THE CITY OF SAN DIEGO

Annual Receiving Waters Monitoring & Toxicity Testing Quality Assurance Report

2013

City of San Diego
Ocean Monitoring Program

Public Utilities Department
Environmental Monitoring and Technical Services Division

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Prepared by:

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Introduction

The Environmental Monitoring and Technical Services (EMTS) Division of the City of San Diego's Public Utilities Department performs comprehensive Quality Assurance/Quality Control (QA/QC) activities to ensure the accuracy and reliability of receiving waters monitoring and toxicity testing data provided to regulatory agencies in compliance with the reporting requirements specified in several National Pollutant Discharge Elimination System (NPDES) permits (Table 1). These QA/QC procedures assure the quality of field sampling, laboratory analysis, record keeping, data entry, electronic data collection/transfer, as well as data analysis and reporting. The procedures are regularly reviewed and revised as necessary to reflect ongoing changes in NPDES permit requirements, sample collection, methods, technology, and applicability of new analytical methods.

Details of the division's QA/QC program for receiving waters monitoring and toxicity testing is documented in a separate Quality Assurance Plan that is currently under revision (City of San Diego, in prep). Additionally, the EMTS Division maintains certification through the International Organization for Standardization 14001 Environmental Management Systems program (ISO 14001). As part of continuation in the ISO 14001 certification process, EMTS underwent and passed an external audit in 2013 conducted by a third-party auditor. This report summarizes the QA/QC activities that were conducted during calendar year 2013 by EMTS staff in support of NPDES permit requirements for receiving waters monitoring and toxicity testing for the City's Point Loma Wastewater Treatment Plant and South Bay Water Reclamation Plant, as well as similar ocean monitoring activities required for the South Bay International Wastewater Treatment Plant owned and operated by the International Boundary and Water Commission, U.S. Section.

Facilities and Staff

The EMTS Division includes three sections (laboratories) that participate in the receiving waters monitoring activities associated with the above NPDES permits: (1) Marine Biology and Ocean Operations; (2) Microbiology; (3) Wastewater Chemistry Services. The Marine Biology and Ocean Operations section (Marine Biology Lab) and the Marine Microbiology and Vector Management work group (Marine Microbiology Lab) of the Microbiology section are located at the EMTS Division's laboratory facilities located at 2392 Kincaid Road, San Diego, CA 92101. Staff scientists of these two labs are responsible for conducting most field operations and performing subsequent biological and oceanographic assessments associated with the City's Ocean Monitoring Program (e.g., water quality, benthic sediments and macrofauna, trawl-caught fishes and invertebrates, contaminant bioaccumulation in fishes). Lab personnel are organized into several different work groups based on their major work responsibilities and areas of expertise (see Appendices A.1, A.2). Brief descriptions of the areas of emphasis for each work group are given in the following sections.

The Wastewater Chemistry Services (WCS) section is located at other City facilities and is responsible for performing chemical analyses of the various seawater, sediment and fish tissue samples collected by the program. Descriptions of the WCS section and their QA procedures are presented in a separate QA report each year.

Table 1

NPDES permits governing receiving waters monitoring and toxicity testing requirements for the City of San Diego's Point Loma Wastewater Treatment Plant (PLWTP) and South Bay Water Reclamation Plant (SBWRP), and the International Boundary and Water Commission, U.S. Section's South Bay International Wastewater Treatment Plant (SBIWTP) for CY2013.

Facility	NPDES Permit No.	Order No.	Effective Dates
PLWTP	CA0107409	R9-2009-0001	August 1, 2010 – July 31, 2018
SBWRP	CA0109045	R9-2013-0006*	April 4, 2013 – April 3, 2018
SBIWTP	CA0108928	96-50	November 14, 1996 – present†

* Replaced Order No. R9-2006-0067; † Under Cease & Desist Order 96-52

Marine Biology and Ocean Operations

***Data Management and Reporting (DM&R)*:** The primary responsibility of the DM&R work group is to analyze and report receiving waters monitoring data. This includes data QA, data analysis, and the interpretation of results from the receiving waters monitoring activities and other contract work. DM&R personnel work closely with the IT/GIS group (described below) to perform QA of all receiving waters monitoring data that are entered into the laboratory's database. Various software packages for data management, data manipulation, statistical analysis, and presentation are used to manage and analyze data from every aspect of receiving waters monitoring. The results and interpretation of these analyses are reported to regulatory and contract agencies in the form of monthly and annual reports.

***Information Technology and Geographic Information Systems (IT/GIS)*:** The IT/GIS work group is primarily responsible for the administration of the lab's database, performing geospatial data analysis, and generating all map products needed for the ocean monitoring program. Daily responsibilities include entry and archiving of ocean monitoring data, validation of data accuracy, maintenance of database structure and integrity, oversight of database access/security issues, and management of database enhancements. This group is also responsible for IT project planning, workflow automation programming, and website maintenance to support Marine Biology and other EMTS laboratory staff.

***Ocean Operations*:** This work group comprises two subsections, Ocean Operations and Vessel Operations. Ocean Operations personnel oversee and conduct water quality sampling, benthic sediment and macrofauna sampling, trawling and rig-fishing, diving operations, and ocean outfall inspections. These staff members maintain and calibrate all oceanographic instrumentation, SCUBA equipment, and the laboratory's remotely operated vehicle (ROV). Vessel operations personnel are primarily responsible for the operation and maintenance of the City's two monitoring vessels (*Oceanus* and *Monitor III*). When in port, the group's 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.

***Taxonomy*:** The Taxonomy work group coordinates and manages the processing of all benthic macrofauna and trawl invertebrate samples, maintains the taxonomic literature and voucher collections, and conducts taxonomic training. In addition, taxonomy staff members produce in-house identification

Table 2
ELAP certifications for EMTS Division Marine Microbiology and Toxicology labs located at 2392 Kincaid Road, San Diego, CA. 92101.

Laboratory	Phone	EPA Lab ID	ELAP Cert. No.
Marine Microbiology	619-758-2360	CA01393	2185
Toxicology	619-758-2348	CA01302	1989

sheets and keys for important species and other taxa. Members of this group participate in a regional taxonomic standardization program and perform all QA/QC procedures to ensure the accuracy of the taxonomic identifications made by laboratory personnel.

***Toxicology*:** The Toxicology Laboratory is certified by the State of California Department of Health Services, Environmental Laboratory Accreditation Program (ELAP), which is renewed on a biennial basis (see Table 2). Toxicology personnel are responsible for conducting all acute and chronic toxicity testing required by the City's NPDES permits and contractual obligations. Primary responsibilities include collection of wastewater effluent or other types of samples, maintaining test organisms and laboratory supplies, calibration of test instruments, conducting acute and chronic bioassays, record keeping, and the statistical evaluation, interpretation and reporting of all toxicology data. In addition, the Toxicology Lab maintains a separate Quality Assurance Manual in accordance with ELAP requirements that contains up-to-date revisions to reflect current laboratory practices and procedures, and to ensure timely document version control.

