appendix C

QUALITY ASSURANCE/ QUALITY CONTROL

Appendix C
QUALITY ASSURANCE/QUALITY CONTROL

This appendix details quality assurance/quality control information for the collection and analyses of water quality, sediment geochemistry, tissue chemistry, and benthic infauna samples for the Orange County Sanitation District's (OCSD) 2013-14 ocean monitoring program.

INTRODUCTION

The Core monitoring program was designed to measure compliance with permit conditions and for temporal and spatial trend analysis. The program includes measurements of:

- Water quality;
- Sediment quality;
- Benthic infaunal community health;
- Fish and macroinvertebrate community health;
- Fish tissue contaminant concentrations (chemical body burden); and
- Fish health (including external parasites and diseases).

The Core monitoring program complies with OCSD's Quality Assurance/Quality Control (QA/QC) Program requirements and applicable federal, state, local, and contract requirements. The objectives of the quality assurance program are as follows:

- Scientific data generated will be of sufficient quality to stand up to scientific and legal scrutiny.

- Data will be gathered or developed in accordance with procedures appropriate for the intended use of the data.

- Data will be of known and acceptable precision, accuracy, representativeness, completeness, and comparability as required by the program.

The various aspects of the program are conducted on a schedule that varies weekly, monthly, quarterly, semi-annually, and annually. Sampling and data analysis are characterized by quarters 1 through 4, which are representative of the summer (July–September), fall (October–December), winter (January–March), and spring (April–June) seasons, respectively. Tables C-1, C-2, and C-3 show that all required samples, excluding sport fishes, were collected in 2013-2014. Not all required sport fish samples were collected by hook-and-line fishing despite fulfilling the 100 person-hours effort.

Table C-1. Ocean monitoring program sample collection requirements and percent completion for water quality, July 2013–June 2014.

Orange County Sanitation District, California.

Quarter	Program Type	Parameter	Nominal # of Samples	Nominal # of QA Duplicates*	# of Samples Collected	# of Duplicates Collected	% Samples Collected
Summer	Water Quality	CTD Drops	146	15	146	15	100
		Ammonium	450	45	450	45	100
		Bacteria	175	NA	175	NA	100
Fall	Water Quality	CTD Drops	146	15	146	15	100
		Ammonium	450	45	450	45	100
		Bacteria	175	NA	175	NA	100
Winter	Water Quality	CTD Drops	146	15	146	15	100
		Ammonium	450	45	450	45	100
		Bacteria	175	NA	175	NA	100
Spring	Water Quality	CTD Drops	146	15	146	15	100
		Ammonium	450	45	450	45	100
		Bacteria	175	NA	175	NA	100

* QA samples are collected at 10% of nominal sampling requirement.
NA = Not Applicable.

Table C-2. Ocean monitoring program sample collection requirements and percent completion for sediments and benthic infauna, July 2013–June 2014.

Orange County Sanitation District, California.

Quarter	Program Type	Parameter	Nominal # of Samples	# of Samples Collected	% Samples Collected
Summer*	Sediment Chemistry	Grain size	29	29	100
		Dissolved Sulfides	29	29	100
		Total Organic Carbon	29	29	100
		Total Nitrogen	29	29	100
		Total Phosphorus	29	29	100
		Metals	29	29	100
		DDT/Pesticides	29	29	100
		PCB	29	29	100
		PAH	29	29	100
		LAB	29	29	100
	Benthic Infauna	Infauna	29	29	100
Winter	Sediment Chemistry	Grain size	29	29	100
		Dissolved Sulfides	29	29	100
		Total Organic Carbon	29	29	100
		Total Nitrogen	29	29	100
		Total Phosphorus	29	29	100
		Metals	29	29	100
		DDT/Pesticides	29	29	100
		PCB	29	29	100
		PAH	29	29	100
	Benthic Infauna	Infauna	29	29	100

* Annual station sampling was not conducted, as the District was given regulatory relief in order to participate in the Bight'13 regional sampling program.

Table C-3. Ocean monitoring program sample collection requirements and percent completion for trawl caught fish and sport fish, July 2013–June 2014.

Orange County Sanitation District, California.

Quarter	Program Type	Parameter	Nominal # of Samples	# of Samples Collected	% Samples Collected
Summer *	Fish Community	Trawls	6	6	100
	Fish Tissue	Hornyhead Turbot	NS	NS	NS
		English Sole	NS	NS	NS
	Sport Fish Tissue Zone 1	Rockfish	NS	NS	NS
		Kelp Bass	NS	NS	NS
		Sand Bass	NS	NS	NS
	Sport Fish Tissue Zone 2	Rockfish	NS	NS	NS
		Kelp Bass	NS	NS	NS
		Sand Bass	NS	NS	NS
Winter	Fish Community	Trawls	6	6	100
	Fish Tissue	Hornyhead Turbot	20	20	100
		English Sole	20	20	100
	Sport Fish Tissue Zone 1	Rockfish	10	28	280
		Sand Bass	10	0	0
		Kelp Bass	10	0	0
	Sport Fish Tissue Zone 2	Rockfish	10	3	30
		Sand Bass	10	0	0
		Kelp Bass	10	0	0

NS = Not Sampled.

* Annual station sampling was not conducted, as the District was given regulatory relief in order to participate in the Bight'13 regional sampling program.

WATER QUALITY NARRATIVE

AMMONIUM

Introduction

OCSD's Environmental Laboratory and Ocean Monitoring (ELOM) staff processed 654, 637, 652, and 619 discrete ammonium samples, respectively, during the four quarterly collections beginning July 1, 2013 and ending June 30, 2014. All samples were iced upon collection, preserved with 1:1 sulfuric acid upon receipt by the ELOM laboratory staff, and stored at 4 ± 2 °C until analysis according to laboratory Standard Operating Procedures (SOPs) (OCSD 2014a).

Analytical Method

The samples were analyzed for ammonium on a segmented flow analyzer using Standard Methods 4500-NH3 G (APHA 2012). In the analysis, sodium phenolate and sodium hypochlorite reacted with ammonium to form indophenol blue in a concentration proportional to the ammonium concentration in the sample. The blue color was intensified with sodium nitroprusside and was measured at 660 nm.

QA/QC

A typical sample batch included a blank at a maximum of every 20 samples, an external reference standard monthly, and a spike in seawater collected from a control site at a maximum of every 20 samples. One spike and one spike replicate were added to the batch for every ten samples. The method detection limit (MDL) for low-level ammonium samples is presented in Table C-4. QA/QC summary data are presented in Table C-5. All samples were analyzed within the required holding time. 149 out of the 149 analyses met the QA/QC criteria for blanks. 147 out of 149 analyses met the QA/QC criteria for blank spikes. Those out of control results were attributed to instrument drift.

Table C-4. Method detection levels for ammonium and bacteria in receiving water, July 2013–June 2014.

Orange County Sanitation District, California.

Parameter	Method Detection Limit (ng/g wet weight)
Ammonium	0.02
Total coliform	10
E. coli	10
Enterococci	10

Table C-5. Water Quality Ammonium QA/QC Summary, July 2013–June 2014.

Orange County Sanitation District, California.

Quarter	Sample Set	Parameter	Description	Number of Compounds Tested	Number of Compounds Passed	Target Accuracy % Recovery	Target Precision % RPD
Summer	NH3WQ130729-1	Ammonium	Blank	4	4	<2X MDL	NA
			Blank Spike	4	4	90-110	NA
			Matrix Spike	7	7	80-120	NA
			Matrix Spike Duplicate	7	*6	80-120	NA
			Matrix Spike Precision	7	*6	NA	< 11%
Summer	NH3WQ130730-1	Ammonium	Blank	3	3	<2X MDL	NA
			Blank Spike	3	3	90-110	NA
			Matrix Spike	6	6	80-120	NA
			Matrix Spike Duplicate	6	6	80-120	NA
			Matrix Spike Precision	6	6	NA	< 11%
Summer	NH3WQ130801-1	Ammonium	Blank	5	5	<2X MDL	NA
			Blank Spike	5	5	90-110	NA
			Matrix Spike	10	10	80-120	NA
			Matrix Spike Duplicate	10	10	80-120	NA
			Matrix Spike Precision	10	10	NA	< 11%
Summer	NH3WQ130806-1	Ammonium	Blank	4	4	<2X MDL	NA
			Blank Spike	4	4	90-110	NA
			Matrix Spike	7	7	80-120	NA
			Matrix Spike Duplicate	7	7	80-120	NA
			Matrix Spike Precision	7	7	NA	< 11%
Summer	NH3WQ130807-1	Ammonium	Blank	3	3	<2X MDL	NA
			Blank Spike	3	3	90-110	NA
			Matrix Spike	5	5	80-120	NA
			Matrix Spike Duplicate	5	5	80-120	NA
			Matrix Spike Precision	5	5	NA	< 11%
Summer	NH3WQ130808-1	Ammonium	Blank	6	6	<2X MDL	NA
			Blank Spike	6	6	90-110	NA
			Matrix Spike	11	11	80-120	NA
			Matrix Spike Duplicate	11	11	80-120	NA
			Matrix Spike Precision	11	11	NA	< 11%

Table C-5 Continues.

Table C-5 Continued.

Quarter	Sample Set	Parameter	Description	Number of Compounds Tested	Number of Compounds Passed	Target Accuracy % Recovery	Target Precision % RPD
Summer	NH3WQ130820-1	Ammonium	Blank	4	4	<2X MDL	NA
			Blank Spike	4	4	90-110	NA
			Matrix Spike	7	7	80-120	NA
			Matrix Spike Duplicate	7	7	80-120	NA
			Matrix Spike Precision	7	7	NA	< 11%
Summer	NH3WQ130919-1	Ammonium	Blank	5	5	<2X MDL	NA
			Blank Spike	5	5	90 - 110	NA
			Matrix Spike	10	10	80-120	NA
			Matrix Spike Duplicate	10	10	80-120	NA
			Matrix Spike Precision	10	10	NA	< 11%
Summer	NH3WQ130920-1	Ammonium	Blank	3	3	<2X MDL	NA
			Blank Spike	3	3	90 - 110	NA
			Matrix Spike	6	6	80-120	NA
			Matrix Spike Duplicate	6	6	80-120	NA
			Matrix Spike Precision	6	6	NA	< 11%
Fall	NH3WQ131106-1	Ammonium	Blank	5	5	<2X MDL	NA
			Blank Spike	5	5	90-110	NA
			Matrix Spike	10	10	80-120	NA
			Matrix Spike Duplicate	10	10	80-120	NA
			Matrix Spike Precision	10	10	NA	< 11%
Fall	NH3WQ131107-1	Ammonium	Blank	3	3	<2X MDL	NA
			Blank Spike	3	3	90-110	NA
			Matrix Spike	6	6	80-120	NA
			Matrix Spike Duplicate	6	6	80-120	NA
			Matrix Spike Precision	6	6	NA	< 11%
Fall	NH3WQ131112-1	Ammonium	Blank	4	4	<2X MDL	NA
			Blank Spike	4	4	90-110	NA
			Matrix Spike	7	7	80-120	NA
			Matrix Spike Duplicate	7	7	80-120	NA
			Matrix Spike Precision	7	7	NA	< 11%

Table C-5 Continues.

Table C-5 Continued.

Quarter	Sample Set	Parameter	Description	Number of Compounds Tested	Number of Compounds Passed	Target Accuracy % Recovery	Target Precision % RPD
Fall	NH3WQ131114-1	Ammonium	Blank	4	4	<2X MDL	NA
			Blank Spike	4	4	90-110	NA
			Matrix Spike	7	7	80-120	NA
			Matrix Spike Duplicate	7	7	80-120	NA
			Matrix Spike Precision	7	7	NA	< 11%
Fall	NH3WQ131120-1	Ammonium	Blank	3	3	<2X MDL	NA
			Blank Spike	3	3	90-110	NA
			Matrix Spike	6	6	80-120	NA
			Matrix Spike Duplicate	6	6	80-120	NA
			Matrix Spike Precision	6	6	NA	< 11%
Fall	NH3WQ131121-1	Ammonium	Blank	4	4	<2X MDL	NA
			Blank Spike	4	4	90-110	NA
			Matrix Spike	7	7	80-120	NA
			Matrix Spike Duplicate	7	7	80-120	NA
			Matrix Spike Precision	7	7	NA	< 11%
Fall	NH3WQ131122-1	Ammonium	Blank	4	4	<2X MDL	NA
			Blank Spike	4	4	90-110	NA
			Matrix Spike	7	7	80-120	NA
			Matrix Spike Duplicate	7	7	80-120	NA
			Matrix Spike Precision	7	7	NA	< 11%
Fall	NH3WQ131209-1	Ammonium	Blank	2	2	<2X MDL	NA
			Blank Spike	2	2	90-110	NA
Fall	NH3WQ131219-1	Ammonium	Blank	4	4	<2X MDL	NA
			Blank Spike	**4	**3	90-110	NA
			Matrix Spike	5	5	80-120	NA
			Matrix Spike Duplicate	5	5	80-120	NA
			Matrix Spike Precision	5	5	NA	< 11%
Fall	NH3WQ131220-1	Ammonium	Blank	5	5	<2X MDL	NA
			Blank Spike	5	5	90-110	NA
			Matrix Spike	9	9	80-120	NA
			Matrix Spike Duplicate	9	9	80-120	NA
			Matrix Spike Precision	9	9	NA	< 11%

Table C-5 Continues.

