SAMPLING AND ANALYSIS PLAN

BERTHS 145 THROUGH 147 DREDGED MATERIAL TESTING (REVISED)

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LIST OF ACRONYMS AND ABBREVIATIONS

ADDAMS	Automated Dredging and Disposal Alternatives Management System
AMEC	AMEC Earth & Environmental
ANOVA	analysis of variance
ASTM	American Society for Testing and Materials
BP	bioaccumulation phase
Calscience	Calscience Environmental Laboratories
cv	coefficient of variation
EPA	U.S. Environmental Protection Agency
ERL	effects range low
ERM	effects range median
FDA	U.S. Food and Drug Administration
ft	feet
GPS	global positioning system
ITM	Inland Testing Manual
LC_{50}	median lethal concentration
LPC	limiting permissible concentration
MDL	method detection limit
MSD	matrix spike duplicate
MLLW	mean lower low water
N/A	not applicable
NBS	National Bureau of Standards
ODMDS	Ocean Dredged Material Disposal Site
OPR	Ongoing precision and recovery
PAHs	polycyclic aromatic hydrocarbons
PCBs	polychlorinated biphenyls
PHL	pierhead line
Port	Port of Los Angeles
ppt	part per thousand
QA/QC	quality assurance/quality control
RSD	relative standard deviation
SAP	sampling and analysis plan
SP	solid phase
SPP	suspended particulate phase
USACE	U.S. Army Corps of Engineers

1.0 INTRODUCTION

The Port of Los Angeles (Port) is proposing improvements to the existing wharf and backlands of Berths 145 through 147 to accommodate berthing of deeper draft ships. Berths 145 through 147 are located in the West Basin of the Port of Los Angeles, Los Angeles County, California (Figure 1). The project includes dredging approximately 260,500 cubic yards of sediment. Two previous sediment characterization studies were undertaken (see project history, below) according to *Evaluation of Dredged Material Proposed for Ocean Disposal* (Green Book) (EPA/U.S. Army Corps of Engineers [USACE] 1991b) to determine if disposal was appropriate at the U.S. Environmental Protection Agency (EPA)-approved LA-2 Ocean Dredged Material Disposal Site (LA-2 ODMDS) or at an undetermined aquatic disposal location (Figure 2).

Due to changes in Port project prioritizations, the project was delayed. However, sediment characterization data is no longer valid after three years (Green Book) for permitting purposes, and in order to provide an updated characterization of the sediment, AMEC has been contracted by the Port to recharacterize the sediment at Berths 145 through 147. The proposed effort will generate current characterization data which is representative of the current site conditions, and necessary for the Port to obtain a dredged material disposal permit for the proposed project. The sampling program has been updated to include the most recent project design information and recent bathymetric data, but the sample locations and approach are essentially the same as the investigation conducted in 1996 (see Section 2.2.3).

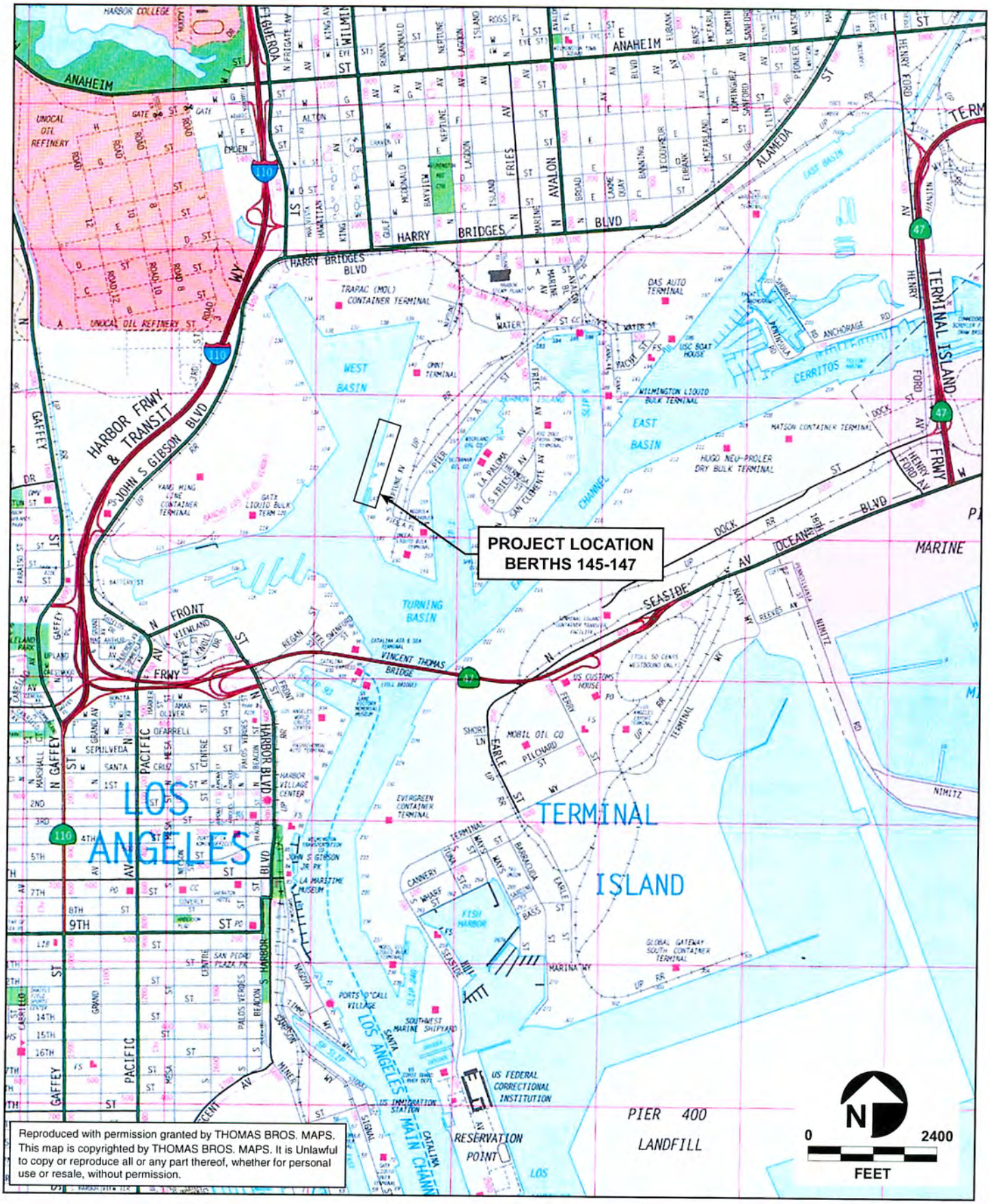
This sampling and analysis plan (SAP) provides background information and justification of the sampling design to determine suitability for the placement of dredged material at the LA-2 ODMDS, at a Port fill site or at an upland disposal location. Ocean disposal is appropriate for these sediments based on site stratigraphy: previous surveys have identified materials above approximately -40 feet mean lower low water (ft MLLW) as native; material above this elevation consists of fill material from West Basin and/or Slip 1 dredging projects. Testing presented in this SAP follows the procedures outlined in the Green Book and regional guidance of EPA Region 9 (1991). The aforementioned guidance documents present an outline for three-tiered effects-based testing to determine acceptability for dredged materials. For this study, Tier III has been selected based on potential contamination near the project site.

2.0 PROJECT DESCRIPTION AND BACKGROUND

The following subsections present the proposed dredging activities presented by the Port and background information on past activities at Berths 145 through 147.

2.1 Proposed Dredging at Berths 145 through 147

The project consists of building a wharf at Berth 145 to 147 with a final depth of -53 ft MLLW. The wharf will connect to a recently built wharf at Berth 144 to the north. Together, they will provide the required wharf length to serve two 1,150 ft vessels simultaneously. Construction will consist of a new wharf at Berth 147 and upgrading the existing concrete wharf at Berths 145



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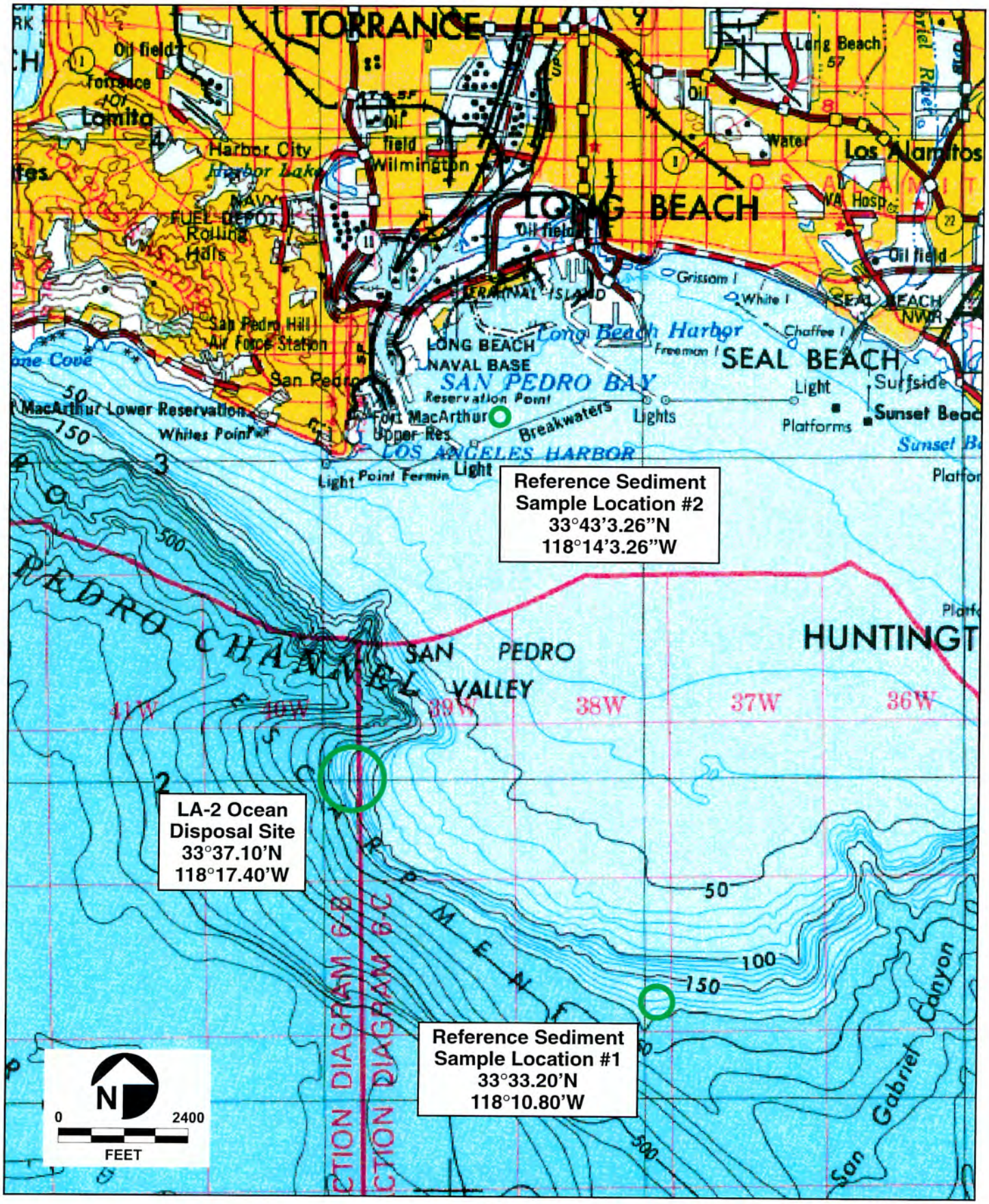
amec

Project Location
Los Angeles Harbor
Berths 145-147

FIGURE

1

GRAPHICS/Aquatic Sciences/POLA Berths 145_147/Berths 145_147 Proj Loc.FH8



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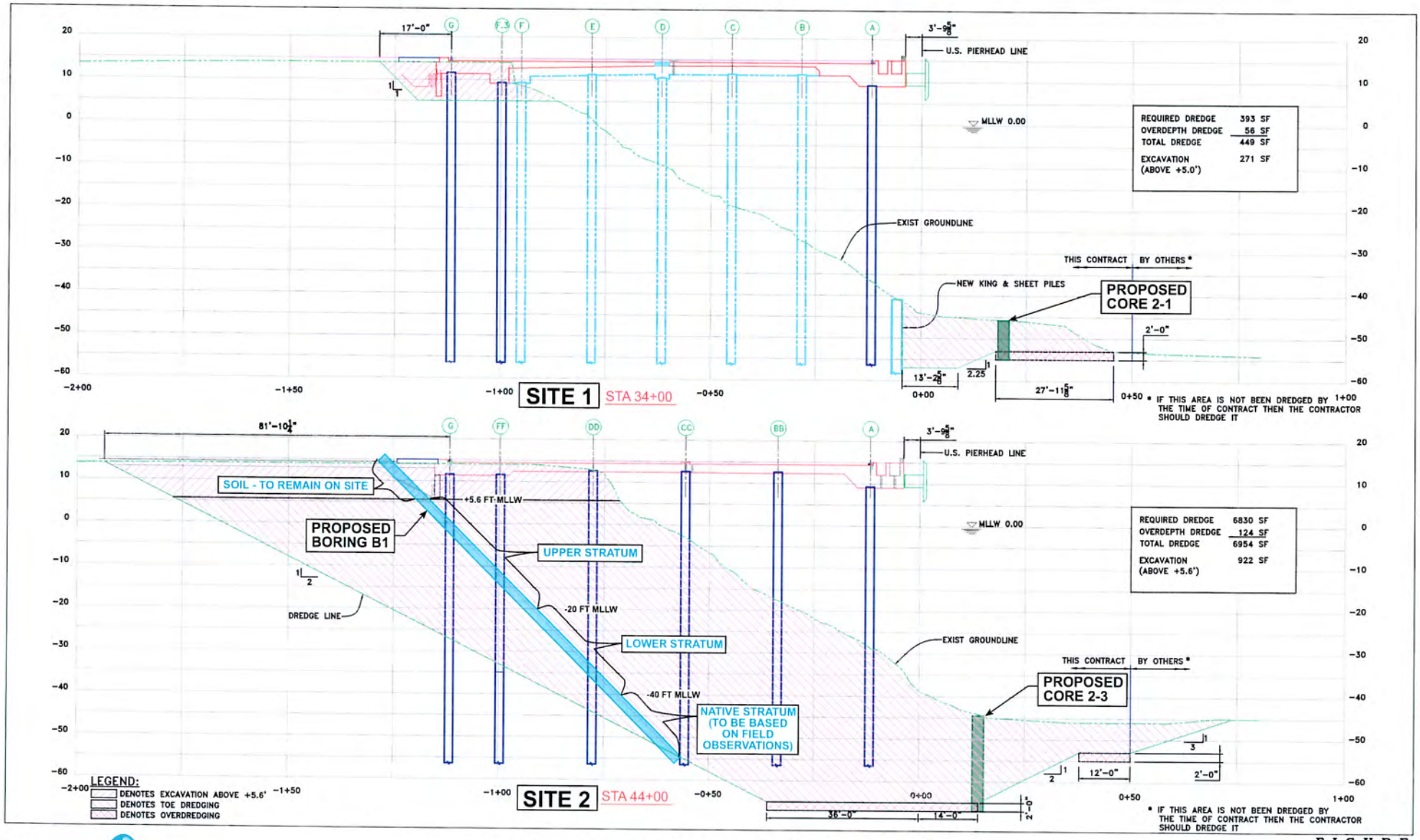
LA-2 Ocean Disposal and
Reference Sediment Collection Sites

FIGURE

2

GRAPHICS/Aquatic Sciences/POLA Berths 145_147/ProjectLocation LA.fh8



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Typical Cross Sections with Onshore Boring and Offshore Coring Locations
Los Angeles Harbor
Berths 145-147

FIGURE 3

Graphics/AquaticSciences/POLA Berths145_147/TypicalXSections_v2.fh8

Table 1. Project Contact Information

Organization	Name	Title	Phone Number	Fax Number
Port of Los Angeles	Kathryn Curtis	Port Project Manager	310-732-3681	310-547-4643
AMEC	Nick Buhbe	AMEC Project Manager	858-300-4321	858-300-4301
Calscience Environmental Lab	Bob Sterns	Laboratory Director	714-895-5494	714-894-7501
Nautilus Environmental	Chris Stransky	California Operations Manager	858-587-7002	858-587-3961
Seaventures	Kenny Nielsen	Captain, *Early Bird*	949-637-2433	N/A
TEG Oceanographic Services	Mark Mertz	Coring Contractor	831-684-2749	831-694-2748

and 146. Berth 147 currently consists of wharf structures, about one-third of which is constructed of concrete (to the northeast of approximately 43+50) and two-thirds of creosote-treated timber piles and decking (to the southwest of approximately 43+50).

