duein 2020, 2022, 2024)

Performance Criteria for Field Sampling

Navigation

Locations of the stations where data are collected are defined in the NPDES permits as a set of coordinates and a target depth. Both the City's ocean monitoring vessels are equipped with Differential Global Positioning Systems (DGPS) to determine vessel positioning and fathometers to determine depth with a high degree of precision and accuracy. The vessel must be positioned within 10% of station depth.

Kelp Bed and Offshore Water Quality Monitoring

The primary objective of monitoring water quality is to evaluate water quality (WQ) conditions within both the nearshore Point Loma and Imperial Beach kelp beds and at offshore stations. Water quality monitoring is conducted weekly at 15 kelp water quality stations, and quarterly at 69 offshore stations (typically in February, May, August, and November). Water quality sampling includes the collection of seawater samples for bacteriological analyses, the deployment of a conductivity, temperature, and depth (CTD) instrument to collect oceanographic parameters (temperature, depth, pH, salinity, dissolved oxygen, transmissivity, chlorophyll *a*, colored dissolved organic matter (CDOM)), and collection of visual observations metadata.

Performance criteria for water quality sampling include: (1) all sampling is conducted within 0.05 nautical miles (nm) of station coordinates; (2) all required samples are collected and labeled properly; (3) oceanographic sampling equipment is properly maintained, and calibrations are logged; (4) all on-board sample collection and sample storage meets the requirements of the MML; (5) all samples are transferred with appropriate chain-of-custody (COC) forms.

Benthic Monitoring

Benthic sampling includes the deployment of a double 0.1 m^2 Van Veen grab to collect sediments from the sea floor for sediment particle size, sediment chemistry, and benthic infauna analyses. All surfaces of the Van Veen grab must be clean and free of rust, and all sampling equipment is rinsed with filtered seawater between deployments to avoid possible contamination. Visual observations are recorded for each sample collection at sea. Performance criteria for the collection of sediments include: (1) all sampling is conducted within 0.05 nautical miles (nm) of station coordinates and within 10% of the station's nominal depth (if applicable); (2) all required samples are collected and labeled properly; (3) sediment in the Van Veen grab meets criteria established by the USEPA (USEPA 1987) to ensure consistency in terms of sample disturbance (i.e., even surface with minimal disturbance, not heavily canted, little or no leakage of the overlying water) and depth of penetration (i.e., a penetration depth of at least 5 cm); (4) samples are stored in such a way to prevent contamination.

Performance criteria specific to the handling of benthic infauna samples include: (1) sediments are handled gently during the sieving process to prevent damage to specimens; (2) organisms are submerged in a magnesium sulfate solution as quickly as possible after sieving for 30 minutes to relax the specimens prior to fixation; (3) samples receive sufficient formalin after relaxation to fix tissue and prevent degradation of proteins or cell structure; (4) samples are changed to an appropriate volume of 70% Ethanol to preserve fixed specimens for future identification; (5) sample jars are labeled properly.

Performance criteria specific to the handling of sediment chemistry, particle size, and toxicity samples include: (1) subsamples are collected from the top 2 cm of the sediment surface within the Van Veen grab, away from the edges, using the correct container(s); (2) subsamples are put in a cooler on ice as soon as possible; (3) appropriate COC paperwork or documentation of samples collected is completed; (4) subsamples are transferred to ECS or TL immediately to prevent exceedance of holding times.

Demersal Fish and Megabenthic Invertebrate Monitoring

Trawling involves the deployment of a 7.6 m Marinovich otter trawl fitted with a 1.3 cm cod-end mesh net targeting demersal fishes and megabenthic invertebrates. Visual observations are recorded for each trawl event. Performance criteria for conducting trawls include: (1) each trawl track crosses within 0.05 nm of the nominal station coordinates at some point while the net is in contact with the sea floor; (2) all required trawls are completed; (3) each trawl reaches proper depth, has the appropriate scope, is towed at the appropriate speed and duration, and the net is at no point fouled (tangled); (4) species-level identifications, or lowest taxonomic level possible, are obtained for all trawled fishes and megabenthic invertebrates captured in the trawl while at sea, or specimens are preserved properly, logged, and returned to Marine Biology Lab for further identification (FID); (5) fish are examined for parasites or anomalies; (6) all specimens are counted by species, with measurements of length and weight obtained

using appropriate techniques for all fishes and some invertebrates when required; (7) all data are accurately recorded on approved field data sheets.

Monitoring of Contaminants in Fish Tissues

Target fishes are collected for tissue analysis of bioaccumulation either by trawl (see above) or by rig fishing. Visual observations are recorded during sample collection at sea. Performance criteria for sampling by rig fishing include: (1) fishes are collected within a 1 km radius of station coordinates; (2) sufficient numbers of target fishes are collected if possible within the accepted level of effort for each composite sample to ensure adequate tissue for chemical analyses; (3) fishes are wrapped in aluminum foil and sealed in re-sealable plastic bags in such a way as to prevent contamination from outside sources; (4) all required composite samples are collected and labeled properly; (5) all samples are stored on dry ice as soon as possible to prevent the degradation of tissues due to death and heat exposure.

Mooring Data Collection

Moorings provide nearly continuous measurements of local ocean currents as well as water temperature and other oceanographic parameters from the area for plume tracking. Performance criteria for operation of the non-telemetered moorings include: (1) moorings are deployed within 2 m of the appropriate depth contour; (2) all instrumentation is properly maintained and calibrated according to manufacturers' instructions; (3) data are downloaded at an appropriate frequency for their battery life. Performance criteria for the RTOMS include: (1) All sensors onboard the RTOMS pass quality conformance testing and pool-based testing per criteria established by Scripps Institution of Oceanography (SIO); (2) Boat operators utilize digital GPS to ensure instrumentation is redeployed as close to the previous position as possible, or to a position determined to be optimal with respect to the outfall. The true location of the RTOMS shifts with current and is recorded by the onboard GPS and broadcast along with the real-time data; (3) At the time of deployment, remote communication is established with the mooring and all sensors are reading expected values. Some sensors (i.e., Carbon Dioxide partial pressure [pCO_2], pH) take several hours to equilibrate and therefore may not be reading accurately at the time of deployment. Therefore, these sensors must be monitored in real-time broadcast data to determine successful deployment. CTD casts, nitrate samples and ocean acidification samples are taken on a quarterly basis to inform sensor calibration offsets and drift (see Section B. Data Generation and Acquisition).

Performance Criteria for Laboratory Analyses

Benthic Infauna Analyses

Laboratory analyses of benthic infauna samples involve three processes: (1) sample preservation including washing, relaxant, fixation, and curation; (2) sample sorting; (3) identification and enumeration of all invertebrate organisms down to the lowest taxonomic level possible. Performance criteria for sample washing and preservation include: (1) samples are processed according to the USEPA 1987 procedures and the recent Bight'18 field manual; (2) samples are transferred carefully to avoid losing any organisms; (3) samples are transferred into appropriately sized, pre-labeled sample containers. For sample sorting, QC is essential to ensuring the validity of the subsequent steps in the sample analysis process. The sorting of preserved benthic samples into major taxonomic groups is contracted to an outside laboratory, with the contract specifying an expected 95% removal efficiency;

this efficiency is verified by City marine biologists upon sample return to the Marine Biology Lab. Finally, performance criteria for the identification of benthic infauna samples includes: (1) all taxonomic identifications meet 90% acceptability criteria; (2) all organisms are counted accurately; (3) species identifications correspond to standard taxonomic nomenclature according to the most current volume of the species list (SCAMIT 2021).

Identification of Collected Fish and Invertebrate Species

Performance criteria for FID demersal fishes and megabenthic invertebrates collected by otter trawl, and fishes collected by rig fishing include: (1) FIDs are stored properly until processed; (2) FIDs are identified and enumerated accurately according to standard taxonomic procedures and nomenclature (e.g., Eschmeyer and Herald 1998, Page et al. 2013, SCAMIT 2021, Love and Passarelli 2020).

Preparation of Fish Tissues for Chemistry Analyses

Fishes collected in the field for contaminant analysis are transported back to the Marine Biology Lab on dry ice and must be dissected and received by the ECS Lab within 20 days of collection. Performance criteria for fish tissue analysis include: (1) appropriate protocols for sterilizing equipment are followed; (2) fishes are thawed to the appropriate softness to minimize tissue disintegration; (3) proper dissection and sample preparation techniques are followed to prevent contamination of tissue samples; (4) sample jars are labeled properly; (5) tissue samples are kept frozen during fish dissections and until transferred to ECS; (6) transfer of samples follows appropriate COC procedures; (7) transfer takes place within the required holding time.

A.8 Special Training and Certifications

All Marine Biology Lab staff are qualified through training, education, and experience to perform the sampling and analyses required for the City's OMP, and positions within the MBOO section may have job-specific requirements for specialized training or certifications. General trainings required of all laboratory employees include, but are not limited to: Laboratory Safety, Hazardous Materials Handling, and New Employee Orientation. Documentation of this training is maintained in an online City database and is accessible by employees and their supervisors. In addition to general trainings required by the City, staff may receive job-specific training (e.g., field operations, fish and invertebrate taxonomy, computer programming), which is provided by supervisors or trained personnel as appropriate or necessary using resources including, but not limited to, this QA Plan, relevant SOPs, and Work Instructions. As appropriate, additional training in various Personal Computer (PC) software packages, specific data analysis programs (e.g., R, PRIMER), and database and data management software (e.g., Oracle, SQL) are also provided as new software is added or updates become available. Documentation of training is maintained by supervisors.

To ensure that Marine Biology Lab staff maintain a certain level of professionalism, training, and expertise, staff are expected to stay abreast of current scientific research through various online journals, libraries, and contacts at other institutions and agencies. The internet allows for online research of electronic journals, libraries, and current research news, as well as the direct exchange of information, data, and taxonomic drawings and photographs with biologists and ecologists of other institutions and agencies. Staff are encouraged to enroll in professional development trainings offered by the City and

non-City contractors, and to attend and present ocean monitoring data results in scientific and professional conferences in their area of expertise.

A.9 Documents and Records

Maintaining this Document

The QA Plan will be reviewed annually and updated as necessary using Ideagen, the division's compliance software, which tracks changes, versions, and approvals. Future amended QA Plans will be held and distributed internally and externally as described previously.

Ocean Monitoring Program Records and Reporting

The results of all receiving waters monitoring activities are reported in monthly and annual regulatory reports that are submitted via the California Integrated Water Quality System Project to the SDRWQCB and the USEPA, and by email to the USIBWC (Table 6). All reports are reviewed by the Program Coordination supervisor and the Senior Marine Biologist prior to distribution. Raw data and visual observations for shoreline (beach), kelp bed, and offshore water quality monitoring are included in the monthly reports, while raw data and visual observations for sediment particle size, sediment chemistry, benthic infauna, trawled fish, trawled invertebrates, and fish tissue chemistry samples are reported on an annual basis in the Interim or Biennial reports as defined in the NPDES permits. Final reports reside indefinitely as electronic files on the EMTS shared network drive and are submitted electronically to the Public Utilities Department Document Control section where they are printed and kept for permanent storage in both physical and electronic format. Backups of electronic files stored on the network occur on a routine basis; full network drive backups occur biweekly, with modified files getting backed-up nightly and are stored off-site. Reports and data are also available on the City's website (City of San Diego 2023), and raw data are available upon request.

Additional records produced during receiving waters monitoring activities include field data sheets, COC forms, calibration logs, and equipment service records. The level of detail required, person(s) responsible, and final disposition for each document is covered in Section B and in associated SOPs.

B. DATA GENERATION AND ACQUISITION

B.1 Sampling Process Design

This section provides a summary of specific sampling design details (e.g., station locations, sampling frequency) concerning the City's Core OMP activities listed in the previous section (Tables 4, 5), with one exception: shoreline (beach) water quality sampling is conducted and analyzed by staff in the Marine Microbiology Laboratory (MML) and is therefore addressed outside this document in their QA Manual. The receiving waters monitoring requirements set forth in the PLWTP, SBWRP, and SBIWTP NPDES permits are designed to measure the effects of the PLOO and SBOO discharge on local ocean waters by addressing the following questions: (1) Does the receiving water meet water quality standards? (2) Are the receiving water conditions getting better or worse over time? (3) What is the relative contribution of the PLOO or SBOO discharge to pollution in the receiving water?

To answer these questions, site-specific monitoring is conducted at set frequencies at fixed locations (stations) arranged in a grid pattern surrounding each outfall (Figures 2–6). The PLOO and SBOO sampling grids are designed to document conditions at nearfield stations within the waste field near the Zone of Initial Dilution (ZID), and at farfield stations beyond the ZID where discharge impacts might be reasonably expected.

During ocean operations, all information pertaining to the sampling event, sampling locations, inclement weather, and sea surface state is logged digitally in a metadata program or a station record sheet if this electronic storage should fail. The information being entered into the metadata program is detailed enough to accurately highlight critical details that support the sampling event. The lead scientist or boat operator shall decide to discontinue sampling if deemed necessary and enter the reason for discontinuing field operations in the software or write in the comment section of the field data sheet, as well as in the ship's logbook. Rescheduling and notification of the next sampling event shall be handled by the Ocean Operations supervisor or a designated marine biologist.

Kelp Bed and Offshore Water Quality Monitoring

Sampling at all WQ stations includes: (1) continuous measurements of temperature, conductivity (salinity), pressure (depth), chlorophyll *a*, CDOM, dissolved oxygen, pH, and transmissivity throughout the water column; (2) visual observations of surface water conditions such as floatables of sewage origin, weather, currents, tidal conditions, water color, oil and grease, turbidity, and odor; (3) collection of discrete water samples at 3–5 fixed depths (Figure 2).

Benthic Monitoring

The assessment of sediment quality is based on three components: (1) physical and chemical properties of seafloor sediments; (2) ecological status of the biological communities (benthic infauna) that live in the seafloor sediments; (3) sediment toxicity to assess bioavailability and toxicity of sediment contaminants.

A total of 49 primary and secondary core benthic stations are sampled semi–annually during the winter (January) and summer (July) (Figure 3). An additional 40 randomly generated regional benthic survey

stations are sampled each summer. Sampling at each benthic station includes: (1) the collection of sediment particle size and chemistry subsamples; (2) the processing and preservation of benthic organisms from sediment; (3) visual observations of climatic and receiving waters characteristics at the time of sampling. In addition, sediment toxicity samples are collected from additional casts of the Van Veen grab at select stations according to the Sediment Toxicity Monitoring Plan and recommendations from the final project report for the SBOO and PLOO Monitoring Regions (City of San Diego 2015, 2019).

