

DRAFT

Sampling and Analysis Plan for  
Characterization of Sediment  
Contaminant Flux for the Inner  
Harbor and Outer Harbor  
Waterbodies to Support  
Sediment TMDL Implementation

Prepared for

Port of Los Angeles  
425 S. Palos Verdes St.  
San Pedro, CA 90731

and

Port of Long Beach  
925 Harbor Plaza  
P.O. Box 570  
Long Beach, CA 90802



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ABBREVIATIONS AND ACRONYMS

ASTM	American Society for Testing and Materials
°C	Degrees Celsius
cm	centimeter
COC	chain of custody
CVAFS	cold vapor atomic fluorescence spectrophotometry
DGPS	Differential Global Positioning System
ER-L	Effects Range - Low
ER-M	Effects Range - Median
BC/FID	Gas chromatography/flame ionization detector
GC/FPD	Gas chromatography/flame photometric detector
GC-MS	Gas chromatography-mass spectrometry
ICP-MS	inductively coupled plasma emissions - mass spectrometer
L	liter
m	meters
mg/kg	milligram per kilogram
mL	milliliter
mm	millimeter
ng/L	nanogram per liter
LA RWQCB	Los Angeles Regional Water Quality Control Board
PAH	polynuclear aromatic hydrocarbon
PCB	polychlorinated biphenyl
POLA	Port of Los Angeles
POLB	Port of Long Beach
QA/QC	quality assurance/quality control
QAP	quality assurance plan
SAP	sampling and analysis plan
SIM	selected ion method
SM	Standard Methods
SPME	Solid Phase MicroExtraction
SVOC	Semivolatile organic compounds
TMDL	total maximum daily load
TOC	total organic carbon
TRPH	total recoverable petroleum hydrocarbon
TTLC	Total Threshold Limit Concentration
USEPA	United States Environmental Protection Agency
WAAS	Wide Area Augmentation System
Weston	Weston Solutions, Inc.
µg/kg	microgram per kilogram

## 1.0 INTRODUCTION

The water quality harbor model currently under development for the Los Angeles Regional Water Quality Control Board (LA RWQCB) estimates contaminant flux with equilibrium partitioning models by measuring sediment and porewater contaminant concentrations using both traditional analytical and solid phase microextraction (SPME) techniques. SPME is a passive sampling technique which exposes a membrane to ambient conditions for a period of time. The membrane absorbs volatile organic compounds which are later extracted and analyzed in a laboratory. These limited data were intended to derive partitioning characteristics that will be applied to the water quality model to estimate contaminant flux from sediments across the region, as part of total contaminant budget estimation for total maximum daily load (TMDL) development. In recent discussions with the Port of Los Angeles (POLA) and the Port of Long Beach (POLB; herein collectively referred to as the Ports), LA RWQCB, Southern California Coastal Water Research Project (SCCWRP), U.S. Environmental Protection Agency (USEPA) and Weston Solutions, Inc. (Weston), a more comprehensive data collection plan has been agreed upon to support the TMDL development process.

This sampling approach and site selection has been developed in coordination with SCCWRP in order to ensure compatibility of all data. This approach has been consistent with the original draft workplan provided by SCCWRP (June 2006). For example, both Weston and SCCWRP efforts are using the same analytical laboratory; therefore, analytical methods and method detection limits will be consistent across both programs.

### 1.1 Background

Potential sources of uncertainty in both the TMDL modeling strategy and estimations of contaminant flux were a concern due to the low number of data collection sites. These sources of uncertainty can be summarized by: spatial variability (i.e., uncertainty as to the range of sediment contaminant concentrations across the jurisdictions of the Ports), and the accuracy of modeled flux estimations (i.e., validation of the proposed model's predictions of water concentrations). These uncertainties will likely have major implications to the future environmental management of the Ports. Accurate estimation of contaminant loadings from sediments within each Port would optimize the balance between environmental responsibility and remedial cost. Inaccurate estimation of loadings might result in under- or over-estimation of environmental liability attributed to the Ports, and might impair effective environmental management and foster stakeholder uncertainty.

This work aims to reduce the uncertainty relating to both spatial variability, by using statistical power analysis and a random spatial sampling design to map both the sediment and pore water contaminant concentrations throughout the Ports, and overlying water concentrations, by using analyses of water at the sediment interface to address whether sediments in the Ports' jurisdictions represent a significant source of contaminant flux. The combination of these two strategies would offer the Ports two lines of evidence to evaluate whether sediments within its jurisdictional boundary offer a significant contribution to the eight Section 303(d) listed contaminants under consideration within the TMDL.

*Spatial variability.* Weston's experience in characterizing sediments in the Ports and a literature review suggests that the limited number of sediment analyses originally proposed by the LA RWQCB's strategy would be unlikely to quantify the spatial variability of contaminants present in the Ports. To reduce uncertainty associated with spatial variability, an assessment of the spatial variability of contaminants in sediment and pore water was performed, with a sampling plan based on a power analysis of the TMDL-related contaminant concentrations in Southern California Bight 2003 Regional Monitoring Program sediment samples collected within the Ports' jurisdictions. The sediment and pore water data may then be used to derive site-specific contaminant flux estimates pertinent to the Ports' sediments, using the equilibrium partitioning approach used in the water quality model. These site-specific estimates could be compared to estimates derived from the LA RWQCB water quality harbor model.

*Accuracy of flux estimations.* Studies of contaminant flux indicate that there is often a non-linear and poorly understood relationship between sediment and pore water concentrations of contaminants, due to issues including availability of binding phases, solubility limits and, for organics, differences in sorption properties of carbon sources. As a result, benthic contaminant flux is both spatially and temporally variable and it is unknown whether the localized sediments serve as a source or sink for contaminants. Measurement of flux rates is methodologically complex, particularly when addressing numerous contaminants with different partitioning characteristics over meaningful spatial and temporal ranges. Ultimately, more time and research intensive procedures may be necessary in a second tier of the evaluation, as a validation of findings from the current investigation. However, due to the data deliverable timeline, a less complex approach will be used to monitor for contaminant concentrations in water overlying the sediment interface. These data may be compared to concentrations predicted by the LA RWQCB water quality model, water quality criteria, numerical targets identified in the TMDL, and ambient data to address whether sediments in the Ports' jurisdictions represent a significant contaminant source.

## 1.2 Overview of Field Activities and Analyses

This sampling and analysis plan (SAP) describes the data collection methods to characterize contaminant concentrations in sediment, pore water, and overlying water to assess the contribution of sediments in the Ports' jurisdictions to contaminant loadings. These data will be used to supplement the data collected on behalf of the USEPA by the SCCWRP and provide a comparison with flux estimates derived from the proposed LA RWQCB modeling strategy. Contact information for POLA and POLB personnel and their subcontractors is provided in Appendix A.

Within each of the Ports' jurisdictional areas, 30 sediment, pore water and overlying water samples will be collected for a total of 60 samples of each matrix. Further, in the POLB, mid-column water samples will be collected and the entire water column will be profiled using a multiparameter water quality instrument at each of the 30 POLB stations. Within each Port, these 30 stations are equally divided across three different regions, or strata: 10 samples within the Inner Harbor waterbody, 10 samples within the Middle Harbor waterbody and 10 samples within the Outer Harbor waterbody. At 11 of the randomly selected sites, SPME data will be collected by SCCWRP. One additional SPME site will be located in the Consolidated Slip in POLA. The selected sites are shown in Figure 1 and a description of how the number and location of the sample sites were selected follows in Section 2.1.2.