The dredging operations for this project consist of two different dredge profiles, both of which will incorporate overdredging and backfilling the areas along the pierhead line (PHL). The dredging at Berths 145 and 146 will consist of constructing a steel underwater bulkhead wall approximately 4.33 ft landward of the Pier Head Line (PHL); dredging to elevation -57 ft MLLW from the underwater bulkhead wall out to approximately 8.75 ft seaward of the PHL; transitioning up to elevation -53 ft MLLW and continuing with a horizontal dredge line until it daylights. The trough at the PHL will then be filled with quarry rock to a final elevation of -53 ft MLLW.

The dredging at Berth 147 consist of dredging to elevation -65 ft MLLW from 36 ft landward of the PHL out to 14 ft seaward of the PHL; transitioning up from -65 ft MLLW on the landward side at a 2:1 slope until it daylight with the existing ground; transitioning up from -65 ft MLLW on the seaward side at a 2:1 slope to elevation -53 ft MLLW and continuing with a horizontal dredge line until it daylights. The dike will then be re-constructed with a final depth of -55 ft MLLW at the PHL which will transition up to -53 ft MLLW approximately 19 ft seaward of the PHL. The final depth with continue at -53 ft until it meets the existing ground at elevation -53 MLLW.

It is anticipated that construction will include dredging operations using a derrick-mounted clamshell dredge for materials below the +5.6 ft MLLW (mean high water) elevation. Dredge line tolerance shall be zero (0) ft above and two (2) ft below horizontal dredge lines. Contractor shall be eligible for over-dredge payment of two (2) ft on all horizontal dredge lines unless noted otherwise. Assumed slough lines and design slope-tolerances shall be done one (1) ft above and zero (0) ft below sloped portions of the proposed dredge area. Core and boring dimensions presented in this SAP have therefore included overdredge allowance for horizontal dredge lines and have assumed none for side slopes. Dredge volumes are approximately 24,800 cy along Berths 145 and 146, and 235,700 cy at Berth 147 (196,400 cy of which is inshore of the pierhead line).

2.2 Past Dredging Activities

2.2.1 Berth 144 Dredged Material Testing (Ogden 1996a)

Berth 144 lies adjacent to and north of the proposed project site, and was characterized in 1996 (Ogden Environmental and Energy Services [Ogden] 1996a). The characterization effort included both land- and water-based sampling efforts. Three shoreline area sediment samples were collected using an upland-based rotosonic drilling device advanced at a 60-degree under the shoreline slope. Tier II analyses were conducted on several individual strata; Tier II and III analyses were performed on the composite samples. The sediment in the shoreline samples of Berth 144 was generally free of chemical contamination (Table 2), with the exception of the top stratum composite of the shoreline area. Statistically significant toxicity was also observed in the top stratum composite solid phase bioassays. Chemical testing of individual shoreline core sediment samples revealed that Core 3 sediments contained elevated levels of DDT and its derivatives. The other two cores were virtually free of chemical contamination and were therefore unlikely sources of toxicity.

Similar isolated contamination was observed in the offshore berthing area, although toxicity was not observed. Chemistry analyses of individual core samples indicated that high levels of PAHs were restricted to Core 1 of the offshore Berthing Area. Core 1 displayed eight individual PAHs at levels above their associated effects range median (ERM) levels while the other four cores did not display any polycyclic aromatic hydrocarbons (PAHs) above their ERM levels. Elevated levels of PAHs were found in the worm and clam tissues of the offshore (i.e., berth-side) bioaccumulation tests. Therefore, it was determined that the bioaccumulation effects were limited to sediments in the vicinity of Berthing Area Core 1.

The results indicated that the majority of sediments were suitable for ocean disposal at LA-2; dredging and ocean disposal of these sediments was completed in 2001. Upland disposal was undertaken for sediments determined to be the likely source of contaminants resulting in significant toxicity or bioaccumulation.

2.2.2 Berth 147 Dredged Material Testing (Ogden 1996b)

Sediments at Berth 147 were also characterized in 1996 (Ogden 1996b). The sampling design at Berth 147 was similar to that employed at Berth 144. The shoreline samples consisted of individual strata samples, one composite from each of the top, middle and bottom strata, and three samples from the native layer. The final sample was a composite of offshore berthing vibracore samples. The four composite samples underwent full Green Book Tier III testing while the individual strata samples and underlying native sediment samples were limited to bulk sediment chemistry analyses (Ogden 1996b). Results are summarized in Table 3. The top stratum of the shoreline area sediments was the only sample that did not display statistically significant toxicity in any of the tests. Observed toxicity and bioaccumulation was attributed to a variety of chemical constituents in the remaining three samples. ERM values were exceeded for a variety of PAHs in the middle and bottom strata of the shoreline sediments as well as for individual PAHs, mercury and 4-4'-DDE in the berthing area sediments (Table 3). Dredging of these sediments has not been undertaken by the Port. The final report executive summary and detailed sediment characterization data is included in Appendix A.

Table 2. Berth 144 - Bulk Sediment Chemistry Results (Ogden 1996a)

Analyte	Units	Guideline Values		Shoreline Area					Berthing Area Composite	Reference Sediment
				Top Stratum Composite	Middle Stratum Composite	Native Sediment				
		ERL	ERM			Core 1	Core 2	Core 3		
General Chemistry										
Percent Solids	%	–	–	23.4	20.9	23.3	23.4	12.9	32.2	24.4
Petroleum Hydrocarbons	mg/kg	–	–	900	7	3	<0.5	<0.5	170	14
Total Organic Carbon (TOC)	%	–	–	0.85	0.48	0.75	0.94	0.2	0.9	0.79
Metals										
Silver	mg/kg	1	3.7	0.1	0.3	0.2	0.2	<0.1	0.2	0.2
Arsenic	mg/kg	8.2	70	5.6	6.6	7.8	4.1	2	6.6	2.5
Cadmium	mg/kg	1.2	9.6	<0.1	<0.09	<0.2	<0.2	<0.08	<0.1	<0.09
Chromium	mg/kg	81	370	21.8	16	36.9	42.2	13.5	34.6	22.4
Copper	mg/kg	34	270	24.1	11.9	***41.7***	***43.4***	5.4	46.9	11.5
Mercury	mg/kg	0.15	0.71	0.074	0.04	0.078	0.066	0.015	0.27	0.021
Nickel	mg/kg	20.9	51.6	15	9.7	***30.4***	***34.3***	7.5	16.8	10.7
Lead	mg/kg	46.7	218	16.5	5.1	16.5	17.2	5.3	38.6	7.7
Selenium	mg/kg	–	–	<0.4	<0.3	<0.8	<0.8	<0.3	<0.4	<0.4
Zinc	mg/kg	150	410	87.5	37.4	77.9	86.3	23.5	93	46.3
Total Pesticides	mg/kg	–	–	0.014	ND	ND	ND	ND	0.013	0.049
Total PCBs	mg/kg	2.7	180	0.077	0.0735	0.077	0.077	0.07	0.17	0.077
Total Phenols	mg/kg	–	–	ND	ND	ND	ND	ND	ND	ND
Total Phthalates	mg/kg	–	–	0.05	ND	ND	ND	ND	0.18	ND
Total PAHs	mg/kg	4.022	44.792	1.95	1.78	1.87	1.87	1.70	11.73	1.87
Total Organotins	µg/kg	–	–	ND	ND	ND	ND	ND	43.5	1.8
Apparent Tier III Effects?*				***Yes***	No	-	-	-	***Yes***	NA

Bold italicized values are above detection and exceed ERL criteria level

Total PAH and PCB concentrations were calculated by adding the results for analytes measured above detection + 1/2 the detection limit for analytes below detection

Table 3. Berth 147 - Bulk Sediment Chemistry Results (Ogden, 1996b)

Analyte	Units	Guideline Values		Shoreline Area						Berthing Area Composite	Reference Sediment
				Top Stratum Composite	Middle Stratum Composite	Bottom Stratum Composite	Native Sediment				
		ERL	ERM				Core 1	Core 2	Core 3		
General Chemistry											
Percent Solids	%	–	–	25.8	24.5	26	32.7	32	30.3	37.9	24.4
Petroleum Hydrocarbons	mg/kg	–	–	15	9	2	2	<0.5	<0.5	240	14
Total Organic Carbon (TOC)	%	–	–	0.4	0.61	0.68	1.6	1.5	1.6	1.5	0.79
Metals											
Silver	mg/kg	1	3.7	0.3	0.3	0.1	0.3	0.2	0.3	0.4	0.2
Arsenic	mg/kg	8.2	70	3.8	5.5	6.4	***8.2***	***8.9***	***9***	***9.4***	2.5
Cadmium	mg/kg	1.2	9.6	<0.09	<0.09	<0.09	0.2	<0.2	<0.09	<0.12	<0.09
Chromium	mg/kg	81	370	15.2	18.4	19.3	37.2	34.7	36.3	54.9	22.4
Copper	mg/kg	34	270	55.3	22.2	22.4	37.3	29.5	33.6	78.1	11.5
Mercury	mg/kg	0.15	0.71	0.043	0.063	0.066	0.093	0.077	0.081	0.52	0.021
Nickel	mg/kg	20.9	51.6	17	13.3	13.9	***26.6***	***23.7***	***25.2***	***26.8***	10.7
Lead	mg/kg	46.7	218	76.2	7.3	7.2	15.3	12.7	12.4	***65.6***	7.7
Selenium	mg/kg	–	–	<0.4	<0.4	<0.4	1	0.9	0.7	<0.5	<0.4
Zinc	mg/kg	150	410	49.3	49.3	48	92.9	86.1	85.7	136	46.3
Total Pesticides	mg/kg	–	–	ND	ND	ND	ND	ND	ND	***0.004***	0.049
Total PCBs	mg/kg	2.7	180	0.081	0.081	0.081	0.088	0.088	0.084	0.164	0.077
Total Phenols	mg/kg	–	–	ND	ND	ND	20.5	ND	ND	6.8	ND
Total Phthalates	mg/kg	–	–	ND	ND	ND	ND	ND	ND	ND	ND
Total PAHs	mg/kg	4.022	44.792	1.96	***13.24***	***7.78***	***10.69***	2.13	3.80	***15.59***	1.87
Total Organotins	µg/kg	–	–	ND	ND	ND	ND	ND	ND	37.5	1.8
Toxic Effects Observed?				No	***Yes***	***Yes***				***Yes***	NA

Bold italicized values are above detection and exceed ERL values
Detailed chemistry results are included in Appendix A.

2.2.3 Berths 145 through 147 Dredged Material Testing (AMEC 2003)

In 2003 AMEC was contracted by the Port to conduct a sediment characterization limited to the offshore areas of Berths 145 through 147 to determine if ocean disposal was appropriate at LA-2 or at an undetermined in-harbor aquatic disposal location (AMEC 2003). Test sediment was collected using a vibracore at five locations within Site 1 and six locations within Site 2. Each core was homogenized independently and subsampled for physical and chemical testing. All sediments from within each site were then composited and subsampled for the same suite of physical and chemical analyses. Sediment collection, handling, and preservation activities followed the procedures outlined in the Green Book.

Sediment chemistry results (Tables 4 and 5) indicated levels of mercury that exceeded the effects range low (ERL) values in almost all samples and exceeded the ERM in two samples. Copper, lead, and nickel exceed their respective ERLs in several cores at Site 1. At Site 2 arsenic, copper, and nickel also exceeded their respective ERLs in all cores. DDT exceeded the ERL in 12 of 13 samples, but did not exceed the ERM. Organotins were also detected in a portion of the sediments. In the bioassay and bioaccumulation tests (Table 5) no solid phase toxicity was observed. Suspended particulate phase toxicity was observed in the Site 2 bivalve larvae test but test data indicates it was likely caused by elevated levels of unionized ammonia levels. No suspended particulate phase toxicity was detected in Site 1 or any of the other suspended particulate phase tests for Site 2.

Dredging of these sediments were not undertaken by the Port and 2003 testing results are now considered dated for dredged material disposal permitting purposes. The proposed effort is being undertaken to obtain data which is representative of current site conditions. The 2003 data is included in Appendix A (sample identifiers match the offshore collection stations proposed herein).

2.3 Regulatory Review

The government agencies with regulatory authority to determine appropriate disposal options for the proposed project are listed below (Table 6). This project will be coordinated with the Los Angeles Region Contaminated Sediments Task Force Advisory Committee.

3.0 SAMPLING DESIGN

This section includes the sampling approach and methodology, sediment collection techniques, and handling and preservation protocols which will be employed during the characterization effort.