Marine Microbiology and Vector Management

***Marine Microbiology*:** The Marine Microbiology Laboratory is also certified by ELAP (see Table 2). This lab is responsible for the identification and quantification of bacteria found in environmental samples. Responsibilities include the preparation of microbiological media, reagents, sample bottles, supplies and equipment, the collection of field samples along the shore, and a variety of laboratory analyses to measure concentrations of fecal indicator bacteria (e.g., membrane filtration, multiple tube fermentation, and Colilert-18 and Enterolert chromogenic substrate analyses) as appropriate to the sample type and as required by the NPDES permits. In addition, the group is responsible for the physical maintenance and quality assurance of large instruments such as autoclaves, incubators, water baths, ultra-freezers, a bacteriological safety cabinet, and three reagent-grade water point-of-use systems. Members are also responsible for developing sampling, analytical, and quality assurance protocols for special projects or studies involving microbiology.

***Vector Management*:** The Vector Management group provides for monitoring, surveillance, control and prevention of insects and other pests that are capable of transmitting diseases or causing harm to humans. The primary methods of control include environmental conservation measures, education, and water management techniques aided by appropriate chemical and biological control technology. The vector control program uses methods to census animal populations to determine control effectiveness and trends. Areas of responsibility include wastewater treatment plants, pump stations, buildings and office facilities. Biological assessments (bioassessments) of urban creeks and streams are conducted to evaluate and analyze short and long-term impacts of sewage spills into watersheds and receiving waters. Field samples of aquatic communities are collected and field water quality indicators are measured.

Physical habitat characteristics and anthropogenic changes are evaluated. Measures, evaluations, and comparisons are made to yield relative ratings of conditions within a specified community.

Scope of Work

Treated effluent from the Point Loma Wastewater Treatment Plant (PLWTP) is discharged to the Pacific Ocean through the Point Loma Ocean Outfall (PLOO), whereas the South Bay Ocean Outfall (SBOO) accepts commingled effluent from the South Bay Water Reclamation Plant (SBWRP) and South Bay International Wastewater Treatment Plant (SBIWTP). The separate NPDES permits associated with each of these treatment facilities define the requirements for toxicity testing and the monitoring of receiving waters for each discharge site. The permits define the sampling plans, compliance criteria, laboratory analyses, statistical analyses and reporting guidelines.

The core receiving waters monitoring efforts for both the Point Loma and South Bay monitoring programs are summarized in Tables 3 and 4, while the fixed-grid sampling sites for each program are shown in Figure 1. These core monitoring activities include weekly sampling of seawater from recreational areas along the shoreline and within the Point Loma and Imperial Beach kelp beds, as well as monthly or quarterly offshore sampling in order to document water quality conditions in the region. Benthic samples are collected semiannually or annually to monitor sediment conditions and macrofaunal communities. Trawl surveys are performed quarterly in the South Bay outfall region and semiannually off Point Loma to monitor the ecological health of demersal fish and megabenthic invertebrate communities. Additionally, fish tissue samples are collected and analyzed on either a semiannual or annual basis to monitor levels of chemical constituents that may have ecological or human health implications. Toxicity testing consists of acute and chronic bioassays of influent, effluent, and groundwater samples. The general toxicity testing required by the NPDES permits is outlined in Table 5. The results of these receiving waters monitoring activities and toxicity tests are analyzed and presented in various regulatory reports that are submitted to the San Diego Regional Water Quality Control Board (SDRWQCB).

In addition to the above core monitoring efforts, the City also conducts “strategic process studies” (i.e., special projects) as part of its regulatory requirements and as defined by the Model Monitoring Program developed for large ocean dischargers in southern California (Schiff et al. 2001). These special studies are determined by the City in coordination with the SDRWQCB and the United States Environmental Protection Agency (USEPA), and are generally designed to address recommendations for enhanced environmental monitoring of the San Diego coastal region put forth in a peer-reviewed report coordinated by scientists at the Scripps Institution of Oceanography (SIO 2004). Data for these directed studies are subject to similar QA/QC procedures as the routine monitoring data, although the projects themselves do not necessarily conform to the same analysis and reporting schedules. Thus, details and results of ongoing QA/QC activities associated with these special studies are not included in this report unless otherwise indicated.

As part of its regulatory requirements, the City also participates in regional monitoring activities for the entire Southern California Bight coordinated by the Southern California Coastal Water Research Project (SCCWRP). The intent of the regional programs is to maximize the efforts of the various partner agencies (e.g., municipal dischargers, research agencies) using a more cost-effective

Table 3

NPDES-permit mandated receiving waters sampling effort for the Point Loma ocean outfall region, excluding resamples, QA/QC analyses (e.g., field and laboratory duplicates), or special studies.

Monitoring Component	Location	No. of Stations/Zones	Sample Type	Discrete No. Samples/Site	Sampling Frequency	Sampling Times/Yr	Discrete No. Samples/Yr	Parameters	No. "Samples" Analyzed/Yr	Notes
Water Quality,	shore	8	Seawater - Bacti	1	weekly	52	416	T, F, E [a]	1248	1 sample/station
Microbiology										
&	kelp	8	Seawater - Bacti	3	5x/month	60	1440	T, F, E [a]	4320	3 depths/station
Oceanographic		8	Seawater - NH_4	3	quarterly	4	96	NH_4	96	3 depths/station/quarter
Conditions		8	CTD	1	5x/month	60	480	CTD profile [c]	3840	1 cast/station
	offshore	3	Seawater - Bacti	3	quarterly	4	36	E [b]	36	3 depths/station (18-m stns)
	(n=36)	11	Seawater - Bacti	3	quarterly	4	132	E [b]	132	3 depths/station (60-m stns)
		11	Seawater - Bacti	4	quarterly	4	176	E [b]	176	4 depths/station (80-m stns)
		11	Seawater - Bacti	5	quarterly	4	220	E [b]	220	5 depths/station (98-m stns)
		3	Seawater - NH_4	3	quarterly	4	36	NH_4	36	3 depths/stn (18-m stns, State Waters)
		9	Seawater - NH_4	3	quarterly	4	108	NH_4	108	3 depths/stn (60-m stns, State Waters)
		3	Seawater - NH_4	4	quarterly	4	48	NH_4	48	4 depths/stn (80-m stns, State Waters)
		36	CTD	1	quarterly	4	144	CTD profile [d]	1296	1 cast/station
Sediment Quality	offshore	22	Grab	1	semiannual	2	44	sediment constituents [e]	396	1 grab/station (Jan, Jul)
Benthic Macrofauna	offshore	22	Grab	2	semiannual	2	88	community structure	88	2 replicate grabs/station (Jan, Jul)
Demersal Fishes & Invertebrates	offshore	6	Trawl	1	semiannual	2	12	community structure	12	1 trawl/station (Jan, Jul)
Bioaccumulation in Fish Tissues	offshore	4	Trawl	3	annual	1	12	liver tissue contaminants [f]	48	3 composites/zone (Oct)
	offshore	2	Hook & Line/Trap	3	annual	1	6	muscle tissue contaminants [f]	24	3 composites/zone (Oct) (2 rig-fishing sites/zones)
Totals							3,494		12,124	