Subsequent to field sampling, sediment subsamples are received by ECS where they are analyzed to determine sediment particle size composition and to determine concentrations of various indicators of organic loading including biochemical oxygen demand (BOD), total organic carbon (TOC), total nitrogen (TN), total sulfides (TS), and total volatile solids (TVS), and a variety of trace metals, chlorinated pesticides, polychlorinated biphenyl compound congeners (PCBs), and polycyclic aromatic hydrocarbons (PAHs) as mandated by NPDES permits. Benthic infauna samples are transported back to the Marine Biology Lab for further processing and then sent out to a contract lab for sorting. Sorted infauna samples are then returned to the Marine Biology Lab where all animals are identified to the lowest taxon possible and enumerated by City marine biologists.

Demersal Fish and Megabenthic Invertebrate Monitoring

A total of 13 trawl stations are sampled semi-annually in winter (January) and summer (July) (Figure 4). Sampling at each station includes: (1) the collection of demersal fishes and megabenthic invertebrates by otter trawl; (2) species identification and enumeration of all organisms collected; (3) length and weight measurement of all fishes; (4) presence/absence of physical anomalies and parasites on fishes; (5) visual observations of weather and water surface conditions.

Monitoring of Contaminants in Fish Tissue

Fish tissue sampling is conducted annually during the fall (October) at nine soft-bottom zones and four rig fishing stations (Figure 5). The monitoring of contaminants in fish tissue includes: (1) liver tissue taken from fishes collected at soft-bottom zones by trawl, rig fishing, or traps; (2) muscle tissue taken from fishes at rig fishing stations by rig fishing; (3) visual observations of weather and water surface conditions. Tissue dissections are performed by City marine biologists under the direction of the Laboratory Operations supervisor. All tissue analyses are performed at the ECS Lab on a wet weight basis to determine the concentrations of a variety of trace metals, chlorinated pesticides, polychlorinated PCBs, PAHs, and lipids as mandated by NPDES permits.

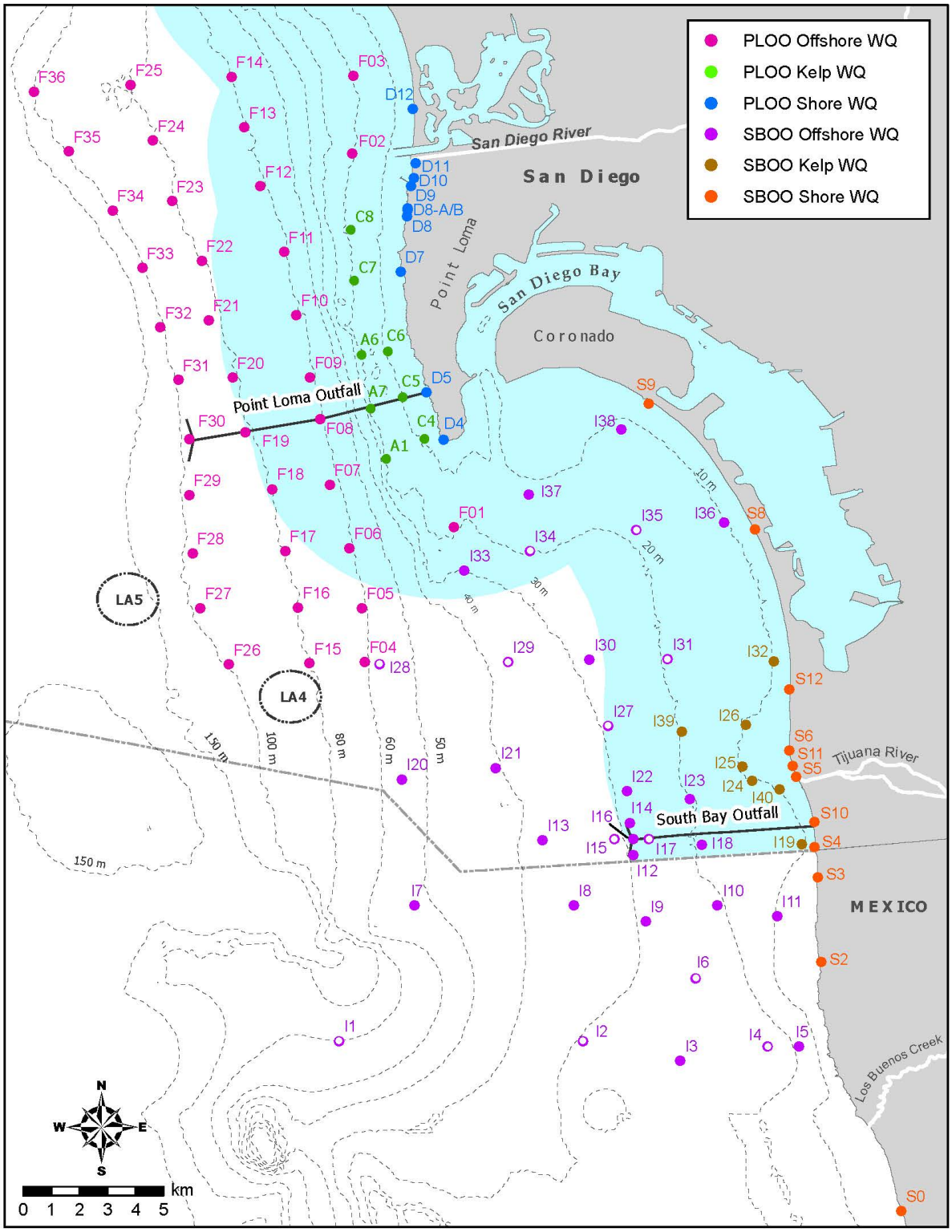

Figure 2 Water quality (WQ) monitoring station locations sampled around the PLOO and SBOO as part of the City of San Diego's Ocean Monitoring Program. Open circles are sampled by CTD only. Light blue shading represents State jurisdictional waters.

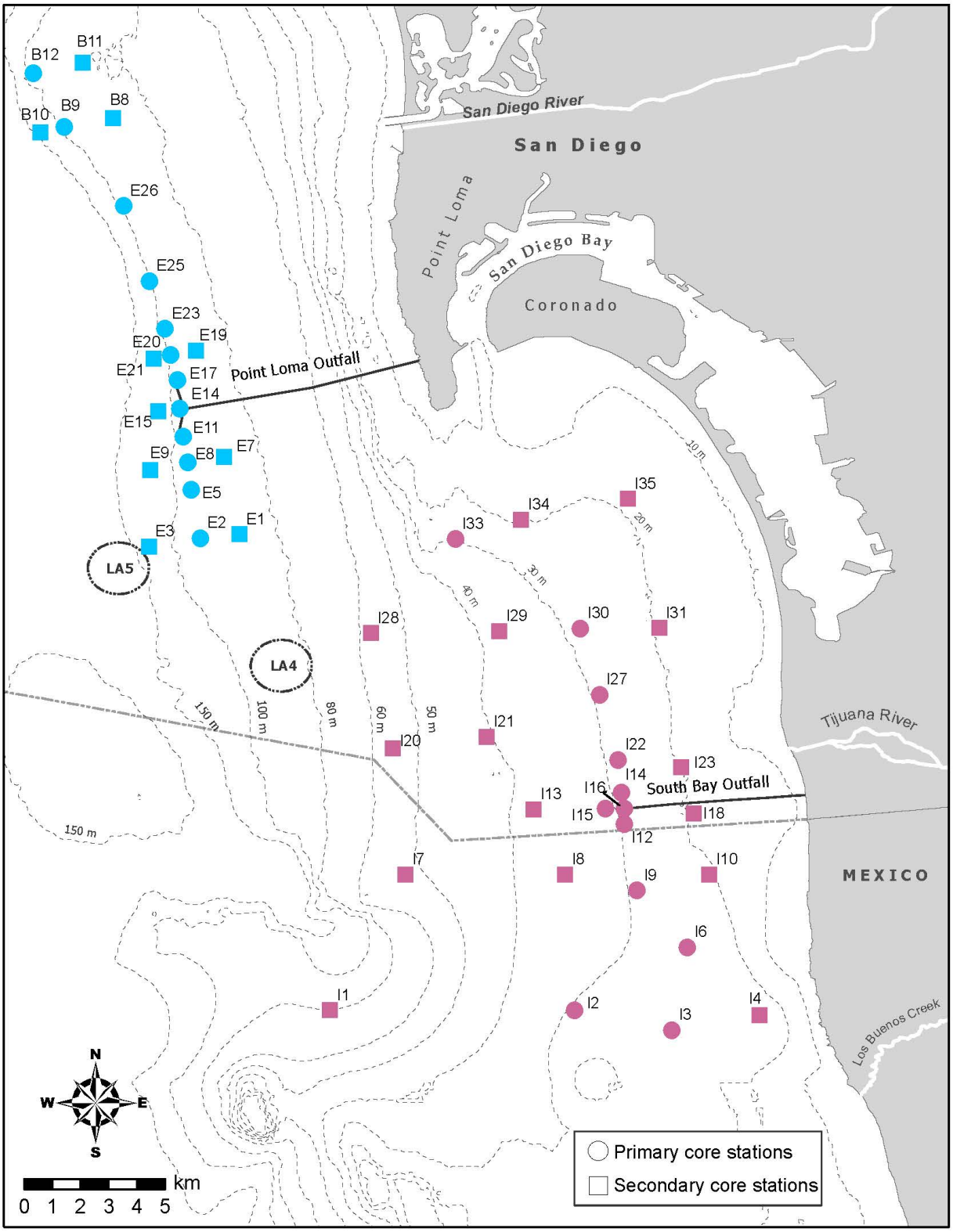

Figure 3 Benthic station locations sampled around the PLOO and SBOO as part of the City of San Diego's Ocean Monitoring Program.

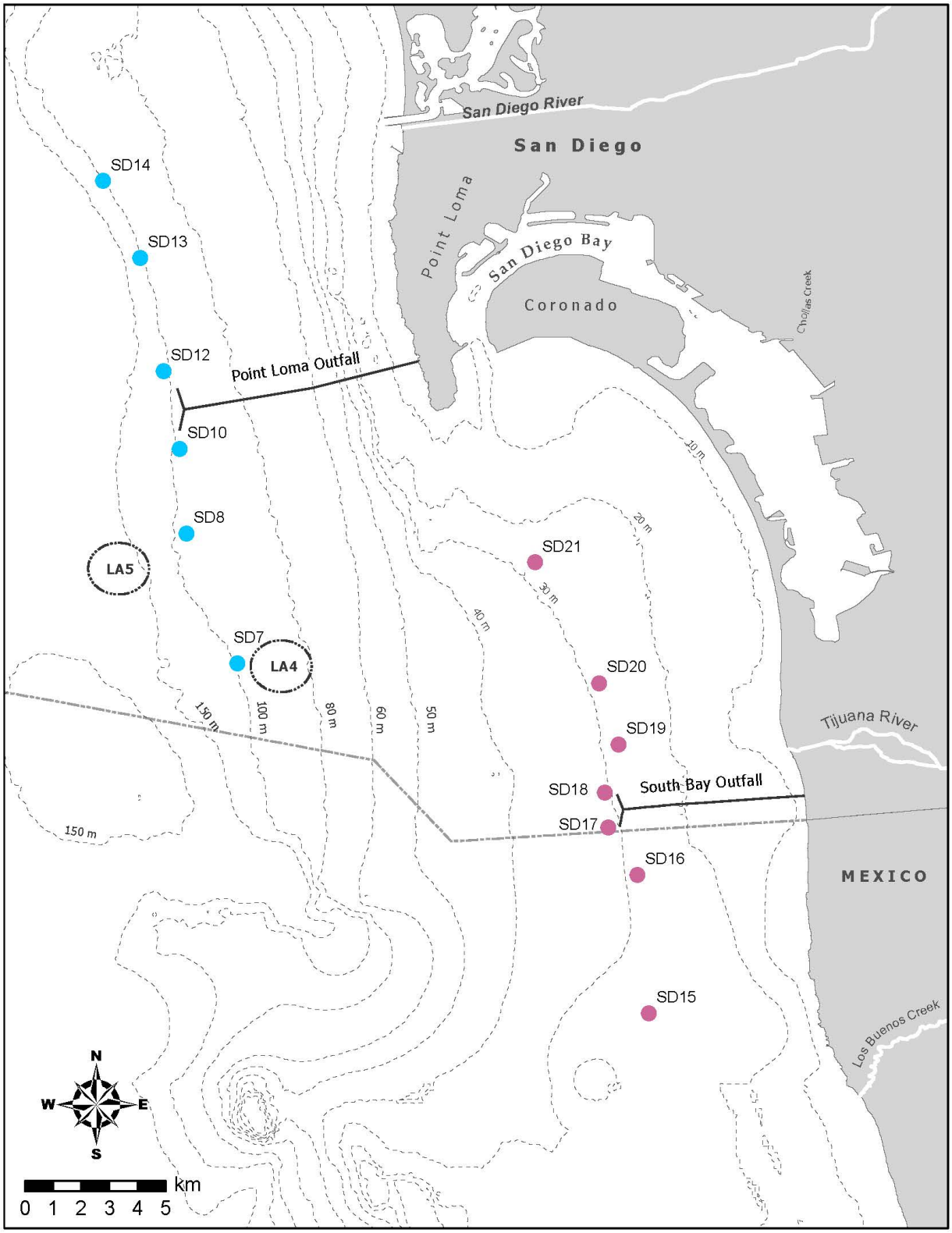

Figure 4 Trawl station locations sampled around the PLOO and SBOO as part of the City of San Diego's Ocean Monitoring Program.