Table C-5 Continued.

Quarter	Sample Set	Parameter	Description	Number of Compounds Tested	Number of Compounds Passed	Target Accuracy % Recovery	Target Precision % RPD
Fall	NH3WQ131229-1	Ammonium	Blank	2	2	<2X MDL	NA
			Blank Spike	2	2	90-110	NA
			Matrix Spike	3	3	80-120	NA
			Matrix Spike Duplicate	3	3	80-120	NA
			Matrix Spike Precision	3	3	NA	< 11%
Winter	NH3WQ140131-1	Ammonium	Blank	2	2	<2X MDL	NA
			Blank Spike	4	4	90-110	NA
			Matrix Spike	4	4	80-120	NA
			Matrix Spike Duplicate	4	4	80-120	NA
			Matrix Spike Precision	2	2	NA	< 11%
Winter	NH3WQ140203-1	Ammonium	Blank	6	6	<2X MDL	NA
			Blank Spike	6	6	90-110	NA
			Matrix Spike	12	12	80-120	NA
			Matrix Spike Duplicate	12	12	80-120	NA
			Matrix Spike Precision	12	12	NA	< 11%
Winter	NH3WQ140205-1	Ammonium	Blank	6	6	<2X MDL	NA
			Blank Spike	11	11	90-110	NA
			Matrix Spike	11	11	80-120	NA
			Matrix Spike Duplicate	11	11	80-120	NA
			Matrix Spike Precision	6	6	NA	< 11%
Winter	NH3WQ140227-1	Ammonium	Blank	3	3	<2X MDL	NA
			Blank Spike	3	3	90-110	NA
			Matrix Spike	4	4	80-120	NA
			Matrix Spike Duplicate	4	4	80-120	NA
			Matrix Spike Precision	4	4	NA	< 11%
Winter	NH3WQ140302-1	Ammonium	Blank	5	5	<2X MDL	NA
			Blank Spike	5	5	90-110	NA
			Matrix Spike	10	10	80-120	NA
			Matrix Spike Duplicate	10	10	80-120	NA
			Matrix Spike Precision	10	10	NA	< 11%

Table C-5 Continues.

Table C-5 Continued.

Quarter	Sample Set	Parameter	Description	Number of Compounds Tested	Number of Compounds Passed	Target Accuracy % Recovery	Target Precision % RPD
Winter	NH3WQ140307-1	Ammonium	Blank	5	5	<2X MDL	NA
			Blank Spike	5	5	90-110	NA
			Matrix Spike	10	10	80-120	NA
			Matrix Spike Duplicate	10	10	80-120	NA
			Matrix Spike Precision	10	10	NA	< 11%
Winter	NH3WQ140313-1	Ammonium	Blank	6	6	<2X MDL	NA
			Blank Spike	6	6	90-110	NA
			Matrix Spike	11	11	80-120	NA
			Matrix Spike Duplicate	11	11	80-120	NA
			Matrix Spike Precision	11	11	NA	< 11%
Winter	NH3WQ140321-1	Ammonium	Blank	3	3	<2X MDL	NA
			Blank Spike	3	3	90-110	NA
			Matrix Spike	5	5	80-120	NA
			Matrix Spike Duplicate	5	5	80-120	NA
			Matrix Spike Precision	5	5	NA	< 11%
Spring	NH3WQ140501-1	Ammonium	Blank	5	5	<2X MDL	NA
			Blank Spike	5	5	90-110	NA
			Matrix Spike	8	8	80-120	NA
			Matrix Spike Duplicate	8	8	80-120	NA
			Matrix Spike Precision	8	8	NA	< 11%
Spring	NH3WQ140514-1	Ammonium	Blank	4	4	<2X MDL	NA
			Blank Spike	4	4	90-110	NA
			Matrix Spike	8	8	80-120	NA
			Matrix Spike Duplicate	8	8	80-120	NA
			Matrix Spike Precision	8	8	NA	< 11%
Spring	NH3WQ140522-1	Ammonium	Blank	3	3	<2X MDL	NA
			Blank Spike	3	3	90-110	NA
			Matrix Spike	5	5	80-120	NA
			Matrix Spike Duplicate	5	5	80-120	NA
			Matrix Spike Precision	5	5	NA	< 11%

Table C-5 Continues.

Table C-5 Continued.

Quarter	Sample Set	Parameter	Description	Number of Compounds Tested	Number of Compounds Passed	Target Accuracy % Recovery	Target Precision % RPD
Spring	NH3WQ140523-1	Ammonium	Blank	4	4	<2X MDL	NA
			Blank Spike	**4	**3	90-110	NA
			Matrix Spike	6	6	80-120	NA
			Matrix Spike Duplicate	6	6	80-120	NA
			Matrix Spike Precision	6	6	NA	< 11%
Spring	NH3WQ140529-1	Ammonium	Blank	5	5	<2X MDL	NA
			Blank Spike	5	5	90-110	NA
			Matrix Spike	10	10	80-120	NA
			Matrix Spike Duplicate	10	10	80-120	NA
			Matrix Spike Precision	10	10	NA	< 11%
Spring	NH3WQ140530-1	Ammonium	Blank	3	3	<2X MDL	NA
			Blank Spike	3	3	90-110	NA
			Matrix Spike	5	5	80-120	NA
			Matrix Spike Duplicate	5	5	80-120	NA
			Matrix Spike Precision	5	5	NA	< 11%
Spring	NH3WQ140606-1	Ammonium	Blank	4	4	<2X MDL	NA
			Blank Spike	4	4	90-110	NA
			Matrix Spike	7	7	80-120	NA
			Matrix Spike Duplicate	7	7	80-120	NA
			Matrix Spike Precision	7	7	NA	< 11%
Spring	NH3WQ140619-1	Ammonium	Blank	8	8	<2X MDL	NA
			Blank Spike	8	8	90-110	NA
			Matrix Spike	16	16	80-120	NA
			Matrix Spike Duplicate	16	16	80-120	NA
			Matrix Spike Precision	16	16	NA	< 11%

* Matrix spike duplicate and matrix spike precision out of control due to matrix interference.

** Blank spike out of control due to instrumentation drift. Associated samples were repeated.

NA = Not Applicable.

All analyses met the QA/QC criteria for the external reference sample. Zero of 69 matrix spike recoveries, one of 69 matrix spike replicate recoveries, and one of 69 precision measurements for the matrix spike and matrix spike replicate samples were out of control for first quarter samples. Zero of 67 matrix spike recoveries, zero of 67 matrix spike replicate recoveries, and zero of 67 precision measurements for the matrix spike and matrix spike replicates were out of control for second and third quarter samples. Zero of 65 matrix spike recoveries, zero of 65 matrix spike replicate recoveries and zero of 65 precision measurements for matrix spike and matrix spike replicates were out of control for fourth quarter samples. In all cases, it was determined that recovery and precision criteria were exceeded due to matrix effect or instrumentation malfunction. Additionally, the set of results following those in question were within the control limits and therefore all results are considered valid.

BACTERIA

Introduction

ELOM staff processed 294, 280, 260, and 244 discrete offshore, water quality bacteria samples, respectively, during the four quarters beginning July 1, 2013 and ending June 30, 2014. Along the surfzone, ELOM staff collected 294, 307, 286, and 287 discrete bacteria samples from core stations and an additional 329, 348, 357, and 339 discrete bacteria samples from regional stations during the same timeframe as mentioned above. All samples were iced upon collection and stored at 4 ± 2 °C until analysis according to laboratory SOPs (OCSD 2014a).

Analytical Method

Samples collected offshore were analyzed for bacteria using Enterolert™ for enterococci and Colilert-18™ for total and fecal coliforms. These methods utilized enzyme substrates that produced, upon hydrolyzation, a fluorescent signal when viewed under long-wavelength (365-nm) ultraviolet light. For samples collected along the surfzone, samples were analyzed by culture-based methods for direct count of bacteria. EPA Method 1600 was applied to enumerate enterococci bacteria. For enumeration of total and fecal coliforms, respectively, Standards Methods 9222B and 9222D were used. MDLs for bacteria are presented in Table C-4.

QA/QC

All samples were analyzed within the required holding time. For recreational samples, samples were processed and incubated within 8 hours of sample collection. Duplicate analyses were performed on a minimum of 10% of samples with at least one sample per sample batch. All equipment, reagents, and dilution waters used for sample analyses were sterilized before use. Each lot of medium was tested for sterility and performance with known positive negative controls prior to use. For surfzone samples, a positive and negative control was run simultaneously with each batch of sample for each type of media used to ensure performance. Each Quanti-Tray sealer was checked by addition of dye to 100 mL of water, and the tray was sealed and subsequently checked for leaking. Each lot of dilution blanks commercially purchased was checked for appropriate volume.

SEDIMENT CHEMISTRY NARRATIVE

FIRST QUARTER – SEMI-ANNUAL SAMPLES ONLY (JULY 2013)

Introduction

ELOM's laboratory staff received 29 sediment samples from ELOM's ocean monitoring staff during July 2013. All samples were stored according to ELOM LOPM. All samples were analyzed for organochlorine pesticides, polychlorinated biphenyl congeners (PCBs), polycyclic aromatic hydrocarbons (PAHs), linear alkyl benzenes (LABs), trace metals, mercury, dissolved sulfides (DS), total organic carbon (TOC), total nitrogen, total phosphorus, and grain size.

Analytical Methods - PAHs and LABs

The analytical methods used to detect PAHs and LABs in the samples are described in the ELOM LOPM (OCSD 2014a). All sediment samples were extracted using an accelerated solvent extractor (ASE) in November 2013 and January 2014. Approximately ten grams (dry weight) of sample were used for each analysis. A separatory funnel extraction was performed using 100 mL of sample when field and rinse blanks were included in the batch.

A typical sample batch included 15 field samples with required quality control (QC) samples. Sample batches that were analyzed for PAHs included the following QC samples: one sand blank, one PAH blank spike, two standard reference materials (SRM), one PAH matrix spike set, and two sample extraction duplicates. One batch was extracted and analyzed for PAHs. The analysis of the blank spike and SRM provided a measure of the accuracy of the analysis. The analysis of the sample, its duplicate, and the two spiked samples were evaluated for precision. MDLs for PAHs are presented in Table C-6. Acceptance criteria for PAH SRMs are presented in Table C-7.

QC samples for LAB analyses included one sand blank, one LAB blank spike, two SRM, one LAB matrix spike set, and two sample extraction duplicates. MDLs for LABs are presented in Table C-6.

Sediment PAH and LAB QA/QC summary data are presented in Table C-8. All analyses were performed within holding times and with appropriate quality control measures, as stated in the program's Quality Assurance Project Plan (QAPP) (OCSD 2014b). Any variances are noted in the Comments/Notes section of each batch summary.

Analytical Methods - Organochlorine Pesticides and PCB Congeners

The analytical methods used to process the organochlorine pesticides and PCB congeners samples are described in the ELOM LOPM (OCSD 2014a). An ASE was used to extract the sediment samples in December 2013 and January 2014. All sediment extracts were analyzed by GC/MS. Approximately ten grams (dry weight) of sample were used for each analysis. If a field blank and rinse were included in the batch, a separatory funnel extraction was performed using 100 mL of the sample.

A typical sample batch consisted of 15 field samples with required QC samples, which included one sand blank, two SRMs, one PCB/pesticide blank spike, one PCB/pesticide matrix spike set, and two duplicate sample extractions. MDLs for PCBs/pesticides are

presented in Tables C-9 and C-10. Acceptance criteria for PCB/pesticide SRMs are presented in Table C-11

Sediment PCB/pesticide QA/QC summary data are presented in Table C-12. All analyses were performed within QAPP (OCSD 2014b) stated holding times and with appropriate quality control measures. When constituent concentrations exceeded the calibration range of the instrument, dilutions were performed and the samples reanalyzed. Any variances are noted in the Comments/Notes section of each batch summary.

Analytical Methods - Trace Metals

Dried sediment samples were analyzed for trace metals in accordance with the ELOM LOPM methods (OCSD 2014a). A typical QC sample batch for arsenic, beryllium, cadmium, chromium, copper, nickel, lead, silver, selenium, and zinc analyses included three blanks, a blank spike, and one SRM. Additionally, duplicate samples, spiked samples, and duplicate spiked samples were analyzed a minimum of once every 10 sediment samples. QC for a typical sample batch for aluminum and iron analyses included only three blanks analyzed a minimum of once every 10 sediment samples. The samples were spiked at 20 mg/kg dry weight whereas the native concentrations ranged between 5,000 and 35,000 mg/kg dry weight.

All samples were analyzed within their 6-month holding times. If any analyte exceeded the appropriate calibration curve and Linear Dynamic Range, the sample was diluted and reanalyzed. MDLs for metals are presented in Table C-13. Acceptance criteria for trace metal SRMs are presented in Table C-14.