[a] T, F, E = total coliform, fecal coliform, and *Enterococcus* bacteria (n = 3 parameters) required at shore and kelp stations
[b] E = *Enterococcus* only required at offshore stations
[c] CTD profile = depth, temperature, salinity, dissolved oxygen, light transmittance (transmissivity), chlorophyll *a*, pH, density (n = 8 parameters)
[d] CTD profile = depth, temperature, salinity, dissolved oxygen, light transmittance (transmissivity), chlorophyll *a,* pH, density, and CDOM (n = 9 parameters)
[e] Sediment constituents = sediment grain size, total organic carbon, total nitrogen, sulfides, metals, PCBs, chlorinated pesticides, PAHs, BOD (n = 9 parameter categories; see NPDES permit for complete list of constituents; BOD = voluntary)
[f] Fish tissue contaminants = lipids, PCBs, chlorinated pesticides, metals (n = 4 parameter categories; see NPDES permit for complete list of constituents)

Table 4

NPDES-permit mandated receiving waters sampling effort for the South Bay ocean outfall region, excluding resamples, QA/QC analyses (e.g., field and laboratory duplicates), or special studies.

Monitoring Component	Location	Number of Stations	Sample Type	Discrete No. Samples/Site	Sampling Frequency	Sampling Times/Yr	Discrete No. Samples/Yr	Parameters	No. "Samples" Analyzed/Yr	Notes
Water Quality,	shore	11	Seawater - Bacti	1	weekly	52	572	T, F, E [a]	1716	1 sample/station
Microbiology										
&	kelp	3	Seawater - Bacti	3	5x/month	60	540	T, F, E [a]	1620	3 depths/station
Oceanographic		3	CTD	1	5x/month	60	180	CTD profile [b]	1440	1 cast/station
Conditions										
	offshore	25	Seawater - Bacti	3	monthly	12	900	T, F, E [a]	2700	3 depths/station
	(n=37)	37	CTD	1	monthly	12	444	CTD profile [c]	3996	1 cast/station
		28	TSS	3	monthly	12	1008	TSS	1008	3 depths/station
		28	Oil & Grease	1	monthly	12	336	O&G	336	1 depth/station
Sediment Quality	offshore	27	Grab	1	semiannual	2	54	sediment constituents [d]	432	1 grab/station (Jan, Jul)
Benthic Macrofauna	offshore	27	Grab	2	semiannual	2	108	community structure	108	2 replicate grabs/station (Jan, Jul)
Demersal Fishes & Invertebrates	offshore	7	Trawl	1	quarterly	4	28	community structure	28	1 trawl/station
Bioaccumulation Fish Tissues	offshore	7	Trawl	3	semiannual	2	42	liver tissue contaminants [e]	210	3 composites/station (Apr, Oct) (trawl sites)
	offshore	2	Hook & Line/Trap	3	semiannual	2	12	muscle tissue contaminants [e]	60	3 composites/station (Apr, Oct) (rig-fishing sites)
"Regional Survey"										
Sediment Quality	random array	40	Grab	1	annual	1	40	sediment constituents [d]	320	1 grab/station (Jul)
Benthic Macrofauna	random array	40	Grab	1	annual	1	40	community structure	40	1 grabs/station (Jul)
Totals							4,304		14,014	

[a] T, F, E = total coliform, fecal coliform, and *Enterococcus* bacteria (n = 3 parameters)
[b] CTD profile = depth, temperature, salinity, dissolved oxygen, light transmittance (transmissivity), chlorophyll *a*, pH, density (n = 8 parameters)
[c] CTD profile = depth, temperature, salinity, dissolved oxygen, light transmittance (transmissivity), chlorophyll *a,* pH, density, CDOM (n = 9 parameters)
[d] Sediment constituents = sediment grain 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 contaminants = total lipids, metals, PCBs, chlorinated pesticides, PAHs (n = 5 parameter categories; see NPDES permit for complete list of constituents)