## 1.3 Additional Solid Phase MicroExtraction Experiment

Weston would like to pursue efforts to conduct additional testing on SPME derived sediment flux data. Currently, estimates for flux are based on field samples, calculations and SPME absorption. SPME uptake in the field may be influenced by field-related factors that may effect the estimation of sediment flux. For example, the SPMEs are exposed to dissolved contaminants within the water column that travel along currents as well as contaminants fluxing from the sediment. We propose conducting a laboratory-based experiment under controlled conditions that isolates the sediment contaminant flux contribution to the water column. At each SPME location, intact cores would be collected from the field in glass tubes. Once received in the laboratory, clean seawater would be placed over the top of the intact core and a SPME device would be mounted above the sediment/water interface. After three weeks, the experiment would be ended and contaminants would be extracted and analyzed from the SPME devices as well as the overlying water, porewater and sediment. These additional results will help to validate and interpret the data generated from the field deployed SPME devices as well as the equilibrium partitioning model.



Figure 1. Sampling location within stratified sampling areas in the Inner and Outer Harbors



## 2.0 FIELD COLLECTION PROGRAM FOR SEDIMENT CORE SAMPLES

### 2.1 Sampling Locations and Depths

#### 2.1.1 Sample Size Determination

Summary statistics from the Southern California Bight 2003 data are presented below (Table 1) for several pollutants which are included in the Section 303(d) list for the Ports' jurisdictions. The coefficient of variation (standard deviation divided by the mean) was calculated for each of the nine TMDL pollutants to illustrate the relative variability.

Table 1. Summary Statistics for Southern California Bight 2003 data collected in San Pedro Bay for Pollutants included in the TMDL

TMDL Pollutant	Mean	Standard Deviation	Coefficient of Variation (%)
<b>Copper</b> (mg/kg)	109.38	115.93	106%
<b>Zinc</b> (mg/kg)	246.02	230.17	94%
<b>Lead</b> (mg/kg)	92.27	150.81	163%
<b>Benzo (a) pyrene</b> (µg/kg)	397.65	415.13	104%
<b>Chrysene</b> (µg/kg)	276.39	299.47	108%
<b>Phenanthrene</b> (µg/kg)	81.80	87.41	107%
<b>Pyrene</b> (µg/kg)	599.66	1119.95	187%
<b>Total Detectable PCBs</b> (µg/kg)	122.34	197.63	162%
<b>Sum DDT</b> (µg/kg)	137.25	264.35	193%

Using the level of contaminant variance, sample sizes required for a confidence level of 90% and differing relative error and power were calculated (Table 2). The TMDL pollutant with highest variability (Sum DDT, Table 1) was used to calculate sample size. Use of the highest variability in the pollutant set provides adequate sample size estimates for seven of the other TMDL pollutants. The sample size is based on the probability that the mean of all samples collected will be within a percentage of the actual mean. For example, 64 samples (bolded in Table 2 below) would provide a 90% confidence that the sample mean would be within plus or minus 60% of the historical mean. This sample size also incorporates an 80% power to detect a difference, if a difference does indeed exist, between these samples and the Effects Range-Low (ER-L) sediment guideline developed by Long et al. (1995), a possible screening guideline proposed by the EPA (from Dominguez Channel TMDL presentation on June 29, 2006). Based on the sample size analysis, each Port will collect 30 samples within their jurisdictional area: 10 samples in each of the Inner, Middle and Outer Harbor waterbodies for a total of 60 samples across both the Los Angeles and Long Beach Harbors.

Table 2. Sample Size Estimates for 90% Confidence and Various Error and Power

Relative Error (%)	Alpha 0.10	
	Power = 80%	Power = 90%
50%	92	127
60%	<b>64</b>	88
70%	47	65
80%	36	50
90%	28	39
100%	23	32

### 2.1.2 Site Selection:

Sample site selection was based on a stratified random sampling design. Three strata were identified within the Ports' jurisdictions: the Inner Harbor, Middle Harbor and Outer Harbor waterbodies. Ten primary sites were randomly selected in each stratum in each Port with the stipulation that the sites be at least 200 meters (m) from each other, for a total of 60 sites (see Figure 1). Five alternate sites were similarly selected in each stratum to be used only if a primary site could not be sampled. The selected sites fall within the spatial grid system to be used in the harbor hydrodynamic model, upon which the water quality model will be based. Grid locations that have been adequately characterized in previous studies were identified and removed from the sampling frame. The stratified random sampling plan represents the variability of sediment chemistry within the Ports and will provide a basis for characterization of the concentrations within each of the strata. At the 60 selected sites, sediment, pore water, overlying water and benthic samples will be collected. The sample identification numbers and target locations for the POLA are provided in Table 4. The sample identification numbers and target locations for the POLA are provided in Table 4. A site will be determined to be successfully occupied if the actual station is within a 100 m radius of the target location. If a primary site cannot be sampled, an alternate site will be used. Two vessels will be used to complete the sampling, the *RV Osprey* and *RV Zephyr*.

### 2.1.3 Navigation

Pre-plotted station positions will be located using the *RV Zephyr*'s Leica 300 SmallMX Differential Global Positioning System (DGPS) or a handheld Garmen eTrex GPS. The systems use U.S. Coast Guard differential correction data or wide area augmentation system (WAAS) correction data, respectively, and are accurate to less than 3 meters. In the event of GPS failure, stations will be located using visual lineups. All final station locations will be recorded in the field using positions from the DGPS or through lineups on the field map.



Table 3. Sediment sample identification, location and depth for the Port of Los Angeles