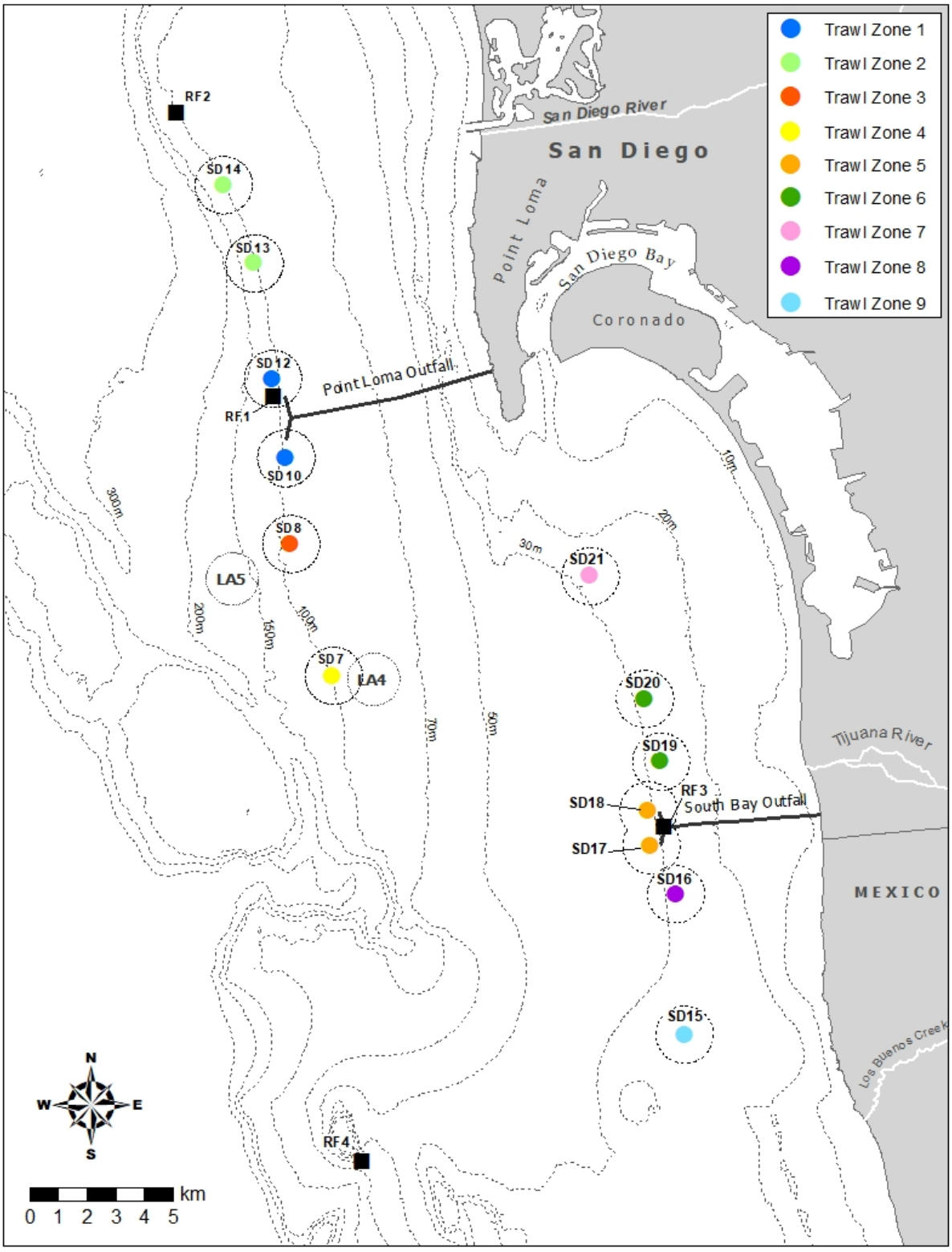

Figure 5 Trawl and rig fishing zone locations sampled around the PLOO and SBOO as part of the City of San Diego's Ocean Monitoring Program.

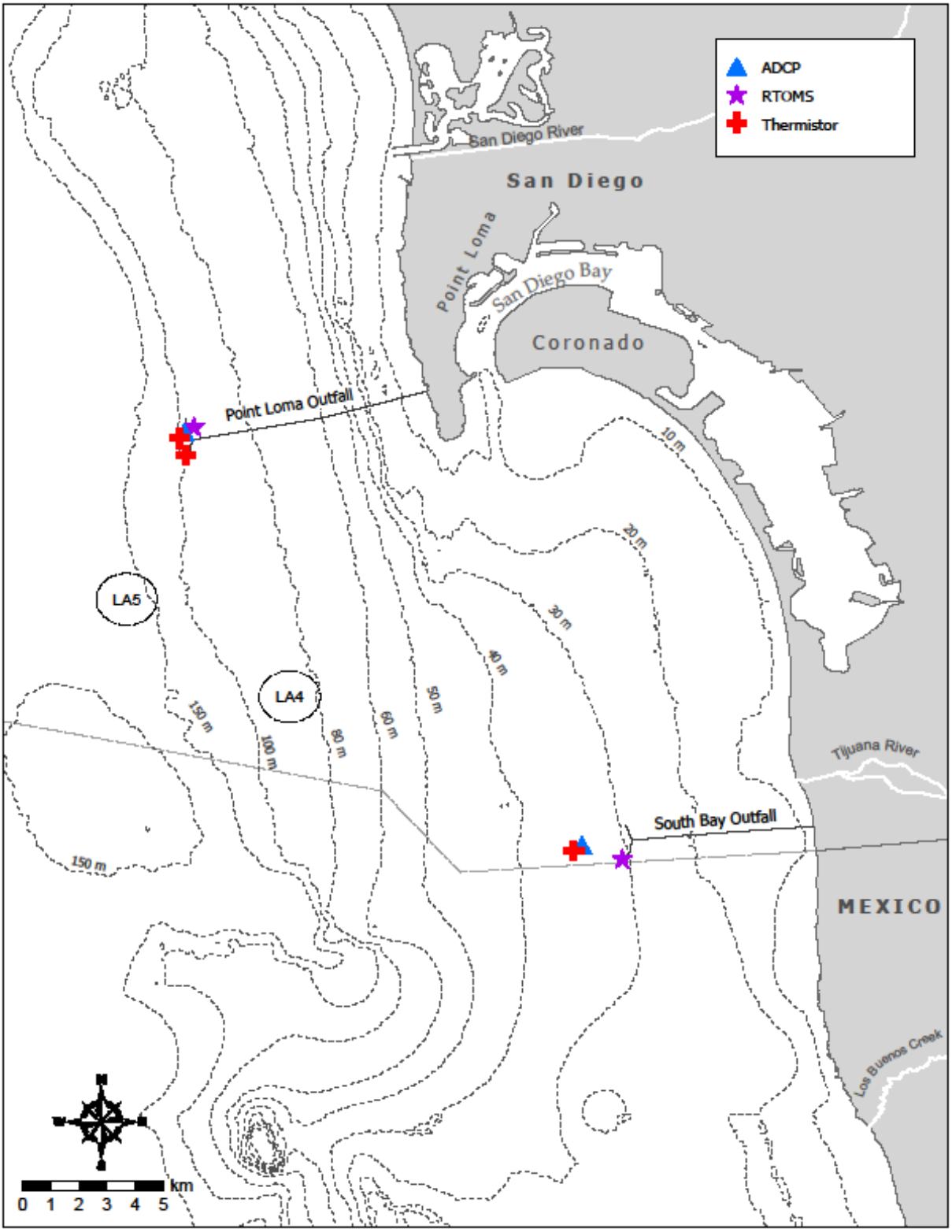

Figure 6 Locations of RTOMS and static moorings (ADCPs and thermistor string arrays) deployed at the terminal ends of the PLOO and SBOO as part of the City's Ocean Monitoring Program.

Mooring Data Collection

The primary objective of the moorings is to examine the dynamics and strength of the thermocline and ocean currents in the region. These data are used in conjunction with other collected data to summarize coastal oceanographic conditions, identify natural and anthropogenic sources of variability, and to evaluate local conditions surrounding both outfalls within the context of regional climate processes. Both the Real-Time Oceanographic Mooring Systems (RTOMS) and static moorings are located just offshore of the ends of the PLOO and the SBOO (Figure 6). At each static mooring location, ocean current data are collected by an Acoustic Doppler Current Profiler (ADCP) instrument that records measurements every five minutes. Temperature data are collected from arrays of vertical temperature sensors (thermistors) that record data every 10 minutes. Data retrieval from the moorings is conducted approximately every four months. The station occupation record shall have comments regarding deployment location, depth, and instrumentation, as well as comments on the deployment/retrieval.

Each RTOMS is outfitted with a suite of instruments and sensors that collect continuous data on critical parameters including temperature, conductivity (salinity), total pH, dissolved oxygen (DO), dissolved carbon dioxide (xCO2), nitrogen (nitrate plus nitrite), chlorophyll *a*, colored dissolved organic matter (CDOM), biological oxygen demand (BOD), and current direction and velocity. Real-time data management and integration support are provided by Scripps Institution of Oceanography (SIO).

B.2 Sampling Methods

This section provides details on the methods and equipment used by Marine Biology Lab staff to collect samples for the City's OMP. Field sampling procedures follow requirements of each of the NPDES permits and represent all phases of field sampling and laboratory analyses. Detailed methods for field sampling and laboratory analyses by marine biologists are found in SOPs (Appendix F.1), and include details on materials, equipment, and reagents needed, procedural instruction, handling and disposal of hazardous materials, and selection and preparation of sample containers, sample volumes, and preservation methods. Maximum holding times for collected samples are included in the Toxicology, Marine Microbiology, and Environmental Chemistry Lab QA Manuals, which are available upon request.

Sampling reports and chain-of-custody (COC) records are used to track samples through all phases of processing, which may involve outside contractors, or other EMTS section laboratories as described in previous sections. For each day of sampling, the designated lead scientist is responsible for ensuring that all field staff are adequately trained and prepared to complete all required sampling according to the standardized procedures. If the winch is being used, it is the winch operator's responsibility to safely operate the winch to raise and lower scientific equipment while keeping in communication with the boat operator, computer operator, and any staff assisting with the movement of equipment.

Navigation and Station Location

Field sampling operations are performed using two ocean monitoring vessels: The Motor Vessel (M/V) Monitor III (42'), and the M/V Oceanus (48'). Both are twin diesel-powered aluminum boats equipped with hydraulic A-frames, several deck winches, and electronic instrumentation including radar, Differential Global Positioning Systems (DGPS), depth sounder, and VHF radio; specific navigational

equipment aboard each vessel is detailed in the Monitoring Vessel Operation and Safety SOP. Sampling stations are located using DGPS with an accuracy of approximately 5 m. Prior to sample collection, the station location and depth are confirmed by the lead scientist and recorded in a field metadata collection software. For water quality and benthic monitoring, the boat operator, with the help of the lead scientist, keeps the boat at or within 0.05 nm of the intended station.

Kelp Bed and Offshore Water Quality Monitoring

Water quality sampling includes measuring various oceanographic parameters (i.e., temperature, salinity, light transmittance, dissolved oxygen, pH, CDOM, chlorophyll *a*) using a SeaBird Electronics (SBE) Model 25 Plus Sealogger (SBE-25+) conductivity, temperature, and depth (CTD) instrument fitted with a SBE 55 Eco Water Sampler (SBE-55) providing six 4 L Niskin bottles for the collection of seawater samples for bacteriological analyses. Each sampling day consists of calibration of a CTD/Rosette array, sample bottle preparation, profiling the water column to measure oceanographic parameters and recording visual observations at each station, as well as the collection of seawater samples at specific depths from a subset of stations for bacteriological analyses. A typical day of water quality sampling requires one boat operator and three marine biologists (i.e., one computer operator/lead scientist, one winch operator, one sample custodian). The computer operator's responsibilities include calibrating the CTD and running the NavOps metadata software, while the winch operator is trained to use the hydraulic A-frame and winch controls to deploy and retrieve the CTD to the vessel. It is the sample custodian's responsibility to collect water samples in accordance with the appropriate SOPs and safety requirements therein. All water quality data go through a QA process and are incorporated into reports.

Oceanographic Parameter Measurement

The CTD consists of up to 10 modular sensors configured to the SBE-25+ and attached to the frame of the SBE-55 water sampler. The CTD can store data internally, or data can be viewed remotely in real-time when matched with the SBE 33 Deck Unit, electro-mechanical cable, and computer. Data setup, upload, acquisition, conversion, and real-time display are conducted using the Seaterm V2, SBE Data Processing, and Seasave V7 programs of the Sea-Bird Electronics, Inc. software package Seasoft V2.

The down cast data are observed and recorded in real-time using Seasave V7, then processed on station using SBE Data Processing and Interactive Graphical Ocean Data Systems (IGODS) software to identify possible outliers. Outliers are identified when the difference between a given point and a five-point running average is greater than the standard deviation automatically calculated by the IGODS software. All data points flagged as outliers are reviewed and documented if removed from the final data set; a backup raw data file is made before removing outliers for each sampling day. If a large portion of the data from a cast appears erroneous, the entire procedure is repeated. Profiles of each parameter are constructed by averaging the data values recorded over 1-m depth intervals (depth bins). This data reduction ensures that physical measurements used in subsequent analyses will correspond to discrete sampling depths for fecal indicator bacteria results. Data are sent to Laboratory Operations staff after each survey for upload into the Oracle database. Visual observations of weather and water conditions are recorded in a field metadata collection software at the time of each CTD cast. After each

sample day, data collected from the metadata software are sent to Laboratory Operations staff for upload to the Oracle database.

Seawater Sample Collection for Bacteriological Analyses

Discrete sampling occurs using a Rosette multi-bottle array system of six 4 L Niskin bottles. Sample depths are confirmed onboard while looking at the real-time depth profiles using Seasave V7. Once the instrument array is brought onboard, seawater samples for bacteriological analyses are drawn from the Niskin bottles into labelled, sterilized 250- or 500-mL polypropylene containers. Samples are refrigerated at 4°C on board the vessel and collected by MML technicians at the dock in order for analyses to begin within eight hours of initial sample collection. Appropriate COC procedures are followed throughout all stages of sample transfer, and all samples are analyzed by the MML to determine concentrations of fecal indicator bacteria. Bacteriological results are entered into the Oracle database via double data entry by Marine Microbiology staff.

Benthic Monitoring

Each sampling day consists of deploying a double 0.1 m^2 Van Veen grab to collect benthic infauna, sediment particle size and sediment chemistry samples, and recording visual observations at each station. Sediment toxicity samples may also be collected by Van Veen grab from a subset of stations. Grabs not meeting performance criteria are rejected and the station is re-sampled. Data concerning depth of penetration, sediment temperature, station depth, and sediment characteristics, as well as visual observations, are recorded using field metadata recording software. A typical day of benthic sampling requires one boat operator and at least four marine biologists (i.e., one computer operator/lead scientist, one winch operator, two infauna sample screeners, and one sediment chemistry sample custodian). The computer operator is responsible for running the NavOps metadata software, while the winch operator is trained to use the hydraulic A-frame and winch controls to deploy and retrieve the benthic grab to the vessel. The lead infauna sample screener rinses the benthic sample, filters it through a sieve to collect infauna, and fixes samples with formaldehyde, while the secondary infauna sample screener assists the lead by transferring samples from the sieve to an appropriately sized jar and relaxing samples in magnesium sulfate solution as well as labeling all containers. It is the responsibility of the infauna sample screeners to collect samples in accordance with the appropriate benthic infauna sampling SOPs and safety requirements therein. The sediment chemistry sample custodian collects sediment samples from the benthic grab into various chemistry containers in accordance with benthic sediment sampling SOPs and safety requirements therein. During annual sediment toxicology sampling, a toxicology sample collector may be added to collect sediment samples. After each sample day, data collected from the metadata software are sent to Laboratory Operations staff for upload to the Oracle database. All benthic monitoring data go through a QA process and are incorporated into reports.