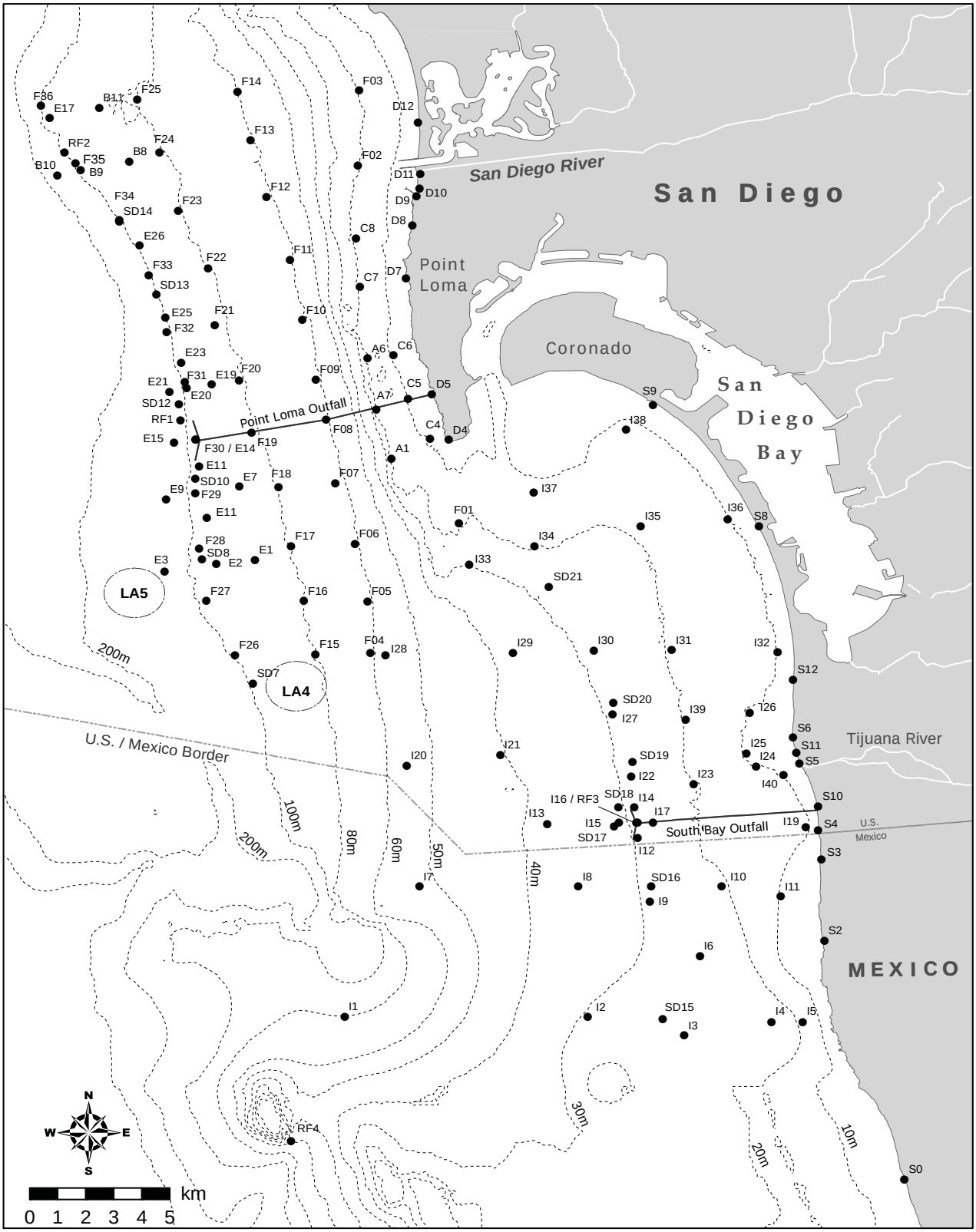

Figure 1
NPDES permit mandated (fixed-grid) water quality, benthic, trawl and rig fishing stations for the City of San Diego's Ocean Monitoring Program for the Point Loma and South Bay ocean outfall regions.

Table 5

Toxicity testing conducted by EMTS staff in accordance with various NPDES permits. Listed effort excludes accelerated testing requirements (e.g., triggered by Notice of Violation), additional QA/QC procedures, or special studies.

Testing Component	Location/ Project	Sample Type	No. samples	Sampling Frequency	Sampling Times/Yr	No. test Species	Effluent/ Ref Tox Tests/Yr	Total Tests/Yr	Endpoints	Dilutions per bioassay	Notes
Point Loma											
Acute toxicity	PLWTP	final effluent	1	semi-annual	2	1	2 + 2 Ref Tox	4	survival	5 + control	species = topsmelt
	(Biennial screening)	final effluent	1	3 x per 2 yrs	3 x per 2 yrs	2	6+ 6 Ref Tox per 2 yrs	12 per 2 yrs	survival	5 + control	screening spp: mysid and topsmelt
Chronic toxicity	PLWTP	final effluent	1	monthly	12	2	24 + 24 Ref Tox	48	sensitive lifestage	5 + control	species = giant kelp plus red abalone or purple sea urchin
	(Biennial screening)	final effluent	1	3 x per 2 yrs	3 x per 2 yrs	4	12 + 12 Ref Tox per 2 yrs	24 per 2 yrs	sensitive lifestage	5 + control	screening spp: giant kelp, red abalone, topsmelt, and purple sea urchin
South Bay											
Acute toxicity	SBWRP/ SBIWTP	comb. effluent	1	annual	1	1	1 + 1 Ref Tox	2	survival	5 + control	species = topsmelt
	(Biennial screening)	comb. effluent	1	3 x per 2 yrs	3 x per 2 yrs	2	6 + 6 Ref Tox per 2 yrs	12 per 2 yrs	survival	5 + control	screening spp: mysid and topsmelt
Chronic toxicity	SBWRP	final effluent	1	monthly	12	1	12 + 12 Ref Tox	24	sensitive lifestage	5 + control	species = red abalone or purple sea urchin
	(Biennial screening)	final effluent	1	3 x per 2 yrs	3 x per 2 yrs	4	12 + 12 Ref Tox per 2 yrs	24 per 2 yrs	sensitive lifestage	5 + control	screening spp: giant kelp, red abalone, topsmelt, and purple sea urchin
	SBWRP/ SBIWTP	comb. effluent	1	quarterly	4	1	4 + 4 Ref Tox	8	sensitive lifestage	5 + control	species = giant kelp
	(Biennial screening)	comb. effluent	1	3 x per 2 yrs	3 x per 2 yrs	4	12 + 12 Ref Tox per 2 yrs	24 per 2 yrs	sensitive lifestage	5 + control	screening spp: giant kelp, red abalone, topsmelt, and purple sea urchin

Comb. Effluent = combined SBWRP + SBIWTP effluent samples
Ref Tox = Reference Toxicant Test
Sensitive lifestage endpoints: (1) red abalone = development; (2) giant kelp = germination and growth; (3) topsmelt = survival and growth; (4) purple sea urchin = fertilization

monitoring design and to best utilize the pooled scientific resources of the region. These bight-wide surveys have included the 1994 Southern California Bight Pilot Project (SCBPP) and subsequent Bight'98, Bight'03, Bight'08, and Bight'13 regional monitoring efforts that began in 1998, 2003, 2008, and 2013, respectively. During these programs, the City's regular sampling and analytical effort may be reallocated as necessary with approval of the SDRWQCB and USEPA. As with the special studies described above, the regional monitoring efforts are typically subject to QA/QC procedures similar to those for routine monitoring data, although these projects also do not conform to the same analysis and reporting schedules. Thus, the details and results of the bight-wide monitoring efforts are not included in this report unless otherwise indicated. However, all documents for the present Bight'13 project, including its Quality Assurance Plan, are available for download at www.sccwrp.org/Documents/BightDocuments.

Summary of Work Performed in 2013

During calendar year (CY) 2013, a total of 9130 discrete samples were collected by EMTS staff, including samples collected as part of permit-mandated special studies (Table 6). Of these, about 7% (n = 631) were QC samples such as field duplicates. In addition, a total of 1658 QA tests were conducted to validate quality of specific analyses such as macrofauna sorting, microbiological analyses and toxicity tests. The results of the QA/QC activities presented in the following sections support the accuracy and precision of the resultant data and validate their use in permit-mandated monitoring or environmental testing and reporting. These include: (1) intercalibration of the Conductivity-Temperature-Depth (CTD) instruments used to sample water quality parameters; (2) results of the bacteriological QA procedures; (3) results of the macrofaunal community sample resorts; (4) results of toxicology QA procedures.

CTD Calibration and Maintenance

Ocean Operations personnel carry out semiannual in-house CTD intercalibration exercises to ensure consistency between the two Sea-Bird Electronics Model 25 CTD instruments used to collect water column profiling data for the City's ocean monitoring program. These exercises are carried out at the end of the 6-month service period for each instrument. For CY 2013, the intercalibration exercises were conducted in June and December. The instrument designated as Unit #3 is a combination CTD/carousel sampler, while Unit #4 is a standalone CTD unit. During each exercise, the two CTDs were attached to each other with similar probes aligned and then deployed to a depth of 110 meters and retrieved three separate times. For each cast, data from depths greater than 100 meters were discarded in an effort to minimize bottom effects. After all three casts were completed, comparisons of the results for six different parameters (i.e., temperature, salinity, dissolved oxygen (DO), pH, chlorophyll *a*, transmissivity) were performed to assess whether deviations between the instruments and sensors were within acceptable limits.