Port of Los Angeles					
Stratum	Station	Latitude	Longitude	Depth (ft)	SPME Locations
Inner Harbor	LAI-1	33° 45.698'	118° 16.014'	33.9	X
	LAI-2	33° 45.072'	118° 16.277'	41.1	
	LAI-3	33° 45.427'	118° 16.620'	36.5	
	LAI-4	33° 45.831'	118° 15.041'	17.9	
	LAI-5	33° 45.908'	118° 16.537'	36.9	
	LAI-6	33° 44.918'	118° 16.287'	40.3	
	LAI-7	33° 45.681'	118° 15.278'	37.2	
	LAI-8	33° 45.475'	118° 15.634'	38.8	
	LAI-9	33° 45.962'	118° 15.152'	20.5	X
	LAI-10	33° 45.366'	118° 15.690'	34.8	
	LAI-CS	SPME Location Only Actual location to be set by SCCWRP			X
	LAI-11*	33° 44.891'	118° 16.530'	34.1	
	LAI-12*	33° 45.648'	118° 16.487'	37.0	
	LAI-13*	33° 45.988'	118° 16.311'	34.7	
	LAI-14*	33° 45.759'	118° 16.555'	35.6	
	LAI-15*	33° 45.871'	118° 15.220'	34.9	
Middle Harbor	LAM-1	33° 44.259'	118° 14.661'	23.9	
	LAM-2	33° 43.653'	118° 15.553'	21.0	
	LAM-3	33° 44.899'	118° 14.866'	14.7	X
	LAM-4	33° 43.722'	118° 16.442'	29.8	
	LAM-5	33° 43.754'	118° 15.748'	16.7	
	LAM-6	33° 44.437'	118° 16.550'	39.7	
	LAM-7	33° 44.902'	118° 15.131'	7.5	
	LAM-8	33° 43.812'	118° 16.171'	19.7	X
	LAM-9	33° 43.556'	118° 16.248'	36.5	
	LAM-10	33° 44.499'	118° 14.936'	20.5	X
	LAM-11*	33° 43.233'	118° 16.632'	21.8	
	LAM-12*	33° 43.595'	118° 15.880'	18.4	
	LAM-13*	33° 44.034'	118° 14.883'	25.5	
	LAM-14*	33° 44.596'	118° 15.076'	17.6	
	LAM-15*	33° 44.641'	118° 16.448'	38.1	
Outer Harbor	LAO-1	33° 42.708'	118° 16.824'	12.7	
	LAO-2	33° 42.612'	118° 16.913'	3.3	
	LAO-3	33° 42.934'	118° 15.636'	49.8	
	LAO-4	33° 42.882'	118° 14.164'	48.2	
	LAO-5	33° 42.840'	118° 16.517'	49.1	
	LAO-6	33° 42.654'	118° 16.321'	48.6	
	LAO-7	33° 42.447'	118° 16.321'	37.1	
	LAO-8	33° 42.641'	118° 15.120'	46.2	
	LAO-9	33° 42.661'	118° 14.987'	44.6	
	LAO-10	33° 42.780'	118° 16.285'	52.5	
	LAO-11*	33° 42.536'	118° 16.151'	40.0	
	LAO-12*	33° 43.505'	118° 14.693'	33.1	
	LAO-13*	33° 42.922'	118° 16.922'	6.0	
	LAO-14*	33° 42.585'	118° 15.386'	43.0	
	LAO-15*	33° 43.265'	118° 14.850'	36.9	
* Shaded stations are alternates. If a primary station cannot be occupied safely, an alternate station will be used instead in order shown.					

Table 4. Sediment sample identification, location and depth for the Port of Long Beach

Port of Long Beach					
Stratum	Station	Latitude	Longitude	Depth (ft)	SPME Locations
Inner Harbor	LBI-1	33° 46.698'	118° 12.361'	unknown	
	LBI-2	33° 46.421'	118° 13.067'	46.4	
	LBI-3	33° 46.014'	118° 13.977'	46.5	
	LBI-4	33° 46.318'	118° 12.302'	12.3	X
	LBI-5	33° 46.088'	118° 13.201'	51.0	
	LBI-6	33° 45.917'	118° 13.316'	44.3	
	LBI-7	33° 46.461'	118° 12.873'	37.5	X
	LBI-8	33° 46.101'	118° 13.403'	42.3	
	LBI-9	33° 46.265'	118° 12.737'	43.1	X
	LBI-10	33° 45.470'	118° 13.085'	58.3	
	LBI-11*	33° 46.328'	118° 13.272'	39.1	
	LBI-12*	33° 46.205'	118° 13.324'	42.1	
	LBI-13*	33° 45.986'	118° 14.239'	54.2	
	LBI-14*	33° 46.143'	118° 13.826'	35.0	
	LBI-15*	33° 46.062'	118° 13.245'	43.5	
Middle Harbor	LBM-1	33° 44.586'	118° 11.803'	50.6	
	LBM-2	33° 45.336'	118° 12.862'	41.2	X
	LBM-3	33° 44.823'	118° 12.442'	57.5	X
	LBM-4	33° 44.540'	118° 12.091'	51.4	
	LBM-5	33° 45.246'	118° 13.977'	38.0	
	LBM-6	33° 45.007'	118° 13.694'	47.5	
	LBM-7	33° 44.234'	118° 11.299'	36.5	
	LBM-8	33° 44.433'	118° 12.264'	52.5	
	LBM-9	33° 44.884'	118° 13.537'	45.8	
	LBM-10	33° 44.587'	118° 12.257'	64.1	
	LBM-11*	33° 44.657'	118° 13.862'	45.2	
	LBM-12*	33° 45.049'	118° 12.948'	46.5	
	LBM-13*	33° 45.033'	118° 13.299'	47.2	
	LBM-14*	33° 44.856'	118° 13.342'	46.0	
	LBM-15*	33° 45.135'	118° 13.856'	46.5	
Outer Harbor	LBO-1	33° 43.298'	118° 13.792'	44.2	
	LBO-2	33° 45.203'	118° 11.102'	56.8	X
	LBO-3	33° 44.082'	118° 13.337'	38.1	
	LBO-4	33° 43.945'	118° 13.357'	44.7	
	LBO-5	33° 43.861'	118° 12.925'	53.8	
	LBO-6	33° 43.464'	118° 13.987'	41.9	
	LBO-7	33° 43.924'	118° 11.586'	47.1	
	LBO-8	33° 44.245'	118° 12.842'	54.2	
	LBO-9	33° 44.121'	118° 13.890'	44.5	
	LBO-10	33° 44.028'	118° 12.759'	65.6	
	LBO-11*	33° 44.182'	118° 13.301'	37.4	
	LBO-12*	33° 44.309'	118° 13.566'	45.9	
	LBO-13*	33° 44.250'	118° 12.414'	63.2	
	LBO-14*	33° 43.477'	118° 11.275'	59.8	
	LBO-15*	33° 44.200'	118° 13.732'	45.1	

\* Shaded stations are alternates. If a primary station cannot be occupied safely, an alternate station will be used instead in order shown.

#### 2.1.4 Sample Collection

##### *Sediment Sample Collection*

Sediment samples will be collected using a stainless steel double Van Veen Grab Sampler (Figure 2) deployed from the *RV Zephyr*. The Van Veen Grab Sampler will be lowered from the stern of the vessel using a standard winch. Upon contact with the sediment, the Van Veen automatically “trips” and the jaws close as the sampler is retrieved, capturing the sediment sample. Acceptable samples will have a penetration depth of at least 4 inches, and will show no evidence of sample “washout” or significant disruption of the sediment surface layer. Upon retrieval, a clean stainless steel spoon will be used to remove sediment from the Van Veen and sediment will be placed in a decontaminated stainless steel bowl, avoiding any material in contact with the sides or top of the sampler. Sediment samples from each sampling location will then be homogenized in the stainless-steel bowl using a large stainless-steel spoon to achieve a uniform texture and color. The homogenized sediment will be placed in pre-cleaned 500 milliliters (mL) glass jars with Teflon<sup>®</sup> lids for chemical and geotechnical analysis. Material for grain size and total organic carbon will be collected in zip lock bags and analyzed at Weston’s laboratory. Additional material will be archived in -1 degrees Celsius (°C) freezers at Weston’s laboratory for possible future analyses.