3.1 Marine Sediment Collection

Sediment collection, handling, and preservation activities will follow the procedures outlined in the Green Book. Test sediment will be collected using a vibracore at five locations within Site 1 and six locations within Site 2 (Figures 4 and 5). Predetermined station latitude and longitude data (Table 7) will be used with Global Positioning System (GPS) instrumentation to locate station locations in the field. The accuracy of the differential GPS system used for this sampling

Table 4. Berths 145 through 147 Bulk Sediment Chemistry Results (AMEC 2003)

				Site 1						Reference sites	
Analyte	**Units**	**ERL**	**ERM**	**1-1**	**1-2**	**1-3**	**1-4**	**1-5**	**1-Comp**	**Ref LA-2**	**Harbor Ref**
Metals											
Arsenic	mg/kg	8.2	70	5.78	4.18	7.50	4.07	2.56	3.83	ND	7.47
Cadmium	mg/kg	1.2	9.6	0.656	0.187	0.532	0.232	0.227	0.259	ND	0.719
Chromium (total)	mg/kg	81	370	43.7	21.0	46.4	30.2	17.2	28.0	13.5	45.4
Copper	mg/kg	34	270	***52.7***	22.4	***44.2***	31.9	17.4	27.4	6.88	***48.4***
Lead	mg/kg	46	218	23.5	14.3	***50.7***	23.9	23.2	19.7	3.97	26.8
Nickel	mg/kg	20.9	51.6	***29.7***	11.1	19.7	14.8	10.3	15.4	6.74	***27.2***
Selenium	mg/kg			ND	ND	ND	0.748	ND	ND	ND	ND
Silver	mg/kg	1	3.7	0.301	ND	0.270	0.208	0.201	ND	ND	0.879
Zinc	mg/kg	150	410	99.6	51.4	92.3	65.5	43.8	60.6	34.5	111
Mercury	mg/kg	0.15	0.71	***0.200***	***0.164***	***0.452***	***0.259***	0.119	***0.211***	0.032	***0.191***
Total PCBs	ug/kg			ND	ND	ND	ND	ND	ND	ND	ND
Total Phenols	ug/kg			ND	ND	ND	ND	ND	ND	ND	ND
Total Phthalates	ug/kg			24	88	39	51	ND	44	51	83
Total Pesticides	ug/kg	1.58	46.1	***7.3***	***7.8***	***30***	***13.9***	1.4	***7.8***	***38***	***10***
Total PAHs	ug/kg	4022	44792	265	364	1130	782	166	488	ND	ND
Dibutyltin	ng/dry g			ND	ND	ND	ND	ND	7.5	ND	ND
Monobutyltin	ng/dry g			ND	ND	ND	ND	ND	ND	ND	ND
Tributyltin	ng/dry g			ND	ND	3.1	44.5	ND	40.8	ND	ND

Bold italicized values are above detection and exceed ERL values

Table 4. Berths 145 through 147 Bulk Sediment Chemistry Results (AMEC 2003) - (Continued)

				Site 2							Reference sites	
Parameter	**Units**	**ERL**	**ERM**	**2-1**	**2-2**	**2-3**	**2-4**	**2-5**	**2-6**	**2-Comp**	**Ref LA-2**	**Harbor Ref**
Metals												
Arsenic	mg/kg	8.2	70	***8.70***	***12.2***	***11.1***	***10.9***	***9.18***	***8.26***	***10.9***	ND	7.47
Cadmium	mg/kg	1.2	9.6	0.339	0.561	0.503	0.325	0.342	0.585	0.612	ND	0.719
Chromium (total)	mg/kg	81	370	40.6	53.3	54.4	47.9	51.5	64.7	65.2	13.5	45.4
Copper	mg/kg	34	270	***40.7***	***85.3***	***73.0***	***50.0***	***58.4***	***65.1***	***83.2***	6.88	***48.4***
Lead	mg/kg	46	218	43.8	***47.9***	45.6	28.7	33.9	***52.6***	***57.7***	3.97	26.8
Nickel	mg/kg	20.9	51.6	***28.5***	***33.9***	***33.0***	***31.9***	***33.8***	***28.1***	***34.9***	6.74	***27.2***
Selenium	mg/kg			0.781	1.11	ND	ND	1.04	ND	ND	ND	ND
Silver	mg/kg	1	3.7	0.192	0.310	0.256	0.169	0.169	0.245	0.239	ND	0.879
Zinc	mg/kg	150	410	94.6	130	124	93.9	103	117	146	34.5	111
Mercury	mg/kg	0.15	0.71	***0.395***	***0.895***	***0.503***	***0.246***	***0.329***	***0.582***	***0.746***	0.032	***0.191***
Total PCBs	ug/kg			ND	ND	ND	ND	ND	ND	ND	ND	ND
Total Phenols	ug/kg			ND	ND	ND	ND	ND	ND	ND	ND	ND
Total Phthalates	ug/kg			ND	21	140	170	65	120	170	51	83
Total Pesticides	ug/kg	1.58	46.1	ND	***12.3***	***4.7***	ND	***4.5***	***16***	***14.3***	38	10
Total PAHs	ug/kg	4022	44792	38	622	724	330	935	2570	1100	ND	ND
Dibutyltin	ng/dry g			ND	ND	13.3	ND	ND	ND	ND	ND	ND
Monobutyltin	ng/dry g			ND	ND	ND	ND	ND	ND	ND	ND	ND
Tributyltin	ng/dry g			ND	3.5	156	11.8	7.5	ND	ND	ND	ND

Bold values are above detection and exceed ERL values
Boxed values exceed ERM values

Table 5. Berth 145-147 Toxicity Results (AMEC 2003)

Site	*Menidia* Average Survival (percent)	Mysid Average Survival (percent)	Bivalve Average Normal Development (percent)	Amphipod Mean Survival (percent)	Mysid Mean Survival (percent)
Control	100	96	99	90	96
Ocean Reference	-	-	-	90	94
Harbor Reference	100	98	89*	89	100
Site 1	100	96	96*	91	94
Site 2	100	92	0*	88	94

* - Indicates statistically significant toxicity ($p<0.05$) in comparison to the respective reference or control treatment.

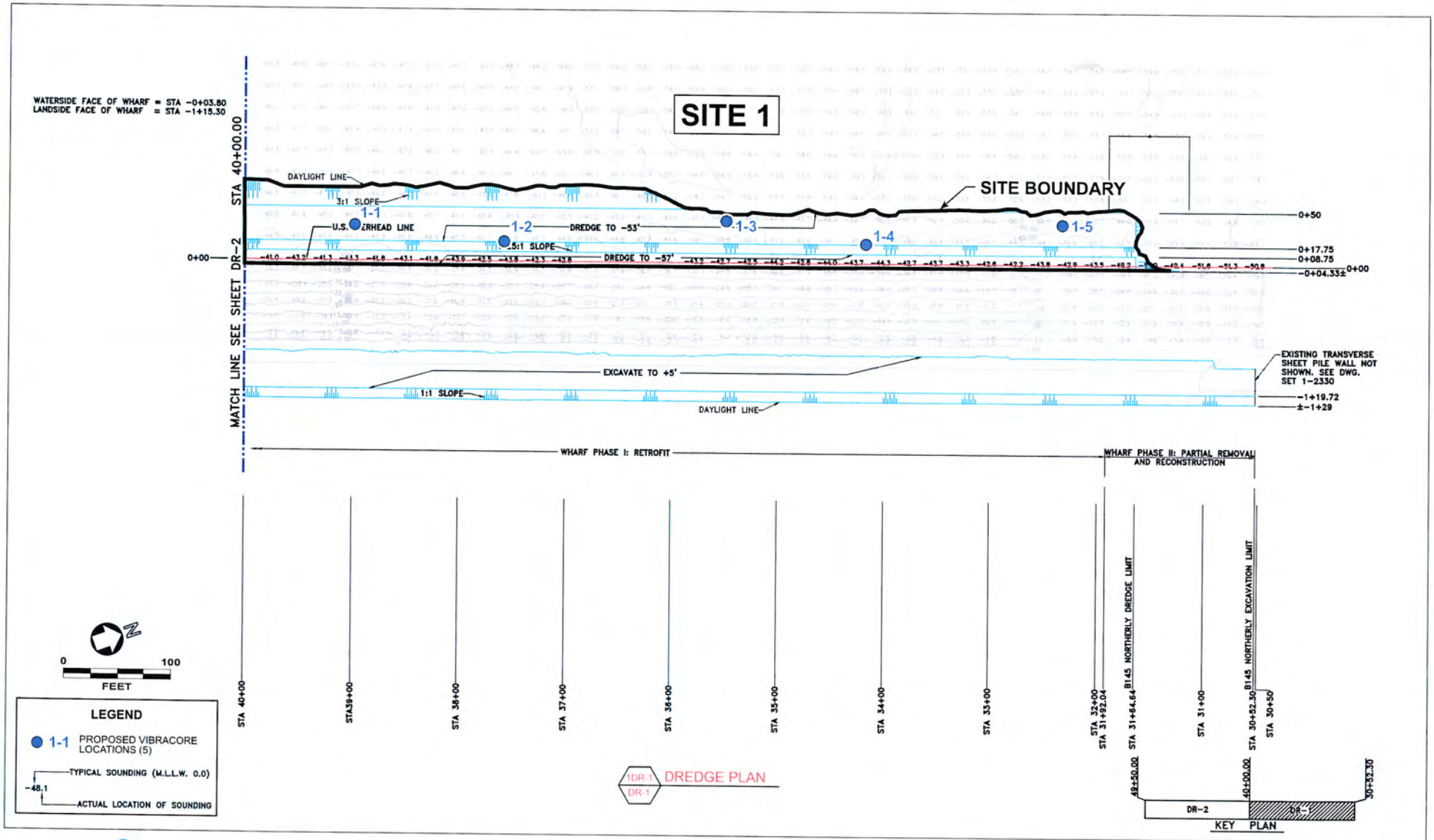
Table 6. Regulatory Agencies

Agency	Contact	Phone Number
USACE	Jack Malone	805-585-2146
EPA – Region 9	Eric Raffini	415-972-3476
RWQCB – Los Angeles	Michael Lyons	213-576-6718
California Coastal Commission	Jack Gregg	415-904-5246

Table 7. Proposed Core Locations

Station ID		Latitude	Longitude	Current Depth (ft)	Dredge Target Depth (ft)	Core length (ft)*
Site 1	Core 1	33.76055	118.27342	-46	-55	11
	Core 2	33.76091	118.27303	-45	-55	10
	Core 3	33.86146	118.27295	-50	-55	5
	Core 4	33.76183	118.27268	-45	-55	10
	Core 5	33.76227	118.28265	-48	-55	7
Site 2	Core 1	33.75819	118.27420	-35	-55	20
	Core 2	33.75883	118.27401	-40	-53	13
	Core 3	33.75976	118.27365	-45	-65	20
	Core 4	33.75976	118.27363	-46	-55	9
	Core 5	33.76013	118.27333	-44	-55	11
	Core 6	33.75804	118.27410	-32	-45	13

*core lengths include a 1' or 2' overdraft as appropriate based on design specifications, and are based on current bathymetric data.
ft = feet

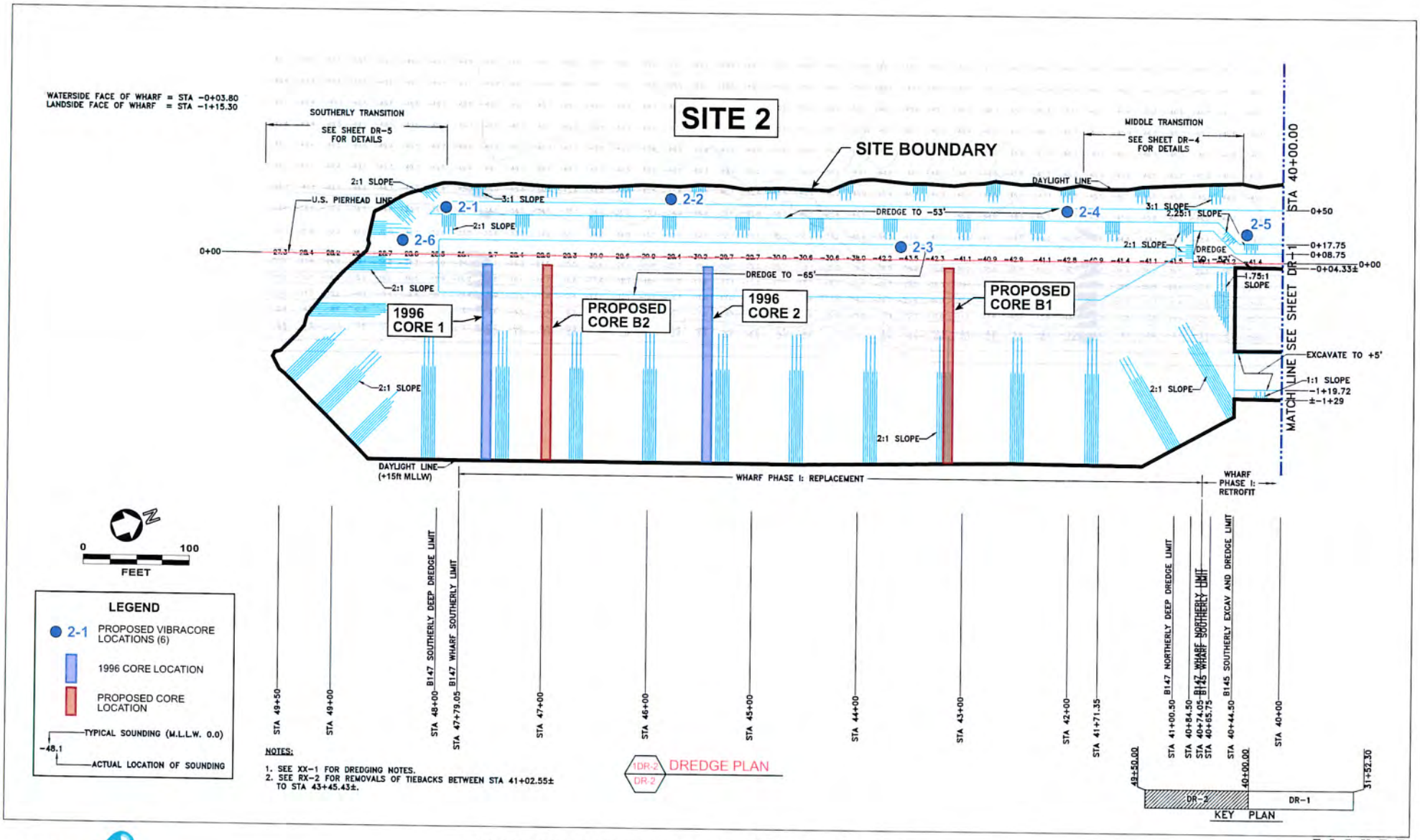


amec

Site 1 Proposed Coring Location
Los Angeles Harbor
Berths 145-147

FIGURE
4

Graphics/AquaticSciences/POLA Berths145_147/Site_1.fh8



amec

Proposed Coring and Boring Locations - Site 2 (Offshore) and Shoreline Areas
Los Angeles Harbor
Berths 145-147

FIGURE
5

Graphics/AquaticSciences/POLA Berths145_147/Site_2_v2.fh8

event will be 5 meters. TEG Oceanographic Services will provide the vibracore equipment and personnel used to sample the sediments while Seaventures will support the collection effort by providing vessel and logistical support.

The vibracore uses a 4-inch-diameter aluminum (alloy 66030) Teflon-lined tube connected to a stainless steel nose piece. The vibrating unit is encased in aluminum and uses electricity (240-volt, 3-phase, 26-amp) to drive two outer-rotating vibrators. The vibracore head and tube will be lowered by a hydraulic winch and vibrated until penetration has been stopped by sediment resistance (e.g., hard clay) or at project depth. The vibracore will then be turned off and the tube extracted from the sediment and returned to the vessel. The sediment will then extruded onto a tray, photographed, and visually examined for strata and other notable characteristics.

The sediment cores collected at each location will be homogenized independently. Subsamples of the homogenate will be transferred to labeled containers and kept in an iced cooler for subsequent transport to the laboratories where they will be stored at 4°C. These subsamples include both large volumes for immediate physical, chemical, and biological analyses (composite samples) and smaller samples that will be retained as archives. Archival material (including but not limited to individual core homogenates) may be submitted to a laboratory for chemical analysis at a later time if data from individual core locations are determined to be useful in the further characterization of the site. Although not expected, unique strata in individual cores greater than 2 ft in dimension will also be subsampled and archived for *post hoc* testing associated with characterizing the distribution of analytes suspected of biotoxicity and/or shown to exhibit bioaccumulative potential. Archive samples will be retained frozen for a period not to exceed one year from the date of sampling.