Processing of Benthic Infauna Samples

Once the grab is deemed acceptable, the side of the Van Veen intended for benthic infauna analysis is transferred to a wash table and thoroughly washed with seawater as it is sieved through a 1.0 mm mesh screen to remove as much sediment debris as possible. The macroinvertebrates retained on the screen are transferred to appropriately sized, labeled sample jars, relaxed for 30 minutes in a magnesium sulfate solution, and then fixed with buffered formalin. The exterior of infauna sample containers is

washed, and samples are inventoried and packaged appropriately for transport to the Marine Biology Lab for further processing (see Section B.4.1). Appropriate COC procedures are followed throughout all stages of sample transfer.

Collection of Sediment Subsamples for Particle Size and Chemistry Analyses
Sediment subsamples for particle size and chemistry analyses are collected from the side of the double Van Veen grab not used for benthic infauna analysis. Sediment subsamples for chemical analyses are collected using a stainless-steel or plastic scoop from the top 2 cm of the sediment surface while staying 1 cm away from the metal sides of the grab to reduce potential contamination of the samples. Additionally, the scoop is rinsed between samples with filtered seawater, and is never allowed to touch the sides of the Van Veen grab, the boat deck, or any other potential sources of contamination. Sediments are distributed into sample containers of the type (i.e., plastic or glass) and volume designated by the ECS Lab to meet analytical standard method requirements. All samples are placed on ice until received by ECS Lab technicians. ECS Lab COC procedures are followed throughout all stages of sample transfer.

Collection of Sediment for Toxicity Testing
Sediment samples for toxicity are collected from the undisturbed portion of a sediment chemistry grab, or from both sides of the Van Veen during subsequent accepted grabs. As above, sediments for toxicity testing are collected from the top 2 cm of sediment, 1 cm away from the sides of the container, and the spoon or trowel is rinsed between samples and stored in such a way to prevent contact with any other potential sources of contamination. Collected sediment is scooped into a labeled single Teflon® bag placed within a trash bag lining a 2-gallon bucket. In the unlikely event that the bag tears, a new bag and additional grabs are necessary to start the process again. Bags are stored in a dark, cool place on the boat between composite grabs. Back at the dock, sediment toxicity samples are inventoried and packaged appropriately for transport to the Toxicology Lab (TL) for further processing. Appropriate TL COC procedures are followed throughout all stages of sample transfer.

Demersal Fish and Megabenthic Invertebrate Monitoring
Trawls are conducted using a 7.6 m Marinovich otter trawl fitted with a 1.3 cm cod-end mesh net which is towed at approximately 2 knots for 10 minutes along the sea floor at a consistent heading to minimize fluctuations in depth. Each sampling day consists of deploying and towing an otter trawl net to collect and enumerate demersal fishes and megabenthic invertebrates at multiple stations. The catch from each trawl is brought onboard, and the net is emptied in large grey tubs that are used to transfer the animals into a large aluminum table with flow-through water for sorting and inspection. A typical day of trawl sampling requires one boat operator and six marine biologists (i.e., one computer operator/lead scientist, one winch operator, one trawl invertebrate taxonomist, one trawl invertebrate data recorder, one fish taxonomist, one fish data recorder). The computer operator is responsible for running the NavOps metadata software, while the winch operator is trained to use the hydraulic A-frame and winch controls to deploy and retrieve the trawl net to the vessel. It is the responsibility of the taxonomists and data recorders to have appropriate taxonomic training and collect taxonomic data in accordance with the appropriate trawl SOPs, Work Instructions, and safety requirements therein. Additional staff may be added to help with trawl processing, especially if large hauls are expected. All trawl data go through a QA process and are incorporated into reports.

Deployment of Otter Trawl Net

Prior to deployment, the trawl net is checked to make sure that the cod-end is tied correctly, the net is clean (i.e., no specimens present from previous trawls), and that the net is properly laid out to both avoid fouling or twisting and ensure safe deployment. Once at the beginning of the designated trawl track, the net and doors are placed in the water while the vessel is underway, ensuring the net does not become entangled prior to or during payout of the bridles and wire. The winch operator is responsible for ensuring that the net is carefully deployed with the appropriate scope and length of time (i.e., length of wire paid out versus water depth; see Table 2 in the Bight'18 Field Manual; SCCWRP 2018) and monitors the wire to ensure proper function of the net (e.g., no entanglements or bouncing). To confirm bottom depth and time, an SBE-39 pressure sensor is attached to the trawl door and retrieved after each trawl. If the net comes up fouled, or with a tear sufficient to allow escape of specimens, or if there is no evidence of contact with the bottom (e.g., no rocks, megabenthic invertebrates, demersal fish), the trawl is considered unacceptable and is repeated. The station occupation information, comments about each trawl, and visual observations of the weather and water surface conditions are logged into field metadata collection software. Comments are also recorded in the ship's log and on the trawl field data sheets.

Trawl Sample Processing

Following deployment, the otter trawl net is brought onboard and emptied in large tubs that are used to transfer the animals into a large stainless-steel sorting table equipped with a flow-through water system. The trawl catch is then rough sorted into major categories (e.g., urchins, shrimp, other invertebrates, flatfishes, rockfishes, other fishes). Any trawl debris present are noted on the first page of the fish data recording sheets. All specimens are identified to species or the lowest taxon possible. If an animal cannot be identified in the field with the aid of taxonomic keys and field guides, invertebrates are put into labeled jars of ethanol (or seawater and into refrigerator if live), and fish are frozen and returned to the laboratory for further identification.

All data are carefully recorded on field data sheets. For each fish species, total biomass (kg, wet weight) is recorded using a hand scale and a basket. The lengths of all fishes are measured using measuring boards or a tape measure for very large specimens and recorded in size classes of 1 cm intervals. Standard lengths are measured for bony fishes, while total lengths and wingspans (when appropriate) are recorded for cartilaginous fishes. Each individual fish is inspected for physical anomalies (e.g., fin rot, lesions, tumors, discoloration, deformation) as well as the presence of external parasites (e.g., copepods, isopods, leeches). All anomalies are recorded on the field data sheet. After each sample day, data collected from the metadata software are sent to Laboratory Operations staff for upload to the Oracle database. All field datasheets are QA'd by other marine biologists trained in data recording. Data are then double entered by trained staff into the Oracle Database.

Monitoring of Contaminants in Fish Tissue

Fish tissue monitoring consists of two components: (1) liver tissue analysis for fishes collected by otter trawl or rig fishing; (2) muscle tissue analysis for fishes collected by rig fishing. All target fishes to be kept for fish tissue analyses are identified to species, measured, sexed, and weighed. External parasites and physical anomalies are also noted on the field data sheet, and visual observations are recorded in

the onboard metadata software. A typical rig fishing event requires one boat operator and five or six marine biologists (i.e., one computer operator/lead scientist, one fish taxonomist, one fish recorder, and general crew to assist with fishing). It is the responsibility of all rig-fishing staff to collect and handle fish in accordance with the appropriate SOP, and safety requirements therein. A typical day of trawl sampling for fish tissue requires one boat operator and four marine biologists (i.e., one computer operator/lead scientist, one winch operator, one fish taxonomist, one fish data recorder). The computer operator is responsible for running the NavOps metadata software, while the winch operator is trained to use the hydraulic A-frame and winch controls to deploy and retrieve the trawl net to the vessel. For both rig fishing and fish tissue trawls, it is the responsibility of the fish taxonomist and data recorder to have appropriate taxonomic training and collect taxonomic data in accordance with the appropriate SOPs, Work Instructions, and safety requirements therein. Rig fishing effort is limited to five hours at each station. Trawl effort is limited to five successful trawls at each zone. All fish tissue monitoring data go through a QA process and are incorporated into reports.

Collection of Fishes

Fishes targeted at trawl stations for liver tissue analyses include, but are not limited to, the Longfin Sanddab (*Citharichthys xanthostigma*), Pacific Sanddab (*Citharichthys sordidus*), Bigmouth Sole (*Hippoglossina stomata*), English Sole (*Parophrys vetulus*), and Hornyhead Turbot (*Pleuronichthys verticalis*). Fishes targeted at rig fishing stations for muscle tissue analyses include, but are not limited to, Vermilion Rockfish (*Sebastes miniatus*) and Copper Rockfish (*Sebastes caurinus*). If enough of these primary species are not present, secondary candidate species such as other flatfish, scorpionfish, or rockfish may be collected, as necessary. Fishes collected are sorted into three composite samples per station, with a minimum of three individuals in each composite. Boat crew maintain an onboard electronic datasheet to ensure the minimum number of fish are collected to ensure adequate amount of fish tissue for analyses. All fishes are wrapped in aluminum foil, labeled, sealed in re-sealable plastic bags, placed on dry ice, and then transported to the Marine Biology Laboratory where they are stored at -20°C prior to dissection and tissue processing.

B.3 Sample Handling and Custody

Sample Handling

Appropriate and consistent sample collection, handling, and documentation during sample receipt and login are crucial to assuring the integrity, validity, and identity of samples analyzed at the laboratory. Procedures for collection, receipt, handling, documentation, login, and storage are detailed in Table 7 and in applicable SOPs. For all samples generated by the Marine Biology Laboratory, unique log numbers are assigned to each sample to facilitate sample tracking and data storage. An Oracle database application is utilized to complete the logging procedure. Depending upon sample type, log numbers are either assigned prior to sampling or when samples arrive at the laboratory.

Chain of Custody

A critical aspect of sound sample collection is the maintenance of strict sample handling and COC procedures, which are used to ensure that samples are properly identified, preserved, analyzed, and reported. A COC form (e.g., Appendix F.3) is completed by field personnel at the time of sample collection. The COC form will contain the following information at a minimum: collection date,

sample description (environmental matrix), number of containers of each sample, analyses required for each sample, warnings, notes, or comments, as needed, contact information and shipping address of the laboratory, and spaces designed to be signed as custody is transferred from sample custodian to sample receiver. Sampling reports and COC records are used to track samples through all phases of processing, which may involve outside contractors (e.g., macrobenthic samples sent out for sorting) or other EMTS section laboratories (e.g., MML, TL, ECS). Storage of COCs associated with samples collected by MBOO shall be for at least 5 years as hardcopy and indefinitely if digitized.

Table 7 Labeling and handling by sample type as part of the City of San Diego's Ocean Monitoring Program.

Sample Type	Parameter(s)	Matrix	Sample Label Requirements	Container Description	Sample Handling Requirements
Fecal Indicator Bacteria	Total coliform, fecal coliform, and *Enterococcus* densities	Seawater	Station, Depth	250- or 500-mL Nalgene bottle	Store in on-board refrigerator at 4°C; complete COC generated by LaboratoryOperations; samples picked up docksideby MML techs and transferred to MML within 8 hours of sample collection
Nitrate + Nitrite	NO_3^- + NO_2^-	Seawater	Date, Station, Depth	250 mL Nalgene bottle	Store in on-board refrigerator; complete COC generated by WQCS; deliver samples to WQCS after return to dock
Inorganic Carbon (pH/TA)	DIC, TA, pH_T, CO_2 fugacity	Seawater	Bottle ID, Date, Station, Depth	500 mL Pyrex Glass Sample Bottle	Store on board in container with foam spacers provided; preserved with 120 µL Saturated Mercuric Chloride Solution
Benthic Infauna	Invertebrate species identification and enumeration	Sediment	Field: Date, Station; Lab: Date, Station, Depth, Log number, Replicate number	250 to 4000 mL Nalgene container	Relax with magnesium sulfate solution; fix with 10% Formaldehyde solution; store in cool location on-board boat. At dock, inventory containers and labels, rinse, place in blue bins, transport to Marine Biology Lab; complete COC as part of sample check-in; place new preprinted label on each container
Sediment Chemistry	Particle size fractions (silt, clay, sand, granules)	Sediment	Date, Station	8 oz plastic container	Store on ice; complete standard City COC; transfer to ECS Lab Tech dockside for transport to ECS Lab

Sample Type	Parameter(s)	Matrix	Sample Label Requirements	Container Description	Sample Handling Requirements
Sediment Chemistry	GC/MS and Pesticides	Sediment	Date, Station	16 oz glass jar	Store on ice; complete standard City COC; transfer to ECS Lab Tech dockside for transport to ECS Lab
Sediment Chemistry	BOD	Sediment	Date, Station	8 oz plastic container	Store on ice; complete standard City COC; transfer to ECS Lab Tech dock- side for transport to ECS Lab
Sediment Chemistry	TOC/TN, Trace Metals, Sulfides	Sediment	Date, Station	4 oz plastic container per parameter	Store on ice; complete standard City COC; transfer to ECS Lab Tech dockside for transport to ECS Lab
Sediment Toxicity	Acute Amphipod Toxicity test	Sediment	Three labels with Date, Station, and Depth placed into:(1) Teflon bag; (2) outer garbage bag; (3) zip-tie used to seal the outer bag	5 L Teflon bag	4 liters of sediment collected at each station homogenized and stored in bag in on-board refrigerator at 4°C; avoid direct light; complete COC generated by Tox Lab; transfer to Tox Lab Tech dockside for transport to Tox Lab.
Trawled Fish FIDs	Species identification, enumeration, length, weight	Otter trawl	Date, Station, Tentative ID	Whirl Packs, glass jars, Zip-lock bags	Store in on-board freezer; note on field sheet or in metadata software; deliver to -20°C freezer in Marine Biology Lab
Trawled Invertebrate FIDs	Species identification and enumeration	Otter trawl	Date, Station, Tentative ID	Glass jars, cooler with cold water	Store with seawater in on-board refrigerator at 4°C; Note on field sheet; deliver to Marine Biology Lab for further identification. If too late in the day, place container in a floating net bag in the large display tank for identification the following day.
Field Collection for Fish Tissue Chemistry	Metals, Pesticides, PCBs, PAHs, Lipids	Whole fish	Date, Station, Species, No. of Fish	Wrapped in Aluminum foil, placed in Zip-lock bag	Store on dry ice on the boat then transferred to -20°C freezer in Marine Biology Lab until dissected.