##### *Pore water Sample Collection*

The double Van Veen Grab Sampler will also be used to collect sediment for pore water extraction at each sampling location, as described above. Each sediment sample will be separately homogenized in a decontaminated stainless-steel bowl using a large stainless-steel spoon to achieve a uniform texture and color. Subsamples will then be transferred to solvent-rinsed 1 liter (L) Teflon<sup>®</sup> containers and centrifuged on the research vessel immediately after sample collection. It is estimated that 20 L of sediment will require centrifuging to generate approximately 2 L of pore water necessary for chemical analyses. Specifically, for sediment consisting of primarily fine grain sediments, about one-half of the sediment moisture content is recovered as pore water upon centrifugation. Additional sediment volume is required for sand-dominated sediments, as a result of limited sediment compaction. Teflon<sup>®</sup> containers will be loaded in the centrifuge in a manner that will create a balanced mass, and the sediment centrifuged for 15 minutes at a force of 1,000g. When completed, containers will be gently removed from the centrifuge to ensure that the sediment is not resuspended into the supernatant. The overlying water will then be decanted into pre-cleaned glass containers and enclosed with Teflon<sup>®</sup> lids. Pore water samples will be stored in the dark at  $4 \pm 2^{\circ}\text{C}$  and delivered to the laboratory within 48 hours of extraction. Pore water samples will be homogenized in the analytical laboratory prior to analysis.

##### *Benthic Infauna Collection*

The developing Sediment Quality Objectives for California will incorporate multiple lines of evidence to determine exceedance of relative criteria. Along with chemical data, one or more of these lines of evidence will include benthic community metrics. Recently, the Dominguez Channel, and Ports of Los Angeles and Long Beach Harbors TMDL project plan has listed benthic communities as impaired in parts of the water bodies. Therefore, benthic samples will be collected and archived for potential future analysis that will be coupled with sediment and pore water chemistry when necessary. Once preserved, benthic samples can be stored indefinitely.

Benthic infaunal samples will be collected using a double Van Veen Grab Sampler, according to the handling procedures described above. For accurate determination of benthic infauna, samples will be determined to be acceptable if the surface of the grab is even, there is minimal surface disturbance, and there is a penetration depth of at least 5 centimeters (cm). Rejected grabs will be discarded and sediment will be re-sampled. The entire contents of each sample including overlying surface water, will be carefully collected in a large plastic tub and processed. Samples will be gently washed through 1.0 millimeter (mm) sieve; benthic invertebrates and debris retained on the sieve will be transferred to a labeled quart jar. To

avoid contamination with water-column organisms, site water used for sample processing will be pre-filtered. An anesthetic, 7 percent (%) magnesium sulfate and seawater solution, will be added to each sample to relax the sample organisms. After a minimum of 30 minutes anesthetization, the samples will be fixed in a 10% buffered formalin-filtered seawater solution. After five to seven days samples will be transferred to ethanol for archived storage. Large debris and rocks will be examined for organisms, which, if found, will be added to the sample and the debris discarded. Samples will be stored at Weston's Benthic Laboratory until analysis is requested by the Port.

#### *Overlying Water Collection*

Scientific divers will be used to collect overlying water, or water located immediately on top of the sediment-water interface. All divers used to collect overlying water have been trained in diving and underwater sample collection techniques in the 100 hour course by the American Association of Underwater Scientists, or have had equivalent training. Divers will use standard diving equipment while collecting samples, or Self Contained Underwater Breathing Apparatus (SCUBA). Approximately 3 L of overlying water will be collected by transporting three sealed 1 L acid-rinsed glass jars to the sediment-water interface, carefully removing the lid, and the water collected and the lid replaced. Care will be taken to collect overlying water without disturbing the underlying sediment or resuspending sediment particles into the water column. If the sediment is disturbed, the water sample will be discarded and a new sample collected.

#### *Enhanced Water Quality Sampling (POLB Only)*

Additional water quality samples will be collected in the POLB at the same stations and in conjunction with the sediment, pore water, and overlying water sampling described above. Specifically, water quality sampling will consist of profiles for temperature, salinity, dissolved oxygen, and transmissivity collected with a Sea-Bird CTD datalogger and grab samples for chemistry. Data recorded for each station will include latitude and longitude (measured by DGPS) and any observations of odor, oil, grease, or other floatable material on the surface of the water. Grab samples will be collected with a Van Dorn sampling bottle at mid-depth. Samples will be analyzed to the low level detection limits as recommended in the Surface Waters Ambient Monitoring Program (SWAMP).

#### *Solid Phase MicroExtraction Sample Collection*

SPMEs will be retrieved by SCUBA divers during the week of October 16, 2006. Additional overlying water will be collected at the same time to allow for comparisons between the SPME extractions and overlying water extraction. Five gallons of overlying water will be collected by SCUBA divers using a Teflon hose. A peristaltic pump will pump the water into a pre-cleaned 5-gallon glass bottle. It is anticipated that the increased volume will allow for greater detection of analytes.

## 2.2 Sample Processing and Storage

Samples will be labeled, placed on ice, and shielded from light until delivered to CRG Marine Laboratories, Calscience Environmental Laboratories or Weston's laboratory personnel for analysis. Any sediment not immediately analyzed will be stored at 4°C at the Weston laboratory in Carlsbad until chemical and geotechnical characterization is complete.

## 2.3 Decontamination of Field Equipment

All sampling devices, mixing equipment and centrifuge equipment will be cleaned prior to use for each sample location. The Teflon<sup>®</sup> centrifuge bottles will be washed with soap and water, rinsed in deionized water and acetone between sample locations.

## 2.4 Documentation and Chain-of-Custody

The principal documents used to identify samples and to document possession are Chain-of-custody (COC) records, field logbooks, and field tracking forms. COC procedures will be used for all samples throughout the collection, transport, and analytical process, and for all data documentation, whether in hard copy or electronic format.

COC forms will be completed (see Appendix B) and placed in a plastic sealed envelope that will travel inside the ice chest containing the listed samples. The person transferring custody of the samples will sign the COC form. The receiver will record the condition of the samples. COC records will be included in the final analytical report prepared by the laboratory, and will be considered an integral part of that report.

Samples are considered to be in custody if they are: (1) in the custodian's possession or view, (2) retained in a secured place (under lock) with restricted access, or (3) placed in a container and secured with an official seal(s) such that the sample cannot be reached without breaking the seal(s). Minimum documentation of sample handling and custody will include the following:

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



Figure 2. Double Van Veen Grab Sampler

### 3.0 CHEMICAL AND GEOTECHNICAL ANALYSIS

Physical and chemical parameters to be measured in this testing program were selected to provide data on potential chemicals of concern in sediments in the Ports. All analytical methods used to obtain contaminant concentrations follow USEPA, Standard Methods (SM) or American Society for Testing and Materials (ASTM) procedures. The specific sediment analyses and target detection limits are listed in Table 5.

#### 3.1 Geotechnical Analyses

To characterize the physical properties of the sediment, tests will be performed to predict the behavior of sediment after disposal and to compare reference and project sediment. Physical analyses of the sediment will include grain size, specific gravity, total organic carbon (TOC), and total solids. Grain size is analyzed to determine the general size classes that make up the sediment (e.g., gravel, sand, silt, and clay). The frequency distribution of the size ranges (reported in millimeters [mm]) of the sediment will be reported in the final data report. Grain size will be conducted using the gravimetric procedure described in Plumb (1981). Specific gravity will be measured using ASTM Method 2710F (ASTM 2003). TOC, made up of volatile and nonvolatile organic compounds, will be determined using the Lloyd Kahn method (USEPA Region II 1988). This procedure involves dissolving inorganic carbon (carbonates and bicarbonates) with hydrochloric acid or sulfuric acid prior to TOC analysis using USEPA 9060A protocol. Total solids will also be measured to convert concentrations of the chemical parameters from a wet-weight to a dry-weight basis. Percent solids will be determined by ASTM Method 2540G (ASTM 2003).