The digested samples were analyzed for arsenic, beryllium, cadmium, chromium, copper, nickel, lead, silver, selenium, and zinc by inductively coupled mass spectroscopy (ICPMS). Aluminum and iron were analyzed using inductively coupled emission spectroscopy (ICPES).

Sediment trace metal QA/QC summary data are presented in Table C-15.

Analytical Methods - Mercury

Dried sediment samples were analyzed for mercury in accordance with methods described in the ELOM LOPM (OCSD 2014a). QC for a typical batch included a blank, blank spike, and SRM. Sediment samples with duplicates, spiked samples and duplicate spiked samples were run approximately once every ten sediment samples. All samples were analyzed within their 6-month holding time. When sample mercury concentration exceeded the appropriate calibration curve, the sample was diluted with the reagent blank and reanalyzed. The samples were analyzed for mercury on a Perkin Elmer FIMS 400 system.

The MDL for sediment mercury is presented in Table C-13. Acceptance criteria for mercury SRM is presented in Table C-14. All QA/QC summary data are presented in Table C-15.

All samples, with some noted exceptions, met the QA/QC criteria guidelines for accuracy and precision.

Analytical Methods - Dissolved Sulfides

Dissolved sulfides samples were analyzed in accordance with methods described in the ELOM LOPM. The MDL for dissolved sulfides is presented in Table C-16. Sediment dissolved sulfides QA/QC summary data are presented in Table C-17. All samples were analyzed within their required holding times. All analyses met the QA/QC criteria for blanks, blank spikes, matrix spike duplicates, and matrix spike precisions. One of four sets of matrix spike recoveries was out of control due to matrix interferences.

Analytical Methods - TOC

TOC samples were analyzed by a contract laboratory: ALS Environmental Services, Kelso, WA. The MDL for TOC is presented in Table C-16. Sediment TOC QA/QC summary data are presented in Table C-18. The samples were analyzed within their required holding times. Three samples were analyzed in duplicate and matrix spike. The samples and their duplicate analyses had a RPD of less than 10%. The recoveries for the matrix spike were within 80-120% range.

Analytical Methods - Grain Size

Grain size samples were analyzed by a contract laboratory: EMSL Analytical, Cinnaminson, NJ. The MDL for sediment grain size is presented in Table C-16. Sediment grain size QA/QC summary data are presented in Table C-19. Three samples and their duplicate analyses had a RPD ≤10%. Thirty replicates of samples from Station 12 were analyzed as grain size reference material and all results were within three standard deviations of SRM for the statistical parameters (median phi, dispersion, and skewness), percent gravel, percent sand, percent clay, and percent silt.

Analytical Methods - Total Nitrogen

Total nitrogen (TN) samples were analyzed by a contract laboratory: TestAmerica Inc., Irvine, CA. The MDL for TN is presented in Table C-16. Sediment TN QA/QC summary data are presented in Table C-20. The samples were analyzed within their required holding times. Two samples were analyzed in duplicate and matrix spike. The samples and their duplicate analyses had a RPD of less than 30%. The recoveries for matrix spike were within 70-130% range.

Analytical Methods - Total Phosphorus

Total phosphorus (TP) samples were analyzed by a contract laboratory: TestAmerica Inc., Irvine, CA. The MDL for TP is presented in Table C-16. Sediment TP QA/QC summary data are presented in Table C-20. The samples were analyzed within their required holding times. Two samples were analyzed in duplicate and matrix spike. The samples and their duplicate analyses had a RPD of less than 30%. A sample spike and spike duplicate analyses did not meet target recoveries of 70-130% range due to matrix interferences. The associated laboratory control sample (LCS) met acceptance criteria.

THIRD QUARTER – SEMI-ANNUAL SAMPLES (JANUARY 2014)

Introduction

ELOM laboratory staff received 29 sediment samples from the ELOM's ocean monitoring staff during the month of January 2014. All samples were stored and analyzed for organochlorine pesticides, PCB congeners, PAHs, trace metals, mercury, dissolved sulfides, grain size, TOC, total nitrogen, and total phosphorus as described above.

Analytical Methods - Organics

All sediment samples that were analyzed for organochlorine pesticides and PCB congeners were extracted during July and August 2014. All sediment samples that were analyzed for PAHs were extracted during June and August 2014. Sediment organochlorine pesticides, PCB congeners, and PAHs QA/QC summary data are presented in Tables C-18 and C12. Any variances are noted in the Comments/Notes section of each batch summary.

Analytical Methods - Trace Metals and Mercury

All samples were analyzed for metals and mercury within their holding times. Sediment metals and mercury QA/QC summary data are presented in Table C-15. All samples met the QA criteria guidelines.

Analytical Methods - Dissolved Sulfides, TOC, Grain Size, TN, and TP

The analyses for TOC, dissolved sulfide, grain size, total nitrogen, and total phosphorus met the QA criteria guidelines specified in the QAPP (Tables C-17 through C-20). Recoveries of matrix spike and matrix spike duplicate for total phosphorus were not in the target ranges due to matrix interferences. The associated LCS met acceptance criteria.

Table C-6. Method detection levels for PAH and LAB compounds in sediments, July 2013–June 2014.

Orange County Sanitation District, California.

Parameter	ASE & GC/MS-SIM Method Detection Limit (ng/g dry weight)	Parameter	ASE & GC/MS-SIM Method Detection Limit (ng/g dry weight)
PAH Compounds			
1,6,7-Trimethylnaphthalene	0.4	Benzo[g,h,I]perylene	0.4
1-Methylnaphthalene	0.5	Benzo[k]fluoranthene	0.5
1-Methylphenanthrene	0.5	Biphenyl	0.8
2,3,6-Trimethylnaphthalene	0.5	Chrysene	0.3
2,6-Dimethylnaphthalene	0.4	Dibenz[a,h]anthracene	0.2
2-Methylnaphthalene	0.9	Dibenzothiophene	0.3
Acenaphthene	0.4	Fluoranthene	0.4
Acenaphthylene	0.4	Fluorene	0.4
Anthracene	0.3	Indeno[1,2,3-c,d]pyrene	0.3
Benz[a]anthracene	0.2	Naphthalene	1.1
Benzo[a]pyrene	0.2	Perylene	0.6
Benzo[b]fluoranthene	0.4	Phenanthrene	0.8
Benzo[e]pyrene	0.4	Pyrene	0.2
PAH Alkylated Homologues			
C1-Chrysenes	2.0	C1-Fluoranthenes/Pyrenes	2.0
C2-Chrysenes	2.0	C1-Naphthalenes	2.0
C3-Chrysenes	2.0	C2-Naphthalenes	2.0
C4-Chrysenes	2.0	C3-Naphthalenes	2.0
C1-Dibenzothiophenes	2.0	C4-Naphthalenes	2.0
C2-Dibenzothiophenes	2.0	C1-Phenanthrenes/Anthracenes	2.0
C3-Dibenzothiophenes	2.0	C2-Phenanthrenes/Anthracenes	2.0
C1-Fluorenes	2.0	C3-Phenanthrenes/Anthracenes	2.0
C2-Fluorenes	2.0	C4-Phenanthrenes/Anthracenes	2.0
C3-Fluorenes	2.0		
LAB Compounds			
2-Phenyldecane	0.1	6-Phenyltetradecane	0.1
3-Phenyldecane	0.1	7-Phenyltetradecane	0.1
4-Phenyldecane	0.1	2-Phenylundecane	0.2
5-Phenyldecane	0.1	3-Phenylundecane	0.1
2-Phenyltridecane	0.3	4-Phenylundecane	0.1
3-Phenyltridecane	0.2	5-Phenylundecane	0.1
4-Phenyltridecane	0.3	6-Phenylundecane	0.1
5-Phenyltridecane	0.4	2-Phenyldodecane	0.3
6+7-Phenyltridecane	0.5	3-Phenyldodecane	0.1
2-Phenyltetradecane	0.1	4-Phenyldodecane	0.2
3-Phenyltetradecane	0.1	5-Phenyldodecane	0.3
4-Phenyltetradecane	0.1	6-Phenyldodecane	0.3
5-Phenyltetradecane	0.1		

Table C-7. Acceptance criteria for standard reference materials of PAHs in sediments, July 2013–June 2014.

Orange County Sanitation District, California.

Compound Name	True Value µg/g	Certified Acceptance Criteria ng/g	
		Min.	Max.
SRM 1944 - New York/New Jersey Waterway Sediment, National Institute of Standards and Technology: PAH			
1-Methylnaphthalene*	470	450	490
1-Methylphenanthrene*	1700	1600	1800
2-Methylnaphthalene*	740	680	800
Acenaphthene*	390	360	420
Anthracene*	1130	1060	1200
Benz[a]anthracene	4720	4610	4830
Benzo[a]pyrene	4300	4170	4430
Benzo[b]fluoranthene	3870	3450	4290
Benzo[e]pyrene	3280	3170	3390
Benzo[g,h,i]perylene	2840	2740	2940
Benzo[k]fluoranthene	2300	2100	2500
Biphenyl*	250	230	270
Chrysene	4860	4760	4960
Dibenz[a,h]anthracene	424	355	493
Dibenzothiophene*	500	470	530
Fluoranthene	8920	8600	9240
Fluorene*	480	440	520
Indeno[1,2,3-c,d]pyrene	2780	2680	2880
Naphthalene*	1280	1240	1320
Perylene	1170	930	1410
Phenanthrene	5270	5050	5490
Pyrene	9700	9280	10120
Percent Dry weight	1.3		

Table C-7 Continues.

Table C-7 Continued.

Compound Name	True Value µg/g	Certified Acceptance Criteria ng/g	
		Min.	Max.
SRM 1941b - Organics in Marine Sediment, National Institute of Standards and Technology: PAH			
1,6,7-Trimethylnaphthalene*	25.5	20.4	30.6
1-Methylnaphthalene*	127	113	141
1-Methylphenanthrene*	73.2	67.3	79.1
2,6-Dimethylnaphthalene*	75.9	71.4	80.4
2-Methylnaphthalene*	276	223	329
Acenaphthene*	38.4	33.2	43.6
Acenaphthylene*	53.3	46.9	59.7
Anthracene*	184	166	202
Benz[a]anthracene	335	310	360
Benzo[a]pyrene	358	341	375
Benzo[b]fluoranthene	453	432	474
Benzo[e]pyrene	325	300	350
Benzo[g,h,i]perylene	307	262	352
Benzo[k]fluoranthene	225	207	243
Biphenyl*	74	66	82
Chrysene	291	260	322
Dibenz[a,h]anthracene	53	43	63
Fluoranthene	651	601	701
Fluorene*	85	70	100
Indeno[1,2,3-c,d]pyrene	341	284	398
Naphthalene*	848	753	943
Perylene	397	352	442
Phenanthrene	406	362	450
Pyrene	581	542	620
Percent Dry weight	1.3		

* Non-certified value.

Table C-8. Sediment PAH/LAB QA/QC summary, July 2013–June 2014.

Orange County Sanitation District, California.

Quarter	Sample Set	Description	Number of Compounds Tested	Number of Compounds Passed	Target Accuracy % Recovery	Target Precision % RPD
Summer	SEDPAHLAB-1307_ES (PAHs and LABs)	Blank Spike	51	50	60-120	NA
		Matrix Spike - Based on Mean of MS and MSD	51	51	40-120	<20%
		Duplicate	69	33	NA	<20%@3 x MDL of sample mean
		SRM Analysis	30	24	25% of the certified or published acceptance limits	NA
Summer	SEDPAHLAB-1307_ET (PAHs and LABs)	Blank Spike	51	48	60-120	NA
		Matrix Spike - Based on Mean of MS and MSD	51	51	40-120	<20%
		Duplicate	27	25	NA	<20%@3 x MDL of sample mean
		SRM Analysis	30	25	25% of the certified or published acceptance limits	NA
Winter	SEDPAHLAB-1401_AC (PAHs only)	Blank Spike	26	24	60-120	NA
		Matrix Spike - Based on Mean of MS and MSD	26	26	40-120	<20%
		Duplicate	25	12	NA	<20%@3 x MDL of sample mean
		SRM Analysis	30	13	25% of the certified or published acceptance limits	NA
Winter	SEDPAHLAB-1401_EV (PAHs only)	Blank Spike	26	26	60-120	NA
		Matrix Spike - Based on Mean of MS and MSD	26	26	40-120	<20%
		Duplicate	28	3	NA	<20%@3 x MDL of sample mean
		SRM Analysis	30	25	25% of the certified or published acceptance limits	NA

Note:

SRM certified values are based on the addition of selected compounds prior to extraction for use as internal standards for quantification purposes.

(NIST, Certificate of Analysis, SRM 1941b, SRM 1944a, Organics in Marine Sediment).

OCSD laboratory results are not corrected for surrogate recoveries, causing some analytes with lower molecular weights and boiling points to fail the established criteria for SRM certified values.

Higher RSD values occurred for the individual analytes that were associated with concentrations near the method detection limits. Corrective action for low % precision involved a review of sample preparation before extraction.

Matrix interferences from duplicate analyses and or matrix spike samples have caused some analytes to fail the established criteria for precision factors and % recoveries respectively. Visual inspection of the replicate samples and the spike samples did not reveal any obvious interferences. A system check was performed prior to sample analysis and all the analytes of concern from calibration standards were within specifications. Data set integrity was verified and accepted. NA = Not Applicable.