The results of the 2013 intercalibration exercises are summarized in Table 7 and Figure 2, and compared to results from previous years in Table 7. All comparisons of average variability between CTDs for temperature, salinity, DO, pH, transmissivity, and chlorophyll *a* were acceptable. However, in contrast to average variability, the maximum transmissometer and fluorometer variabilities were greater in June than previously reported. The maximum transmissometer variability of 16.8% was caused by a malfunctioning unit that has since been serviced, while the

Table 6

Number of discrete samples collected and analyzed by EMTS staff for NPDES permit-related activities during 2013. NA = not applicable; WCS = Wastewater Chemistry Services.

	Number of Samples Collected		Number of Analyses per Sample Type	
Sample Type	**Regular**	**QC**	**Regular**	**QA**
Sediment Grabs				
Particle Size Subsample	139 [ab]	NA	(performed by WCS)	
Chemistry Subsamples	539 [abc]	NA	(performed by WCS)	
Benthic Infauna Grabs	178 [ab]	NA	178	35 [g]
Otter Trawl	61 [b]	NA	61	NA
Fish Tissue	72	NA	(performed by WCS)	
Water Quality				
CTD Casts	1248	NA	10,595 [e]	NA
Microbiology	4551 [d]	463	12,497 [f]	1564 [f]
Suspended Solids	1008	96	(performed by WCS)	
Oil and Grease	336	72	(performed by WCS)	
Ammonia (as nitrogen)	288	NA	288	NA
Toxicology				
Acute Bioassay	4	NA	8	12
Chronic Bioassay	43	NA	48	36
Sediment Bioassay	32	NA	38	11

[a] PLOO limited to primary core stations in January

[b] includes Bight'13 stations

[c] PLOO stations had five subsamples per grab; Bight'13 stations had three subsamples per grab; all other stations had four subsamples per grab

[d] includes resamples

[e] includes up to nine parameters per cast (depth, temperature, salinity, dissolved oxygen, light transmittance, chlorophyll *a*, pH. density, CDOM)

[f] includes up to three types of analyses (total coliform, fecal coliform, *Enterococcus*)

[g] projected estimate based on preliminary sorting numbers (see Table 10)

maximum variability of 17.29 µg/L observed for chlorophyll *a* resulted from samples collected during a phytoplankton bloom.

In addition to the semi-annual CTD intercalibration exercises, manufacturers of various probes recommend annual recalibrations at their factories. Since four sets of conductivity, temperature, pressure, pH and DO probes are inventoried in-house, each instrument is rotated out of service and sent back to the factory every six months for recalibration. Because there are only three sets of fluorometers and transmissometers, and two CDOM probes, these sensors are rotated out for external/factory recalibration service on an annual basis. However, if in-house calibration results indicate a problematic probe, it will be serviced earlier than scheduled. The overall rotation schedule of the probes between CTDs is staggered by six months to ensure that each instrument receives a replacement set within the annual calibration period.

Table 7

Summary of the CTD intercalibration casts. (A) casts conducted during 2013. Values are the mean difference (Mean∆) and maximum difference (Max∆) between Unit #3 and Unit #4, as well as the cast number (i.e., 1, 2, or 3), and depth (m) at which the maximum difference occurred; (B) results of CTD intercalibration exercises conducted from 2009 through 2013. Values are the differences between Unit #3 and Unit #4 averaged over all depths (0–100 m).

A.

	June 2013				December 2013			
Parameter	**Mean∆**	**Max∆**	**Cast**	**Depth (m)**	**Mean∆**	**Max∆**	**Cast**	**Depth (m)**
Temperature (°C)	0.02	0.86	1	48	0.01	0.14	3	24
Salinity (psu)	0.01	0.08	1	75	0.01	0.01	2	42
DO (mg/L)	0.06	0.71	1	48	0.05	0.14	1	43
pH	0.03	0.06	3	98	0.04	0.05	2, 3	25, 26
Transmissivity (%)	2.92	16.80	1	19	1.44	2.54	2	2
Chlorophyll *a* (µg/L)	0.76	17.29	1	20	0.07	0.23	3	32

B.

Parameter	**2009**	**2010**	**Jun 2011**	**Jan 2012**	**Aug 2012**	**Dec 2012**	**Jun 2013**	**Dec 2013**
Temperature (°C)	0.07	0.03	0.03	0.01	0.04	0.04	0.02	0.01
Salinity (psu)	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01
DO (mg/L)	0.44	0.10	0.17	1.02	0.37	0.50	0.06	0.05
pH	0.02	0.01	0.02	0.02	0.03	0.31	0.03	0.04
Transmissivity (%)	0.47	1.61	1.74	0.76	0.65	1.02	2.92	1.44
Chlorophyll *a* (µg/L)	0.49	0.07	0.08	0.03	1.63	2.55	0.76	0.07

The probes actively in use on each CTD undergo further in-house evaluations prior to and during each survey. The DO probe on each instrument is calibrated monthly to check for sensor drift. If the sensor drift is ≥ 5% from the factory calibration, the sensor coefficients are changed; if the sensor drift reaches 10%, it is removed from service and replaced with a factory calibrated probe. The pH and transmissivity probes are checked in the morning prior to each sampling cruise to ensure proper function. For pH calibrations, three buffer solutions are used to bracket the expected pH range of pH7–pH9. If the reading of a particular buffer solution deviates by more than 0.05 pH units, the probe is adjusted electronically using factory provided software and then recalibrated. The transmissometer is checked by cleaning the windows of the LED light path and then noting the zero reading by blocking the light path and the full range reading by removing the obstruction. If any probe fails to calibrate or seems to have drifted out of range, it is removed from the instrument and replaced with a spare. Additionally, the results of each probe are evaluated by reviewing the data following each cast. If any probe 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.