#### 3.2 Sediment, Pore Water and Overlying Water Chemistry

Project and reference sediments, pore water and overlying water will be analyzed for the chemicals indicated in Table 5. The target detection limits (sediment – dry weight) are also presented in Table 5.

The analysis for priority pollutant metals (except mercury) will be conducted using an inductively coupled plasma emissions spectrometer equipped with a mass detector (ICP-MS), in accordance with USEPA 6020m. In porewater and sediment, mercury analysis will be conducted using cold vapor atomic fluorescence spectrophotometry (CVAFS) in accordance with USEPA 245.7m. In overlying water, mercury analysis will be conducted using atomic fluorescence in accordance with USEPA 1634m in order to achieve a lower detection limit. The latter method requires a greater volume of water and therefore is not logistically feasible for porewater analysis. The analysis for total and dissolved sulfides will follow SM 4500 S2-D. The analysis for ammonia will follow SM4500-NH3F. Oil and grease will be measured using USEPA 1664A. Total recoverable petroleum hydrocarbons (TRPH) will be measured by USEPA 418.1.

Acid extractable compounds and semivolatile organics (SVOC) including polynuclear aromatic hydrocarbons (PAHs), chlorinated pesticides, and polychlorinated biphenyls (PCBs), will be analyzed using gas chromatography-mass spectrometry (GC/MS) with selected ion monitoring (SIM) according to USEPA Method 8270m. This method will follow serial extraction with methylene chloride and alumina and gel permeation column cleanup procedures. PCBs will be identified as Aroclors and individual congeners, separately. Organotins will be conducted using gas chromatograph/flame photometric detector (GC/FPD). The analytical method used to determine TBT involves methylene chloride extraction, followed by Grignard derivatization and analyzed by GC/MS (Krone et al., 1989).

Results of chemical analyses of project sediment samples will be compared to ER-L and Effects Range-Median (ER-M) values developed by Long et al. (1995), and regulatory levels or total threshold limit concentration (TTLC) values. The ER-L and ER-M values are helpful in assessing the potential



significance of elevated sediment-associated contaminants of concern, in conjunction with biological analyses. Briefly, these values were developed from a large data set where results of both benthic organism effects (e.g., amphipod toxicity tests) and chemical analysis were available for individual samples. The ER-L was then calculated as the lower 10th percentile of the observed effects concentrations and the ER-M as the 50<sup>th</sup> percentile of the observed effects concentrations.

Table 5. Chemical and Physical Measures, Analytical Methods, and Target Detection Limits for Sediment, Pore Water and Overlying Water Samples.

Chemical/Physical Measure	Method	Procedure	Sediment Target Detection Limits (dry weight)	Pore Water and Overlying Water Detection Limits
<b>Physical / Conventional Tests</b>				
Grain Size	Plumb (1981)	Sieve/Pipette	1.0%	n/a
Specific Gravity	ASTM 2710F	Gravimetric	0.001 g/cc	n/a
TOC	Lloyd Kahn (1988)	Combustion IR	0.01%	0.1 mg/L
Percent Total Solids	SM 2540G	Gravimetric	0.1%	n/a
Dissolved Ammonia	SM 4500-NH <sub>3</sub> F	Titrametric	0.001 mg/kg	n/a
Total Sulfides	SM 4500-S <sub>2</sub> D	Titrametric	0.1 mg/kg	n/a
Dissolved Sulfides	SM 4500-S <sub>2</sub> D	Titrametric	0.1 mg/kg	n/a
Oil and Grease	USEPA 1664A	Gravimetric	0.1 mg/kg	n/a
TRPH	USEPA 418.1	IR Spectroscopy	0.1 mg/kg	n/a
Dissolved Organic Carbon	USEPA 415.1	Combustion IR	n/a	0.100 mg/L
Total Suspended Solids	SM 2540 D	Gravimetric	n/a	0.5 mg/L
<b>Metals</b>				
Aluminum (Al)	USEPA 6020M	ICP-MS	1 mg/kg	3 µg/L
Antimony (Sb)	USEPA 6020M	ICP-MS	0.025 mg/kg	0.010 µg/L
Arsenic (As)	USEPA 6020M	ICP-MS	0.025 mg/kg	0.010 µg/L
Barium (Ba)	USEPA 6020M	ICP-MS	0.025 mg/kg	0.005 µg/L
Beryllium (Be)	USEPA 6020M	ICP-MS	0.025 mg/kg	0.005 µg/L
Cadmium (Cd)	USEPA 6020M	ICP-MS	0.025 mg/kg	0.005 µg/L
Chromium (Cr)	USEPA 6020M	ICP-MS	0.025 mg/kg	0.025 µg/L
Copper (Cu)	USEPA 6020M	ICP-MS	0.025 mg/kg	0.010 µg/L
Iron (Fe)	USEPA 6020M	ICP-MS	1 mg/kg	0.500 µg/L
Lead (Pb)	USEPA 6020M	ICP-MS	0.025 mg/kg	0.005 µg/L
Mercury (Hg)	USEPA 245.7M	CVAFS	0.010 mg/kg	0.010 µg/L
Mercury (Hg) overlying water only	USEPA 1631M	Atomic fluorescence	n/a	0.001 µg/L
Nickel (Ni)	USEPA 6020M	ICP-MS	0.025 mg/kg	0.005 µg/L
Selenium (Se)	USEPA 6020M	ICP-MS	0.025 mg/kg	0.010 µg/L
Silver (Ag)	USEPA 6020M	ICP-MS	0.025 mg/kg	0.020 µg/L
Zinc (Zn)	USEPA 6020M	ICP-MS	0.025 mg/kg	0.005 µg/L
<b>Pesticides</b>				
2-4' DDD	USEPA 8270M	GC/MS SIM	1 µg/kg	1 ng/L
4-4' DDD	USEPA 8270M	GC/MS SIM	1 µg/kg	1 ng/L
2-4'-DDE	USEPA 8270M	GC/MS SIM	1 µg/kg	1 ng/L
4-4'-DDE	USEPA 8270M	GC/MS SIM	1 µg/kg	1 ng/L
2-4'-DDT	USEPA 8270M	GC/MS SIM	1 µg/kg	1 ng/L
4-4'-DDT	USEPA 8270M	GC/MS SIM	1 µg/kg	1 ng/L
Chlordane and derivatives	USEPA 8270M	GC/MS SIM	1 µg/kg	1 ng/L
Dieldrin	USEPA 8270M	GC/MS SIM	1 µg/kg	1 ng/L
Lindane	USEPA 8270M	GC/MS SIM	1 µg/kg	1 ng/L
Toxaphene	USEPA 8270M	GC/MS SIM	10 µg/kg	10 ng/L
<b>PCBs</b>				
Individual Congeners (41)	USEPA 8270M	GC/MS SIM	1 µg/kg	1 ng/L
Total PCBs	USEPA 8270M	GC/MS SIM	n/a	n/a