Table C-9. Method detection levels for PCB congeners and pesticides in sediments, July 1, 2013–March 25, 2014.

Orange County Sanitation District, California.

Parameter	ASE & GC/MS-SIM Method Detection Limit (ng/g dry weight)	Parameter	ASE & GC/MS-SIM Method Detection Limit (ng/g dry weight)
Aldrin	0.27	PCB 82	0.28
gamma-BHC*	0.5	PCB 87	0.1
cis-Chlordane	0.1	PCB 92	0.1
trans-Chlordane	0.11	PCB 99	0.1
Oxychlordane	0.14	PCB 101	0.12
Dieldrin	0.17	PCB 105	0.1
Endosulfan-*alpha**	2	PCB 110	0.1
Endosulfan-*beta**	5	PCB 114	0.1
Endosulfan-sulfate*	0.5	PCB 118	0.1
Endrin*	0.5	PCB 119	0.11
Heptachlor epoxide*	1	PCB 123	0.1
Heptachlor*	0.5	PCB 126	0.1
Hexachlorobenzene	0.31	PCB 128	0.1
Mirex	0.1	PCB 138	0.1
cis-Nonachlor*	0.5	PCB 146	0.1
trans-Nonachlor*	5	PCB 149	0.1
2,4'-DDD	0.1	PCB 151	0.12
2,4'-DDE	0.1	PCB 153/168	0.15
2,4'-DDT	0.17	PCB 156	0.1
4,4'-DDD*	0.5	PCB 157	0.12
4,4'-DDE	0.33	PCB 158	0.1
4,4'-DDT*	0.5	PCB 167	0.1
4,4'-DDMU	0.13	PCB 169	0.1
PCB 8	0.1	PCB 170	0.1
PCB 18	0.1	PCB 177	0.1
PCB 28	0.1	PCB 180	0.12
PCB 37	0.1	PCB 183	0.1
PCB 44	0.14	PCB 187	0.1
PCB 49	0.11	PCB 189	0.12
PCB 52	0.13	PCB 194	0.1
PCB 66	0.1	PCB 195	0.1
PCB 70	0.1	PCB 200	0.1
PCB 74	0.1	PCB 201	0.12
PCB 77	0.1	PCB 206	0.1
PCB 81	0.12	PCB 209	0.1

* Value is the reporting limit.

Table C-10. Method detection levels for PCB congeners and pesticides in sediments, March 26, 2014–June 30, 2014.

Orange County Sanitation District, California.

Parameter	ASE & GC/MS-SIM Method Detection Limit (ng/g dry weight)	Parameter	ASE & GC/MS-SIM Method Detection Limit (ng/g dry weight)
Aldrin	0.25	PCB 82	0.28
gamma-BHC	0.44	PCB 87	0.61
cis-Chlordane	0.26	PCB 92	0.1
trans-Chlordane	0.36	PCB 99	0.15
Oxychlordane	0.41	PCB 101	0.13
Dieldrin*	2	PCB 105	0.17
Endosulfan-*alpha*	0.96	PCB 110	0.12
Endosulfan-*beta**	5	PCB 114	0.14
Endosulfan-sulfate	0.55	PCB 118	0.14
Endrin	0.77	PCB 119	0.16
Heptachlor	0.29	PCB 123	0.16
Heptachlor epoxide*	1	PCB 126	0.16
Hexachlorobenzene	0.58	PCB 128	0.14
Mirex	0.28	PCB 138	0.18
cis-Nonachlor	0.34	PCB 146	0.1
trans-Nonachlor	0.28	PCB 149	0.15
2,4'-DDD	0.71	PCB 151	0.15
2,4'-DDE	0.29	PCB 153/168	0.34
2,4'-DDT	0.3	PCB 156	0.16
4,4'-DDD	0.28	PCB 157	0.16
4,4'-DDE	0.39	PCB 158	0.15
4,4'-DDT	0.57	PCB 167	0.15
4,4'-DDMU	0.32	PCB 169	0.16
PCB 8	0.13	PCB 170	0.18
PCB 18	0.1	PCB 177	0.15
PCB 28	0.1	PCB 180	0.23
PCB 37	0.12	PCB 183	0.15
PCB 44	0.13	PCB 187	0.16
PCB 49	0.13	PCB 189	0.14
PCB 52	0.12	PCB 194	0.18
PCB 66	0.13	PCB 195	0.14
PCB 70	0.12	PCB 200	0.22
PCB 74	0.13	PCB 201	0.15
PCB 77	0.16	PCB 206	0.24
PCB 81	0.14	PCB 209	0.17

* Value is the reporting limit.

Table C-11. Acceptance criteria for standard reference materials of pesticides/PCBs in sediments, July 2013–June 2014.

Orange County Sanitation District, California.

Parameter	True Value (ng/g)	Acceptance Range (ng/g)		Parameter	True Value (ng/g)	Acceptance Range (ng/g)	
		min.	max.			min.	max.
SRM 1944 - Organics in Marine Sediment, National Institute of Standards and Technology, New York/New Jersey Waterway Sediment							
gamma-BHC*	2	1.7	2.3	PCB 101	73.4	70.9	75.9
cis-Chlordane	16.51	15.68	17.34	PCB 105	24.5	23.4	25.6
trans-Chlordane*	19	17.3	20.7	PCB 110	63.5	58.8	68.2
Hexachlorobenzene	6.03	5.68	6.38	PCB 118	58	53.7	62.3
cis-Nonachlor*	3.7	3	4.4	PCB 128	8.47	8.19	8.75
trans-Nonachlor	8.2	7.69	8.71	PCB 138	62.1	59.1	65.1
2,4'-DDD*	38	30	46	PCB 149	49.7	48.5	50.9
2,4'-DDE*	19	16	22	PCB 151	16.93	16.57	17.29
4,4'-DDD*	108	92	124	PCB 153/168	74	71.1	76.9
4,4'-DDE*	86	74	98	PCB 156	6.52	5.86	7.18
4,4'-DDT*	170	138	202	PCB 170	22.6	21.2	24
PCB 8	22.3	20	24.6	PCB 18	51	48.4	53.6
PCB 28	80.8	78.1	83.5	PCB 180	44.3	43.1	45.5
PCB 44	60.2	58.2	62.2	PCB 183	12.19	11.62	12.76
PCB 49	53	51.3	54.7	PCB 187	25.1	24.1	26.1
PCB 52	79.4	77.4	81.4	PCB 194	11.2	9.8	12.6
PCB 66	71.9	67.6	76.2	PCB 195	3.75	3.36	4.14
PCB 87	29.9	25.6	34.2	PCB 206	9.21	8.7	9.72
PCB 99	37.5	35.1	39.9	PCB 209	6.81	6.48	7.14
Percent Dry Weight	1.3						
SRM 1941B - Organics in Marine Sediment, National Institute of Standards and Technology, New York, New Jersey Waterway Sediment							
cis-Chlordane	0.85	0.74	0.96	PCB 101	5.11	4.77	5.45
trans-Chlordane	0.566	0.473	0.659	PCB 105	1.43	1.33	1.53
Hexachlorobenzene	5.83	5.45	6.21	PCB 110	4.62	4.26	4.98
cis-Nonachlor	3.7	3	4.4	PCB 118	4.23	4.04	4.42
trans-Nonachlor	0.438	0.365	0.511	PCB 128	0.696	0.652	0.74
2,4'-DDE*	0.38	0.26	0.5	PCB 138	3.6	3.32	3.88
4,4'-DDD	4.66	4.2	5.12	PCB 149	4.35	4.09	4.61
4,4'-DDE	3.22	2.94	3.5	PCB 153/168	5.47	5.15	5.79
4,4'-DDT*	1.12	0.7	1.54	PCB 156	0.507	0.417	0.597
PCB 8	1.65	1.46	1.84	PCB 158*	0.65	0.5	0.8
PCB 28	4.52	3.95	5.09	PCB 170	1.35	1.26	1.44
PCB 44	3.85	3.65	4.05	PCB 18	2.39	2.1	2.68
PCB 49	4.34	4.06	4.62	PCB 180	3.24	2.73	3.75
PCB 52	5.24	4.96	5.52	PCB 183	0.979	0.892	1.066
PCB 66	4.96	4.43	5.49	PCB 187	2.17	1.95	2.39
PCB 70*	4.99	4.7	5.28	PCB 194	1.04	0.98	1.1
PCB 74*	2.04	1.89	2.19	PCB 195	0.645	0.585	0.705
PCB 77*	0.31	0.28	0.34	PCB 201	0.777	0.743	0.811
PCB 87	1.14	0.98	1.3	PCB 206	2.42	2.23	2.61
PCB 99	2.9	2.54	3.26	PCB 209	4.86	4.41	5.31
Percent Dry Weight	1.3						

* Non-certified value.

Table C-12. Sediment PCB/pesticide QA/QC summary, July 2013–June 2014.

Orange County Sanitation District, California.

Quarter	Sample Set	Parameter	Description	Number of Compounds Tested	Number of Compounds Passed	Target Accuracy % Recovery	Target Precision % RPD
Summer	SED1307_FI	PCB & Pesticides	Blank Spike	64	58	60-120	NA
			Matrix Spike	64	61	40-120	NA
			Matrix Spike Duplicate	64	62	40-120	NA
			Matrix Spike Precision	64	60	NA	<20%
			Duplicate	128	117	NA	<20%@3 x MDL of sample mean
			SRM Analysis*	75	54	80-120% or certified value whichever is greater.	NA
Summer	SED1307_FJ	PCB & Pesticides	Blank Spike	64	64	60-120	NA
			Matrix Spike	64	64	40-120	NA
			Matrix Spike Duplicate	64	63	40-120	NA
			Matrix Spike Precision	64	64	NA	<20%
			Duplicate	130	128	NA	<20%@3 x MDL of sample mean
			SRM Analysis*	75	61	80-120% or certified value whichever is greater.	NA
Winter	SED1401_AC	PCB & Pesticides	Blank Spike	65	59	60-120	NA
			Matrix Spike	65	61	40-120	NA
			Matrix Spike Duplicate	65	61	40-120	NA
			Matrix Spike Precision	65	55	NA	<20%
			Duplicate	130	102	NA	<20%@3 x MDL of sample mean
			SRM Analysis*	75	61	80-120% or certified value whichever is greater.	NA
Winter	SED1401_FL	PCB & Pesticides	Blank Spike	65	59	60-120	NA
			Matrix Spike	60	59	40-120	NA
			Matrix Spike Duplicate	60	59	40-120	NA
			Matrix Spike Precision	60	60	NA	<20%
			Duplicate	120	118	NA	<20%@3 x MDL of sample mean
			SRM Analysis*	75	40	80-120% or certified value whichever is greater.	NA

* SRMs used for analysis: SRM 1941b and SRM 1944, Organics in Marine Sediment, National Institute of Standards and Technology, New York, New Jersey Waterway Sediment.
NA = Not Applicable.

Table C-13. Method detection limits for trace metals in sediments, July 2013–June 2014.

Orange County Sanitation District, California.

Parameter	Detection Limits (mg/kg dry weight)
Aluminum	50
Antimony	0.10
Arsenic	0.15
Barium	0.10
Beryllium	0.01
Cadmium	0.01
Chromium	0.15
Copper	0.10
Iron	50
Lead	0.10
Nickel	0.10
Mercury	0.00011
Selenium	0.15
Silver	0.02
Zinc	0.15

Table C-14. Acceptance criteria for standard reference materials of metals in sediments, July 2013–June 2014.

Orange County Sanitation District, California.

Environmental Resource Associates D074-540 Priority PollutnT™/CLP Inorganic Soils – Microwave Digestion Environmental Resource Associates			
Parameter	True Value (mg/kg)	Certified Acceptance Criteria (mg/kg)	
		Min.	Max.
Aluminum	9510	4160	14800
Antimony	72.9	18.7	206
Arsenic	161	114	209
Barium	385	286	484
Beryllium	146	110	182
Cadmium	149	110	191
Chromium	180	127	233
Copper	162	122	207
Iron	13000	4220	21800
Lead	103	73.0	132
Nickel	133	97.4	172
Mercury	3.73	1.90	5.55
Selenium	153	103	202
Silver	71.1	47.8	94.5
Zinc	352	254	450

Table C-15. Sediment metals QA/QC summary, July 2013–June 2014.

Orange County Sanitation District, California.