Sample Type	Parameter(s)	Matrix	Sample Label Requirements	Container Description	Sample Handling Requirements
Fish Tissue Chemistry	Metals, Pesticides, PCBs, PAHs, Lipids	Liver, Muscle Tissues	Date, Station. Tissue Type, Weight of Tissue	4 oz glass jar	Store in freezer at -20°C; complete COC; transfer to ECS Lab Tech for transport to ECS Lab. Tissue samples must be delivered to ECS within 20 days of collection in the field.

Transport of Samples

Samples that are transported under the responsibility of the EMTS Division, where necessary, are done safely and according to storage conditions, City Guidelines, and the US Department of Transportation Materials of trade exceptions (MOTS 49 CFR 173.6). This includes moving samples within the EMTS Division, as well as to/from external customers/vendors. Specific safety operations related to sample transport/transfer are addressed outside of this document in relevant SOPs.

Sample Storage

Samples are kept in appropriate storage areas except during laboratory analysis or transport; storage details per sample type are included in relevant SOPs. All personnel/sample custodians who receive samples are responsible for the care and custody of samples from the time each sample is received until the samples are archived or disposed of. All samples shall be kept in designated storage areas, which are controlled by the appropriate supervisor (i.e., samples managed by Laboratory Operations, TL, or Ocean Operations).

B.4 Analytical Methods

This section provides details on the additional processing and analysis of benthic infauna and fish tissue samples performed by Marine Biology Lab staff. All protocols are thoroughly detailed in the SOPs. Other sample types, including seawater samples collected for bacteriological analyses and sediment samples collected for particle size, chemistry, or toxicity analysis, are received and transported by MML, ECS, or TL staff immediately following sample collection. Details for the analyses of these samples are detailed in the QA Manuals maintained by each lab.

Benthic Infauna Samples

Benthic Infauna Sample Check-In

Benthic Infauna samples are checked in upon arrival at the Marine Biology Lab following each benthic sampling day. Preprinted labels with unique sample log numbers are generated by the Laboratory Operations group and applied to each sample container. Each sample container and associated field labels are verified against information taken from the field metadata software and entered in the Grab Check-In Log (Appendix F.4). The Grab Check-In Log also serves as the official COC for benthic infauna samples. COC procedures are followed throughout all stages of sample processing and transport. If a sample is lost, damaged, or incompletely preserved, that station must be resampled.

Benthic Infauna Sample Processing

Benthic infauna samples are stored in at least a 10% formalin solution (magnesium sulfate, seawater, and buffered formalin) for a minimum of 72 hours and a maximum of 10 days before transfer to 70% ethanol. A change-to-ethanol date and a shipped-to-sorters date is recorded on the COC. Following preservation in ethanol, samples are transported to a contracted company for sorting. The contractor removes all organisms from the sediment (grunge) and sorts each sample into six predetermined taxa groups—Annelida, Mollusca, Arthropoda, Ophiuroidea, other Echinodermata, Miscellaneous phyla (all other taxa). The remaining grunge and ethanol from each sample is retained in the original labeled sample containers. When sorting is completed, samples are transported back to the Marine Biology Lab with summary sheets prepared by the contract sorting lab personnel. For quality control (QC), ten percent of each sorters' grunge samples are inspected by Laboratory Operations staff for any remaining organisms to assess initial sorting efficiency. Grunge samples are stored in an easily accessible location until grunge assessment occurs, then maintained on site until storage of sample is deemed no longer necessary by the Laboratory Operations supervisor.

Identification of Benthic Organisms

Marine Biology Lab taxonomists identify and enumerate all organisms in each of the benthic infauna samples. To facilitate the identification of organisms to species, taxonomists utilize taxonomic keys and literature, voucher collections, and materials developed internally by the Laboratory Operations work group as well as the Southern California Association of Marine Invertebrate Taxonomists (SCAMIT 2021). Provisional names are erected for those specimens considered distinctive by an individual taxonomist, which do not match an existing description, but are supported by a written provisional voucher sheet. These diagnoses are circulated among other City marine biologists as reference for future surveys. All data are entered either from paper bench sheets or directly in electronic data sheets and are subject to QA protocols by the Laboratory Operations work group and supervisor via synoptic review and data resolution meetings.

Fish Tissue Dissection

Fish tissue for bioaccumulation analysis must be transferred to ECS within 20 days of field collection. Prior to dissection, a COC form with pre-assigned sample log numbers and sample labels is prepared by Laboratory Operations and sample jars are received from the ECS Lab. Each individual fish included in each sample is weighed, measured, sexed, and any parasites or tumors are noted on the Fish Description Form. Muscle or liver tissues are removed and placed into tared, chilled, labeled sample jars specific to tissue type. To avoid contamination, a separate set of instruments is used for external and internal dissection cuts, and scalpel blades are changed between samples. Additionally, caution is taken not to cut or puncture the liver, gall bladder, or gut, which would cause contamination.

Tissue weights are recorded on a Fish Description Form and, when the appropriate amount of tissue has been obtained for each sample, the final sample weights are recorded on a Sample Weight Record Form. When the batch of samples is completed, the COC is filled out, and the sample jars are stored in a -20°C freezer until transported to ECS. COC procedures are followed throughout all stages of sample transfer.

B.5 Quality Control

Quality control data are analyzed and, when found to be outside pre-defined criteria, data are flagged, and action is taken to correct the problem and to prevent incorrect results from being reported. QC protocols for a selection of marine biology field and laboratory methods are detailed below, and as a required section in all method SOPs (Appendix F.1). Field and laboratory QC protocols such as duplicates, blanks, spikes, splits, etc. for bacteriological, fish tissue, sediment particle size, chemistry or toxicity analyses are detailed in the QA Plans maintained by the MML, ECS Lab and the TL. The results of all QA/QC activities are reported annually in the Annual Receiving Waters Monitoring and Toxicity Testing Quality Assurance Report (City of San Diego 2003-2023). QA/QC procedures for ECS are presented in a separate QA report each year.

Benthic Infauna Quality Control Checks

Species-level identification of benthic infauna is completed by multiple taxonomists and includes the following QC measures: (1) infauna sorting procedures; (2) infauna taxonomic procedures; (3) voucher collection procedures; (4) interagency taxonomic standardization.

Infauna Sorting QA/QC Procedures

Sorting QC is essential to assuring the validity of the subsequent steps in the sample analysis process. The sorting of benthic samples into major taxonomic groups is contracted to an outside laboratory, with the contract specifying an expected 95% removal efficiency. Sorting efficiency is calculated as follows:

$$\%\ Sorting\ Efficiency = \frac{original\ count}{(original\ count + re-sort\ count)} \times 100$$

The contractor performs their own in-house QA by sorting a subsample of each jar. Additionally, at least ten percent of the sorted whole samples from each sorter at the contract lab are subjected to re-sorting as QA internally by MBOO taxonomists. The original sorting of a sample fails the QA criterion if the abundance in the re-sorted sample deviates more than five percent from the total abundance of all animals from that sample. If more than one failure occurs, the contract requires the re- sorting of all samples previously sorted by an individual contract sorter.

Infauna Taxonomic QA/QC Procedures

Re-identifications (re-IDs) are performed on at least ten percent of the samples processed by each taxonomist to maintain consistency amongst taxonomists both within and outside the City. All re- IDs are conducted by taxonomists other than those who originally analyzed the samples and are completed without access to original results. Results of re-IDs are recorded on a Discrepancy Report, and significant discrepancies in count (±5% of original count) are resolved by a third taxonomist count. The effect of the resolution (increase, decrease, or no change) on the number of taxa and the total organism count reported in the original results is determined. These results are then used to calculate the percent error for three aspects of sample analysis: number of taxa discriminated, total organism count, and identification accuracy. The calculations used are as follows:

$$\%\ Error\ taxa = \frac{(\#\ Taxa\ resolved - \#\ Taxa\ original)}{\#Taxa\ Resolved} \times 100$$

$$\%\ Error\ organisms = \frac{(\#\ Organisms\ resolved - \#\ Organisms\ original)}{\#\ Organisms\ resolved} \times 100$$

$$\%\ Error\ ID\ Accuracy = \frac{\#\ Taxa\ misidentified}{\#\ Taxa\ resolved} \times 100$$

The first and second aspects provide measures of data quality as it relates to community parameters such as species richness, abundance, and diversity. The third aspect, identification accuracy, is expressed as percent error in identification of individual taxa. It provides a measure of data quality in representation of community composition. If error rates exceed ten percent, corrective action is taken, including, but not limited to, having the taxonomist review the notebook material, voucher specimens, and literature associated with the specific taxa that were misidentified.

Trawled Specimen Quality Control Checks

The quality of demersal fish and megabenthic invertebrate assemblage data is highly dependent on identifications and measurements made in the field. Therefore, it is expected that the lead demersal fish and megabenthic invertebrate taxonomists will have a wide range of knowledge of the common trawl-caught species. This expertise is developed and maintained using taxonomic aids and references specific to the Southern California Bight (SCB), the maintenance of voucher specimens, and participation in SCAMIT or SCAITE.

Additionally, Marine Biology Lab staff participate in several QA/QC activities required as part of the SCB Regional trawl surveys. These include intercalibration cruises, intercalibration specimen identification exercises, external audits of trawl equipment, deployment, and sample processing protocols, taxonomic QC voucher checks, and internal audits of species identifications, fish weight and length measurements (SCCWRP 2018). An internal QA/QC process for fish weight and length measurements is in development, and details of this process will be added to this QAP when fully developed.

Mooring Quality Control Checks

Real-Time Oceanographic Mooring QC Samples

During offshore sampling, CTD casts, nitrate samples, and spectrophotometric pH/Total Alkalinity (pH/TA) samples are taken on a quarterly basis to provide an additional comparison of sensor performance and to inform nitrate and pH sensor calibration offsets and drift. A CTD cast is completed as near to the mooring as possible, a side-by-side comparison of CTD parameters and RTOMS parameters is performed to check for gross offsets and sensor malfunctions on the moorings. This comparison is summarized in a table by year and used to inform flagging decisions. Water samples for nitrate (plus nitrite) and for pH/TA are also collected at the same depths as RTOMS sensors and may be used to provide drift corrections to sensor data as appropriate. Nitrate samples are analyzed by the Water Quality Chemistry Services Laboratory (WQCS), and pH/TA samples are analyzed by

SCCWRP to determine total dissolved inorganic carbon (DIC), total alkalinity (TA), pH (total scale; pH_T), and CO_2 Fugacity.

Mooring Data QA/QC Procedures
Data broadcast in real time by the RTOMS are processed by SIO personnel prior to publication on the SIO website (https://mooring.ucsd.edu/ploo/ploo_03/) to remove pre/post deployment data, warmup data from burst sensors (xC02, SUNA [nitrate], Eco-triplet [chlorophyll *a*, CDOM, turbidity], UV-lux [BOD]), apply calibrations and remove any gross outliers. RTOMS data published to the SIO website undergo further QC by City personnel, who compare the gross range of all data to the climatological range. Staff may perform additional quality control, including visual assessment and multi-parameter comparison, spike tests, rate of change analysis, and flat line tests, per national data standards for flagging real-time data under Quality Assurance of Real-Time Oceanographic Data (QARTOD) methodologies (US IOOS 2017, 2020). QARTOD is a collaborative effort formed to address the data quality issues of the U.S. Integrated Ocean Observing System (US IOOS) community.

Data logged internally on each sensor may be downloaded post-deployment and used to fill any gaps in the real-time broadcast data. Based on a comparison of results from nitrate + nitrite and pH/TA sample analysis and CTD casts completed near the RTOMS, drift correction of sensor data may be used when deemed appropriate. Any data that have been adjusted to accommodate for sensor drift are assigned a unique flag, as are data that are determined to be bad or suspect. Parameters that are associated (i.e., read from the same sensor or otherwise covarying) are cross-referenced when flags are assigned. Notes about suspect data and flagging decisions are recorded in a table that is curated by the RTOMS coordinator and included in reports.

B.6 Instrument/Equipment Testing, Inspection, and Maintenance

All instruments and equipment used by marine biologists are subject to ongoing testing, inspection, and maintenance according to the manufacturer's instructions or standardized protocols established to keep the gear in good working order. Depending on the instrument, various vendors are used to maintain equipment and calibrated as needed to ensure data quality. Compliance management software is used to log all instrumentation and equipment maintenance to ensure the latest information is available for multiple users. Procedures are described below and detailed in relevant SOPs.

Ocean Monitoring Vessels
The boat operators are responsible for operation and maintenance of the monitoring vessels. Operation and maintenance events for vessels are documented via ship's logs maintained on each vessel. Daily testing, inspections, and maintenance include ensuring: (1) vessel has operable engines, generator, and all general running gear; (2) sufficient fuel to accomplish the planned run and return to the dock with adequate reserves; (3) all safety gear including life jackets, life raft, man overboard marker/float, and life ring are functional and properly stored; (4) first aid and medical first responder kits, automatic external defibrillator (AED), emergency oxygen, flare kit, air horn, and bell are readily available and operational; (5) each bilge compartment is connected to a bilge pump with a backup pump in place; (6) a minimum of three fire extinguishers are maintained onboard in addition to the automatic/manual fire suppression system in the engine room; (7) at least one set of anchor gear is carried at all times;

(8) all shipboard electronic instrumentation, including the VHF radio, DGPS/GPS, fathometer, and radar are operational and functioning properly. In addition to the daily inspections and internal/external maintenance, each boat is taken to the boat yard for an annual inspection and maintenance by an approved vendor. Annual upkeep may also include inspecting and/or servicing the life raft on each vessel.

Field Equipment

Water Quality Sampling

The CTD is inspected before and after each sampling day. Cables are examined for cuts and abrasions and instruments are inspected for damage. Tubing is checked to ensure it is secured in place and free of any foreign material or bacterial growth. All gear is washed with freshwater and allowed to air dry at the end of each boat day it is used. Equipment maintenance, calibration, and servicing of all instrumentation associated with a CTD setup is documented and maintained. RTOMS caging and sensors also undergo extensive testing and checks prior to deployment, and are regularly inspected during quarterly sampling.

Benthic Sampling

Prior to the beginning of benthic sampling, the double Van Veen grabs are inspected for rust and cleanliness. Chains are checked for structural integrity and to ensure that shackles are tight and secured with zip ties. The Van Veen grabs are also checked to confirm that they are not leaking excessive amounts of water when closed. If they are leaking more than desired, the seams and hinges of the grab are gently tapped with a hammer to carefully tighten the gaps causing the leaks. The doors are also checked to ensure they are closing properly, and that the screen material is not compromised. A backup double Van Veen grab is available to use in case the first one is found to be damaged. The wash-down table and the screen are also inspected at the beginning of each survey. Two backup screens are available in case damage is found. All gear is washed with freshwater, scrubbed, and allowed to air dry at the end of each boat day.