The field supervisor will be responsible for all decisions concerning station positioning. If a significant deviation from this SAP is being considered due to conditions encountered during sampling, the field supervisor will notify the project manager. Coordination between field personnel, the project manager, and the Port will resolve any significant issues and will be conducted as appropriate. The sampling crew will be provided with a portable cellular telephone to allow rapid and direct consultation.

3.2 Shoreline Sediment Collection

Shoreline sediments will be collected from the portion of the projects shoreward of the PHL using a rig-mounted rotary boring drill. Augers will be advanced into the sediments at an approximate 45 degree angle at 5-ft increments and sediments collected from a 4-inch sleeve. California-registered geologists will be on site to log the sediments.

Sediments will be sampled such that three strata will be sampled: material from +5.6 ft MLLW to -20 ft MLLW (the upper stratum), from -20 ft MLLW to -40 ft MLLW (the lower stratum), and material below an approximate elevation/depth of -40 ft MLLW (the native stratum) (Figure 5). The upper boundary of the native stratum has been determined roughly from existing boring data, but will be verified in the field by the on-site geologists (and altered as needed based on boring-specific stratigraphy).

Two boring sites have been designated at locations which will generate samples representative of the site. Two composite samples will be generated: an upper composite and a lower composite. These samples will be tested for bulk sediment chemistry, grain size characteristics, and biological testing. In addition, the native sediments from each boring will be analyzed for bulk sediment chemistry. Archive material will be retained for each of the individual strata for the individual borings for potential future analysis.

3.3 Reference Sediment Collection

Reference sediment will be collected at an uncontaminated site (33° 33.20' North latitude and 118° 10.80' West longitude) (Figure 2) located near the disposal site using a stainless steel pipe dredge. This reference site has been used for numerous dredged material bioassays in the past and has a sediment quality that has been accepted by the EPA and the USACE for comparison with sediments proposed for disposal at LA-2. In addition, the sediment composition at this site is ideal for conducting solid-phase bioassay and bioaccumulation testing with the proposed test animals. A second reference site in the Los Angeles Harbor will also be used during testing. The site (33°43'3.26" North latitude and 118°14'3.26" West longitude) is located next to the middle breakwater and next to the Western Anchorage, a site used previously (AMEC 2003) for sediment characterization efforts in the Long Beach Harbor.

3.4 Control Sediment Collection

Control sediment is uncontaminated material obtained from the site of animal collection. Control sediment bioassays will be performed concurrent to test and reference assays to assess the general fitness of the test animals.

3.5 Sample Collection Documentation

The integrity of each sample from the time of collection to the point of data reporting must be maintained throughout the study. Proper record keeping and chain-of-custody procedures will be implemented to allow samples to be traced from collection to their final disposition. After collection of sediment, documentation on various logs and forms (listed below) will be required to adequately identify and catalog station and sample information.

The following information will be recorded during the test sediment collection program in project-specific field logs. Field log entries will be completed at the time that observations are made.

- date and time of collection
- sample identification code
- sampling location (latitude/longitude to within a 3-meter accuracy)
- water depth (as applicable)
- tidal stage and currents (as applicable)
- climatic conditions
- sampling method
- sampler penetration (sample length)
- description of the material type obtained in the samples
- description of any vertical stratification in each core/boring

- description of any subsampling of sediments (e.g., due to stratification)
- photographic record of each core/boring

Sample container identification information will be recorded on a chain-of-custody form. The chain-of-custody form will also identify the sampling organization, point of contact, sample collection date and time, type of sample, and project. The form will also serve as a sample analysis request form. Each set of samples sent to a laboratory will be accompanied by a chain-of-custody form identifying any pretreatment applied to the sample and the analyses to be conducted (by referencing a list of specific analyses or the statement of work for the laboratory). These forms will be prepared in triplicate; the field supervisor will retain one copy, and the other two copies will accompany the shipment.

Proper completion of all chain-of-custody documentation will be the responsibility of the field manager. Chain-of-custody forms will be completed and signed before the end of each sampling day and before the samples are removed from the vessel or pass from the control of the field supervisor. Chain-of-custody forms will be signed at each additional point of transfer of samples between the field and the laboratory as well as within the laboratory.

3.6 Sample Handling and Delivery

Recommended sediment size, handling, and storage are detailed in Table 8. All sample containers will be provided by the laboratory and prepared in accordance with EPA guidelines prior to field operations. Immediately after they are filled, all sample containers will be placed on ice in a cooler at 4° Centigrade. For those subsamples that will be frozen (i.e., archive samples), sufficient headspace will be left in each jar to accommodate expansion during freezing.

Chain-of-custody forms will be completed and signed upon the return of the field crew to the laboratory and delivered with the samples to the laboratory. The laboratory chosen to conduct the analyses will be a California-certified testing laboratory that has accreditation to conduct the analyses required for this program. Samples for analysis will be delivered to the chemical analytical laboratory for prompt analysis. Archived sediment samples for possible future chemical analyses will be frozen upon delivery to the laboratory. These archived samples will be held at the laboratory pending a decision to begin analyses within the 1-year holding time for frozen samples. Chain of custody forms will be enclosed in the coolers with the samples and will be signed at the laboratory upon receipt of samples.

3.7 Physical Analyses

Grain size analyses will be conducted on all test sediments using the sieve and hydrometer method (ASTM 1967). Percent sand, silt, and clay will be reported to 0.1 percent. Total solids/moisture content will also be determined and reported to 0.1 percent.

3.8 Chemical Analyses

Chemical analyses will be conducted on the individual cores and composite sediment samples. The constituents to be analyzed, along with their respective detection limits, are presented in Table 9.

Table 8. Recommended Sediment Sample Sizes, Containers, Storage Criteria, and Holding Times for Physical and Chemical Testing

Parameter	Sample Size[1]	Container Type[2]	Storage	Holding Time[3]
Total Organic Carbon	50 g	WMG	4°±2°C	28 days
Grain Size	100 g (60 ml)		4°±2°C	6 months
Total and Soluble Sulfides	50 g	WMG/Septa[2]	4°±2°C	7 days
Metals	200 g (600 ml)	WMG[2]	4°±2°C	6 months 28 days for Hg
Organotins	200 g (250 ml)	WMG[2]	4°±2°C	14 days (until extraction) 40 days (after extraction)
Pesticides	200 g (250 ml)	WMG[2]	4°±2°C	14 days (until extraction) 40 days (after extraction)
Petroleum Hydrocarbons		WMG[2]	4°±2°C	14 days (until extraction)
Polychlorinated biphenyls	200 g (250 ml)	WMG[2]	4°±2°C	14 days (until extraction) 40 days (after extraction)
PAHs, Phenols, and Phthalates	200 g (250 ml)	WMG[2]	4°±2°C	14 days (until extraction) 40 days (after extraction)

1 Recommended sediment or tissue sample size in wet weight (volumetric equivalents are given for field collection of sediments). The amounts shown are not intended as firm values. The sample volumes indicated should be sufficient to allow for an analysis, a replicate or matrix spike replicate, and enough to repeat the analysis if necessary. If additional laboratory analyses are required (e.g., laboratory replicates, allowance for retesting), the field sample size should be increased accordingly. To reduce detection limits, it may be necessary to use a larger sample size (in conjunction with a sample cleanup step and smaller extract volume for GC/MS analysis). For some chemical analysis, smaller sample sizes may be used if comparable sensitivity can be obtained by adjusting instrumentation extract volume, or other factors of the analysis.

2 AG - amber glass; WMG - wide mouth glass, Septa - no headspace.

3 Holding times indicate maximum elapsed time between sample collection and sample analysis. These holding times are for sediment and tissue based on administrative guidance. There are no promulgated, scientifically based holding time criteria available.

°C - degrees Centigrade
g - gram
ml – milliliter
PAHs – polycyclic aromatic hydrocarbons

Table 9. Recommended Methods for Sample Preparation, Cleanup, Analysis, and Detection Limits for Sediments and Tissues

Analyte	Analysis Method	Sediment Target Detection Limits[a, b]	Tissue Target Detection Limits[a, b]
Total solids	160.3	0.1 %	N/A
Total organic carbon	9060	0.1 %	N/A
Total ammonia	350.2M[c]	0.2 mg/kg	N/A
Total & soluble sulfides	376.2M[c]	0.1 mg/kg	N/A
Arsenic	6020/6010B[d]	0.1 mg/kg	0.25 mg/kg
Cadmium	6020/6010B[d]	0.1 mg/kg	0.1 mg/kg
Chromium	6020/6010B[d]	0.1 mg/kg	0.02 mg/kg
Copper	6020/6010B[d]	0.1 mg/kg	0.1 mg/kg
Lead	6020/6010B[d]	0.1 mg/kg	0.1 mg/kg
Mercury	7471A[d]	0.02 mg/kg	0.02 mg/kg
Nickel	6020/6010B[d]	0.1 mg/kg	0.02 mg/kg
Selenium	6020/6010B[d]	0.1 mg/kg	0.1 mg/kg
Silver	6020/6010B[d]	0.1 mg/kg	0.1 mg/kg
Zinc	6020/6010B[d]	2.0 mg/kg	1.0 mg/kg
TRPH	418.1M[d]	5.0 mg/kg	N/A
PAHs[e]	8270C[d]	20 µg/kg	20 µg/kg
Chlorinated pesticides[f]	8081A[d]	0.5 – 30 µg/kg	0.5 - 2.0 µg/kg
PCBs[g]	8082[d]	20 µg/kg	20 µg/kg
Phenols	8270C[d]	20 – 100 µg/kg	N/A
Phthalates	8270C[d]	10 µg/kg	N/A
Organotins	Rice *et al.*[h]	1.0 µg/kg	N/A

[a] Sediment minimum detection limits are on a dry-weight basis. Tissue minimum levels are on a wet-weight basis.
[b] Reporting limits provided by Calscience Environmental Laboratories, Inc. and CRG Marine Laboratories Inc.
[c] Standard Methods for the Examination of Water and Wastewater, 19th Edition APHA *et al.* 1995.
[d] EPA 1986-1996. SW -846. Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, 3rd Edition.
[e] Includes naphthalene, acenaphthylene, acenaphthene, fluorene, phenanthrene), fluoranthene, pyrene, benzo(a)anthracene, chrysene, benzo(b,k)fluoranthene, benzo(a)pyrene, indeno(1,2,3-c,d)pyrene, dibenzo(a,h)anthracene, benzo(g,h,i)perylene.
[f] Includes aldrin, α-BHC, β-BHC, γ-BHC (lindane), δ-BHC, chlordane, 2,4- and 4,4-DDD, 2,4- and 4,4-DDE, 2,4- and 4,4-DDT, dieldrin, endosulfan I and II, endosulfan sulfate, endrin, endrin aldehyde, heptachlor, heptachlor epoxide, and toxaphene.
[g] Includes Aroclors 1016, 1221, 1232, 1242, 1248, 1254, 1260, and 1262.
[h] Rice, C.D. *et al.* 1987, or similar (e.g. Krone *et al.* 1989)
PAH – polycyclic aromatic hydrocarbon
PCB — polychlorinated biphenyl
TRPH — total recoverable petroleum hydrocarbons
mg/kg — milligrams per kilogram (parts per million)
µg/kg – micrograms per kilogram (parts per billion)

Quality assurance/quality control (QA/QC) will be maintained during the analytical portion of this study by using duplicate sample analyses, reagent blanks, and spiked samples as specified in the EPA methods for individual analytes (Table 9). All QA/QC information will be included with the draft and final testing reports.

3.9 Bioassay Testing

Bioassay analyses will be conducted on the composite marine sediment samples within the 6-week holding time for bioassay sediments. The test series will include bioassays conducted on three sediment phases: (1) suspended particulate phase, (2) solid phase, and (3) bioaccumulation phase. Each of these tests will be performed in accordance with the Green Book, the ITM, and EPA Region 9's *General Requirements for Sediment Testing of Dredged Material Proposed for Ocean Dumping* (U.S. EPA 1991a). Summary test procedure methodologies are included in Appendix B. Seawater used in tests will be collected at the Scripps Institute of Oceanography Pier (La Jolla, CA) and transported to the bioassay laboratory for use in the tests.

3.9.1 Test Organisms

The organisms to be tested in the three-phase bioassay series are outlined in Table 10. Note that the polychaete worm *Neanthes-arenaceodentata* has been substituted for the mysid shrimp used in previous solid phase testing (AMEC 2003). Test organisms will undergo a holding period under laboratory and test conditions prior to test initiation. The holding period will include an initial 48-hour acclimation period, which serves to evaluate the health and acceptability of field-collected test specimens. During the acclimation period, test animals will be slowly exposed to laboratory water, test temperature, and other test and laboratory conditions. If the animals are deemed acceptable after the acclimation period, they will undergo a holding period during which animal health will be closely monitored. An evaluation of test organism acceptability during the acclimation and holding periods will be used to determine whether testing should proceed or should be delayed until a new batch of test organisms is obtained.

Table 10. Proposed Test Species

Test Organism	Taxon	SPP	SP*	BP
Bivalve Larvae	*Mytilus edulis*	X		
Fish	*Menidia beryllina*	X		
Mysid	*Americamysis bahia*	X		
Amphipod	*Ampelisca abdita*		X	
Polychaete	*Neanthes arenaceodentata*		X	
Polychaete	*Nereis virens*			X
Mollusk	*Macoma nasuta*			X

*According to the USACE, only two species must be tested during solid phase analyses as long as the three required species types are represented (i.e., filter feeder, deposit feeder, and burrower). This requirement is met when both mysids and amphipods are the test species.

SP - Solid Phase

SPP - Suspended Particulate Phase

BP - Bioaccumulation Phase

3.9.2 Suspended Particulate Phase Toxicity Tests

The test solution used in the suspended particulate phase bioassays is prepared by mixing seawater and test sediment to yield a volumetric sediment:water ratio of 1:4. Aeration and mechanical mixing, using a stainless steel impeller, are applied to vigorously agitate the mixture for 30 minutes. A 1-hour settling time follows, after which the supernatant is drained from the top of the mixing chamber. This material is considered to be 100 percent elutriate and is used to mix the concentrations used for all suspended particulate phase testing.

The supernatant is diluted with clean seawater in order to prepare the four test concentrations, which include 0 percent (control, no supernatant), 10, 50, and 100 percent supernatant solutions. The test material is distributed to individual test chambers, and initial water quality readings are taken. Readings will include dissolved oxygen, pH, temperature, ammonia, and salinity. If dissolved oxygen is found to be below 60 percent of saturation, all test chambers will be aerated. Testing is initiated by adding test organisms randomly to individual test chambers. Water quality is monitored daily thereafter to ensure proper and constant test conditions.

3.9.3 Solid Phase Toxicity Tests

Ten-day amphipod survival and reburial tests and polychaete tests will be conducted under static-renewal conditions according to American Society for Testing and Materials (ASTM) protocol (ASTM 1990). Tests are prepared with the addition of a 2-centimeter layer of control, reference, or test sediment and clean seawater into each test chamber.

Twenty amphipods are distributed randomly to each chamber, with five replicates exposed to each sediment treatment. The polychaete test is conducted with ten individuals per replicate container. After 10 days, test animals are removed by gently sieving the contents of each beaker through a nitex mesh screen (animals are collected on the screen). After final organism counts are made, amphipods are placed in fresh control sediment and monitored for 1 hour to determine the percentage that rebury themselves.