Quarter	Sample Set	Parameter	Description	Number of Compounds Tested	Number of Compounds Passed	Target Accuracy % Recovery	Target Precision % RPD
Summer	HMSED131213-1	Arsenic, Beryllium, Cadmium, Chromium, Copper, Lead, Nickel, Selenium, Silver, Zinc	Blank	48	47*	<3X MDL	NA
			Blank Spike	24	24	90-110	NA
			Matrix Spike	36	31**	70-130	NA
			Matrix Spike Duplicate	36	32**	70-130	NA
			Matrix Spike Precision	36	36	NA	< 20%
			Duplicate Analysis	36	35***	NA	@ ≥ 10 X MDL < 20%
			SRM Analysis	12	9	80-120% or certified value, whichever is greater.	NA
Summer	ALFESED131213-1	Aluminum, Iron	Blank	8	8	<3X MDL	NA
Summer	HGSED131106-1	Mercury	Blank	2	2	<3X MDL	NA
			Blank Spike	2	2	90-110	NA
			Matrix Spike	3	3	70-130	NA
			Matrix Spike Duplicate	3	3	70-130	NA
			Matrix Spike Precision	3	3	NA	< 20%
			Duplicate Analysis	3	3	NA	@ ≥ 10 X MDL < 20%
			SRM Analysis	1	1	80-120% or certified value, whichever is greater.	NA
Winter	HMSED140429-1	Arsenic, Beryllium, Cadmium, Chromium, Copper, Lead, Nickel, Selenium, Silver, Zinc	Blank	48	48	<3X MDL	NA
			Blank Spike	24	24	90-110	NA
			Matrix Spike	36	33****	70-130	NA
			Matrix Spike Duplicate	36	32**	70-130	NA
			Matrix Spike Precision	36	36	NA	< 20%
			Duplicate Analysis	36	35*****	NA	@ ≥ 10 X MDL < 20%
			SRM Analysis	12	12	80-120% or certified value, whichever is greater.	NA
Winter	ALFESED140429-1	Aluminum, Iron	Blank	8	8	<3X MDL	NA

Table C-15 Continues.

Table C-15 Continued.

Quarter	Sample Set	Parameter	Description	Number of Compounds Tested	Number of Compounds Passed	Target Accuracy % Recovery	Target Precision % RPD
Winter	HGSED140527-1	Mercury	Blank	2	2	<3X MDL	NA
			Blank Spike	2	2	90-110	NA
			Matrix Spike	3	3	70-130	NA
			Matrix Spike Duplicate	3	3	70-130	NA
			Matrix Spike Precision	3	3	NA	< 20%
			Duplicate Analysis	3	3	NA	@ $\geq$ 10 X MDL < 20%
			SRM Analysis	1	1	80-120% or certified value, whichever is greater.	NA

* Blank high for Zn, average for blanks ND.
** Recovery out of control for Pb and Sb. All other metals within QA limits, suspect matrix interference.
*** RPD out of control for Cu, sample not homogeneous. All other metals within QA limits.
**** Recovery out of control for Sb. All other metals within QA limits, suspect matrix interference.
***** RPD out of control for Pb, sample not homogeneous. All other metals within QA limits.
NA = Not Applicable.

Table C-16. Method detection limits for dissolved sulfides, total organic carbon, total nitrogen, total phosphorus, and grain size in sediments, July 2013–June 2014.

Orange County Sanitation District, California.

Parameter	Detection Limits
Dissolved Sulfides (OCSD)	1.03 mg/kg dry weight
Total Organic Carbon (ALS Environmental)	0.10 %
Total Nitrogen (TestAmerica)	7.4 mg/kg dry weight
Total Phosphorus (TestAmerica)	2.4 mg/kg dry weight
Grain Size (EMSL Analytical)	0.001 %

Table C-17. Sediment dissolved sulfides QA/QC summary, July 2013–June 2014.

Orange County Sanitation District, California.

Quarter	Sample Set	Parameter	Description	Number of Compounds Tested	Number of Compounds Passed	Target Accuracy % Recovery	Target Precision % RPD
Summer	SULFIDE130719-1 SULFIDE130723-1 SULFIDE130726-1 SULFIDE130801-1	Dissolved Sulfides	Blank	4	4	<2X MDL	NA
			Blank Spike	4	3	80 -120	NA
			Matrix Spike	4	3*	70 - 130	NA
			Matrix Spike Duplicate	4	4	70 - 130	NA
			Matrix Spike Precision	4	4	NA	<30%
Winter	SULFIDE140311-1 SULFIDE140314-1 SULFIDE140326-1	Dissolved Sulfides	Blank	3	3	<2X MDL	NA
			Blank Spike	3	3	80 -120	NA
			Matrix Spike	3	3	70 - 130	NA
			Matrix Spike Duplicate	3	3	70 - 130	NA
			Matrix Spike Precision	3	3	NA	<30%

* Matrix spike recovery was out of control due to matrix interferences.

Table C-18. Sediment total organic carbon QA/QC summary, July 2013–June 2014.

Orange County Sanitation District, California.

Quarter	Sample Set	Parameter	Description	Number of Compounds Tested	Number of Compounds Passed	Target Accuracy % Recovery	Target Precision % RPD
Summer	TOC-130821-1	Total Organic Carbon	Duplicate and Matrix Spike	3	3	80-120**	<10%**
Winter	TOC-140204-1	Total Organic Carbon	Duplicate and Matrix Spike	3	2*	80-120**	<10%**

* One sample duplicate RPD (11.8%) was out of control due to matrix interferences.
** TOC Target Precision/Accuracy of QC Criteria is not described in the Core Monitoring Quality Assurance Project Plan.

Table C-19. Sediment grain size QA/QC summary, July 2013–June 2014.

Orange County Sanitation District, California.

Quarter	Sample Set	Parameter	Description	Number of Compounds Tested	Number of Compounds Passed	Target Accuracy % Recovery	Target Precision % RPD
Summer	PSIZE130911-1	Grain Size	Reference Standard	30	30	NA	Mean ± 3 σ of the reference standard for median phi, skewness, dispersion, % gravel, % sand, % clay, and % silt
			Duplicate	3	3	NA	≤10%
Winter	PSIZE140224-1	Grain Size	Reference Standard	0	0	NA	NA
			Duplicate	3	3	NA	≤10%

Table C-20. Sediment total nitrogen and total phosphorus QA/QC summary, July 2013–June 2014.

Orange County Sanitation District, California.

Quarter	Sample Set	Parameter	Description	Number of Compounds Tested	Number of Compounds Passed	Target Accuracy % Recovery	Target Precision % RPD
Summer	TN130815-1	Total Nitrogen	Blank	2	2	NA	NA
			Blank Spike	2	2	80 -120	NA
			Matrix Spike	2	2	70 - 130	NA
			Matrix Spike Duplicate	2	2	70 - 130	NA
			Matrix Spike Precision	2	2	NA	<30%
Summer	TP130815-1	Total Phosphorus	Blank	2	2	NA	NA
			Blank Spike	2	2	80 -120	NA
			Matrix Spike	2	1*	70 - 130	NA
			Matrix Spike Duplicate	2	1*	70 - 130	NA
			Matrix Spike Precision	2	2	NA	<30%
Winter	TN140203-1	Total Nitrogen	Blank	2	2	NA	NA
			Blank Spike	2	2	80 -120	NA
			Matrix Spike	2	2	70 - 130	NA
			Matrix Spike Duplicate	2	2	70 - 130	NA
			Matrix Spike Precision	2	2	NA	<30%
Winter	TP140203-1	Total Phosphorus	Blank	2	2	NA	NA
			Blank Spike	2	2	80 -120	NA
			Matrix Spike	2	0*	70 - 130	NA
			Matrix Spike Duplicate	2	1*	70 - 130	NA
			Matrix Spike Precision	2	2	NA	<30%

* Matrix spike recovery was out of control due to matrix interferences.
NA = Not Applicable.

FISH TISSUE CHEMISTRY NARRATIVE

THIRD QUARTER (JANUARY 2014)

Introduction

ELOM laboratory staff received 33 individual rig fish samples and 40 individual trawl fish samples from ELOM's ocean monitoring staff during January 2014. The individual samples were stored, dissected, and homogenized according to methods described in the OCSD ELOM LOPM (OCSD 2014a). A 1:1 muscle to water ratio was used for muscle samples. No water was used for liver samples. After the individual samples were homogenized, equal aliquots of muscle from each rig fish sample and equal aliquots of muscle and liver from each trawl fish sample were frozen and distributed to the metals and organic chemistry sections of the analytical chemistry laboratory for analyses.

The organic chemistry section extracted 33 rig fish muscle samples, 40 trawl fish muscle samples, and 40 trawl fish liver samples, and analyzed them for PCB congeners and organochlorine pesticides. Percent lipid content was also determined for each sample.

A typical organic tissue sample batch included 15 field samples with required QC samples. The QC samples included one hydromatrix blank, two duplicate sample extractions, one matrix spike, one matrix duplicate spike, two SRMs, and one blank spike (matrix of choice was tilapia).

For mercury analysis, one sample batch consisted of 15–20 fish tissue samples and the required QC samples, which included a blank, blank spike, SRM, sample duplicates, matrix spikes, and matrix spike duplicates.

Analytical Methods - Organochlorine Pesticides and PCB Congeners

The analytical methods used for organochlorine pesticides and PCB congeners were according to methods described in the ELOM LOPM. All fish tissue was extracted using an ASE 200 and analyzed by GC/MS.

The MDLs for pesticides and PCBs in fish tissue are presented in Table C-21. Acceptance criteria for PCB and pesticide SRMs in fish tissue are presented in Tables C-22 and C-23. Fish tissue pesticide and PCB QA/QC summary data are presented in Table C-24. All analyses were performed within the required holding times and with appropriate quality control measures. In cases where constituent concentrations exceeded the calibration range of the instrument, the samples were diluted and reanalyzed. Any variances that occurred during sample preparation or analyses are noted in the Comments/Notes section of each batch summary.

Analytical Methods – Lipid Content

Percent lipid content was determined for each sample of fish using methods described in the ELOM LOPM. Lipids were extracted by dichloromethane from approximately 1 to 2 g of sample and concentrated to 2 mL. A 100 µL aliquot of the extract was placed in a tared aluminum weighing boat and the solvent allowed to evaporate to dryness. The remaining residue was weighed, and the percent lipid content calculated. Lipid content QA/QC summary data are presented in Table C-25. All analyses were performed within the required holding times and with appropriate quality control measures. Any variances that

occurred during sample preparation or analyses are noted in the Comments/Notes section of the Fish Tissue Percent QA/QC Summary.

Analytical Methods - Mercury

Fish tissue samples were analyzed for mercury in accordance with ELOM SOP 245.1A. Typical QC analyses for a tissue sample batch included a blank, a blank spike, and SRMs (liver and muscle). In the same batch, additional QC samples included duplicate analyses of the sample, spiked samples and duplicate spiked samples, which were run approximately once every ten samples.

The MDL for fish mercury is presented in Table C-26. Acceptance criteria for the mercury SRMs are presented in Table C-27. Fish tissue mercury QA/QC summary data are presented in Table C-28. All samples were analyzed within their 6-month holding times and met the QA criteria guidelines. When sample mercury concentration exceeded the appropriate calibration curve, the sample was diluted with the reagent blank and reanalyzed. The samples were analyzed for mercury on a Perkin Elmer FIMS 400 system.

All sample analyses met the QA criteria guidelines for accuracy and precision.

Table C-21. Method detection levels for pesticides and PCB congeners in fish tissue, July 2013– June 2014

Orange County Sanitation District, California.

Parameters	ASE & GC/MS Method Detection Limit (ng/g dry weight)	Parameters	ASE & GC/MS Method Detection Limit (ng/g dry weight)
Pesticides			
2,4'-DDD	0.33	*trans*-Chlordane	0.25
2,4'-DDE	0.23	Oxychlordane*	1
2,4'-DDT	0.33	Dieldrin	0.31
4,4'-DDD	0.16	Endrin	0.64
4,4'-DDE	0.31	Heptachlor	0.23
4,4'-DDT	0.24	Heptachlor epoxide	0.37
4,4'-DDMU	0.43	*cis*-Nonachlor	0.19
cis-Chlordane	0.33	*trans*-Nonachlor	0.21
PCB Congeners			
PCB 18	0.24	PCB 126	0.11
PCB 28	0.21	PCB 128	0.08
PCB 37	0.27	PCB 138	0.16
PCB 44	0.36	PCB 149	0.33
PCB 49	0.17	PCB 151	0.22
PCB 52	0.17	PCB 153/168	0.23
PCB 66	0.26	PCB 156	0.1
PCB 70	0.23	PCB 157	0.1
PCB 74	0.24	PCB 167	0.09
PCB 77	0.21	PCB 169	0.15
PCB 81	0.19	PCB 170	0.18
PCB 87	0.17	PCB 177	0.09
PCB 99	0.44	PCB 180	0.18
PCB 101	0.14	PCB 183	0.13
PCB 105	0.13	PCB 187	0.06
PCB 110	0.19	PCB 189	0.12
PCB 114	0.1	PCB 194	0.17
PCB 118	0.22	PCB 201	0.2
PCB 119	0.14	PCB 206	0.11
PCB 123	0.21		

* Reporting level used for oxychlordane.

Table C-22. Acceptance criteria for standard reference materials of pesticides and PCB congeners in fish tissue, CARP-2*, July 2013–June 2014.

Orange County Sanitation District, California.