Otter Trawl Sampling

During initial trawl sampling setup, the otter trawl net is thoroughly inspected to ensure no holes are present. All hardware is visually inspected, and shackles are checked to make sure the pins are tight, and zip tied. After each trawl is conducted, the trawl net is cleaned of all the trawl-caught animals and is thoroughly inspected for any damage caused during the previous trawl. The vessel is typically supplied with backup nets, trawl doors and bridles so sampling can continue should problems arise. Several trawl nets are available as backup in case one gets damaged beyond repair or needs to be sent off to be repaired by a third-party vendor. The trawl organism sorting table is also inspected prior to each survey. The spring-loaded and digital scales used for fish biomass are calibrated using a series of check weights, and the power level of digital scales is checked by zeroing the scale a few times; batteries are replaced, as necessary. The trawl net is dragged behind the boat for cleaning and sprayed with freshwater at the dock; all other gear is washed with freshwater, scrubbed, and dried at the end of each sampling event.

Rig Fishing Gear
Rig fishing rods and reels are inspected and repaired or replaced annually. Multiple sets of gear are available at sea to accommodate any problems that may arise. All gear is washed with freshwater, scrubbed, and dried at the end of each boat day it is used.

Laboratory Equipment
Microscopes used for taxonomic identifications are cleaned semi-annually by a professional microscope technician, and documentation of this maintenance is managed by the Laboratory Operations supervisor. Additionally, ventilation hoods are serviced annually by an external vendor, and records of service are maintained in Ideagen.

B.7 Instrument/Equipment Calibration and Frequency

Field Equipment
CTD Intercalibration Exercises
Ocean Operations personnel carry out semiannual in-house CTD intercalibration exercises to ensure consistency between the two Sea-Bird Electronics SBE-25plus CTD instruments used to collect water column profiling data. During these exercises, the two CTDs—one with sensors used for the prior 6 months, the other with newly-factory-calibrated sensors—are attached to each other with similar sensors aligned and then deployed to a depth of 120 m and retrieved three separate times. After the three casts are completed, comparisons of the results for temperature, salinity, dissolved oxygen (DO), pH, transmissivity, and chlorophyll *a* are performed to assess whether deviations between the instruments and sensors are within acceptable limits: temperature: ± 0.1ºC; salinity: ± 1.0 ppt; DO: ± 0.5 mg/l; pH: ± 0.1 units; transmissivity: > 5%. If sensors pass intercalibration, old sensors on one CTD are replaced with factory-calibrated sensors from the other; the CTD then undergoes an additional in-house calibration before field use.

If any deviations are found during data review that are outside of the acceptable limits, those sensors are removed from the CTD package and sent to the manufacturer for factory calibration. Results from the in-house intercalibration exercises are reported in Annual Receiving Waters Monitoring and Toxicity Testing Quality Assurance Reports (City of San Diego 2003-2023). Compliance management software is used to log all instrumentation associated with a CTD setup and document sensor (i.e., probe) maintenance, calibration, service, and movement from one setup to/from another or to/from storage.

CTD Sensor Calibration and Service
In addition to the semi-annual CTD intercalibration exercises, manufacturers of various sensors recommend annual recalibrations at their factories. The sensors actively in use on each CTD undergo further in-house evaluations prior to and during each survey. Acceptance criteria and corrective actions for each sensor are defined in the method SOPs, and if any sensor fails to calibrate or seems to have drifted out of range, it is removed from the CTD unit and replaced with a newly calibrated spare. Additionally, the results of each sensor are evaluated by reviewing the data following each cast. If any sensor is determined to be faulty and a field repair cannot be completed, sampling will be terminated immediately so that the needed repairs can be completed back at the laboratory. Documentation of

sending sensors for service, removal from CTD unit, switching of sensors from another unit, and calibration are maintained using calibration logs and compliance management software.

RTOMS Sensor Calibration and Service
Prior to each deployment, sensors are calibrated, and documentation from manufacturer is maintained and used to monitor potential sensor drift or malfunction. Configuration of sensors location and individual sensors used are also maintained for each mooring's deployment. During the year-long deployment, sensors are monitored via the real-time mooring websites, which display live data/information from each of the two RTOMS Any major sensor problems and associated corrective actions are documented in a table that is later included in regulatory reports. When needed sensors are remotely accessed or physical visits to mooring locations are made to implement corrective actions to resolve problematic sensors.

Laboratory Equipment
Balances used in fish tissue collection for bioaccumulation analyses are calibrated annually by an external vendor, and documentation is maintained by the EMTS Quality Manager. If calibration results fall outside of specifications: (1) the equipment is removed from service until repaired, or (2) records are maintained of correction factors to correct all measurements.

B.8 Inspection/Acceptance of Supplies and Consumables

Field Supplies and Consumables
Inspection of critical supplies and consumables for field activities is the responsibility of the lead scientist assigned for each boat day. The lead scientist ensures that all required materials are of acceptable quality and loaded on the boat for each type of sampling. For water quality and benthic sampling days, they visually inspect sample bottles and jars for cracks, breakage, and cleanliness. Other examples of field supplies and consumables include zip ties, whirl packs, rope, parafilm, tare baskets, and scissors, as well as personal protective equipment. These items are also inspected upon receipt for quality and acceptability and restocked or ordered from vendors as necessary to maintain field operations.

If unacceptable supplies or consumables are found, then the lead scientist will initiate corrective action. Corrective measures may include repair or replacement of measurement equipment, or notifications to vendors or other labs and subsequent replacement of defective or inappropriate materials.

Laboratory Supplies and Consumables
Critical supplies for benthic infauna sample processing, and for subsequent infauna taxonomic identifications are the responsibility of the Laboratory Operations supervisor or designee. This marine biologist ensures that all required materials (e.g., ethanol, dram vials, sample labels, archival ink pens, markers, mechanical pencils, sample vials and jars, tape, counters) are available to all taxonomists in adequate quantities and in acceptable condition.

Critical supplies for fish tissue dissections are the responsibility of the Laboratory Operations supervisor or designee. This marine biologist ensures that all required materials (e.g., nitric acid,

acetone, scissors, surgical blades, cleaning supplies, gloves, sample jars) are available at the time of fish tissue dissections, and are in acceptable condition (i.e., free of cracks, clean, appropriately sealing lids to jars). If sample jars, or any other required materials, do not meet acceptability criteria, the Laboratory Operations supervisor or designee will initiate corrective action. Corrective measures may include repair or replacement of measurement equipment, or notifications to vendors or other labs and subsequent replacement of defective or inappropriate materials.

B.9 Non-direct Measurements

Non-direct data (i.e., historical reports, maps, literature searches, previously collected data) may be used in the preparation of reports (Table 6). These data may come from sources such as prior OMP results that were collected, reviewed, and reported according to protocols detailed in this QA Plan, pertinent data collected by other agencies, such as during SCB surveys that have been subject to QA/QC policies and practices similar to those found in this QA Plan, or from contracted special studies, such as annual reports of satellite imagery submitted by a contracted vendor, all of which are subject to their own QA/QC practices.

B.10 Data Management

The flow of data from field collection to final report is controlled to ensure that data are of known integrity and documented quality. The general flow of data is described by sample type in Appendices F.5–F.10. Oceanographic, bacteriological, benthic infauna, trawled demersal fish, trawled megabenthic invertebrate, visual observation, and fish tissue dissection data are managed by Marine Biology Lab staff. Sediment particle size, sediment chemistry, and tissue burden chemistry data are maintained by ECS Lab staff and are retrieved from the ECS Lab database for analysis and reporting by staff. WQCS uploads data to the LIMS and e-mails a PDF of sample results to MBOO on request. Additionally, Ocean Operations maintains an excel document with nitrate sampling information that is used to compare CTD results to mooring data. All data are reviewed to validate individual fields and to verify that the dataset is complete before any data analysis is performed. Upon receipt of pH/TA data, these are maintained by the Marine Biology Lab staff, and used in reports. Sediment toxicity data are maintained and reported by TL staff.

Data Review Procedures

To avoid errors that are impossible to correct after the fact, marine biologists collecting field data review all recorded data for accuracy and completeness prior to leaving each station. Errors or omissions are corrected immediately. Prior to database population, all digital and hardcopy field data sheets are subjected to several rounds of QA reviews for accuracy and completeness of the information.

Data Entry/Storage Procedures

Data entry or data upload to the Oracle database is conducted by members of Laboratory Operations or other trained marine biologists. Most OMP data are stored in an Oracle database and each data type is subjected to a unique protocol of rigorous data validation. Oceanography data are collected electronically in the field. Raw data are loaded into the Oracle database via an automated routine. Bacteriological data are entered by MML staff using double data entry procedures. Benthic infauna

data are loaded from ACCESS files. Trawled fish and invertebrate data are entered into the Oracle database using double data entry procedures. Fish tissue dissection data are entered into the Oracle database using sample-login routines and then crosschecked against the dissection forms.

Data Analysis and Reporting

Once OMP data have been validated, they are analyzed and reported to the appropriate regulatory or contract agencies. Data QA and analysis processes are documented in Work Instructions (Appendix F.2) to ensure that the data are accurately reported. Although the procedures differ somewhat for each data type, the process is intended to identify missing data or outliers and to ensure that all metadata are accounted for before and during analysis. Examples of common QA checks include, but are not limited to: stations sampled, depths sampled, number of samples collected, abundances of individuals per species. A thorough review of resulting data tables and figures occurs before any report drafts are produced. Finally, each report is reviewed by an exhaustive process that includes reviewers and production editors, and a senior editor.

Data analyses are performed using several different platforms. Basic statistical analyses, such as descriptive community parameters, and tables and figures are generally computed using command-line SQL, SQL scripts, Excel, or R. More complex multivariate and pattern analyses are performed using the PRIMER (Plymouth Routines in Multivariate Ecological Research) statistical software application. Some analyses of mooring data are completed in MATLAB (MATrix LABoratory). Map products representing the distribution of spatial data are prepared in ESRI GIS software. Presentation of the data for reports is often accomplished using a combination of word processing and InDesign.

C. ASSESSMENT AND OVERSIGHT

C.1 Assessments and Response Actions

Field Sampling Reviews

Prior to each month's sampling events, a calendar of sampling days is created. When on station, it is the responsibility of the lead scientist to ensure that protocols are being followed and to ensure sampling quality control (QC) procedures are followed. It is the responsibility of the Ocean Operations supervisor or the lead scientist on the boat to monitor all field sampling procedures and to maintain sampling consistency through training materials and frequent participation in field surveys. All trainings are documented and maintained using a compliance management software.

Laboratory Reviews

Laboratory Operations conducts assessments of taxonomic procedures through re-identification reviews, synoptic data reviews, and inter-agency meetings and training exercises. It is the responsibility of the Laboratory Operations supervisor to ensure consistency of all taxonomic procedures using SOPs and group meetings. It is the responsibility of the Laboratory and Ocean Operations work groups to assess the taxonomic procedures used on all trawl-caught species. By reviewing the field sheets, participating in synoptic data reviews, and training exercises, marine biologists ensure consistency and accuracy in the data collected. All trainings are documented and maintained using a compliance management software.

Data Reviews

All data stored in the Oracle database go through a rigorous data validation process prior to reporting. This is done on a monthly, quarterly, semi-annual, or annual basis, depending on the data type. Data are compared to historical results to look for any inconsistencies which may relate to sampling error. If such inconsistencies are found, those performing the assessment confirm the data with field crew that were present at the time of sampling to determine if there were any errors in field procedures which would then result in the determination and completion of corrective actions.

Corrective Actions

Corrective actions are taken to eliminate the causes of an existing nonconformance, defect, or other undesirable situation to prevent recurrence. All field personnel share the responsibility of identifying and resolving errors or inconsistencies in sampling procedures. The Senior Marine Biologist or designee is responsible for initiating corrective action on routine data reviews (e.g., resampling, training exercises, updating SOPs or Work Instructions, omitting data) in relation to field activities, taxonomic identifications, data validation, and data assessment, or where there is doubt about the compliance to divisional policies and procedures. The Quality Manager is responsible for recording and monitoring the implementation of corrective action(s). Deficiencies are evaluated, and a corrective action plan is developed and implemented if determined necessary. The Senior Marine Biologist is responsible for ensuring that all staff are properly trained for each position and that procedures detailed within this QA Plan and referenced documents are followed. All trainings are documented and maintained using a compliance management software.

C.2 Reports to Regulators

The Marine Biology Laboratory produces an annual Quality Assurance Report that is submitted to the SDRWQCB and USEPA (City of San Diego 2003-2023). The results of various QA/QC procedures conducted during the year are presented in this report, including: (1) intercalibration of the conductivity, temperature, and depth instruments used to sample water quality parameters; (2) results of real-time mooring data quality assessment; (3) results of the bacteriological QC procedures; (4) results of the benthic infauna community sample re-sorts; (5) results of toxicological QC procedures.

D. DATA VALIDATION AND USABILITY

D.1 Data Review, Verification, and Validation

Field Data

Prior to database population, all digital and hardcopy field data sheets are subjected to several rounds of quality assurance (QA) inspections for accuracy and completeness of the information. Field data are reviewed at sea at the end of each sampling event/station, and at the end of each sampling day before submitting the data to Laboratory Operations for upload or data entry to the Oracle database. Errors or omissions are corrected immediately. At each review, field data are examined to ensure that equipment calibrations, sample collection, handling, preservation, and storage were conducted in accordance with the protocols described in this QA Plan and supporting SOPs.

Laboratory Data

Taxonomic data review and validation of benthic infauna data are conducted by the person performing the identifications, MBOO laboratory subgroups by taxa, and the Laboratory Operations supervisor. Validation of reported data is done through QA checks in taxonomy review processes by the Laboratory Operations group during the upload process to Oracle, as well as by MBOO personnel during data analysis and report production.

Taxonomic data review and validation for trawl data is conducted by members of Ocean Operations and other marine biologists as appropriate. Validation of reported data is done through QA checks in taxonomy review processes by Laboratory Operations during the upload process to Oracle, as well as by MBOO personnel during data analysis and report production.

D.2 Verification and Validation Methods

Field Data

Field data are reviewed to ensure that: (1) entry into the on-board electronic databases is completed and the information recorded accurately reflects activities that were performed; (2) all COC paperwork is completed and accurate; (3) equipment calibrations, sample collection, handling, preservation, and storage were conducted in accordance with the protocols described in this QAP, and in relevant SOPs and Work Instructions.