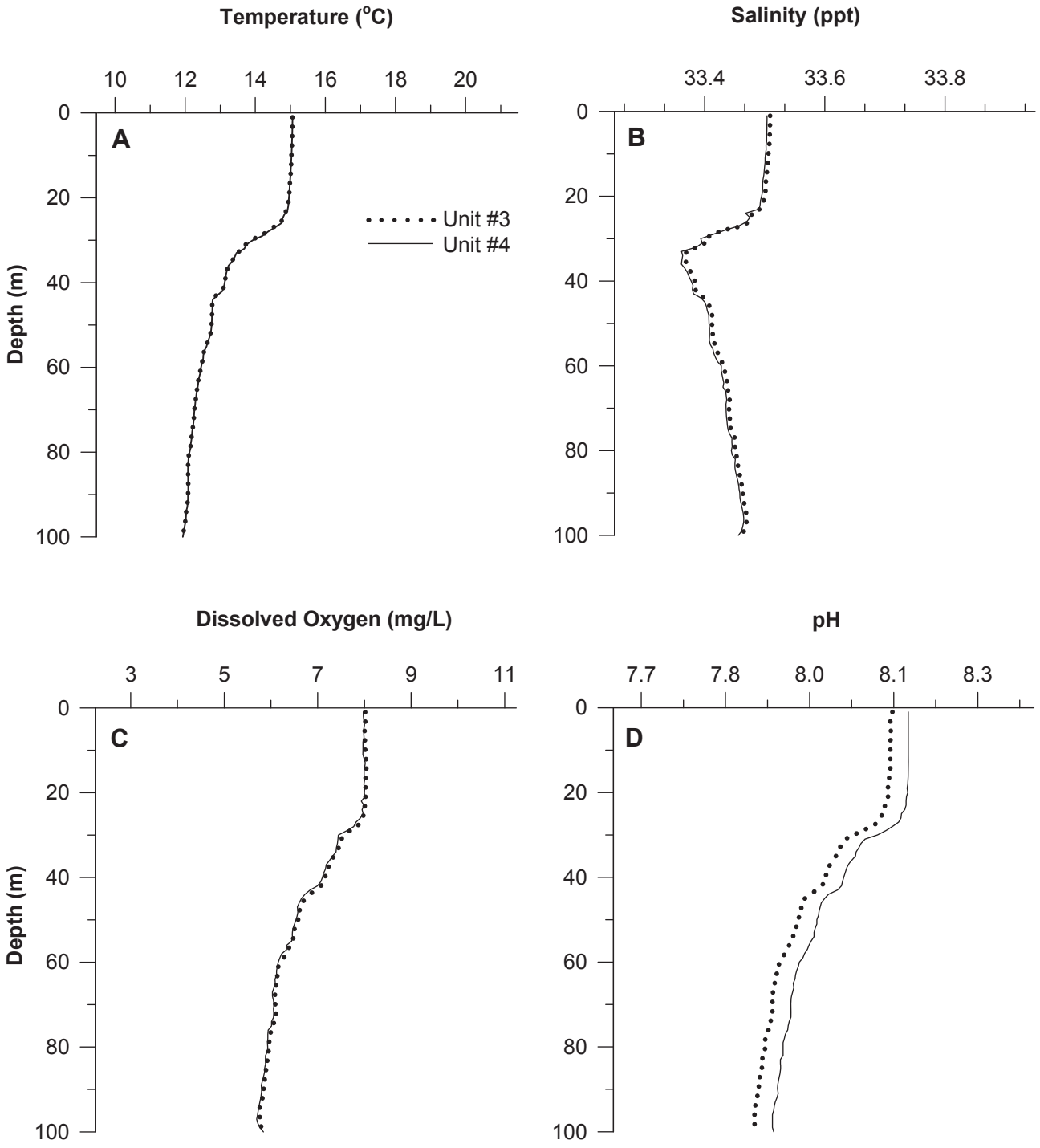

Figure 2

Comparison of results from CTD Units #3 and #4 from one representative cast made during the 2013 CTD intercalibration exercises. Data include cast profiles for (A) temperature, (B) salinity, (C) dissolved oxygen, (D) pH, (E) transmissivity, and (F) chlorophyll *a*.

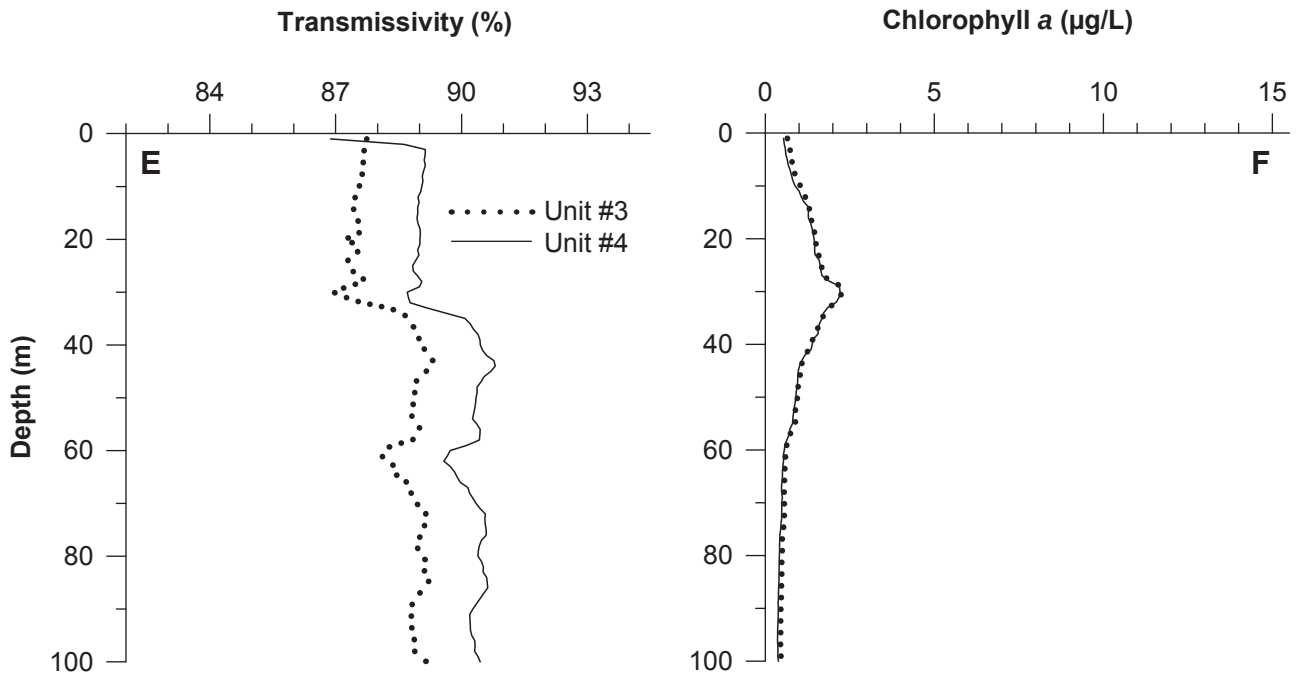

Figure 2 *continued*

Bacteriological Quality Assurance Analyses

Duplicate analyses are run throughout the year as QA checks on bacteriological data reported by the City. Field duplicates are two separate samples taken from the same station at the same time and then processed by a single analyst to measure variability between samples. Laboratory duplicates are designed to test whether analysts can replicate their own results, and consist of two samples that are diluted, filtered, and plated from a single sample container by a single analyst to measure analyst precision. A total of 463 bacteriological QA samples were collected during CY 2013, while duplicate laboratory analyses were performed on ~12% (n=1564) of the water quality monitoring samples collected for the Point Loma and South Bay outfall programs. The raw data for these analyses have been reported previously in the Point Loma and South Bay monthly receiving waters monitoring reports.