Parameter	True Value (ng/g)	Acceptance Range (ng/g)	
		Minimum	Maximum
2,4'-DDD**	21.8	21.1	22.5
2,4'-DDE**	2.9	2.4	3.4
4,4'-DDD**	90.9	82.4	99.4
4,4'-DDE**	158	144	172
Dieldrin**	8.3	7.5	9.1
trans-Chlordane**	4.5	3.8	5.2
trans-Nonachlor**	11	10.1	11.9
PCB 18	27.3	23.3	31.3
PCB 28	34	26.8	41.2
PCB 44	86.6	60.7	112
PCB 52	138	95.5	181
PCB 66**	174	122	226
PCB 101**	145	97	193
PCB 105**	53.2	37.6	68.8
PCB 118	148	115	181
PCB 128	20.4	16	24.8
PCB 138**	103	73	133
PCB 153/168	105	83	127
PCB 170**	20.6	17.7	23.5
PCB 180	53.3	40.3	66.3
PCB 187**	37.1	30.8	43.4
PCB 194	10.9	7.8	14
PCB 206	4.4	3.3	5.5
Lipid	7		

* CARP-2: Ground Whole Carp Reference Material for Organochlorine Compounds, National Research Council Canada.
** Non-certified value.

Table C-23. Acceptance criteria for standard reference materials of pesticides and PCB congeners in fish tissue, SRM-1946*, July 2013–June 2014.

Orange County Sanitation District, California.

Parameter	True Value (ng/g)	Acceptance Range (ng/g)		Parameter	True Value (ng/g)	Acceptance Range (ng/g)	
		Minimum	Maximum			Minimum	Maximum
2,4'-DDD	2.2	1.95	2.45	PCB 77	0.327	0.3	0.35
2,4'-DDE**	1.04	0.75	1.33	PCB 87	9.4	8	10.8
2,4'-DDT**	22.3	19.1	25.5	PCB 99	25.6	23.3	27.9
4,4'-DDD	17.7	14.9	20.5	PCB 101	34.6	32	37.2
4,4'-DDE	373	325	421	PCB 105	19.9	19	20.8
4,4'-DDT	37.2	33.7	40.7	PCB 110	22.8	20.8	24.8
cis-Chlordane	32.5	30.7	34.3	PCB 118	52.1	51.1	53.1
trans-Chlordane	8.36	7.45	9.27	PCB 126	0.38	0.36	0.4
Oxychlordane	18.9	17.4	20.4	PCB 128	22.8	20.9	24.7
Dieldrin	32.5	29	36	PCB 138	115	102	128
Heptachlor epoxide	5.5	5.27	5.73	PCB 149	26.3	25	27.6
cis-Nonachlor	59.1	55.5	62.7	PCB 153/168	170	161	179
trans-Nonachlor	99.6	92	107	PCB 156	9.52	9.01	10
PCB 18**	0.84	0.73	0.95	PCB 170	25.2	23	27.4
PCB 28**	2	1.76	2.24	PCB 180	74.4	70.4	78.4
PCB 44	4.66	3.8	5.52	PCB 183	21.9	19.4	24.4
PCB 49	3.8	3.41	4.19	PCB 187	55.2	53.1	57.3
PCB 52	8.1	7.1	9.1	PCB 194	13	11.7	14.3
PCB 66	10.8	8.9	12.7	PCB 201**	2.83	2.7	2.96
PCB 70	14.9	14.3	15.5	PCB 206	5.4	4.97	5.83
PCB 74	4.83	4.32	5.34	Lipid**	10.17	- - -	- - -

* SRM 1946, Organics in Lake Superior Fish Tissue, National Institute of Standards and Technology.
** Non-certified value.

Table C-24. Fish tissue PCB/pesticide QA/QC summary, July 2013–June 2014.

Orange County Sanitation District, California.

Quarter	Sample Set	Parameter	Description	Number of Compounds Tested	Number of Compounds Passed	Target Accuracy % Recovery	Target Precision % RPD
Winter	FISHJAN14_LL	PCB & Pesticides	Blank Spike	59	55	75-125	NA
			Matrix Spike	59	57	70-130	NA
			Matrix Spike Duplicate	59	53	70-130	NA
			Matrix Spike Precision	59	58	NA	<25%
			Duplicate	118	116	NA	<25%@ 3 x MDL of sample mean
			SRM Analysis*	69	56	80-120% or certified value whichever is greater.	NA
Winter	FISHJAN14_LM	PCB & Pesticides	Blank Spike	54	51	75-125	NA
			Matrix Spike	54	50	70-130	NA
			Matrix Spike Duplicate	54	51	70-130	NA
			Matrix Spike Precision	54	50	NA	<25%
			Duplicate	108	107	NA	<25%@ 3 x MDL of sample mean
			SRM Analysis*	64	51	80-120% or certified value whichever is greater.	NA
Winter	FISHJAN14_LN	PCB & Pesticides	Blank Spike	54	45	75-125	NA
			Matrix Spike	54	12	70-130	NA
			Matrix Spike Duplicate	54	50	70-130	NA
			Matrix Spike Precision	54	21	NA	<25%
			Duplicate	108	104	NA	<25%@ 3 x MDL of sample mean
			SRM Analysis*	64	48	80-120% or certified value whichever is greater.	NA
Winter	FISHJAN14_ML	PCB & Pesticides	Blank Spike	54	49	75-125	NA
			Matrix Spike	54	49	70-130	NA
			Matrix Spike Duplicate	54	50	70-130	NA
			Matrix Spike Precision	54	51	NA	<25%
			Duplicate	108	103	NA	<25%@ 3 x MDL of sample mean
			SRM Analysis*	64	54	80-120% or certified value whichever is greater.	NA

Table C-24 Continues.

Table C-24 Continued.

Quarter	Sample Set	Parameter	Description	Number of Compounds Tested	Number of Compounds Passed	Target Accuracy % Recovery	Target Precision % RPD
Winter	FISHJAN14_MM	PCB & Pesticides	Blank Spike	54	53	75-125	NA
			Matrix Spike	54	50	70-130	NA
			Matrix Spike Duplicate	54	53	70-130	NA
			Matrix Spike Precision	54	53	NA	<25%
			Duplicate	108	107	NA	<25%@ 3 x MDL of sample mean
			SRM Analysis*	64	52	80-120% or certified value whichever is greater.	NA
Winter	FISHJAN14_MN	PCB & Pesticides	Blank Spike	54	52	75-125	NA
			Matrix Spike	54	49	70-130	NA
			Matrix Spike Duplicate	54	50	70-130	NA
			Matrix Spike Precision	54	49	NA	<25%
			Duplicate	108	108	NA	<25%@ 3 x MDL of sample mean
			SRM Analysis*	64	59	80-120% or certified value whichever is greater.	NA
Winter	FISHJAN14_MO	PCB & Pesticides	Blank Spike	54	53	75-125	NA
			Matrix Spike	54	49	70-130	NA
			Matrix Spike Duplicate	54	51	70-130	NA
			Matrix Spike Precision	54	51	NA	<25%
			Duplicate	108	108	NA	<25%@ 3 x MDL of sample mean
			SRM Analysis*	64	54	80-120% or certified value whichever is greater.	NA
Winter	FISHJAN14_MP	PCB & Pesticides	Blank Spike	54	50	75-125	NA
			Matrix Spike	54	51	70-130	NA
			Matrix Spike Duplicate	54	52	70-130	NA
			Matrix Spike Precision	54	50	NA	<25%
			Duplicate	108	107	NA	<25%@ 3 x MDL of sample mean
			SRM Analysis*	64	54	80-120% or certified value whichever is greater.	NA

* SRMs used in the analysis: SRM 1946, Lake Superior Fish Tissue, National Institute of Standards and Technology.
CARP-2, National Research Council Canada.

Table C-25. Fish tissue percent lipid QA/QC summary, July 2013–June 2014.

Orange County Sanitation District, California.

Sample Set	Tissue Type	Parameter	Description	Number of Compounds Tested	Number of Compounds Passed	Target Precision % RPD
FISH-EXLIPJAN14_ML	Muscle	Percent Lipid	Duplicate Samples	2	2	<25%
FISH-EXLIPJAN14_MM	Muscle	Percent Lipid	Duplicate Samples	2	2	<25%
FISH-EXLIPJAN14_MN	Muscle	Percent Lipid	Duplicate Samples	2	2	<25%
FISH-EXLIPJAN14_MO	Muscle	Percent Lipid	Duplicate Samples	2	2	<25%
FISH-EXLIPJAN14_MP	Muscle	Percent Lipid	Duplicate Samples	2	2	<25%
FISH-EXLIPJAN14_LL	Liver	Percent Lipid	Duplicate Samples	2	2	<25%
FISH-EXLIPJAN14_LM	Liver	Percent Lipid	Duplicate Samples	2	2	<25%
FISH-EXLIPJAN14_LN	Liver	Percent Lipid	Duplicate Samples	2	1	<25%
FISH-EXLIPJAN 14_SL	Liver	Percent Lipid	Duplicate Samples	1	1	<25%

Table C-26. Method detection levels for metals in fish tissue, July 2013–June 2014.

Orange County Sanitation District, California.

Parameter	Method Detection Limit (mg/kg wet weight)
Arsenic	0.15
Mercury	0.002
Selenium	0.10

Table C-27. Acceptance criteria for standard reference materials of mercury in fish tissue, July 2013–June 2014.

Orange County Sanitation District, California.

Parameter	Standard Reference Material*	True Value (ng/g)	Acceptance Range (mg/kg)	
			Minimum	Maximum
Arsenic	DORM-3	6.88	6.58	7.18
Mercury	DORM-3	0.382	0.322	0.442
Selenium**	DORM-3	3.3	NA	NA

* Dogfish Muscle and Liver Reference Material for Mercury, National Research Council Canada.
** Certified results for selenium not calculated due to the lack of independent confirmation values. The true value is for informational purposes only.

Table C-28. Fish tissue metals QA/QC summary, July 2013–June 2014.

Orange County Sanitation District, California.

Quarter	Sample Set	Parameter	Description	Number of Compounds Tested	Number of Compounds Passed	Target Accuracy % Recovery	Target Precision % RPD
Winter	HGFISH140226-1	Mercury	Blank	2	2	<2X MDL	NA
			Blank Spike	2	1*	90-110	NA
			Matrix Spike	4	4	70-130	NA
			Matrix Spike Dup	4	4	70-130	NA
			Matrix Spike Precision	4	4	NA	<25%
			Duplicate	4	4	NA	@ ≥10 X MDL <30%
			SRM Analysis	1	1	80-120% or certified value whichever is greater.	NA
Winter	HGFISH140310-1	Mercury	Blank	2	2	<2X MDL	NA
			Blank Spike	2	2	90-110	NA
			Matrix Spike	4	4	70-130	NA
			Matrix Spike Dup	4	4	70-130	NA
			Matrix Spike Precision	4	4	NA	<25%
			Duplicate	4	4	NA	@ ≥10 X MDL <30%
			SRM Analysis	1	1	80-120% or certified value whichever is greater.	NA
Winter	HGFISH140324-1	Mercury	Blank	3	3	<2X MDL	NA
			Blank Spike	3	3	90-110	NA
			Matrix Spike	5	5	70-130	NA
			Matrix Spike Dup	5	5	70-130	NA
			Matrix Spike Precision	5	5	NA	<25%
			Duplicate	5	5	NA	@ ≥10 X MDL <30%
			SRM Analysis	1	1	80-120% or certified value whichever is greater.	NA

Table C-28 continues.

Table C-28 continued.

Quarter	Sample Set	Parameter	Description	Number of Compounds Tested	Number of Compounds Passed	Target Accuracy % Recovery	Target Precision % RPD
Winter	HMFISH140410-1	Arsenic and Selenium	Blank	8	7**	<2X MDL	NA
			Blank Spike	4	4	90-110	NA
			Matrix Spike	8	8	70-130	NA
			Matrix Spike Dup	8	8	70-130	NA
			Matrix Spike Precision	8	8	NA	<25%
			Duplicate	8	8	NA	@ ≥10 X MDL <30%
			SRM Analysis	2	2	80-120% or certified value whichever is greater.	NA

* Blank spike rounds to within 90-110% recovery.

** Blank value out of control for Se, however blanks average to ND.

NA = Not Applicable.

BENTHIC INFAUNA NARRATIVE

SORTING AND TAXONOMY QA/QC

The sorting and taxonomy QA/QC follows the 2013-14 QAPP (OCSD 2014b). No annual survey was conducted; therefore, all three QA samples came from the semi-annual samples. Sorting QA/QC procedures were conducted for both the summer (July 2013, Cruise # OC-2013-021) and winter (January 2014, Cruise # OC-2014-001) surveys.

Sorting QA/QC Procedures

The infauna community was monitored by collecting marine sediments from 29 semi-annual stations at depths from 52–65 m in July 2013 (summer) and January 2014 (winter) for a total of 58 samples for the year (Figure 2-2, Table A-1). Single replicates were collected at all stations. The sorting procedure involved removal by the contractor (Marine Taxonomic Services, Inc. (MTS)) personnel of all biological organisms and fragments from each benthic sample. Organisms were sorted by major taxa, transferred to separate vials, and total counts per station were made. When all samples from a cruise passed MTS's in-house sorting efficiency criteria, they were returned with any remaining particulates (RPs) to OCSD for identification and enumeration. Three randomly selected semi-annual stations from both the summer and winter surveys (a total of 6 samples) were re-sorted by OCSD. A tally was made of any countable organisms missed by MTS. A sample passes QA if the total number of countable animals (heads) found in the re-sort is ≤ 5% of the total number of individuals reported for that sample.