Chemical/Physical Measure	Method	Procedure	Sediment Target Detection Limits (dry weight)	Pore Water and Overlying Water Detection Limits
<b>Organotins</b>				
Monobutyltin	Krone et al. (1989)	GC/MS	1 µg/kg	n/a
Dibutyltin	Krone et al. (1989)	GC/MS	1 µg/kg	n/a
Tributyltin	Krone et al. (1989)	GC/MS	1 µg/kg	n/a
Tetrabutyltin	Krone et al. (1989)	GC/MS	1 µg/kg	n/a
<b>Semivolatile Organic Compounds</b>				
Biphenyl	USEPA 8270M	GC/MS SIM	1 µg/kg	1 ng/L
2,6-Dimethylnaphthalene	USEPA 8270M	GC/MS SIM	1 µg/kg	1 ng/L
1-Methylphenanthrene	USEPA 8270M	GC/MS SIM	1 µg/kg	1 ng/L
1-Methylnaphthalene	USEPA 8270M	GC/MS SIM	1 µg/kg	1 ng/L
2-Methylnaphthalene	USEPA 8270M	GC/MS SIM	1 µg/kg	1 ng/L
1,6,7-Trimethylnaphthalene	USEPA 8270M	GC/MS SIM	1 µg/kg	1 ng/L
Naphthalene	USEPA 8270M	GC/MS SIM	1 µg/kg	1 ng/L
Acenaphthylene	USEPA 8270M	GC/MS SIM	1 µg/kg	1 ng/L
Acenaphthene	USEPA 8270M	GC/MS SIM	1 µg/kg	1 ng/L
Fluorene	USEPA 8270M	GC/MS SIM	1 µg/kg	1 ng/L
Phenanthrene	USEPA 8270M	GC/MS SIM	1 µg/kg	1 ng/L
Anthracene	USEPA 8270M	GC/MS SIM	1 µg/kg	1 ng/L
Fluoranthene	USEPA 8270M	GC/MS SIM	1 µg/kg	1 ng/L
Pyrene	USEPA 8270M	GC/MS SIM	1 µg/kg	1 ng/L
Chrysene	USEPA 8270M	GC/MS SIM	1 µg/kg	1 ng/L
Benzo(a)anthracene	USEPA 8270M	GC/MS SIM	1 µg/kg	1 ng/L
Benzo(b)fluoranthene	USEPA 8270M	GC/MS SIM	1 µg/kg	1 ng/L
Benzo(a)pyrene	USEPA 8270M	GC/MS SIM	1 µg/kg	1 ng/L
Benzo(e)pyrene	USEPA 8270M	GC/MS SIM	1 µg/kg	1 ng/L
Indeno(1,2,3-cd)pyrene	USEPA 8270M	GC/MS SIM	1 µg/kg	1 ng/L
Dibenzo(a,h)anthracene	USEPA 8270M	GC/MS SIM	1 µg/kg	1 ng/L
Benzo(g,h,i) perylene	USEPA 8270M	GC/MS SIM	1 µg/kg	1 ng/L
Benzo(k)fluoranthene	USEPA 8270M	GC/MS SIM	1 µg/kg	1 ng/L
Total PAHs	USEPA 8270M	GC/MS SIM	n/a	n/a
%      percent ng/kg    nanogram per kilogram µg/kg    microgram per kilogram mg/L     milligram per liter g/cc     gram per cubic centimeter n/a      not applicable GC/MS   gas chromatography/mass spectrometry SIM     selected ion monitoring				

### 3.3 Mid-Depth Water Chemistry (for Enhanced Sampling Program at the POLB)

Mid-depth water samples collected as part of the enhanced water quality sampling program at the POLB will be analyzed for the chemicals indicated in Table 6. These water samples will be analyzed to low level detection limits as presented in Table 6.

Dissolved organic carbon and total organic carbon will be analyzed by combustion or oxidation according to USEPA 415.1. The analysis for priority pollutant [particulate] metals will be conducted using an ICP-MS, in accordance with USEPA 6020. Total metals will be analyzed by ICP-MS according to USEPA 1640. SVOCs will be analyzed using GC/MS according to USEPA 8270C. Petroleum hydrocarbons will be analyzed according to USEPA 413.1. Gasoline and diesel range total petroleum hydrocarbons will be

analyzed with a gas chromatograph/flame ionization detector (GC/FID) according to USEPA 8015B. Organotins will be analyzed using a GC/FPD. Chlorinated pesticides and PCBs will be analyzed using USEPA 8081A/8082. PCBs will be identified as aroclors and individual congeners, separately.

Table 6. Chemical and Physical Measures, Analytical Methods, and Target Detection Limits for Mid-Depth Water Column Samples.

Chemical/Physical Measure	Method	Procedure	Mid-Depth Water
<b>Physical / Conventional Tests</b>			
TOC	USEPA 415.1	Combustion IR	0.1 mg/L
Dissolved Organic Carbon	USEPA 415.1	Combustion IR	0.1 mg/L
Oil and Grease	EPA 413.1		1 mg/L
Total Petroleum Hydrocarbons – Gasoline Range	EPA 8015B	GC/FID	70 µg/L
Total Petroleum Hydrocarbons – Diesel Range	EPA 8015B	GC/FID	50 µg/L
<b>Total Metals</b>			
Arsenic (As)	USEPA 1640	ICP-MS	0.010 µg/L
Cadmium (Cd)	USEPA 1640	ICP-MS	0.005 µg/L
Chromium (Cr)	USEPA 1640	ICP-MS	0.025 µg/L
Copper (Cu)	USEPA 1640	ICP-MS	0.01 µg/L
Lead (Pb)	USEPA 1640	ICP-MS	0.005 µg/L
Mercury (Hg)	USEPA 1640	ICP-MS	0.01 µg/L
Nickel (Ni)	USEPA 1640	ICP-MS	0.005 µg/L
Selenium (Se)	USEPA 1640	ICP-MS	0.010 µg/L
Silver (Ag)	USEPA 1640	ICP-MS	0.02 µg/L
Zinc (Zn)	USEPA 1640	ICP-MS	0.005 µg/L
<b>Particulate Metals</b>			
Arsenic (As)	USEPA 6020	ICP-MS	0.010 µg/L
Cadmium (Cd)	USEPA 6020	ICP-MS	0.005 µg/L
Chromium (Cr)	USEPA 6020	ICP-MS	0.025 µg/L
Copper (Cu)	USEPA 6020	ICP-MS	0.01 µg/L
Lead (Pb)	USEPA 6020	ICP-MS	0.005 µg/L
Mercury (Hg)	USEPA 6020	ICP-MS	0.01 µg/L
Nickel (Ni)	USEPA 6020	ICP-MS	0.005 µg/L
Selenium (Se)	USEPA 6020	ICP-MS	0.010 µg/L
Silver (Ag)	USEPA 6020	ICP-MS	0.02 µg/L
Zinc (Zn)	USEPA 6020	ICP-MS	0.005 µg/L
<b>Pesticides</b>			
2-4' DDD	USEPA 8081A/8082	GC/MS SIM	0.01 µg/L
4-4' DDD	USEPA 8081A/8082	GC/MS SIM	0.01 µg/L
2-4'-DDE	USEPA 8081A/8082	GC/MS SIM	0.01 µg/L
4-4'-DDE	USEPA 8081A/8082	GC/MS SIM	0.01 µg/L
2-4'-DDT	USEPA 8081A/8082	GC/MS SIM	0.01 µg/L
4-4'-DDT	USEPA 8081A/8082	GC/MS SIM	0.01 µg/L
Aldrin	USEPA 8081A/8082	GC/MS SIM	0.01 µg/L
α BHC	USEPA 8081A/8082	GC/MS SIM	0.01 µg/L
β BHC	USEPA 8081A/8082	GC/MS SIM	0.01 µg/L
δ BHC	USEPA 8081A/8082	GC/MS SIM	0.01 µg/L
γ BHC (Lindane)	USEPA 8081A/8082	GC/MS SIM	0.01 µg/L
Chlordane	USEPA 8081A/8082	GC/MS SIM	0.1 µg/L
Dieldrin	USEPA 8081A/8082	GC/MS SIM	0.01 µg/L
Endosulfan I	USEPA 8081A/8082	GC/MS SIM	0.01 µg/L
Endosulfan II	USEPA 8081A/8082	GC/MS SIM	0.01 µg/L
Endosulfan Sulfate	USEPA 8081A/8082	GC/MS SIM	0.01 µg/L
Endrin	USEPA 8081A/8082	GC/MS SIM	0.01 µg/L
Endrin Aldehyde	USEPA 8081A/8082	GC/MS SIM	0.01 µg/L
Heptachlor	USEPA 8081A/8082	GC/MS SIM	0.01 µg/L