3.9.4 Bioaccumulation Phase

Bioaccumulation testing will be performed using the polychaete worm (*Nereis virens)* and the bent-nose clam (*Macoma nasuta*) over a 28-day test period under flow-through conditions. Testing is initiated using reference and test sediments in the same manner as described for other 10-day testing, except that tests will be carried out in aquaria designed to accommodate the polychaete worms and clams necessary to yield the biomass required to achieve the specified detection limits. The chambers will be maintained under flow-through conditions and daily water quality measurements will be taken on each chamber as specified in the 10-day test.

Upon test termination, the reference and test sediments will be sieved to remove the worms and clams. Surviving animals will be placed, by replicate, in clean sand in an aquarium and held under flow-through conditions to depurate for 48 hours. Sediments eliminated by the animals during depuration will be removed daily. Following depuration, animals will be carefully removed from the holding chambers and placed into labeled, zipper-sealed plastic storage bags to be frozen. Each bag will be assigned a random number. Frozen test tissue will be transported by laboratory personnel to the analytical laboratory for chemical analyses. As a quality control

measure, pre-test samples of tissue from both species will be frozen for future analysis, if needed.

A similar suite of chemical analyses to that used for test sediments will be applied to the bioaccumulation tissue samples. The constituents to be analyzed, along with their respective detection limits, are presented in Table 8. Tissue analyses may not be performed, however, if significant toxicity (mortality) is observed in the 10-day bioassay tests (upon consultation with Port staff).

4.0 PROJECT DATA QUALITY OBJECTIVES

4.1 Expected Data Quality

The contaminants of concern are primarily heavy metals, PAHs, and DDT pesticides and its derivatives. Both the chemical and biological testing proposed in this SAP are of sufficient sensitivity to ensure that any adverse water column, benthic, and bioaccumulation impacts are identified. Sediment characterization results will be compared to available sediment quality guidance (e.g., ERL and ERM) to assess the degree of chemical contamination. Bioassay and bioaccumulation results of test sediment will be compared statistically to reference site results to assess potential adverse impact on the water column during dredging and disposal operations, and on benthic communities at the disposal site. Data analysis objectives are detailed in Table 11.

4.2 Data Quality Indicators

Data quality indicators are presented in Tables 11 through 13.

4.3 Quality Assurance/Quality Control

4.3.1 Instrumental Sensitivity and Detection Limits

Detection limit targets are specified for sediments and tissue samples in EPA Region 9's general requirements. Replicate analyses for each type of determination are performed on each type of sample matrix. Precision is expressed as the difference in results of replicate analyses ("analysis" includes all steps of preparation and determination) divided by the average of those values and expressed as a percentage. Thus, a relative percent difference of 0 percent means that replicate results were identical. Instrumental calibration and verification are done using EPA and/or National Bureau of Standards (NBS) traceable reference materials. Quality control requirements for this study are outlined in Tables 14, 15, and 16.

4.3.2 Bioassay Organisms

Test organisms used in the bioassay and bioaccumulation tests either will be collected in areas known to be generally free of pollutants or purchased from reputable culturists. Organisms are purchased from vendors who are screened by their reputation, depth of knowledge concerning the organism of choice, and their ability to consistently deliver healthy test organisms.

Table 11. Sediment Quality Analysis for Ocean Disposal Dredged Materials Studies

Biological Test	Sediment Quality Assessment	Sediment Quality Determination
Solid Phase		
Amphipod	Mortality in test sediment is statistically greater ($p \leq 0.05$) than reference sediment and exceeds mortality in the reference sediment by more than 20%	Benthic Limiting Permissible Concentration (LPC) is exceeded
Polychaete	Mortality is statistically greater ($p \leq 0.05$) and exceeds mortality in the reference sediment by more than 10%	Benthic LPC is exceeded
Suspended Particulate Phase		
Silverside	Mortality is statistically greater ($p \leq 0.05$) than control survival and the concentration in the water column after a 4-hr initial mixing period is greater than 0.01of the LC_{50}	Water column LPC is exceeded
Mysid Shrimp	Mortality is statistically greater ($p \leq 0.05$) than control survival and the concentration in the water column after a 4-hr initial mixing period is greater than 0.01of the LC_{50}	Water column LPC is exceeded
Bivalve Larvae	Abnormally developed larvae are statistically greater ($p \leq 0.05$) than control larvae and the concentration in the water column after a 4-hr initial mixing period is greater than 0.01of the LC_{50}	Water column LPC is exceeded
Bioaccumulation		
Metals	Bioaccumulation is statistically greater ($p \leq 0.05$) in test tissues than reference tissues.	Severity of bioaccumulation must be addressed using Green Book criteria (Section 6.3)
Organics	Test tissue bioaccumulation exceeds FDA Action Limits for Fish and Shellfish	Severity of bioaccumulation must be addressed using Green Book criteria (Section 6.3)
Whole Sediment	Comparison to sediment quality guidance such as ERLs and ERMs	Sediment quality based on effects data listed above

ERL – effects range low
ERM – effects range medium
FDA – U.S. Food and Drug Association
LC_{50} – median lethal concentration
LPC – limiting permissible concentration

Table 12. Measurement Quality Objectives for Inorganic and Organic Chemical Analyses of Sediment

Constituent	Unit (dry weight)	MDL	Accuracy	Frequency	Precision	Frequency
Arsenic	mg/kg	0.1	±20 percent	1/batch	≤20 percent	1/batch
Cadmium	mg/kg	0.1	±20 percent	1/batch	≤20 percent	1/batch
Chromium	mg/kg	0.1	±20 percent	1/batch	≤20 percent	1/batch
Copper	mg/kg	0.1	±20 percent	1/batch	≤20 percent	1/batch
Lead	mg/kg	0.1	±20 percent	1/batch	≤20 percent	1/batch
Mercury	mg/kg	0.02	±20 percent	1/batch	≤20 percent	1/batch
Nickel	mg/kg	0.1	±20 percent	1/batch	≤20 percent	1/batch
Selenium	mg/kg	0.1	±20 percent	1/batch	≤20 percent	1/batch
Silver	mg/kg	0.1	±20 percent	1/batch	≤20 percent	1/batch
Zinc	mg/kg	2.0	±20 percent	1/batch	≤20 percent	1/batch
Organotins	µg/kg	1.0	±20 percent	1/batch	≤20 percent	1/batch
Organochlorine Pesticides	µg/kg	0.5-30	±20 percent	1/batch	≤20 percent	1/batch
PCBs/Aroclors	µg/kg	20	±20 percent	1/batch	≤20 percent	1/batch
PAHs	µg/kg	20	±20 percent	1/batch	≤20 percent	1/batch
Phenols	µg/kg	20-100	±20 percent	1/batch	≤20 percent	1/batch
Phthalates	µg/kg	10	±20 percent	1/batch	≤20 percent	1/batch
Petroleum Hydrocarbons	mg/kg	0.1	±20 percent	1/batch	≤20 percent	1/batch
Percent Solids	percent	0.1	N/A	N/A	≤20 percent	N/A
Total Organic Carbon	percent	0.1	±20 percent	1/batch	≤20 percent	1/batch
Volatile Organics	µg/kg	10.0	±20 percent	1/batch	≤20 percent	1/batch
Ammonia	mg/kg		±20 percent	1/batch	≤20 percent	1/batch
Total Sulfides	mg/kg	0.1	±20 percent	1/batch	≤20 percent	1/batch
Water Soluble Sulfides	mg/kg	0.1	±20 percent	1/batch	≤20 percent	1/batch
Particle size	percent	0.1	±20 percent	N/A	≤20 percent	N/A

MDL- method detection limit
mg/kg - milligram per kilogram
µg/kg - microgram per kilogram
N/A - not applicable
PAHs - polycyclic aromatic hydrocarbons
PCBs - polychlorinated biphenyls

Table 13. Measurement Quality Objectives for Toxicity Tests and Tissue Bioaccumulation Analyses

Measurement Parameter	Accuracy	Precision	Completeness
Toxicity Tests:			100
Solid Phase Amphipod	N/A	C.V. ≤30%	
Solid Phase Polychaete	N/A	C.V. ≤30%	
Suspended Particulate Phase Silverside	N/A	C.V. ≤30%	
Suspended Particulate Phase Mysid Shrimp	N/A	C.V. ≤30%	
Suspended Particulate Phase Bivalve Larvae	N/A	C.V. ≤30%	
Water Quality Measurements:			100
Temperature	N/A	±0.1°C	
Salinity	N/A	±0.5 ppt	
pH	N/A	±0.1 units	
Ammonia	N/A	±0.05 mg/L	
Sulfides	N/A	±0.05 mg/L	
Dissolved Oxygen	N/A	±0.2 mg/L	
Tissue Chemical Analyses:			100
Percent Solids	≤20 percent	≤20 percent	
Metals	≤20 percent	≤20 percent	
Organochlorine Pesticides	≤20 percent	≤20 percent	
PCBs	≤20 percent	≤20 percent	

c.v. - coefficient of variation
mg/L - milligrams per liter
N/A - not applicable
PCBs - polychlorinated biphenyls
ppt - parts per thousand

Table 14. Minimum Laboratory Quality Control[1]

Analysis Type	Method Blanks[2]	Surrogates[3]	Duplicate[2,4]	Ongoing Precision and Recovery[2,5,6]	Matrix Spike[2,5,7]	Matrix Spike Duplicate[2,4,5,7]
Total Solids	X		X	X		
TOC	X		X	X	X	
Ammonia	X		X	X	X	
Sulfides	X		X	X	X	
Particle (Grain) Size			X			
Metals	X		X	X	X	
PAH	X	X		X	X	X
PCB	X	X		X	X	X
Pesticides	X	X		X	X	X
Phenols	X	X		X	X	X
Phthalates	X	X		X	X	X
Hydrocarbons	X			X	X	X
Butyltins	X	X		X	X	X

1 The laboratory may (and is encouraged to) perform and report more than the minimum required quality control. All quality control cited in the method specified in the sampling and analysis plan (SAP) must also be performed.

2 Prepare, extract, clean up, and concentrate the QC sample with each sample batch; batches are normally limited to 20 samples of the same matrix started through the extraction or preparation process on the same 12-hour shift.

3 Surrogate spikes are required for every sample, including method blanks, ongoing precision and recovery (OPR), reference materials, matrix spikes (MSs), and all actual samples including duplicates.

4 Duplicates are to be run when a hit is expected (e.g., most metals) and a matrix spike is to be run when a hit is not expected. The purpose of these duplicates is to access precision. Replicating a sample with a nondetect value does not provide a measure of precision. Likewise, spiking a sample with a native background level is often ineffective because of the ratio of the spike level to the native background level.

5 All analytes will be included in the OPR and matrix spikes.

6 The OPR test, sometimes termed a "laboratory control sample," "quality control check sample," "blank spike," or "laboratory-fortified blank," is used to ensure that the laboratory remains in control during the period that samples are analyzed, and it separates laboratory performance from method performance in the sample matrix. The test consists of a single aliquot of reference matrix spiked with the analyte(s) of interest and carried through the entire analytical process with each batch of samples. The concentration of the target analyte(s) in the spike solution may vary between one and five times the concentration used to establish the lowest calibration point (i.e., one to five times the minimum level [ML]).

7 Matrix spikes and matrix spike duplicates (MSDs) must be performed on project samples. The recoveries of the analytes, relative to the spike, are determined in each sample. The precision of the determinations also is assessed by measuring the relative standard deviation of the analyte concentrations measured in the MS and MSD. The MS and MSD samples should each be spiked at a level that results in the concentration of the target analytes being one to five times the background concentration of unspiked field samples or at the level specified in the method, whichever is greater.

PAH - polycyclic aromatic hydrocarbon
PCB - polychlorinated biphenyl
TOC - total organic carbons

Table 15. Acceptance Limits and Corrective Actions for Minimum Quality Control

QC Category	Acceptance Limits	Corrective Action
Method Blank (MB)	<2.2 MDL or ≥0.10 analyte level	Correct source of contamination, obtain acceptable blank values, and prepare fresh aliquots of the samples and reanalyze.[2]
Surrogate[1]	Analyte specfic	
Duplicate RSD	25	
OPR	18	The source of the problem must be identified and resolved before continuing analyses. Prepare fresh aliquots of the samples and reanalyze.[2]
MS & MSD[1]	35	If MB and OPR are in control, the problem is judged to be matrix related, not system related. Evaluate need to perform method of standard addition (MSA) or the data need to be qualified as suspected matrix effect.[2]
MS & MSD RSD	25	

[1] It is essential that laboratories calculate in-house performance criteria for matrix spike recoveries and surrogate recoveries. The development of in-house performance criteria and the use of control charts or similar procedures to track laboratory performance cannot be overemphasized. Many data systems and commercially available software packages support the use of control charts. Once established, control limits and warning limits for surrogates should be reviewed after every 20 to 30 field samples of the same matrix and should be updated at least semiannually. The matrix spike and surrogate results should all be generated using the same set of extraction, cleanup, and analysis techniques. For example, do not mix results from sediment samples extracted by ultrasonic extraction with those extracted by Soxhlet. In-house QC limits must be examined for reasonableness. It is not the intent to legitimize poor recoveries that are due to the incorrect choice of methods or spiking levels.

[2] Any matrix spike, surrogate, or OPR results outside of the control limits require evaluation by the laboratory. Such actions should begin with a comparison of the results from the samples or matrix spike samples with the OPR results. If the recoveries of the analytes in the OPR are outside of the control limits, then the problem may lie with the application of the extraction or cleanup procedures applied to the sample matrix or with the analytical procedures. Once the problem has been identified and addressed, corrective action may include the reanalysis of samples, or the extraction and analysis of new sample aliquots, including new matrix spike samples and OPR.

MDL - method detection limit
MS - matrix spike
MSD - matrix spike duplicate
OPR - ongoing precision and recovery
QC - quality control
RSD - relative standard deviation

Table 16. Minimum Laboratory Quality Control for Bioassay Testing

Analysis Type	Reference Toxicity Test	Dissolved Oxygen Concentration	Test Chamber Temperature	Control Organism Health	Age of Organism	Organism Maintenance	Salinity
ASTM E 724	X	X	X	X	X		
ASTM E 729	X	X	X	X		X	
ASTM E 1022	X	X	X	X		X	
ASTM E 1367	X	X	X	X		X	
ASTM E 1463	X	X	X	X			X
ASTM E 1562	X	X	X	X			X
ASTM E 1611	X	X	X	X	X	X	
ASTM E 1688		X	X	X	X	X	X

ASTM - American Society for Testing and Materials

Upon receipt in the bioassay laboratory, test organisms will be slowly acclimated to test conditions in environmentally controlled holding areas. Acclimation is performed in accordance with each test protocol for each test organism. Test organisms are evaluated on a performance basis for every test conducted in the laboratory. A control and/or reference toxicant test (for those species that have established effects levels data published) are run concurrent to each test to evaluate the health of the test organisms and the suitability of the test conditions.