The sign test (Gilbert, 1987) was used to statistically compare the results from the paired laboratory and field duplicate analyses performed in CY 2013 (Table 8). When matched pairs of samples are used, the sign test assumes that the probability of observing samples with differing plate counts is equally distributed among positive (sample A > sample B) and negative (sample A < sample B) results. Samples that do not differ (i.e., A - B = 0) are ignored. During 2013, results from duplicate field and laboratory analyses were not significantly different ($p > 0.05$) for each of the three tested indicator bacteria (i.e., total coliforms, fecal coliforms, *Enterococcus*), indicating low variability between samples and repeatability of laboratory measurements.

In addition to the above QA analyses, the Marine Microbiology Lab conducts monthly comparisons of bacterial colony counts to quantify the counting precision of each analyst. Counts are performed on a single plate by pairs of analysts, with the criterion being that counts by any two analysts must fall within

Table 8

Summary of bacteriological QA analyses conducted during 2013 for the City of San Diego's Ocean Monitoring Program. n = number of sample pairs with different colony counts (samples without differences are not considered); B = the number of positive differences between pairs; Z_b = sign test outcome; H_o = the probability of observing positive and negative differences in plate counts between paired samples is equal (see text). Paired samples were compared using the sign test (see Gilbert 1987) at a $p = 0.05$ level of significance.

Sample Type	Parameter	n	B	Z_b	p	H_o
Field Duplicate	Total	42	24	0.926	>0.05	Accept
	Fecal	51	24	-0.420	>0.05	Accept
	Entero	41	18	-0.781	>0.05	Accept
Lab Duplicate	Total	121	58	-0.455	>0.05	Accept
	Fecal	75	33	-1.039	>0.05	Accept
	Entero	71	34	-0.356	>0.05	Accept

10% of each other. This calculation is known as the Relative Percent Difference (RPD). During 2013, 144 count comparisons were performed, and all results for *Enterococcus* comparisons were within the required RPD. For total coliform counts, 4 out of 32 comparisons had an RPD greater than 10%. For fecal coliform counts, 4 out of 60 comparisons had an RPD greater than 10%. These exceedances were due to high counts of non-typical colonies with indistinct morphologies that were difficult to read.

Macrofaunal Community – Resort Analysis

Laboratory analyses of benthic macrofaunal samples involve three processes: (1) sample washing and preservation; (2) sample sorting, and identification; (3) enumeration of all invertebrate organisms. Quality control of sorting is essential to assuring the value of the subsequent steps in the sample analysis process. The sorting of benthic samples to the major taxonomic groups is contracted to an outside laboratory, with a 95% removal efficiency expected. Ten percent of the sorted samples from each technician (sorter) at the contract lab are subject to resorting as QA for the contract. The original sorting of a sample fails the QA criterion if the resorted sample contains more than 5% of the total abundance of all animals from that sample. Failure requires the re-sorting of all samples previously sorted by that sorter. The resort results for the January 2013 and July 2013 benthic samples are shown in Table 9. Percentages of animals found in all re-analyzed PLOO and SBOO samples were $\leq 5\%$ of the total sample abundance. However, projected estimates for re-analyzed Bight'13 samples indicated a high failure rate for grabs sorted by one technician, triggering all samples initially sorted by that technician to be returned to the contractor for complete resorting.

Toxicology Quality Assurance Analyses

The Toxicology Laboratory conducts routine reference toxicant testing as a part of its quality assurance program. A reference toxicant is a standard chemical used to measure the sensitivity of the test organisms and test precision. Consistency among the reference toxicant test results enhance confidence in the concurrent toxicity data obtained from the test material (e.g., wastewater effluent). A specific reference

Table 9

Results of benthic macrofauna sample resort analyses conducted during 2013 for the City of San Diego's Ocean Monitoring Program. Percent = (the # of animals found in the resorted sample/the total sample abundance) X 100; ¹ and ² indicate sample replicate number. NA indicates that taxonomic analysis of samples remains incomplete (i.e., total sample abundance unknown); * projected to fail (> 5%) based on preliminary sorting numbers.

PLOO			SBOO			Bight'13		
Survey	**Station**	**Percent**	**Survey**	**Station**	**Percent**	**Survey**	**Station**	**Percent**
Jan-13	B-9[2]	0.41	Jan-13	I-21[1]	0.61	Jul-13	9001	0.00
	E-11[2]	0.00		I-34[2]	0.00		9005	NA*
	E-25[2]	0.34		I-33[1]	0.41		9028	NA
	E-5[1]	0.00		I-2[1]	0.00		9030	NA*
				I-3[2]	0.00		9037	0.00
Jul-13	E-5[1]	0.00		I-13[1]	0.00		9040	NA
	E-25[1]	0.00		I-18[1]	0.61		9069	NA*
	E-11[1]	0.36		I-10[1]	0.79		9071	NA*
				I-27[2]	3.09		9080	NA
							9092	NA
			Jul-13	I-27[1]	0.00		9093	0.00
				I-10[1]	0.00		9107	0.00
				I-35[1]	0.00		9109	0.00
				I-14[1]	0.66		9121	NA
				I-2[1]	0.40			

toxicant is used for each combination of test material, test species, test conditions, and endpoints, and the material is chosen from a list developed by the USEPA. The reference toxicant is purchased from a supplier in aqueous form (stock solution), and the supplier must verify the concentration of the stock solution and provide written documentation of such analysis.

In most instances, a reference toxicant test is performed at the same time the test material is evaluated. A control chart for each test method is maintained by the QA officer and/or Laboratory Supervisor using results from no fewer than 20 of the most recent reference toxicant tests. Charted parameters include control performance, percent minimum significant difference, effect concentrations (e.g., no observable effect concentration and point estimate), and coefficient of variability (CV).

Using a nominal error rate of 5%, results from 19 of the most recent 20 reference toxicant tests are expected to fall within two standard deviations of the simple moving average (i.e., unweighted running mean), while one of these tests may fall outside the control chart limits by chance alone. Additionally, a series of EPA-recommended quality control limits are also used to further evaluate test sensitivity.

Each violating run would trigger an investigation of animal supply, reference toxicant stock quality, and laboratory practices. Additional testing may also be conducted to determine whether an exceedance is anomalous or if remedial measures are needed. All NPDES mandated tests conducted with the affected animals are flagged, reviewed for anomalous responses, and, in certain cases, repeated with a new batch of animals. In 2013, all reference toxicant control charts met the acceptability criteria.

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Schiff, K.C., J.S. Brown, and S.B. Weisberg. (2001). Model Monitoring Program for Large Ocean Discharges in Southern California. Technical Report No. 357. Southern California Coastal Water Research Project, Westminster, CA.