Chemical/Physical Measure	Method	Procedure	Mid-Depth Water
Heptachlor Epoxide	USEPA 8081A/8082	GC/MS SIM	0.025 µg/L
Toxaphene	USEPA 8081A/8082	GC/MS SIM	0.5 µg/L
<b>PCBs</b>			
Aroclors	USEPA 8081A/8082	GC/MS SIM	0.1 µg/L
Individual Congeners (41)	USEPA 8081A/8082	GC/MS SIM	1 ng/L
Total PCBs	USEPA 8081A/8082	GC/MS SIM	n/a
<b>Semivolatile Organic Compounds</b>			
1,2,4-Trichlorobenzene	USEPA 8270C	GC/MS SIM	1 µg/L
1,2-Dichlorobenzene	USEPA 8270C	GC/MS SIM	1 µg/L
1,3-Dichlorobenzene	USEPA 8270C	GC/MS SIM	1 µg/L
1,4-Dichlorobenzene	USEPA 8270C	GC/MS SIM	1 µg/L
2,4,6-Trichlorophenol	USEPA 8270C	GC/MS SIM	1 µg/L
2,4-Dichlorophenol	USEPA 8270C	GC/MS SIM	1 µg/L
2,4-Dimethylphenol	USEPA 8270C	GC/MS SIM	1 µg/L
2,4-Dinitrophenol	USEPA 8270C	GC/MS SIM	5 µg/L
2,4-Dinitrotoluene	USEPA 8270C	GC/MS SIM	1 µg/L
2,6-Dinitrotoluene	USEPA 8270C	GC/MS SIM	1 µg/L
2-Chloronaphthalene	USEPA 8270C	GC/MS SIM	1 µg/L
2-Chlorophenol	USEPA 8270C	GC/MS SIM	1 µg/L
2-Nitrophenol	USEPA 8270C	GC/MS SIM	1 µg/L
3,3'-Dichlorobenzidine	USEPA 8270C	GC/MS SIM	1 µg/L
4,6-Dinitro-2-Methylphenol	USEPA 8270C	GC/MS SIM	5 µg/L
4-Bromophenyl-Phenyl Ether	USEPA 8270C	GC/MS SIM	1 µg/L
4-Chloro-3-Methylphenol	USEPA 8270C	GC/MS SIM	1 µg/L
4-Chlorophenyl-Phenyl Ether	USEPA 8270C	GC/MS SIM	1 µg/L
4-Nitrophenol	USEPA 8270C	GC/MS SIM	1 µg/L
Acenaphthene	USEPA 8270C	GC/MS SIM	1 µg/L
Acenaphthylene	USEPA 8270C	GC/MS SIM	1 µg/L
Anthracene	USEPA 8270C	GC/MS SIM	1 µg/L
Benzidine	USEPA 8270C	GC/MS SIM	1 µg/L
Benzo (a) Anthracene	USEPA 8270C	GC/MS SIM	1 µg/L
Benzo (a) Pyrene	USEPA 8270C	GC/MS SIM	1 µg/L
Benzo (b) Fluoranthene	USEPA 8270C	GC/MS SIM	1 µg/L
Benzo (g,h,i) Perylene	USEPA 8270C	GC/MS SIM	1 µg/L
Benzo (k) Fluoranthene	USEPA 8270C	GC/MS SIM	1 µg/L
Bis(2-Chloroethoxy) Methane	USEPA 8270C	GC/MS SIM	1 µg/L
Bis(2-Chloroethyl) Ether	USEPA 8270C	GC/MS SIM	1 µg/L
Bis(2-Chloroisopropyl) Ether	USEPA 8270C	GC/MS SIM	1 µg/L
Bis(2-Ethylhexyl) Phthalate	USEPA 8270C	GC/MS SIM	1 µg/L
Butyl Benzyl Phthalate	USEPA 8270C	GC/MS SIM	1 µg/L
Chrysene	USEPA 8270C	GC/MS SIM	1 µg/L
Di-n-Butyl Phthalate	USEPA 8270C	GC/MS SIM	1 µg/L
Di-n-Octyl Phthalate	USEPA 8270C	GC/MS SIM	1 µg/L
Dibenz (a,h) Anthracene	USEPA 8270C	GC/MS SIM	1 µg/L
Diethyl Phthalate	USEPA 8270C	GC/MS SIM	1 µg/L
Dimethyl Phthalate	USEPA 8270C	GC/MS SIM	1 µg/L
Fluoranthene	USEPA 8270C	GC/MS SIM	1 µg/L
Fluorene	USEPA 8270C	GC/MS SIM	1 µg/L
Hexachlorobenzene	USEPA 8270C	GC/MS SIM	1 µg/L
Hexachloro-1,3-Butadiene	USEPA 8270C	GC/MS SIM	1 µg/L
Hexachlorocyclopentadiene	USEPA 8270C	GC/MS SIM	1 µg/L
Hexachloroethane	USEPA 8270C	GC/MS SIM	1 µg/L
Indeno (1,2,3-c,d) Pyrene	USEPA 8270C	GC/MS SIM	1 µg/L
Isophorone	USEPA 8270C	GC/MS SIM	1 µg/L
N-Nitroso-di-n-propylamine	USEPA 8270C	GC/MS SIM	1 µg/L
N-Nitrosodimethylamine	USEPA 8270C	GC/MS SIM	1 µg/L
N-Nitrosodiphenylamine	USEPA 8270C	GC/MS SIM	1 µg/L

Chemical/Physical Measure	Method	Procedure	Mid-Depth Water
Naphthalene	USEPA 8270C	GC/MS SIM	1 µg/L
Nitrobenzene	USEPA 8270C	GC/MS SIM	1 µg/L
Pentachlorophenol	USEPA 8270C	GC/MS SIM	1 µg/L
Phenanthrene	USEPA 8270C	GC/MS SIM	1 µg/L
Phenol	USEPA 8270C	GC/MS SIM	1 µg/L
Pyrene	USEPA 8270C	GC/MS SIM	1 µg/L
1,2-Diphenylhydrazine	USEPA 8270C	GC/MS SIM	1 µg/L
Total PAHs	USEPA 8270C	GC/MS SIM	n/a
<b>Organotins</b>			
Monobutyltin	Krone	GC/MS	1 ng/L
Dibutyltin	Krone	GC/MS	1 ng/L
Tributyltin	Krone	GC/MS	1 ng/L
Tetrabutyltin	Krone	GC/MS	1 ng/L