5.0 DATA ANALYSIS

Statistical analyses used to evaluate all bioassays will follow the guidelines in the Green Book and *ITM*. In cases where average survival in the test medium equals or exceeds that of the reference, no statistical analysis will be performed. A student's *t*-test is used for suspended particulate phase (SPP) data to assess significant reductions in survival at each test concentration. If average survival in the test medium is lower than the reference in the 10-day mortality test, Dunnett's test will be used to determine if the difference in survival is statistically significant ($p \leq 0.05$). Prior to testing for significant differences, normality will be checked with Shapiro-Wilk's test and homogeneity of variances using Bartlett's test.

Statistical analysis of the bioaccumulation test data compares tissue levels from animals held in reference sediment to levels from the test sediment. Significance is determined using a single-classification, one-tailed analysis of variance (ANOVA). To ensure that test data meet the assumptions of ANOVA, Shapiro-Wilk's test will be performed to determine normality, while Bartlett's test will confirm homogeneity of variances. If one or both assumptions are not met, a

data transformation (e.g., square root, natural log) will be performed and the assumptions tested again. If the transformed data meet the assumptions of ANOVA, Dunnett's test is conducted. If the data do not meet the assumptions, a nonparametric test (such as Kruskall-Wallis) will be used. For analytes measured at or below the detection limit, the statistical test will be carried out using the detection limit as the data point. When the ANOVA yields a significant statistic, Dunnett's test will be used to compare each test value to the appropriate reference concentration. If the tissue level in the reference is higher than the test level, no statistical analysis will be done.

In addition, two other statistical determinations will be performed: the limiting permissible concentration (LPC), and the median lethal concentration (LC_{50}). The LPC is calculated if the LC_{50} is less than 100 percent. The LPC will be determined by inputting applicable chemical concentrations, toxicity results, and disposal site water-quality parameters into the Automated Dredging and Disposal Alternatives Management System (ADDAMS) (Schroeder and Palermo 1990). The LC_{50} will be determined by either the probits, moving average, or linear interpolation method using the computer program TOXCALC (Tidepool Scientific Software 1992-1994).

6.0 REPORT PREPARATION

When all analyses have been completed, draft and final reports will contain the following information:

- Introduction - Includes a project description and, if necessary, a dredge history of the site, historical uses, a summary of previous bioassay or sediment work, known contamination or discharges, and other general information
- Site and Project Maps including sample locations
- Methods and Materials - Includes all information pertaining to test sediment collection, handling, and analyses
- Results - Includes detailed results from all physical, biological, and chemical analyses, including a description of any deviations from this SAP
- Conclusion - An accurate conclusion will be developed, based upon experimental evidence, as to the relative quality of the dredged material
- References
- Quality Assurance/Quality Control Information - Includes all raw data sheets, spike and recovery information, and internal QC audits
- Pertinent Letters - Copies of all correspondence between regulatory agencies and the Port pertaining to the project

A draft report will be submitted to the Port for review prior to delivery of the final report. The final report will in turn be submitted to the Port and forwarded to the Los Angeles District USACE, the EPA Region 9-Los Angeles Field Office, Los Angeles Regional Water Quality Control Board, and other appropriate regulatory agencies for permitting purposes.

7.0 REFERENCES

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Appendix A
Historical Bulk Sediment Chemistry Results - Berths 144 and 147 (Ogden 1996b andAMEC 2003)

Final Report
Dredged Material Testing for Ocean Disposal
Berth 147
Project Directive Number 10
Agreement No. 1831

Prepared for

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EXECUTIVE SUMMARY

The Los Angeles Harbor Department is planning to improve the existing wharf and backlands at Berth 147 located in the West Basin of the Port of Los Angeles. The proposed project will require replacement of an existing concrete wharf and transit shed with a new wharf capable of mooring deeper-draft vessels. Dredging of approximately 125,000 cubic yards (cy) of bay sediment will be necessary to accommodate the new wharf bulkhead expansion.

The primary disposal option being pursued for the dredged material is unconfined open water disposal at the agency-designated LA-2 disposal site located approximately 5 miles south of San Pedro, California. This dump site is commonly used for disposal of sediment from the Port of Los Angeles. To determine the suitability of the sediment for placement at LA-2, a comprehensive suite of bioassay, bioaccumulation, and analytical chemistry tests were conducted on the dredged material. Sample collection and analysis followed the United States Army Corps of Engineers (ACOE) and Environmental Protection Agency (EPA) procedural manual referred to as the "Green Book," as well as regional guidance in the document titled "EPA Region 9 General Requirements for Sediment Testing of Dredged Material Proposed for Ocean Dumping."

The testing program for Berth 147 included separating the project footprint into two separate areas: 1) the Shoreline Area, and 2) the Berthing Area.

1. The Shoreline Area, which is located inshore of the existing pierhead line, consists of approximately 65,000 cy of sediments. This test area was all below +5.6 feet (ft) mean lower low water (MLLW). This site was further divided into four distinct layers based on each layer's depth and geologic make-up (referred to Top, Middle, Bottom, and Native Layers). In addition to 65,000 cy of marine sediment proposed for dredging, the site construction program will include the removal of 15,000 cy of rock rip-rap which will be reused as armament for the new slope.

2. The Berthing Area is located offshore of the existing bulkhead at Berth 147. This area contains about 60,000 cy of marine sediment proposed for removal. The

proposed design depth is -46 ft MLLW with a two-foot overdredge allowance (i.e., -48 ft MLLW).

Bioassay Results Summary

A total of four test sites (Top, Middle, Bottom, and Berthing) underwent full Green Book bioassay, chemical, and physical assessment. The Native sediment layer underwent chemical testing only (Green Book Tier II testing). Bioassay/bioaccumulation testing was conducted on composite samples of each site prepared by mixing sediment collected at various locations throughout each individual site.

Results of the bioassay tests conducted on Berth 147 sediment are summarized in Table ES-1. In general, the results show:

- No statistically significant solid or suspended-particulate phase mortality for the Top Layer of the Shoreline Area.

- Statistically significant shrimp and worm mortality in solid phase test; statistically significant shrimp and bivalve mortality in suspended-particulate phase tests from the Middle Layer of the Shoreline Area.

- Shrimp tests were statistically significant in solid and suspended-particulate phase test for the Bottom Layer of the Shoreline Area.

- No significant amphipod toxicity for any of the three test sites from the Shoreline Area or the Berthing Area test site.

- No statistically significant suspended-particulate phase mortality for the Berthing Area. Statistically significant solid phase mortality in shrimp and worm tests.

Bioaccumulation Results Summary

Bioaccumulation tests were conducted as part of this study using both a clam and worm. Test exposures were conducted for 28-days (with a 2-day depuration period), following which animal tissue was assayed for heavy metals, PCBs, organochlorine pesticides, and PAHs. The results of these analyses are summarized on Table ES-2 and generally show:

Shoreline Area Site

- Top Layer sediments did not have bioaccumulation of PAHs, pesticides, or PCBs. In clam tissues, only nickel was found to bioaccumulate in statistically significant amounts.

- No analytical evaluation of clam or worm tissue was conducted on the Middle Layer of the Shoreline Area because significant toxicity was observed in the suspended particulate and solid phase bioassays. These tissue samples are being maintained at -20°C in a lab freezer if further analyses are necessary.

- No organochlorine pesticides or PCBs were found above detection in clam tissue exposed to the sediment from the Bottom Layer of the Shoreline Area. PAHs were found in low amounts. Although metals were detected, none were statistically significant. No bioaccumulation tests were done on worm tissue because there was not enough tissue.

Berthing Area Site

- No detectable bioaccumulation of organochlorine pesticides or PCBs occurred in clam or worm tissue exposed to Berthing Area test sediment.

- Several individual PAHs were detected in somewhat elevated levels in both worm and clam tissue exposed to Berthing Area sediment. Based on bulk sediment chemistry analyses, Cores 1 and 5 accounted for the majority of the

total PAHs detected in the test sediment for this site. These cores were, no doubt, responsible for the majority of the PAH bioaccumulation observed in the site composite.

- No significant heavy metal bioaccumulation in worm or clam tissue exposed to Berthing Area sediment.

Sediment Chemistry Summary

Comprehensive sediment chemical data for the Berth 147 study are outlined on Table ES-3. Chemical analyses for this study were performed on each individual core segment, as well as the composite samples that were used to conduct the bioassay/bioaccumulation analyses. The logic for conducting sediment analyses in this manner was to assist in the identification of core segments containing elevated levels of chemical which may have been responsible for any toxicity observed in the bioassay analyses. If a sediment segment(s) can be identified as the likely cause of the observed toxicity, it can be isolated and disposed of by some alternative means (other than ocean disposal). The goal of testing in this fashion, therefore, is to maximize the amount of sediment that can be placed at LA-2, and to minimize the volume of sediment that has to undergo an alternative disposal method.

Results of the sediment chemical analyses for the Shoreline Area are summarized in Table ES-4. This table illustrates where the contaminated sediment is located and which individual core segment contributes the chemicals. Based on this analysis, the following conclusions can be made regarding the quality of the Berth 147 sediment.

Shoreline Area Site

- The Top Layer sediment was essentially free of chemical contamination for all cores. Core 1 had a slight hit of dibutyltin that was measured at 1.6 µg/kg (which is only slightly above detection). Core 3 had copper, nickel, and lead above the ER-L.

- The Middle Layer sediment was also basically free of chemical contamination with the exception of PAHs in Core 3. The PAHs in Core 3 caused the total PAH value to exceed the ER-L.

- The Bottom Layer sediment was also basically free of chemical contamination with the exception of metals (arsenic, copper, and nickel) in Core 1 and PAHs in Core 3. The PAHs in Core 3 caused the total PAH value to exceed the ER-L.

- The Native Layer sediment was essentially free of any chemical contamination. Arsenic, copper, and nickel were only slightly above their respective ER-L levels. These results probably represent increased elemental levels of these metals. PAHs were found at levels above detection in Cores 1 and 3 and are most likely from the creosote on the pilings.

Berthing Area Site

- The Berthing Area sediment composite had metals and PAHs above ER-L and ER-M values. DDD and DDE were also found in concentrations above their respective ER-L values, however, no pesticides were detected above the ER-M in the site composite. The tPAH level for the site composite was 15.59 mg/kg versus the ER-L of 4.022 mg/kg.

Conclusions

In conclusion, toxicity was observed in some of the suspended-particulate phase and solid phase analyses conducted as part of the Berth 147 study. Of the four locations tested at Berth 147, only the Top Layer of the Shoreline Area did not display statistically significant toxicity.

Bioaccumulation was generally absent in clam and worm tissue with the exception of metals and PAHs. Nickel (in the Top Layer) was the only metal that was found to be statistically significant in any of the test sites. PAH bioaccumulation was primarily due to

the presence of high levels of PAHs in specific cores in the Middle, Bottom, and Berthing sites.

Although toxicity and bioaccumulation of PAHs was observed in Middle, Bottom, and Berthing test sites, sediment samples from these sites were generally free of chemical contamination with the exception of specific core samples (e.g., Core 3 of Middle and Bottom Layers and Cores 1 and 5 of Berthing Area). Because the majority of chemicals were found in specific core segments and thus do not indicate widespread contamination, the majority of sediment within the proposed Berth 147 dredge footprint should be considered suitable for ocean disposal at LA-2 based on the provisions in the Marine Protection Research and Sanctuaries Act of 1972 (i.e., the Ocean Dumping Law).

Table ES-1. Bioassay Test Results Summary - Port of Los Angeles - Berth 147

Solid Phase Analyses				
Test Organism	Top Layer	Middle Layer	Bottom Layer	Berthing Area
Shrimp	NS	S†	S†	S†
Worm	NS	S†	NS	S
Amphipod	NS	NS	NS	NS

Suspended Particulate Phase Analyses				
Test Organism	Top Layer LC_{50}/EC_{50} (% elutriate)	Middle Layer LC_{50}/EC_{50} (% elutriate)	Bottom Layer LC_{50}/EC_{50} (% elutriate)	Berthing Area LC_{50}/EC_{50} (% elutriate)
Shrimp	>100	31*†	52*†	>100
Sanddab	>100	>100	>100	>100
Bivalve Larvae	>100 / >100	62* / 66†	>100 / 81	>100 / 76

S = statistically significant

NS = not significant based on test survival being within 10 percent (20 percent for amphipods) of reference survival

* = Statistically significant based on a one-tail, t-test

LC50/EC50s determined using linear interpolation

†Exceeds LPC (Limiting Permissible Concentration)

Table ES-2. Tissue Bioaccumulation Results Summary
Port of Los Angeles - Berth 147

Worms Reference Site Metals: Some Detected Pesticides: None Detected PCBs: None Detected PAHs: None Detected Organotins: None Detected	Clams Reference Site Metals: Some Detected Pesticides: None Detected PCBs: None Detected PAHs: None Detected Organotins: None Detected
Worms Top Sediment Layer Metals: **Zinc** Statistically Significant Pesticides: None Detected PCBs: None Detected PAHs: None Detected Organotins: None Detected	Clams Top Sediment Layer Metals: Some Detected, None Statistically Significant Pesticides: None Detected PCBs: None Detected PAHs: None Detected Organotins: None Detected
Worms Middle Sediment Layer Not evaluated due to significant toxicity in solid phase bioassays	Clams Middle Sediment Layer Not evaluated due to significant toxicity in solid phase bioassays
Worms Bottom Sediment Layer Not evaluated due to lack of tissue	Clams Bottom Sediment Layer Metals: Some Detected Pesticides: None Detected PCBs: None Detected PAHs: Some Detected, None Statistically Significant Organotins: None Detected
Worms Berthing Site Metals: Some Detected, None Statistically Significant Pesticides: None Detected PCBs: None Detected PAHs: Some Detected Organotins: None Detected	Clams Berthing Site Metals: Some Detected, None Statistically Significant Pesticides: None Detected PCBs: None Detected PAHs: Some Detected Organotins: None Detected

Table ES-3. Bulk Sediment Chemistry Results from Individual Cores and Composites
Berth 147 - Port of Los Angeles