2013-14 Sorting QA/QC Results

Sorting results for all 2013-14 QA samples were well below the 5% QC limit (95% accuracy). The average was less than 1%, with results ranging from 0–0.4% (n=6).

Taxonomic Identification QA/QC Procedures

Benthic infauna samples underwent comparative taxonomic analysis by two independent groups of taxonomists. Samples were randomly chosen for re-identification from each taxonomist's allotment of assigned samples. These were swapped between taxonomists with the same expertise in the major taxon. The resulting data sets were compared and a discrepancy report generated. The participating taxonomists reconciled the discrepancies. Necessary corrections to taxon names or abundances were made to the database. The results were scored and errors tallied by station. Percent errors were calculated using the equations below:

Equation 1. $\%Error_{\#\,Taxa} = [(\#\,Taxa_{Resolved} - \#\,Taxa_{Original}) \div \#\,Taxa_{Resolved}] * 100$

Equation 2. $\%Error_{\#\,Individuals} = (\#\,Individuals_{Resolved} - \#\,Individuals_{Original}) \div \#\,Individuals_{Resolved}] * 100$

Equation 3. $\%Error_{\#\,ID\,Taxa} = (\#\,Taxa_{Misidentified} \div \#\,Taxa_{Resolved}) * 100$

Equation 4. $\%Error_{\#\,ID\,Individuals} = (\#\,Individuals_{Misidentified} \div \#\,Individuals_{Resolved}) * 100$

Please refer to the 2013-14 QAPP (OCSD 2014b) for detailed explanation of the variables.

When applied to a station as a whole, these equations are a measure of taxonomic accuracy (i.e., QA) for the survey. The first three equations are considered gauges of errors in accounting (e.g., recording on wrong line, miscounting, etc.), which, by their random nature, are difficult to predict. Sample accuracy (i.e., QC) is calculated by station using the fourth equation reported herein. Equation 4 (Eq. 4) is the preferred measure of identification accuracy. It is weighted by abundance and has a more rigorous set of consequences (corrective actions) when errors are greater than 10%. Corrective actions include a reanalysis of additional samples for the affected taxa and additional, targeted training. Equation 3, while included herein, is technically an assessment of identification accuracy (i.e., QC). However, it is too sensitive a measure for sample fractions with low diversities.

2013-14 Taxonomic QA/QC Results

Tables C-29 and C-30 contains the QA/QC results of the re-identifications. All QC objectives were met for percent error of number of identified individuals (Eq. 4), with a mean of 2.5%. All samples were also under the actionable threshold for all QA measures.

In addition to the re-identifications, a synoptic data review was conducted upon completion of all data entry and QA. This consisted of a review of the infauna data for the survey year aggregated by taxonomist (including both in-house and contractor). From this, we can identify anomalous species reports, e.g., species reported outside a known depth range, nomenclatural differences of name application, possible data entry errors, etc. There were no significant changes made this year.

Table C-29. Re-identification results for July 2013 QA samples.

Orange County Sanitation District, California.

Station	Rep	Description	Original Count	Misidentified	Final Count
85	1	No. of Individuals	764	7	763
		No. of Taxa	111	6	108
79	1	No. of Individuals	594	4	594
		No. of Taxa	104	3	104
77	1	No. of Individuals	412	8	417
		No. of Taxa	110	5	106

Table C-30. Percent error rates calculated for July 2013 QA samples.

Orange County Sanitation District, California.

Error Type	Station (rep)			
	85 (1)	79 (1)	77 (1)	Mean
1. %Error $_{\#\ Taxa}$	2.8	4.0	3.8	3.5
2. %Error $_{\#\ Individuals}$	0.1	0.0	1.2	0.4
3. %Error $_{\#\ ID\ Taxa}$	5.6	3.0	4.7	4.4
4. %Error $_{\#\ ID\ Individuals}$	0.9	0.7	1.9	1.2

OTTER TRAWL NARRATIVE

The OCSD trawl sampling protocols are based upon regionally developed sampling methods (Mearns and Stubs 1974; Mearns and Allen 1978) and US Environmental Protection Agency 301(h) guidance documents (Tetra Tech 1986). These include a maximum distance from the nominal trawl station co-ordinates, sampling depth, vessel speed, and distance (trawl track) covered. Table C-31 lists the trawl quality assurance objectives (QAO).

Established regional survey methods for southern California requires that a portion of the trawl track must pass within a 100-m circle that originates from the nominal sample station position and be within 10% of the station's nominal depth. The speed of the trawl should range from 0.77 to 1.0 m/s or 1.5 to 2.0 kts. Since 1985, the District has trawled a set distance of 450 meters (the distance that the net is actually on the bottom collecting fish and invertebrates); regional survey trawls are based on time on the bottom, not distance.

Summer 2013

For summer 2013, trawl distances ranged from 462 to 576 m, with the average trawl length being 492.6 m and the average trawl speed being 1.9 kts for all trawls combined (Table C-32). All of the trawls passed through the designated 100-meter circle (Figure C-1). Trawl depths and time on the bottom were determined using an attached pressure sensor that showed excellent trawl repeatability in both depth (Table C-33) and distance traveled (Figure C-2).

Winter 2014

For winter 2014, all trawl lengths ranged from 448 to 459 m, with the average trawl length being 451.4 m and the average trawl speed being 1.8 kts for all trawls combined (Table C-34). All the trawls passed through the designated 100-meter circle (Figure C-3). Trawl depths and time on the bottom were determined using an attached pressure sensor that showed excellent trawl repeatability in both depth (Table C-35) and distance traveled (Figure C-4).

Table C-31. Districts quality assurance objectives for trawl sampling, July 2013–June 2014.

Orange County Sanitation District, California.

Measure	Quality Assurance Objective (QAO)
Trawl Track Depth	±10% of nominal station depth (at any point during the trawl)
Trawl Track Length	450 m
Distance from nominal	100 m
Vessel Speed	1.5–2.0 knots

Table C-32. Trawl sample dates, track distances, percent difference from target track distance, elapsed time, and vessel speed, July 2013.

Orange County Sanitation District, California.

Date	Station	Haul	Distance Trawled (meters)	Percent Difference from Target Distance*	Elapsed Time (seconds)	Trawl speed (knots)**
July 10, 2013	T1	1	575.6	27.9	586	1.9
July 9, 2013	T11	1	483.7	7.5	589	1.6
July 10, 2013	T12	1	520.1	15.6	474	**2.1**
July 10, 2013	T17	1	479.9	6.7	474	2.0
July 10, 2013	T22	1	463.5	3.0	411	**2.2**
July 9, 2013	T23	1	462.0	2.7	515	1.7
Mean value			492.6	9.5	504.6	1.9

* Target Distance – 450 meters.

** Target Speed – 1.5 – 2.0 knot.

Hauls with speeds less than 1.5 knots or greater than 2 knots are denoted in bold.

Table C-33. Ten percent trawl depth QA, July 2013.

Orange County Sanitation District, California.

Date	Station	Haul	Nominal Depth (m)	QA Range (m)	Data Source	Average Bottom Depth (m)	10% Y/N
July 10, 2013	T1	2	55	49.5–60.5	SBE DATA	56.6	Y
					SOD DATA	55.0	Y
July 9, 2013	T11	2	60	54.0–66.0	SBE DATA	60.0	Y
					SOD DATA	57.5	Y
July 10, 2013	T12	1	57	51.3–62.7	SBE DATA	57.8	Y
					SOD DATA	56.0	Y
July 10, 2013	T17	1	60	54.0–66.0	SBE DATA	61.2	Y
					SOD DATA	59.0	Y
July 10, 2013	T22	1	60	54.0–66.0	SBE DATA	62.3	Y
					SOD DATA	59.5	Y
July 9, 2013	T23	1	58	52.2–63.8	SBE DATA	60.6	Y
					SOD DATA	58.0	Y

Abbreviations:

SBE = Seabird Electronics.

SOD = Station occupation data.

Y = Yes (Pass).

N = No (Fail).

Table C-34. Trawl sample dates, track distances, percent difference from target track distance, elapsed time, and vessel speed, January 2014.

Orange County Sanitation District, California.

Date	Station	Haul	Distance Trawled (meters)	Percent Difference from Target Distance*	Elapsed Time (seconds)	Trawl speed (knots)**
January 15, 2014	T1	1	447.8	-0.5	444.0	2.0
January 15, 2014	T11	1	449.2	-0.2	429.0	2.0
January 15, 2014	T12	1	458.7	1.9	498.0	1.8
January 16, 2014	T17	1	450.8	0.2	486.0	1.8
January 16, 2014	T22	1	455.3	1.2	490.0	1.8
January 16, 2014	T23	1	447.8	-0.5	478.0	1.8
Mean value			451.4	0.3	483.7	1.8

* Target Distance – 450 meters.

** Target Speed – 1.5 – 2.0 knots.

Table C-35. Ten percent trawl depth QA, January 2014.

Orange County Sanitation District, California.

Date	Station	Haul	Nominal Depth (m)	QA Range (m)	Data Source	Average Bottom Depth (m)	10% Y/N
January 16, 2014	T1	1	55	49.5–60.5	SBE DATA	57.1	Y
					SOD DATA	55.0	Y
January 15, 2014	T11	2	60	54.0–66.0	SBE DATA	61.8	Y
					SOD DATA	60.0	Y
January 15, 2014	T12	1	57	51.3–62.7	SBE DATA	57.1	Y
					SOD DATA	55.0	Y
January 16, 2014	T17	1	60	54.0–66.0	SBE DATA	63.4	Y
					SOD DATA	63.0	Y
January 16, 2014	T22	1	60	54.0–66.0	SBE DATA	62.7	Y
					SOD DATA	61.5	Y
January 16, 2014	T23	1	58	52.2–63.8	SBE DATA	61.7	Y
					SOD DATA	58.0	Y

Abbreviations:

SBE = Seabird Electronics.

SOD = Station occupation data.

Y = Yes (Pass).

N = No (Fail).

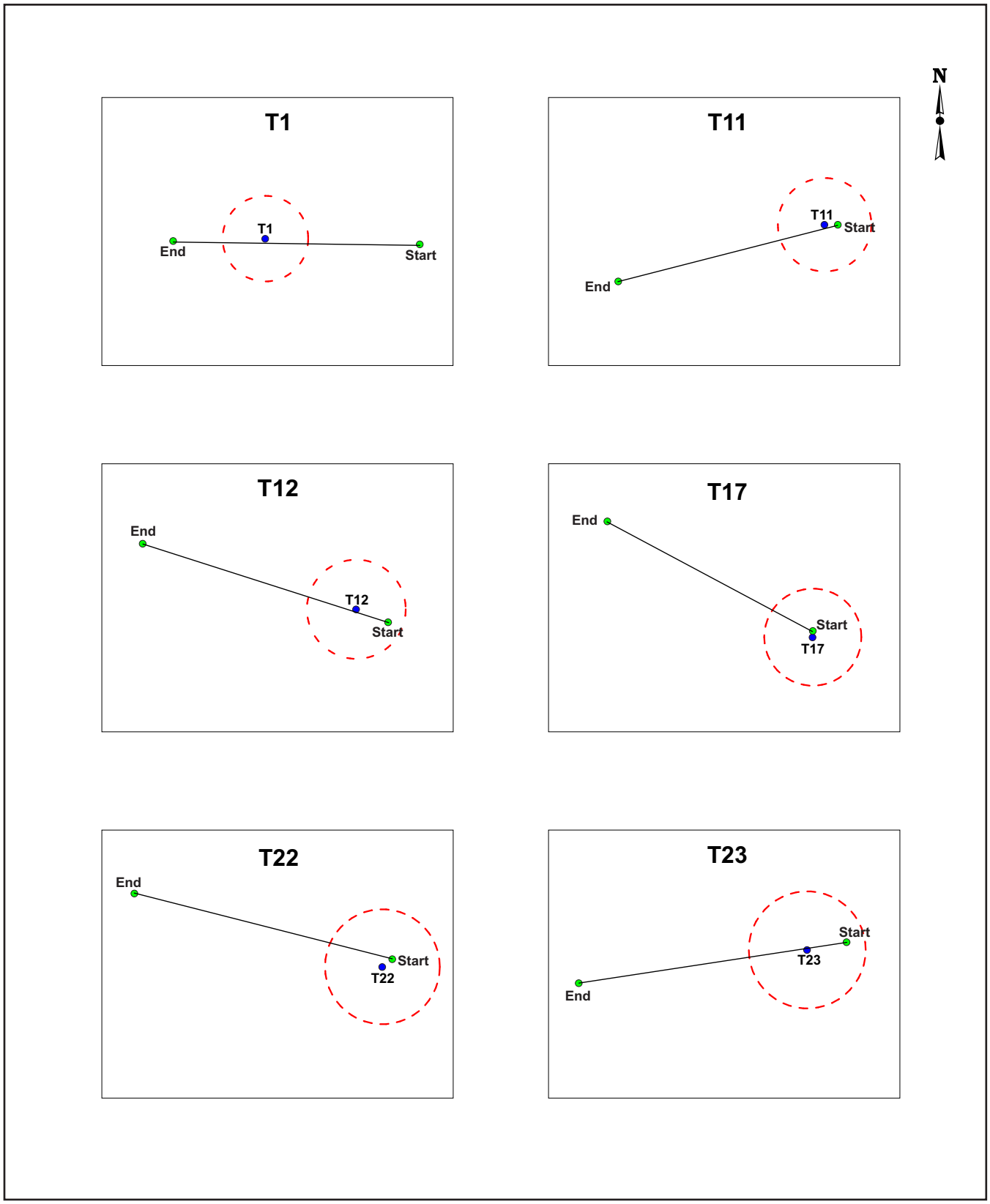

Figure C-1. Quality assurance plots of distance to station for otter trawl hauls, July 2013.