Laboratory Data

Taxonomic identifications are reviewed to ensure that: (1) all hand-entered data are entered completely and accurately; (2) all species are verified as being present in the region; (3) all samples have been accounted for. Handling, preservation, and storage of samples and relevant data was conducted in accordance with the protocols described in this QAP.

Assessment and Reporting

Prior to the submission of data to regulatory agencies, all data are reviewed for completeness and correctness, and are validated by using R scripts, various plots and graphics, multivariate analyses, and range checks in combination with historical analyses to identify possible outliers, missing data, or

anomalies. All data analyses are reviewed and approved by staff, supervisors, and the Senior Marine Biologist. To ensure data are protected from inadvertent changes or unintentional destruction, the EMTS Division's laboratories use procedures—both manual and automated—to check calculations and data transfers.

The MBOO laboratory ensures that computers or user-developed software or analytical equipment used for environmental test data are: (1) documented in sufficient detail and validated as being adequate for use; (2) protected for integrity of data entry or collection, data storage, data transmission and data processing; (3) held secure including the prevention of unauthorized access to, and the unauthorized amendment of, computer records; (4) to the extent possible, maintained to ensure proper functionality and provided with environmental and operating conditions necessary to maintain the integrity of environmental test data.

D.3 Reconciliation with User Requirements

To ensure that validated data meets the data quality objectives and criteria for measurement data, a combination of qualitative and statistical procedures are conducted to check the quality of the data. Prior to final submission to the regulatory agencies, all data are evaluated for quality, quantity, and representativeness for the requirements set forth in the individual NPDES permits. This evaluation is conducted by staff and is approved by the Senior Marine Biologist. The objective of reconciling with the requirements defined by the data user/decision maker is to ensure that all datasets are complete and defensible, and that data are of the quality and integrity required to meet the monitoring requirements stated in the NPDES permits.

Data that fail to meet the data quality criteria detailed in Section A.7, as well as in SOPs and Work Instructions, may result in sample reprocessing, resample collection, flagging of the data, or removal of the data, depending on the magnitude of the non-conformance, logistical constraints, schedule, and cost. Data that do not meet the quality objectives are removed and documented in an electronic metadata file maintained by staff and stored on the Oracle database or the shared drive where applicable. Limitations on the use of the data are communicated within the various reports produced by the OMP.

Nonconforming Work

Should issues with the results arise such that they do not meet user requirements, procedures for nonconforming work outlined in the EMTS Quality Assurance Manual shall be followed (City of San Diego 2020). The policy for control of nonconforming work is to identify the nonconformance, determine if it will be permitted, and take appropriate action. All employees have the authority to notify management when any aspect of the process does not conform to monitoring program requirements. Procedures are in place for investigating and taking appropriate corrective actions of nonconforming work. Formal corrective action procedures must be followed for nonconforming work that could reoccur (beyond expected random quality control failures) or where there is doubt about compliance with the policies and procedures outlined in this and referenced documents. The Senior Marine Biologist evaluates the significance of the nonconforming work and takes corrective action. The regulatory agency, outside contractors, and staff should be notified if their data have been affected.

The discovery of a nonconformance for results that have already been reported to the customer must be evaluated for significance of the nonconformance, its acceptability to the customer, and determination of the appropriate corrective action.

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F. APPENDIX

Appendix F.1 List of Standard Operating Procedures (SOPs) used as part of the City of San Diego's Ocean Monitoring Program for completing both laboratory and ocean operations.

Work Group	SOP No. (Flow Chart No.)	SOP Title
Laboratory Operations	1669	LabOps_Benthic Infauna Grab Transfer
	1678	LabOps_Benthic Infauna Sample Field Collection
	1670	LabOps_Buffering Formaldehyde for Fixing Samples at Sea
	1671	LabOps_Cleaning Benthic Containers After Grunge Disposal
	1682	LabOps_Fish Tissue Dissection for Chemical Analyses
	1673	LabOps_Grunge Assessment
	1674	LabOps_Identification of Organisms in Infauna Samples
	1667	LabOps_Infauna Sample Check-in After Field Collection
	1668	LabOps_Infauna Sample Retrieval from Boat
	1676	LabOps_Mixing Ethanol for Infauna Samples
	14600	LabOps_Mixing Relaxant for Infauna Samples
	1665	LabOps_Re-sort Analysis for Assessing Removal Efficiency
	1666	LabOps_Sample Check-In After Sorting
	1677	LabOps_Sample Transport - Sorting Lab
Ocean Operations	1680	OcnOps_ADCP Maintenance, Deployment, and Retrieval
	1681	OcnOps_Benthic Field Sampling
	1683	OcnOps_Kelp/Offshore Water Quality Sampling
	1684	OcnOps_Mission Manager Metadata Software Operation
	13282	OcnOps_Monitoring Vessel Operation and Safety
	6434	OcnOps_Nutrient Sampling
	1691	OcnOps_Onset Thermistor Launch, Calibration, and Readout
	10515	OcnOps_Outfall_External_Inspection
	1688	OcnOps_Rig Fishing for Fish Tissue Chemical Analyses
	1689	OcnOps_Seabird CTD Calibration and Setup
	1690	OcnOps_Static Mooring Recovery and Deployment
	1692	OcnOps_Trawl Sampling

Appendix F.2 List of work instruction (WI) used as part of the City of San Diego's Ocean Monitoring Program for processing ocean monitoring related support.

Flow Chart Reference	WI Title
A	Benthic Login and Label Creation
B	Chemistry Sample Export
C	Trawl Fish Field Data Sheet Procedures
D	Trawl Invert Field Data Sheet Procedures
E	Species per Rep Data Entry into Oracle
F	Excel Entry/Management of Fish Weight and Length Data
G	Updating Species List
H	Monthly Water Quality Data QA, Analysis, and Reporting
I	Annual Report Chapters
J	Annual Report Chapter - Water Quality
K	Annual Report Chapter - Trawl
L	Annual Report Chapter - Tissue Burden
M	Annual Report Chapter - Ocean Conditions
N	Annual Report Chapter - Macrobenthic Communities
O	Satellite Imagery
P	Primer
Q	FID Procedures - Fish
R	FID Procedures - Inverts
T	Visual Observations Upload
U	IGODS Data Upload
V	Kelp and ITP Login
W	Chemistry Label Creation
X	Trawl Login
Y	Trawl Data Entry and QA
Z	Tissue Burden Login, Label, Export to Chemistry
AA	Benthic Visobs Upload
AB	Benthic Data Upload to ORACLE
-	Annual QA Report
1672	LabOps_Electronic Taxonomy Datasheet Generation and Consolidation
1675	LabOps_Labeling Infauna Vials

Appendix F.3 Example Chain of Custody form used in the collection and transfer of water quality samples.

City of San Diego Public Utilities Department
Environmental Monitoring & Technical Services Division
Marine Microbiology Laboratory
2392 Kincaid Rd.
San Diego, CA 92101-0811

Date:	**Sampler(s):**	
Contact: Lara Asato **Phone:** (619) 758-2314	**Contact:** Adriano Feit **Phone:** (619) 758-2377	**Notes:**
Sampling Equipment: CTD carousel & Niskin bottles		
Analyses: Total & Fecal Coliform, Enterococcus		
Type: Seawater grab, 250ml unless otherwise noted		

PLOO

Source / ID	Time	Initials
A1 (1, 12, & 18m)		
A7 (1, 12, & **18m***)		
A6 (1, 12, & 18m)		
C7 (1, 12, & **18m***)		
C8 (1, **12***, & 18m)		
C6 (1, 3, & 9m)		
C5 (1, 3, & 9m)		
C4 (1, 3, & 9m)		

SBOO

Source / ID	Time	Initials
I39 (2, 12, & 18m)		
I19 (2, **6***, & 11m)		
I40 (2, **6***, & 9m)		
I24 (2, 6, & 11m)		
I25 (2, 6, & 9m)		
I26 (2, 6, & 9m)		
I32 (2, 6, & 9m)		

***500ml**

Comments: _____

_____

Relinquished by (print): _____ Received by (print): _____ Date/Time: _____

Sign: _____ Sign: _____ Location: Driscoll's Wharf

Relinquished by (print): _____ Received by (print): _____ Date/Time: _____

Sign: _____ Sign: _____ Location: Marine Micro/NTC

Receipt Temperature (°C): **45** samples

Y:\EMTS\41_Sections\Micro\MarineMicro\Forms\Fieldsheets\Kelp WQ Chain of Custody.docx MMVM-F-270.1-1220

Appendix F.4 Example benthic infaunal samples Check-in, Change and COC Log sheet used by Marine Biology Lab staff in the collection and transfer of samples between the Marine Biology Lab and the external sorting lab.

Benthic Grab Check-in/out and Changing Log

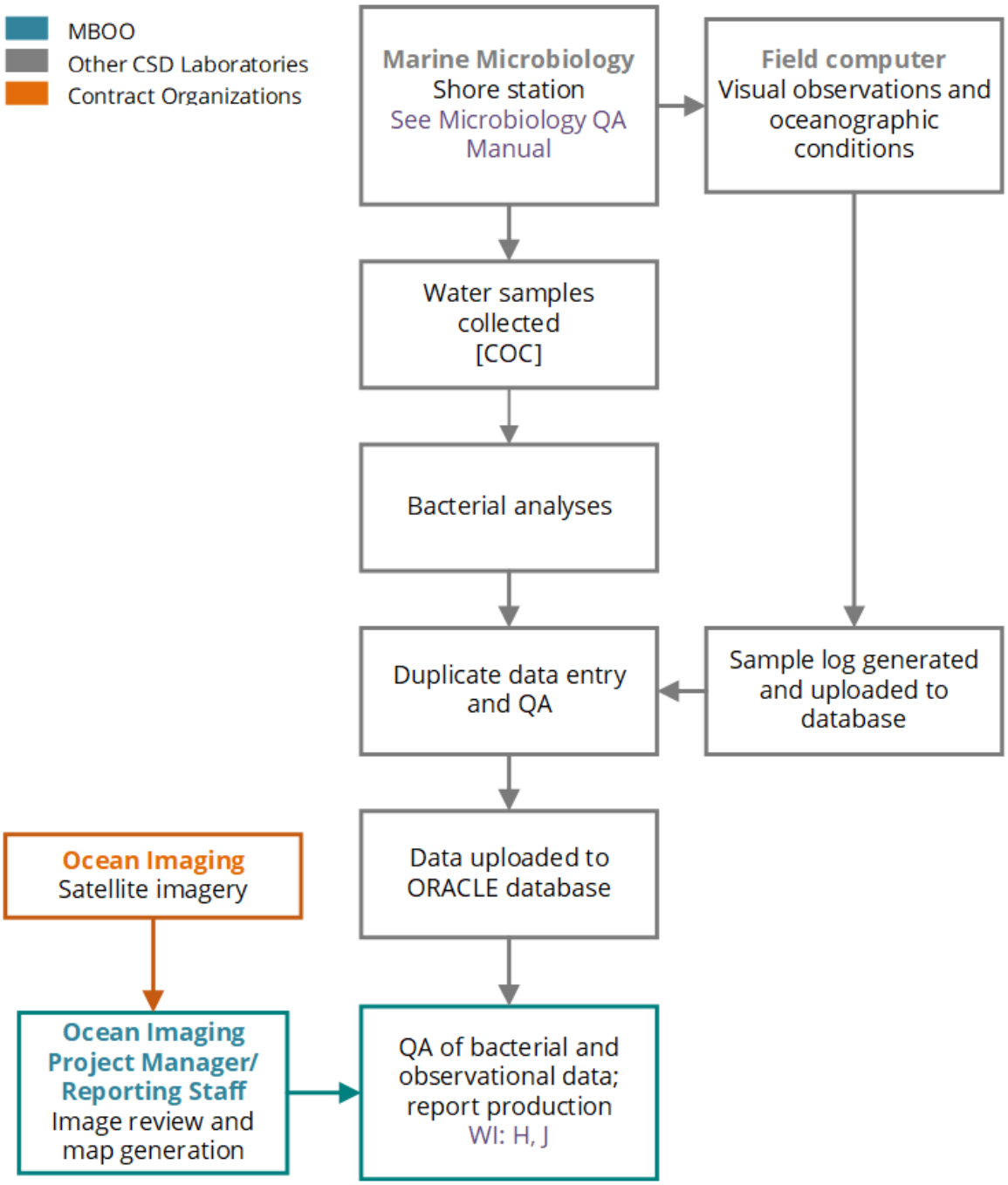
09-Jul-2021

Check In							Check Out				
Project	Date	Station	DEPTH	REP 1	Begin Date	End Date	EtOH change Completion Date	INI	Log Number	Date Sent to Sorters	INI
REG	09-Jul-2021	9237	326.7	1	12-Jul-2021	19-Jul-2021					
REG	09-Jul-2021	9240	501.1	1	12-Jul-2021	19-Jul-2021					
REG	09-Jul-2021	9238	58.1	1	12-Jul-2021	19-Jul-2021					
REG	09-Jul-2021	9239	19.0	1	12-Jul-2021	19-Jul-2021					
REG	09-Jul-2021	9236	58.0	1	12-Jul-2021	19-Jul-2021					
REG	09-Jul-2021	9235	98.2	1	12-Jul-2021	19-Jul-2021					
REG	09-Jul-2021	9234	42.1	1	12-Jul-2021	19-Jul-2021					