Analyte	Reference	Top Layer				Middle Layer				Bottom Layer				ER-L	ER-M
		Core 1	Core 2	Core 3	Composite	Core 1	Core 2	Core 3	Composite	Core 1	Core 2	Core 3	Composite		
General Chemistry															
Percent Moisture	24.4	26.3	24.6	24.5	25.8	26.8	27.5	24.6	24.5	28.2	27.2	25.1	26	--	--
Ammonia	13.7	<4.0	5.4	7	4.4	17.3	11.9	29.2	16.2	49.3	26.2	31.8	34.4	--	--
Petroleum Hydrocarbons	14	9	12	60	15	4	4	57	9	<0.5	3	10	2	--	--
Sulfide	0.78	<0.20	<0.20	<0.20	<0.20	0.8	1.4	<0.20	<0.99	0.54	<0.20	<0.20	<0.20	--	--
Dissolved Sulfide	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.99	<0.20	<0.20	<0.20	<0.20	--	--
Total Organic Carbon (TOC)	0.79	0.97	0.34	<0.59	0.4	0.45	0.53	0.63	0.61	1.5	0.41	0.65	0.68	--	--
Metals															
Silver	0.2	0.1	<0.1	0.2	0.3	0.2	<0.1	<0.1	0.3	0.2	0.1	0.2	0.1	1	3.7
Arsenic	2.5	3.2	4	5.8	3.8	8.7	6.1	4.9	5.5	9.1	6.9	5.9	6.4	8.2	70
Cadmium	<0.09	<0.08	<0.08	0.4	<0.09	<0.1	<0.1	<0.1	<0.09	<0.12	<0.08	<0.1	<0.09	1.2	9.6
Chromium	22.4	13	15.8	17.7	15.2	21.7	20.4	17.7	18.4	28.6	15.1	19.1	19.3	81	370
Copper	11.5	7.2	11.5	198	55.3	25.5	26.3	18.7	22.2	36.1	17.2	20.9	22.4	34	270
Mercury	0.021	0.035	0.046	0.073	0.043	0.067	0.094	0.068	0.063	0.093	0.053	0.056	0.066	0.15	0.71
Nickel	10.7	8.4	10.5	40.1	17	15.8	15.7	12.2	13.3	21.1	10.6	13.8	13.9	20.9	51.6
Lead	7.7	5.5	7	137	76.2	9.5	8.9	8.2	7.3	12.7	7.8	8.5	7.2	46.7	218
Selenium	<0.4	<0.3	<0.3	<0.4	<0.4	<0.4	<0.4	0.4	<0.4	<0.5	<0.03	<0.4	<0.4	--	--
Zinc	46.3	30.1	38.7	223	99.4	54.6	61	45.8	49.3	72.5	38.6	50.3	48	150	410
Pesticides															
Aldrin	<0.0023	<0.0023	<0.0023	<0.0023	<0.0023	<0.0023	<0.0023	<0.0023	<0.0023	<0.0024	<0.0023	<0.0023	<0.0023	--	--
Alpha-BHC	<0.0022	<0.0023	<0.0023	<0.0023	<0.0023	<0.0023	<0.0023	<0.0023	<0.0023	<0.0024	<0.0023	<0.0023	<0.0023	--	--
Beta - BHC	<0.0022	<0.0023	<0.0023	<0.0023	<0.0023	<0.0023	<0.0023	<0.0023	<0.0023	<0.0024	<0.0023	<0.0023	<0.0023	--	--
Gamma - BHC	<0.0022	<0.0023	<0.0023	<0.0023	<0.0023	<0.0023	<0.0023	<0.0023	<0.0023	<0.0024	<0.0023	<0.0023	<0.0023	--	--
Delta - BHC	<0.0022	<0.0023	<0.0023	<0.0023	<0.0023	<0.0023	<0.0023	<0.0023	<0.0023	<0.0024	<0.0023	<0.0023	<0.0023	--	--
Chlordane	<0.022	<0.023	<0.023	<0.023	<0.023	<0.023	<0.023	<0.023	<0.023	<0.024	<0.023	<0.023	<0.023	0.00005	0.006
4,4' - DDD	<0.0022	<0.0023	<0.0023	<0.0023	<0.0023	<0.0023	<0.0023	<0.0023	<0.0023	<0.0024	<0.0023	<0.0023	<0.0023	0.002	0.02
4,4' - DDE	0.049	<0.0023	<0.0023	<0.0023	<0.0023	<0.0023	<0.0023	<0.0023	<0.0023	<0.0024	<0.0023	<0.0023	<0.0023	0.002	0.015
4,4' - DDT	<0.0022	<0.0023	<0.0023	<0.0023	<0.0023	<0.0023	<0.0023	<0.0023	<0.0023	<0.0024	<0.0023	<0.0023	<0.0023	0.001	0.007
Dieldrin	<0.0022	<0.0023	<0.0023	<0.0023	<0.0023	<0.0023	<0.0023	<0.0023	<0.0023	<0.0024	<0.0023	<0.0023	<0.0023	0.00002	0.008
Endosulfan I	<0.0022	<0.0023	<0.0023	<0.0023	<0.0023	<0.0023	<0.0023	<0.0023	<0.0023	<0.0024	<0.0023	<0.0023	<0.0023	--	--
Endosulfan II	<0.0022	<0.0023	<0.0023	<0.0023	<0.0023	<0.0023	<0.0023	<0.0023	<0.0023	<0.0024	<0.0023	<0.0023	<0.0023	--	--
Endosulfan Sulfate	<0.0044	<0.0045	<0.0044	<0.0044	<0.0044	<0.0045	<0.0046	<0.0044	<0.0044	<0.0046	<0.0045	<0.0044	<0.0045	--	--
Endrin	<0.0022	<0.0023	<0.0023	<0.0023	<0.0023	<0.0023	<0.0023	<0.0023	<0.0023	<0.0024	<0.0023	<0.0023	<0.0023	0.00002	0.045
Endrin Ketone	<0.0022	<0.0023	<0.0023	<0.0023	<0.0023	<0.0023	<0.0023	<0.0023	<0.0023	<0.0024	<0.0023	<0.0023	<0.0023	--	--
Heptachlor	<0.0022	<0.0023	<0.0023	<0.0023	<0.0023	<0.0023	<0.0023	<0.0023	<0.0023	<0.0024	<0.0023	<0.0023	<0.0023	--	--
Heptachlor Epoxide	<0.0022	<0.0023	<0.0023	<0.0023	<0.0023	<0.0023	<0.0023	<0.0023	<0.0023	<0.0024	<0.0023	<0.0023	<0.0023	--	--
Methoxychlor	<0.011	<0.011	<0.011	<0.011	<0.011	<0.011	<0.011	<0.011	<0.011	<0.012	<0.011	<0.011	<0.011	--	--
Toxaphene	<0.022	<0.023	<0.023	<0.023	<0.023	<0.023	<0.023	<0.023	<0.023	<0.024	<0.023	<0.023	<0.023	--	--
PCBs															
Aroclor - 1016	<0.022	<0.023	<0.023	<0.023	<0.023	<0.023	<0.023	<0.023	<0.023	<0.024	<0.023	<0.023	<0.023	--	--
Aroclor - 1221	<0.022	<0.023	<0.023	<0.023	<0.023	<0.023	<0.023	<0.023	<0.023	<0.024	<0.023	<0.023	<0.023	--	--
Aroclor - 1232	<0.022	<0.023	<0.023	<0.023	<0.023	<0.023	<0.023	<0.023	<0.023	<0.024	<0.023	<0.023	<0.023	--	--
Aroclor - 1242	<0.022	<0.023	<0.023	<0.023	<0.023	<0.023	<0.023	<0.023	<0.023	<0.024	<0.023	<0.023	<0.023	--	--
Aroclor - 1248	<0.022	<0.023	<0.023	<0.023	<0.023	<0.023	<0.023	<0.023	<0.023	<0.024	<0.023	<0.023	<0.023	--	--
Aroclor - 1254	<0.022	<0.023	<0.023	<0.023	<0.023	<0.023	<0.023	<0.023	<0.023	<0.024	<0.023	<0.023	<0.023	--	--
Aroclor - 1260	<0.022	<0.023	<0.023	<0.023	<0.023	<0.023	<0.023	<0.023	<0.023	<0.024	<0.023	<0.023	<0.023	--	--
Total PCB's	0.077	0.081	0.081	0.081	0.081	0.081	0.081	0.081	0.081	0.084	0.081	0.081	0.081	2.7	180
Phenols															
Phenol	<0.22	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	<1.1	<0.45	<0.24	<0.23	<0.45	<0.23	--	--
2-Chlorophenol	<0.22	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	<1.1	<0.45	<0.24	<0.23	<0.45	<0.23	--	--
2-Methylphenol	<0.22	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	<1.1	<0.45	0.17	<0.23	<0.45	<0.23	--	--
4-Methylphenol	<0.22	<0.23	<0.23	<0.23	<0.22	<0.23	<0.23	<1.1	<0.45	0.19	<0.23	<0.45	<0.22	--	--
2-Nitrophenol	<0.22	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	<1.1	<0.45	<0.24	<0.23	<0.45	<0.23	--	--
2,4-Dimethylphenol	<0.22	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	<1.1	<0.45	0.29	<0.23	0.24	<0.23	--	--
2,4-Dichlorophenol	<0.22	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	17	<0.45	<0.24	<0.23	<0.17	<0.23	--	--
4-Chloro-3-Methylphenol	<0.22	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	<1.1	<0.45	<0.24	<0.23	<0.45	<0.23	--	--
2,4,6-Trichlorophenol	<0.22	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	<5.6	<0.45	<0.24	<0.23	<0.45	<0.23	--	--
2,4,5- Trichorophenol	<1.1	<1.2	<1.1	<1.1	<1.1	<1.2	<1.2	<1.1	<2.3	<1.2	<1.2	<2.3	<1.1	--	--
2-Methyl-4,6-Dinitrophenol	<1.1	<1.2	<1.1	<1.1	<1.1	<1.2	<1.2	<5.6	<2.3	<1.2	<1.2	<2.3	<1.1	--	--
Pentachlorophenol	<1.1	<1.2	<1.1	<1.1	<1.1	<1.2	<1.2	19	<2.3	<1.2	<1.2	<2.3	<1.1	--	--
4-Nitrophenol	<1.1	<1.2	<1.1	<1.1	<1.1	<1.2	<1.2	<1.1	<2.3	<1.2	<1.2	<2.3	<1.1	--	--
Phathalates															
Dimethylphathalate	<0.22	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	<1.1	<0.45	<0.24	<0.23	<0.45	<0.23	--	--
Diethylphthalate	<0.22	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	9.4	<0.45	<0.24	<0.23	<0.45	<0.23	--	--
Di-N-Butylphathalate	<0.22	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	6.4	<0.45	<0.24	<0.23	<0.45	<0.23	--	--
Butylbenzylphthalate	<0.22	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	0.86	<0.45	<0.24	<0.23	<0.45	<0.23	--	--
Bis(2-ethylhexyl)Phthalate	<0.22	0.26	0.19	<0.23	<0.23	<0.23	<0.23	<1.1	<0.45	<0.24	<0.23	<0.45	<0.23	--	--
Di-N-Octylphthalate	<0.22	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	<1.1	<0.45	<0.24	<0.23	<0.45	<0.23	--	--
PAH's															
Acenaphthylene	<0.22	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	**7.6**	<0.45	<0.24	<0.23	<0.45	<0.23	0.044	0.64
Acenaphthene	<0.22	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	<5.6	1.2	<0.24	<0.23	**4**	0.77	0.016	0.50
Flourene	<0.22	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	<5.6	1.7	<0.24	<0.23	**4.3**	0.91	0.019	0.54
Phenanthrene	<0.22	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	**4.0**	**5.8**	<0.24	<0.23	**10**	**1.9**	0.24	1.50
Anthracene	<0.22	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	<1.1	**0.86**	<0.24	<0.23	**2.4**	**0.42**	0.0853	1.10
Fluoranthene	<0.22	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	4.1	1.6	<0.24	<0.23	**3.7**	0.72	0.60	5.10
Pyrene	<0.22	<0.23	<0.23	0.16	<0.23	<0.23	<0.23	<1.1	0.97	<0.24	<0.23	2.1	<0.23	0.665	2.60
Naphthalene	<0.22	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	<1.1	0.57	0.35	<0.23	8.7	1.3	--	--
Benzo(a)Anthracene	<0.22	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	0.81	0.23	<0.24	<0.23	0.45	0.09	0.261	1.60
Chrysene	<0.22	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	<1.1	0.16	<0.24	<0.23	0.44	0.07	0.384	2.80
Benzo(b)Fluoranthene	<0.22	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	<1.1	<0.45	<0.24	<0.23	<0.45	<0.23	--	--
Benzo(k)Fluoranthene	<0.22	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	<1.1	<0.45	<0.24	<0.23	<0.45	<0.23	--	--
Benzo(a)Pyrene	<0.22	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	<1.1	<0.45	<0.24	<0.23	<0.45	<0.23	0.43	1.6
Indeno(1,2,3-cd)Pyrene	<0.22	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	<1.1	<0.45	<0.24	<0.23	<0.45	<0.23	--	--
Dibenzo(a,h)Anthracene	<0.22	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	<1.1	<0.45	<0.24	<0.23	<0.45	<0.23	0.0634	0.26
Benzo(g,h,i)Perylene	<0.22	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	<1.1	<0.45	<0.24	<0.23	<0.45	<0.23	--	--
2-Methylnaphthalene	<0.22	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	8	0.57	<0.24	<0.23	<0.45	0.68	--	--
Total PAH's	1.87	1.96	1.96	2.00	1.96	1.96	1.96	35.61	13.24	2.27	1.96	37.89	7.78	4.02	44.79
Organotins															
Tributyltin	<1.3	<1.4	<1.3	<1.3	<1.4	<1.4	<1.4	<1.3	<1.3	<1.4	<1.4	<1.3	<1.4	--	--
Dibutyltin	1.8	1.6	<1.3	<1.3	<1.4	<1.4	2.6	<1.3	<1.3	<1.4	<1.4	<1.3	<1.4	--	--
Monobutyltin	<1.3	<1.4	<1.3	<1.3	<1.4	<1.4	<1.4	<1.3	<1.3	<1.4	<1.4	<1.3	<1.4	--	--

Bold values concentration exceeds ER-L criteria levels

concentration exceeds ER-M criteria levels

Total PAH and PCB concentrations were calculated by adding the results for analytes measured above detection + 1/2 the detection limit for analytes below detection.

Table ES-3 (continued). Bulk Sediment Chemistry Results from Individual Cores and Composites
Berth 147 - Port of Los Angeles