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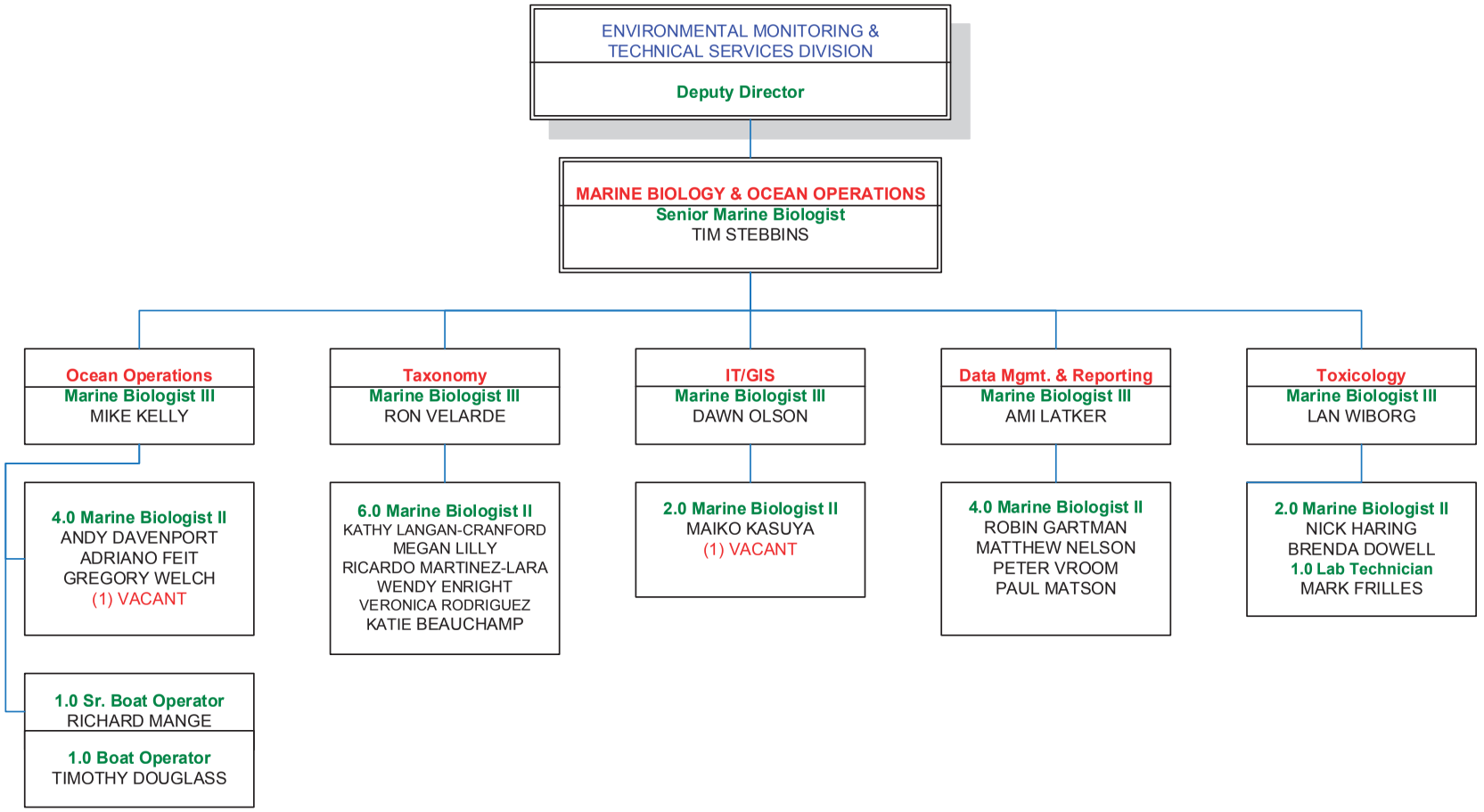
APPENDIX A

Organizational Charts

Appendix A.1

Organizational chart for the Marine Biology and Ocean Operations section of EMTS.



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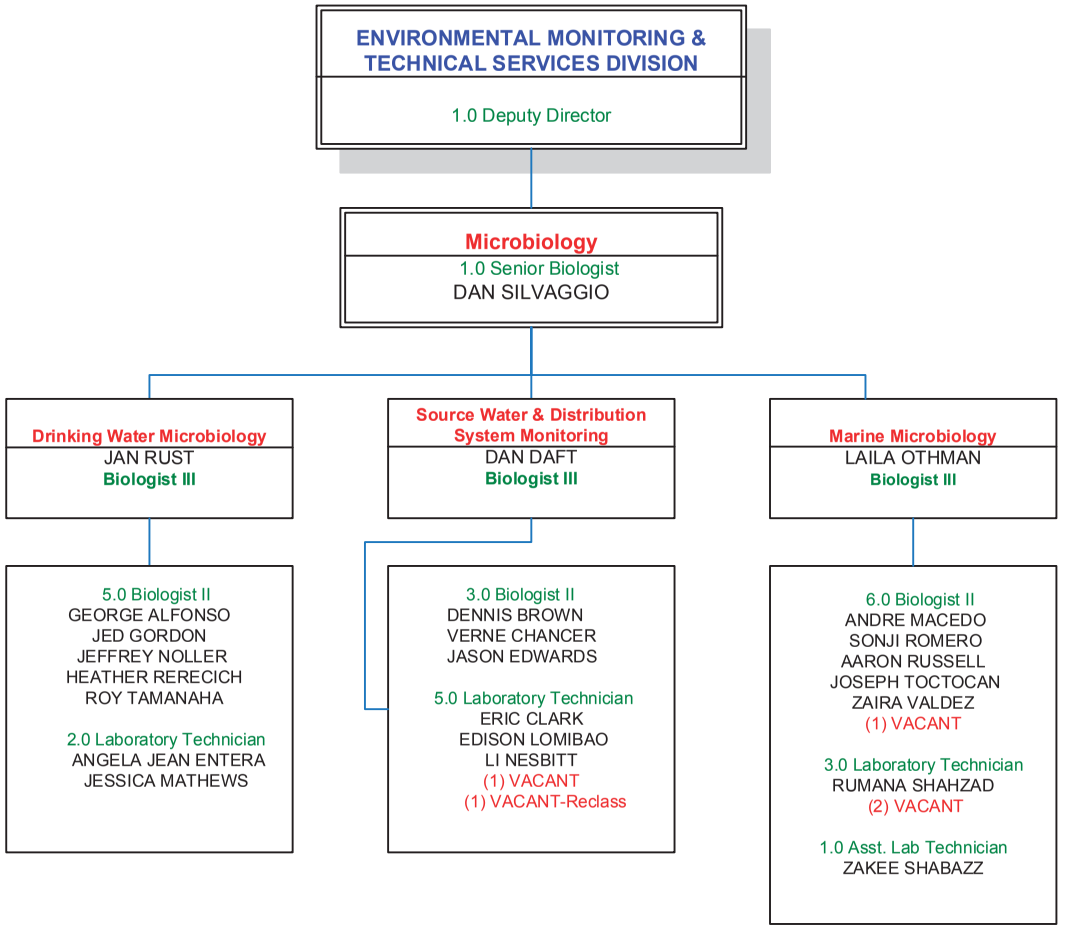
Appendix A.2

Organizational chart for the Microbiology section of EMTS.



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