% percent  
 ng/kg nanogram per kilogram  
 µg/kg microgram per kilogram  
 mg/L milligram per liter  
 g/cc gram per cubic centimeter  
 n/a not applicable  
 GC/MS gas chromatography/mass spectrometry  
 SIM selected ion monitoring

### 3.4 Quality Assurance/Quality Control (QA/QC)

The QA objectives for chemical analysis conducted by the participating analytical laboratories are detailed in their Laboratory QA Manual(s). These objectives for accuracy and precision involve all aspects of the testing process, including the following:

- Methods and Standard Operating Procedures
- Calibration methods and frequency
- Data analysis, validation, and reporting
- Internal QC
- Preventive maintenance
- Procedures to ensure data accuracy and completeness

Results of all laboratory QC analyses will be reported with the final data. Any QC samples that fail to meet the specified QC criteria in the methodology or Quality Assurance Plan (QAP) will be identified, and the corresponding data will be appropriately qualified in the final report.

All QA/QC records for the various testing programs will be kept on file for review by regulatory agency personnel.

#### 4.0 DATA REVIEW, MANAGEMENT, AND ANALYSIS

##### 4.1 Data Review

All data will be reviewed and verified by participating team laboratories to determine whether all data quality objectives have been met, and that appropriate corrective actions have been taken, when necessary.

##### 4.2 Data Management

All laboratories will supply analytical results in both hard copy and electronic formats. Laboratories will have the responsibility of ensuring that both forms are accurate.

##### 4.3 Data Analysis

Weston staff will prepare a Draft Report, to include discussion and mapping of the patterns in spatial distribution of TMDL pollutant concentrations in Harbor sediments and waters.

The sediment, pore water and overlying water data can be used in the model to estimate benthic contaminant flux within the harbors. The model estimates benthic flux at each site using the equilibrium partitioning approach used in the water quality model. Data not included as inputs can be used to validate the model. Mapping of the sediment contamination profile will also provide information on the spatial variability, the magnitude and direction of benthic fluxes, and the uncertainty of benthic flux estimations across the sediment-water interface. The overlying water data will also be compared to water quality criteria and TMDL numerical targets to assess the environmental implications of the water quality in the harbor. The sediment data may also be applied to evaluate the spatial patterns of surficial sediment contamination within the Ports' jurisdictions.

Subsequent to the field effort, data from the Sea-Bird CTD will be processed using software provided with the instrument. Data will be averaged into one-meter depth intervals.

## 5.0 REPORTING

### 5.1 Draft and Final Reports

After all results are received, statistical analyses completed, and all evaluations made, draft and final reports will be prepared. These will include summaries of all activities associated with collecting, transporting, and the chemical and geotechnical analyses of sediment samples. The chemical and geotechnical data reports will be included as appendices. As a minimum, the following will be included in the final report:

- Summary of all field activities, including a description of any deviations from the approved SAP and QAP
- Locations of sediment sampling stations, reported in latitude and longitude (DD MM.MMMM) (NAD 83)
- Final QA/QC report, as described in Section 5.2
- Data Results. In addition to hard copies of field data, laboratory analysis results, and associated QA/QC data, electronic copies for all data will be stored

### 5.2 QA/QC and Laboratory Data Report

Analytical laboratories will provide a QA/QC narrative that describes the results of the standard QA/QC protocols that accompany analysis of field samples. The QAP details these protocols. All hard copies of results will be maintained in a project and included in the final report. In addition, back-up copies of results generated by the contract chemistry laboratory will be maintained at their facility. At a minimum, the laboratory reports will contain results of the laboratory analysis, QA/QC results, all protocols and any deviations from the project SAP and QAP, and a case narrative of COC details.

## 6.0 SCHEDULE

Field collection is scheduled to begin October 2, 2006. Once initiated, field sampling activities are anticipated to take approximately 10 -12 days. Upon completion of the field sampling effort, chemical analysis of sediment will be completed in approximately four weeks. Once all results have been collected and undergone QA/QC review, a draft report will be prepared. It is anticipated that the draft report will be available to the Ports for review by December 15, 2006.



## 7.0 REFERENCES

- Krone, C.A., D.W. Brown, D.G. Burrows, R.G. Bogar, S.L. Chan, and U. Varanasi. 1989. A method for analysis of butyltin species in measurement of butyltins in sediment and English sole livers from Puget Sound. *Marine Environmental Research* 27:1-18.
- Long, E.R., D.D. MacDonald, S.L. Smith, and F.D. Calder. 1995. Incidence of Adverse Biological Effects within Ranges of Chemical Concentrations in Marine and Estuarine Sediments. *Environmental Management* 19:1 pp 81-97.
- Plumb, R.H., Jr. 1981. *Procedure for handling and chemical analysis of sediment and water samples. Technical Report EPA/CE-81-1*. U.S. Environmental Protection Agency/U.S. Army Corps of Engineers Technical Committee on criteria for dredged and fill material, U.S. Army Waterways Experimental Station. Vicksburg, MS.
- United States Environmental Protection Agency, Region II (USEPA Region II). 1988. Determination of Total Organic Carbon in Sediment (Lloyd Kahn Method). Edison, N.J. 27 July.

## Appendix A

### Point-of-Contact Information

Table A-1: Point-of-Contact Information

Organization	Point of Contact	Address	Phone/FAX	E-mail
Port of Los Angeles	Ms. Kathryn Curtis Mr. Andrew Jirik	425 S. Palos Verdes St. San Pedro, CA 90731	(310) 732-3681 (310) 547-4643	kcurtis@portla.org ajirik@portla.org
Port of Long Beach	Mr. Richard Cameron Mr. Matt Arms	925 Harbor Plaza, P.O. Box 570 Long Beach, CA 90802	(562) 590-4160	rcameron@polb.com marms@polb.com
CRG Marine Laboratories, Inc.	Mr. Rich Gossett	355 Van Ness Ave. Torrance, CA	(310) 533-5190 (310) 533-5003	crglabs@sbcglobal.net
Weston Solutions, Inc.	Dr. David Moore Dr. Shelly Anghera	2433 Impala Drive Carlsbad, CA 92010	(760) 931-8081 (760) 931-1580	david.moore@westonsolutons.com shelly.anghera@westonsolutions.com

Appendix B  
CHAIN OF CUSTODY FORM



## CHAIN OF CUSTODY

№- 10150

- ☐ 2433 Impala Drive • Carlsbad, CA 92008 • (760) 931-8081, FAX 931-1580
- ☐ 98 Main St., Ste. #428 • Tiburon, CA 94920 • (415) 435-1847, FAX 435-0479
- ☐ 1440 Broadway, Ste. 908 • Oakland, CA 94612 • (510) 808-0302, FAX 891-9710
- ☐ 152 Sunset View Lane • Sequim, WA 98382 • (360) 562-1758, FAX 582-1679
- ☐ 4729 NE View Drive • Port Gamble, WA 98364 • (360) 297-6903, FAX 297-6905

[illegible]