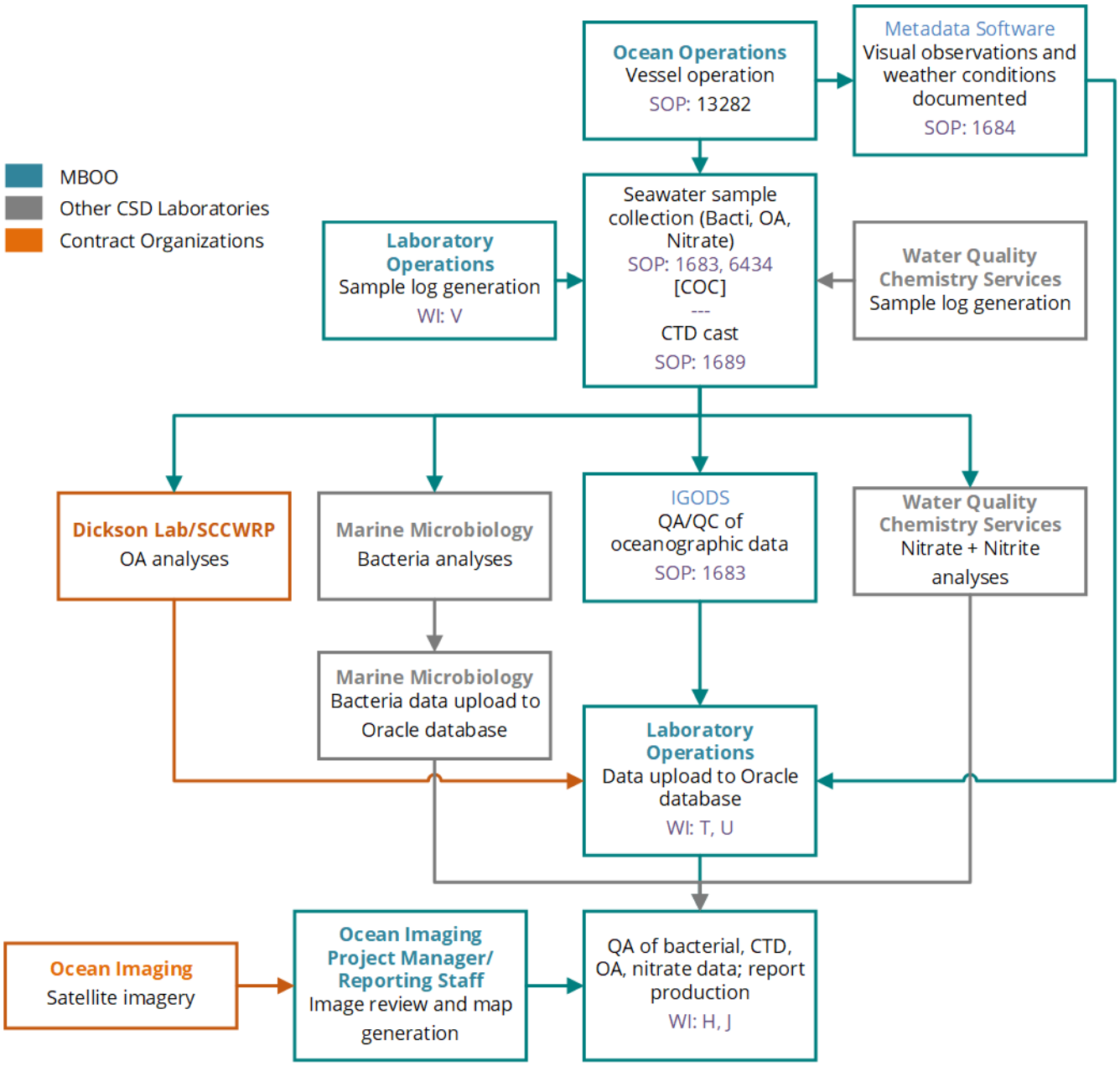
Chain of Custody	
Samples Relinquished By	Samples Received By
Signature	Signature
Firm/Agency	Firm/Agency
Date/Time	Date/Time

Chain of Custody	
Samples Relinquished By	Samples Received By
Signature	Signature
Firm/Agency	Firm/Agency
Date/Time	Date/Time

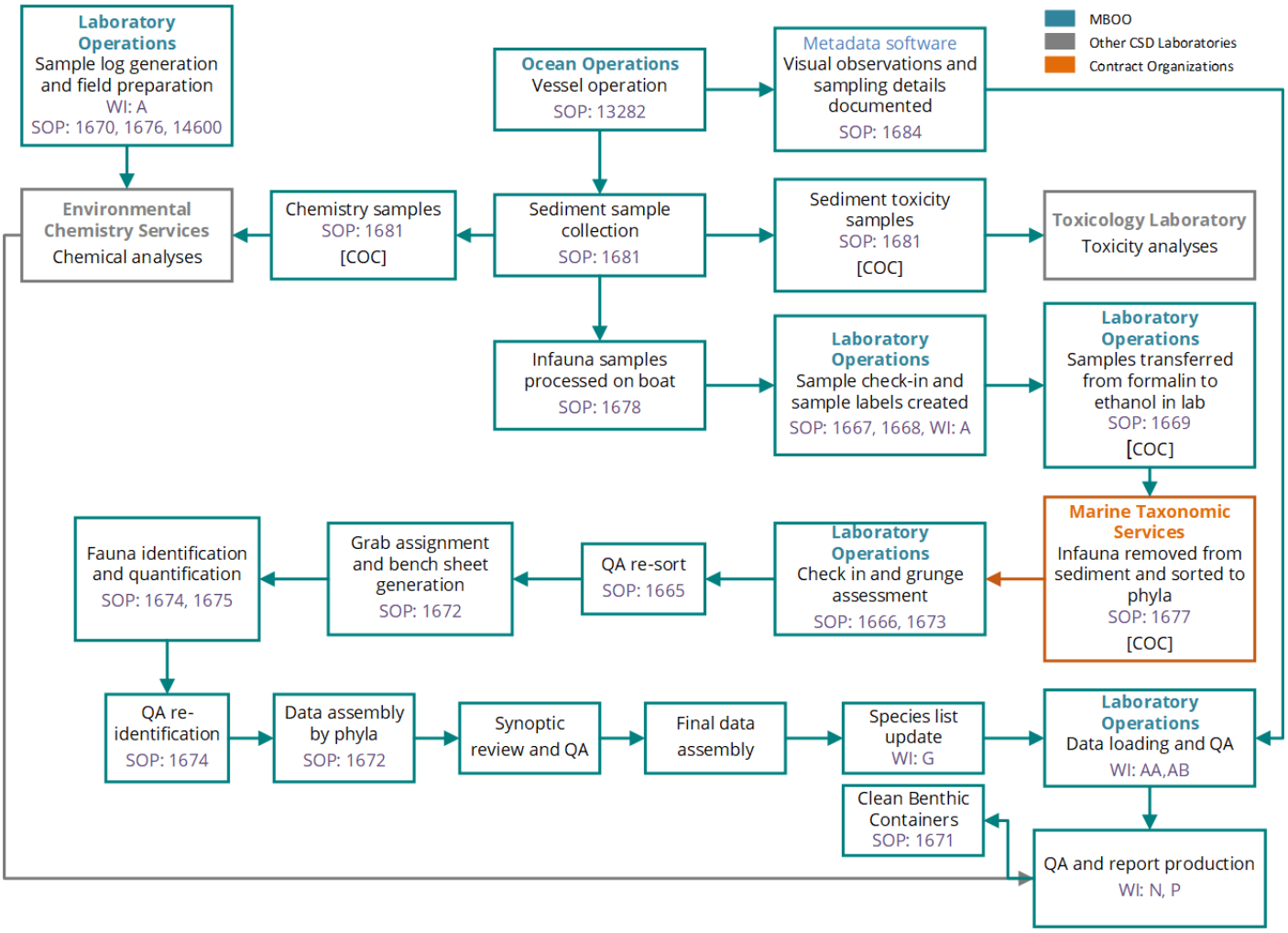
Appendix F.5 Data flow chart for shoreline water quality sampling.



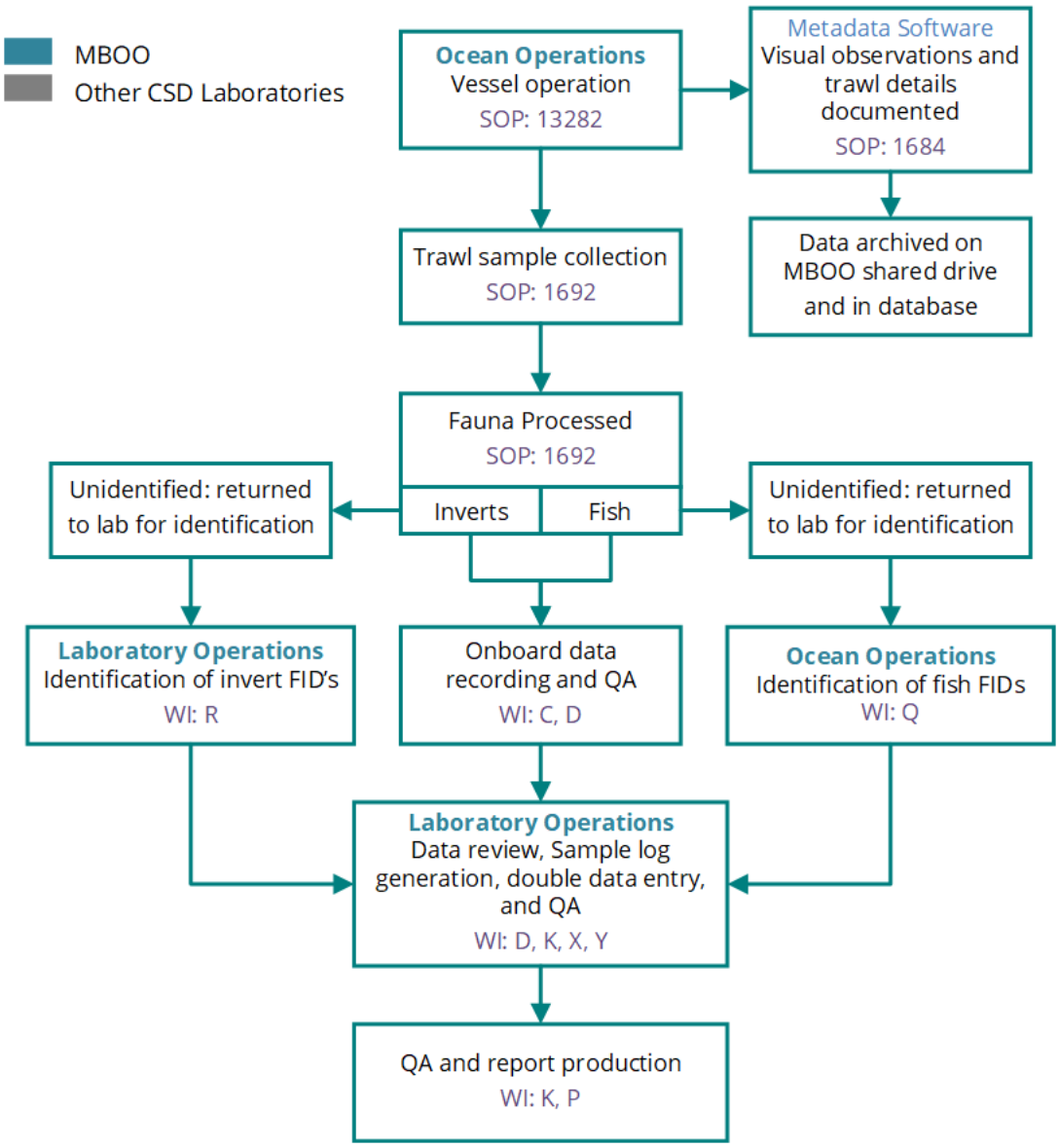
Appendix F.6 Data flow chart for kelp and offshore water quality sampling.



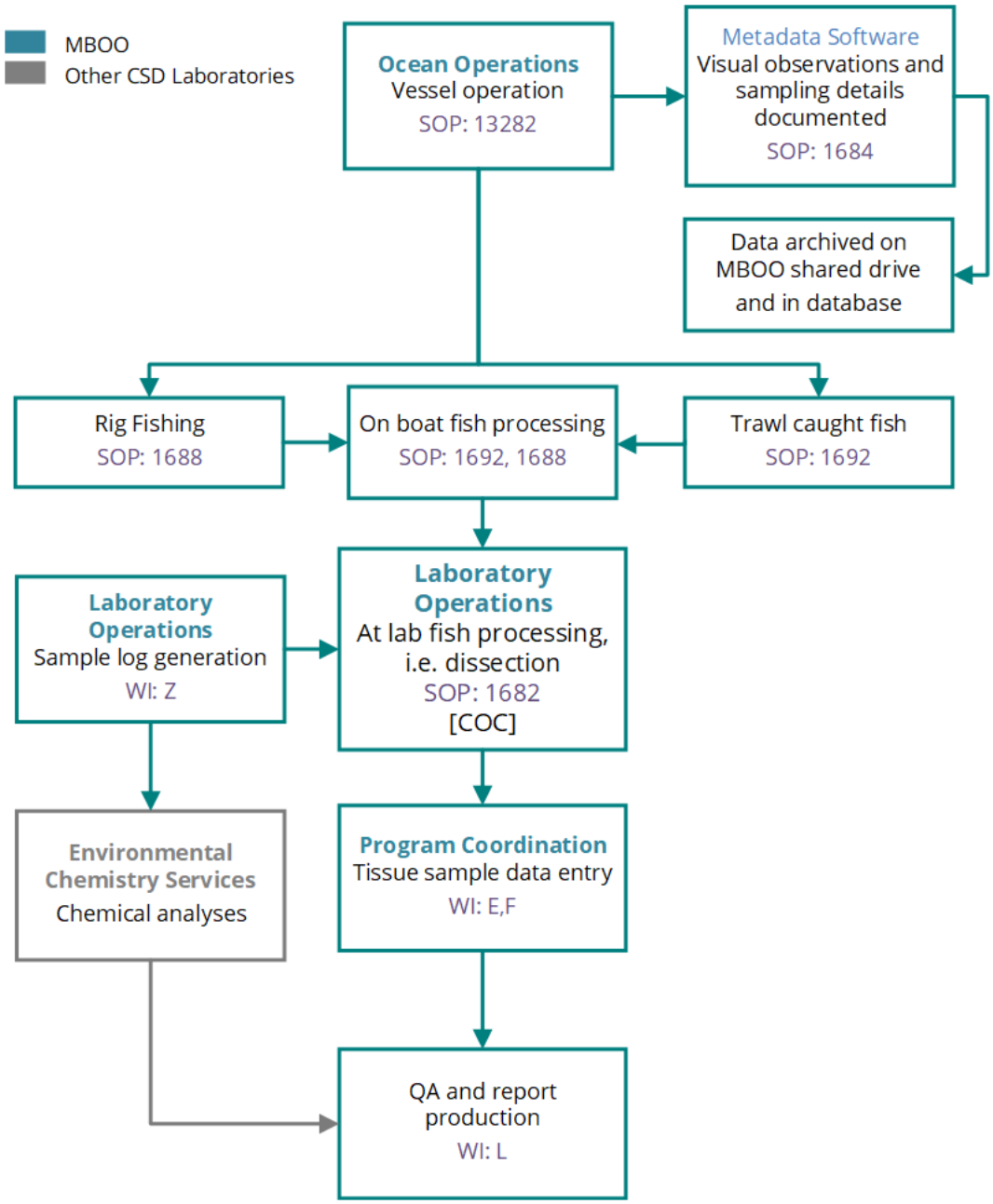
Appendix F.7 Data flow chart for benthic monitoring.



Appendix F.8 Data flow chart for trawl monitoring.



Appendix F.9 Data flow chart for fish tissue sampling.



Appendix F.10 Data flow chart for static mooring data collection.