Red circle represents 100 meter distance from nominal trawl station center point.
Black lines represent trawl path while net is on the bottom.
Trawl endpoints are labeled by Start and End.

Orange County Sanitation District, California.

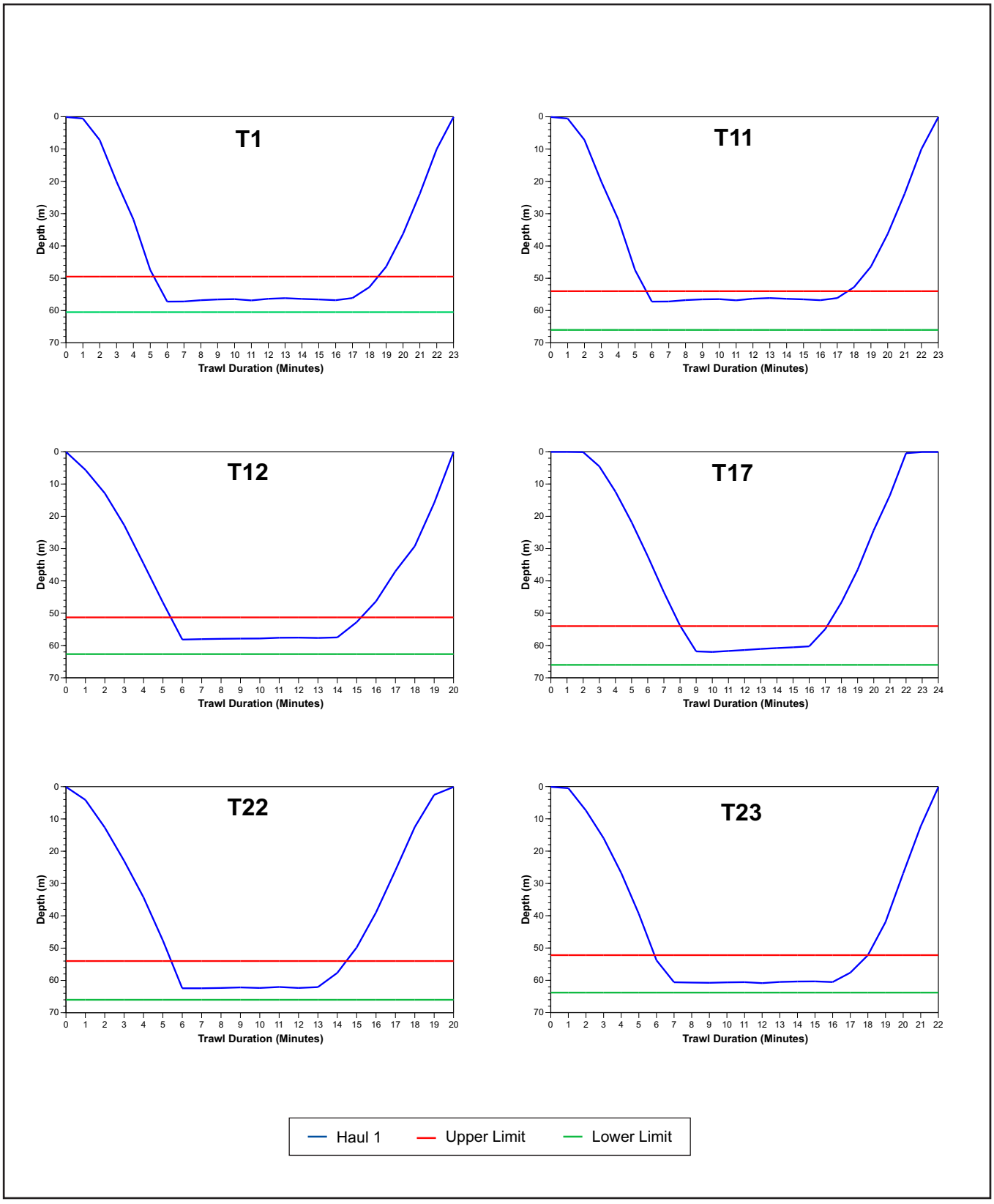

Figure C-2. **Quality assurance plots of trawl depth and trawl duration per haul for otter trawl stations, July 2013.**
Upper and lower limit lines are ± 10% of nominal trawl depth.
Data for a number of stations was unavailable due to instrument malfunction.

Orange County Sanitation District, California.

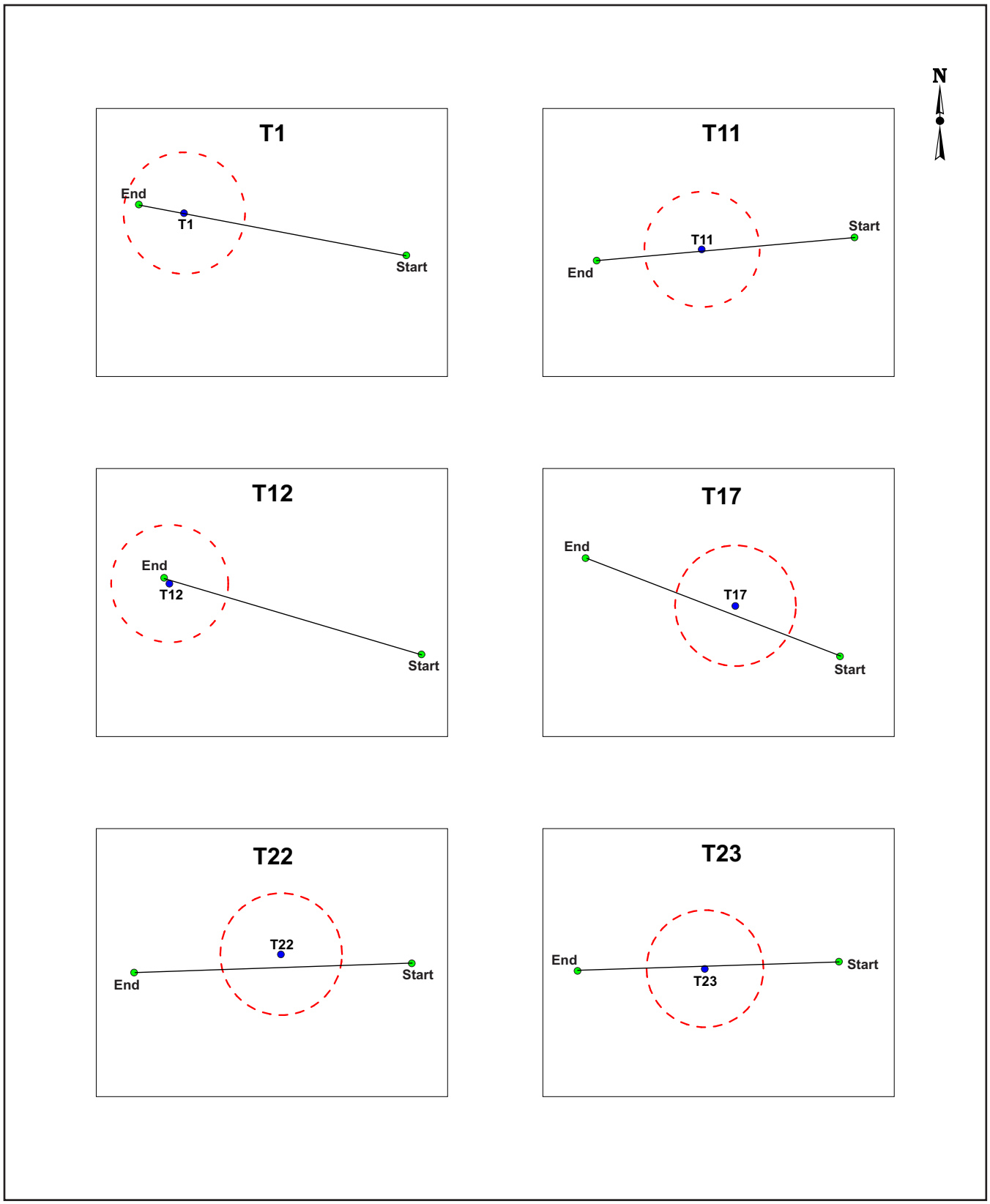

Figure C-3. Quality assurance plots of distance to station for otter trawl hauls, January 2014.

Red circle represents 100 meter distance from nominal trawl station center point.
Black lines represent trawl path while net is on the bottom.
Trawl endpoints are labeled by Start and End.

Orange County Sanitation District, California.

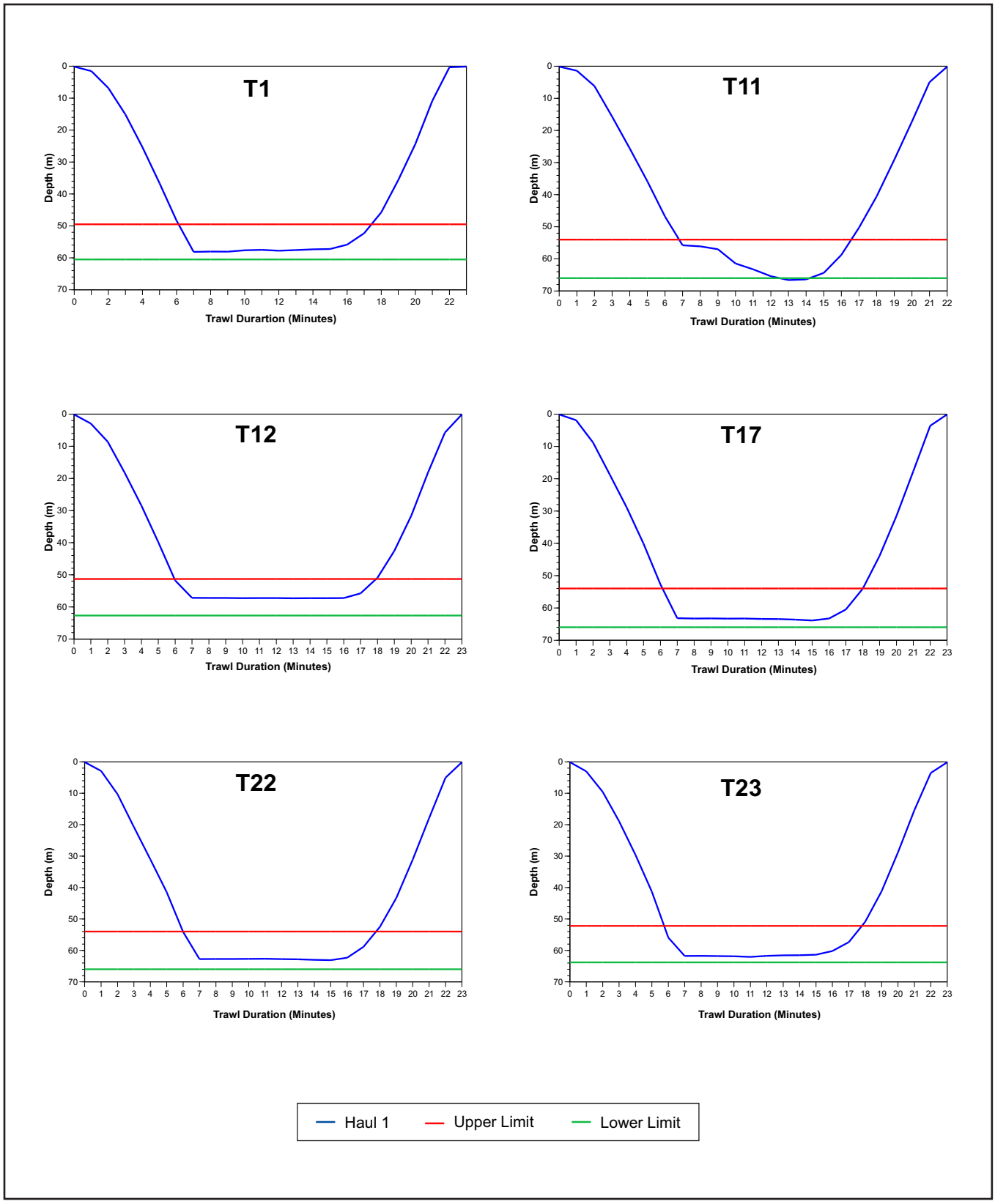

Figure C-4. **Quality assurance plots of trawl depth and trawl duration per haul for otter trawl stations, January 2014.**
Upper and lower limit lines are ± 10% of nominal trawl depth.
Data for a number of stations was unavailable due to instrument malfunction.

Orange County Sanitation District, California.

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