Analyte	Reference	Native Layer			Berthing Area						ER-L	ER-M
		Core 1	Core 2	Core 3	Core 1	Core 2	Core 3	Core 4	Core 5	Composite		
General Chemistry												
Percent Moisture	24.4	32.7	32	30.3	35.2	41.5	38.6	41.1	31.2	37.9	--	--
Ammonia	13.7	92	70.7	59.8	85.7	25.9	90.2	22.4	46.5	49.1	--	--
Petroleum Hydrocarbons	14	2	<0.5	<0.5	100	150	300	220	680	240	--	--
Sulfide	0.78	<0.20	<0.20	<0.20	785	188	207	111	139	147	--	--
Dissolved Sulfide	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.2	<0.20	<0.20	--	--
Total Organic Carbon (TOC)	0.79	1.6	1.5	1.6	1.7	1.6	1.8	1.2	1.4	1.5	--	--
Metals												
Silver	0.2	0.3	0.2	0.3	0.4	0.4	0.6	0.4	0.4	0.4	1	3.7
Arsenic	2.5	**8.2**	**8.9**	9	**9.4**	**10**	**10.8**	10.4	7.1	9.4	8.2	70
Cadmium	<0.09	0.2	<0.2	<0.09	<0.11	<0.1	<0.12	<0.12	<0.1	<0.12	1.2	9.6
Chromium	22.4	37.2	34.7	36.3	55.1	50.5	58.7	48	40.3	54.9	81	370
Copper	11.5	**37.3**	29.5	33.6	**96.8**	**88.9**	**85.6**	**75.1**	**58.8**	**78.1**	34	270
Mercury	0.021	0.093	0.077	0.081	**1.07**	**0.51**	**0.76**	**0.48**	**0.57**	**0.52**	0.15	0.71
Nickel	10.7	**26.6**	**23.7**	**25.2**	**24.9**	**27.1**	**25.8**	**24.5**	**18.2**	**26.8**	20.9	51.6
Lead	7.7	15.3	12.7	12.4	**85.1**	**47.7**	**59.3**	**47**	**56.8**	**65.6**	46.7	218
Selenium	<0.4	1	0.9	0.7	0.5	<0.4	<0.4	<0.5	<0.4	<0.5	--	--
Zinc	46.3	92.9	86.1	85.7	**190**	**151**	**150**	**131**	**106**	**136**	150	410
Pesticides												
Aldrin	<0.0023	<0.0025	<0.0025	<0.0024	<0.0026	<0.0029	<0.0028	<0.0029	<0.0025	<0.0027	--	--
Alpha-BHC	<0.0022	<0.0025	<0.0025	<0.0024	<0.0026	<0.0029	<0.0028	<0.0029	<0.0025	<0.0027	--	--
Beta - BHC	<0.0022	<0.0025	<0.0025	<0.0024	<0.0026	<0.0029	<0.0028	<0.0029	<0.0025	<0.0027	--	--
Gamma - BHC	<0.0022	<0.0025	<0.0025	<0.0024	<0.0026	<0.0029	<0.0028	<0.0029	<0.0025	<0.0027	--	--
Delta - BHC	<0.0022	<0.0025	<0.0025	<0.0024	<0.0026	<0.0029	<0.0028	<0.0029	<0.0025	<0.0027	--	--
Chlordane	<0.022	<0.025	<0.025	<0.024	<0.026	<0.029	<0.028	<0.029	<0.025	<0.027	0.00005	0.006
4,4' - DDD	<0.0022	<0.0025	<0.0025	<0.0024	**0.012**	**0.0063**	**0.022**	**0.0022**	**0.012**	**0.004**	0.002	0.02
4,4' - DDE	**0.049**	<0.0025	<0.0025	<0.0024	**0.0088**	**0.0097**	**0.022**	<0.0029	**0.017**	<0.0027	0.002	0.015
4,4' - DDT	<0.0022	<0.0025	<0.0025	<0.0024	<0.0026	<0.0029	<0.0028	<0.0029	<0.0025	<0.0027	0.001	0.007
Dieldrin	<0.0022	<0.0025	<0.0025	<0.0024	<0.0026	<0.0029	<0.0028	<0.0029	<0.0025	<0.0027	0.00002	0.008
Endosulfan I	<0.0022	<0.0025	<0.0025	<0.0024	<0.0026	<0.0029	<0.0028	<0.0029	<0.0025	<0.0027	--	--
Endosulfan II	<0.0022	<0.0025	<0.0025	<0.0024	<0.0026	<0.0029	<0.0028	<0.0029	<0.0025	<0.0027	--	--
Endosulfan Sulfate	<0.0044	<0.0049	<0.0049	<0.0047	<0.0051	<0.0056	<0.0054	<0.0056	<0.0048	<0.0053	--	--
Endrin	<0.0022	<0.0025	<0.0025	<0.0024	<0.0026	<0.0029	<0.0028	<0.0029	<0.0025	<0.0027	0.00002	0.045
Endrin Ketone	<0.0022	<0.0025	<0.0025	<0.0024	<0.0026	<0.0029	<0.0028	<0.0029	<0.0025	<0.0027	--	--
Heptachlor	<0.0022	<0.0025	<0.0025	<0.0024	<0.0026	<0.0029	<0.0028	<0.0029	<0.0025	<0.0027	--	--
Heptachlor Epoxide	<0.0022	<0.0025	<0.0025	<0.0024	<0.0026	<0.0029	<0.0028	<0.0029	<0.0025	<0.0027	--	--
Methoxychlor	<0.011	<0.012	<0.012	<0.012	<0.013	<0.014	<0.014	<0.014	<0.012	<0.013	--	--
Toxaphene	<0.022	<0.025	<0.025	<0.024	<0.026	<0.029	<0.028	<0.029	<0.025	<0.027	--	--
PCBs												
Aroclor - 1016	<0.022	<0.025	<0.025	<0.024	<0.026	<0.029	<0.028	<0.029	<0.025	<0.027	--	--
Aroclor - 1221	<0.022	<0.025	<0.025	<0.024	<0.026	<0.029	<0.028	<0.029	<0.025	<0.027	--	--
Aroclor - 1232	<0.022	<0.025	<0.025	<0.024	<0.026	<0.029	<0.028	<0.029	<0.025	<0.027	--	--
Aroclor - 1242	<0.022	<0.025	<0.025	<0.024	<0.026	<0.029	<0.028	<0.029	<0.025	<0.027	--	--
Aroclor - 1248	<0.022	<0.025	<0.025	<0.024	<0.026	<0.029	<0.028	<0.029	<0.025	<0.027	--	--
Aroclor - 1254	<0.022	<0.025	<0.025	<0.024	0.059	<0.029	0.12	0.076	0.071	0.083	--	--
Aroclor - 1260	<0.022	<0.025	<0.025	<0.024	<0.026	<0.029	<0.028	<0.029	<0.025	<0.027	--	--
Total PCBs	0.077	0.088	0.088	0.084	0.137	0.102	0.204	0.163	0.146	0.164	[illegible]	150
Phenols												
Phenol	<0.22	0.8	<0.25	<0.24	<2.6	<0.58	<1.4	<0.29	<2.5	<1.4	--	--
2-Chlorophenol	<0.22	<0.51	<0.25	<0.24	<2.6	<0.58	<1.4	<0.29	<2.5	<1.4		--
2-Methylphenol	<0.22	1.6	<0.25	<0.24	<2.6	<0.58	<1.4	<0.29	<2.5	<1.4		--
4-Methylphenol	<0.22	3	<0.25	<0.24	<2.6	<0.58	<1.4	<0.29	<2.5	<1.4		--
2-Nitrophenol	<0.22	<0.51	<0.25	<0.24	<2.6	<0.58	<1.4	<0.29	<2.5	<1.4	--	--
2,4-Dimethylphenol	<0.22	3.1	<0.25	<0.24	<2.6	<0.58	<1.4	<0.29	<2.5	<1.4	--	--
2,4-Dichlorophenol	<0.22	12	<0.25	<0.24	<2.6	<0.58	<1.4	<0.29	<2.5	<1.4	--	--
4-Chloro-3-Methylphenol	<0.22	<0.51	<0.25	<0.24	<2.6	<0.58	<1.4	<0.29	<2.5	<1.4	--	--
2,4,6-Trichlorophenol	<0.22	<0.51	<0.25	<0.24	<2.6	<0.58	<1.4	<0.29	<2.5	<1.4	--	--
2,4,5- Trichlorophenol	<1.1	<2.5	<1.3	<1.2	<13	<2.9	<6.9	<1.4	<12	<6.8	--	--
2-Methyl-4,6-Dinitrophenol	<1.1	<2.5	<1.3	<1.2	<13	<2.9	<6.9	<1.4	<12	<6.8	--	--
Pentachlorophenol	<1.1	<2.5	<1.3	<1.2	<13	<2.9	<6.9	<1.4	<12	<6.8	--	--
4-Nitrophenol	<1.1	<2.5	<1.3	<1.2	<13	<2.9	<6.9	<1.4	<12	<6.8	--	--
Phthalates												
Dimethylphthalate	<0.22	<0.51	<0.25	<0.24	<2.6	<0.58	<1.4	<0.29	<12	<6.8	--	--
Diethylphthalate	<0.22	<0.51	<0.25	<0.24	<2.6	<0.58	<1.4	<0.29	<2.5	<1.4	--	--
Di-N-Butylphthalate	<0.22	<0.51	<0.25	<0.24	<2.6	<0.58	<1.4	<0.29	<2.5	<1.4	--	--
Butylbenzylphthalate	<0.22	<0.51	<0.25	<0.24	<2.6	<0.58	<1.4	<0.29	<2.5	<1.4	--	--
Bis(2-ethylhexyl)Phthalate	<0.22	<0.51	<0.25	<0.24	<2.6	0.29	<1.4	0.2	<2.5	<1.4	--	--
Di-N-Octylphthalate	<0.22	<0.51	<0.25	<0.24	<2.6	<0.58	<1.4	<0.29	<2.5	<1.4	--	--
PAH's												
Acenaphthylene	<0.22	<0.51	<0.25	<0.24	<2.6	<0.58	<1.4	<0.29	<2.5	<1.4	0.044	0.64
Acenaphthene	<0.22	**1.3**	<0.25	**0.9**	**2.2**	<0.58	**0.33**	<0.29	**0.63**	**0.56**	0.016	0.50
Flourene	<0.22	**0.98**	<0.25	**0.06**	**1.7**	<0.58	**0.29**	<0.29	<2.5	**0.52**	0.019	0.54
Phenanthrene	<0.22	**1.5**	<0.25	0.06	**7.7**	<0.58	**0.65**	<0.29	1.3	**1.4**	0.24	1.50
Anthracene	<0.22	<0.51	<0.25	<0.24	**1.4**	<0.58	**0.33**	0.08	**0.63**	**0.68**	0.0853	1.10
Fluoranthene	<0.22	1.5	<0.25	<0.24	**8.8**	0.21	**1.2**	0.1	**2.8**	**2.4**	0.60	5.10
Pyrene	<0.22	<0.51	<0.25	<0.24	**5.7**	0.34	**2.1**	0.19	**4.5**	**2.1**	0.665	2.60
Naphthalene	<0.22	<0.51	<0.25	1.2	<2.6	<0.58	<1.4	<0.29	<2.5	<1.4	--	--
Benzo(a)Anthracene	<0.22	0.49	<0.25	<0.24	1.3	0.12	**0.49**	0.11	**0.63**	**0.72**	0.261	1.60
Chrysene	<0.22	0.27	<0.25	<0.24	1.4	0.19	**0.44**	0.16	**0.87**	1.1	0.384	2.80
Benzo(b)Fluoranthene	<0.22	<0.51	<0.25	<0.24	1.4	0.58	1.2	0.53	0.87	0.84	--	--
Benzo(k)Fluoranthene	<0.22	<0.51	<0.25	<0.24	0.57	0.29	0.46	0.14	0.48	0.43	--	--
Benzo(a)Pyrene	<0.22	<0.51	<0.25	<0.24	**0.88**	0.38	**0.7**	0.29	**0.73**	**0.64**	0.43	1.6
Indeno(1,2,3-cd)Pyrene	<0.22	<0.51	<0.25	<0.24	<2.6	0.19	0.37	0.14	<2.5	<1.4	--	--
Dibenzo(a,h)Anthracene	<0.22	<0.51	<0.25	<0.24	<2.6	<0.58	<1.4	<0.29	<2.5	<1.4	0.0634	0.26
Benzo(g,h,i)Perylene	<0.22	<0.51	<0.25	<0.24	<2.6	0.21	0.37	0.16	<2.5	<1.4	--	--
2-Methylnaphthalene	<0.22	2.1	<0.25	0.14	<2.6	<0.58	<1.4	<0.29	<2.5	<1.4	--	--
Total PAH's	1.87	**10.69**	2.13	3.80	**40.85**	**4.83**	**11.73**	2.92	**22.19**	**15.59**	4.022	44.792
Organotins												
Tributyltin	<1.3	<1.5	<1.5	<1.4	21	24	41	23	42	22	--	--
Dibutyltin	1.8	<1.5	<1.5	<1.4	6.9	17	18	14	9.6	11	--	--
Monobutyltin	<1.3	<1.5	<1.5	<1.4	2.9	7.6	5.1	7.8	4.1	4.5	--	--

Bold values concentration exceeds ER-L criteria levels
concentration exceeds ER-M criteria levels

Total PAH and PCB concentrations were calculated by adding the results for analytes measured above detection + 1/2 the detection limit for analytes below detection.

Table ES-4. Sediment Chemistry Results Summary
Soil Boring Cores
Berth 147 - Port of Los Angeles

Berth 147 Core 1	Berth 147 Core 2	Berth 147 Core 3
Top Sediment Layer Metals: None above ER-L Pesticides: None Detected PCBs: None Detected PAHs: None Detected **Organotins: Dibutyltin @ 1.6 µg/kg**	Top Sediment Layer Metals: None above ER-L Pesticides: None Detected PCBs: None Detected PAHs: None Detected Organotins: None Detected	Top Sediment Layer **Metals: Copper, Nickel, and Lead above ER-L** Pesticides: None Detected PCBs: None Detected PAHs: None above ER-L Organotins: None Detected
Middle Sediment Layer **Metals: Arsenic slightly above ER-L** Pesticides: None Detected PCBs: None Detected PAHs: None Detected Organotins: None Detected	Middle Sediment Layer Metals: None above ER-L Pesticides: None Detected PCBs: None Detected PAHs: None Detected **Organotins: Dibutyltin @ 2.6 µg/kg**	Middle Sediment Layer Metals: None above ER-L Pesticides: None Detected PCBs: None Detected **PAHs: Flouranthene above ER-L; acenaphthylene and phenanthrene above ER-L and ER-M** **tPAHs @ 35.61 mg/kg above ER-L** Organotins: None Detected
Bottom Sediment Layer **Metals: Arsenic, Copper, and Nickel slightly above ER-L** Pesticides: None Detected PCBs: None Detected PAHs: None Detected Organotins: None Detected	Bottom Sediment Layer Metals: None above ER-L Pesticides: None Detected PCBs: None Detected PAHs: None above ER-L Organotins: None Detected	Bottom Sediment Layer Metals: None above ER-L Pesticides: None Detected PCBs: None Detected PAHs: None Detected **PAHs: Four above ER-M, Two above ER-L** **tPAHs @ 37.89 mg/kg above ER-L** Organotins: None Detected
Native Sediment Layer **Metals: Arsenic, Copper, and Nickel slightly above ER-L** Pesticides: None Detected PCBs: None Detected **PAHs: Four above ER-L, Two above ER-M** **tPAHs @ 10.69 mg/kg above ER-L** Organotins: None Detected	Native Sediment Layer **Metals: Arsenic and Nickel slightly above ER-L** Pesticides: None Detected PCBs: None Detected PAHs: None Detected Organotins: None Detected	Native Sediment Layer **Metals: Arsenic and Nickel slightly above ER-L** Pesticides: None Detected PCBs: None Detected **PAHs: Flourene above ER-L, Acenapthene above ER-M** Organotins: None Detected

Bold indicates analytes above ER-L/ER-M or above detection

Final Report
Sediment Characterization for Ocean or Harbor Disposal Berths 145 through 147 Port of Los Angeles

Prepared for
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April 2003

ADP No. 020228-006

Project Number 324340008

Port of Los Angeles
Berths 145-147 (AMEC 2003)
Raw Sediment Chemistry Data

	Site 1						Site 2							Reference sites	
Parameter	1-1	1-2	1-3	1-4	1-5	1-COMP	2-1	2-2	2-3	2-4	2-5	2-6	2-Comp	Ref LA-2	Ref Harbor
Physical/Conventional Tests															
Total Solids (TS), % [1]	66.9	74.9	69.6	69.8	76.8	74.4	64.9	63.7	63.5	64.9	69.4	61.6	65.1	75.6	60.8
Total Sulfides, mg/kg	ND<0.15	4.0	20	2.9	0.39	4.3	3.6	12	11	7.1	3.5	2.9	15	ND<0.13	0.49
Soluble Sulfides, mg/kg	ND<0.15	ND<0.13	ND<0.15	ND<0.14	ND<0.13	ND<0.13	ND<0.15	ND<0.16	ND>0.16	ND<0.15	ND<0.14	ND<0.16	ND<0.15	ND<0.13	ND<0.16
Ammonia-N, mg/kg	6.3	ND<0.13	4.9	2.0	0.73	2.6	38	29	25	21	5.5	37	21	5.0	2.5
TRPH, mg/kg	54	50	150	91	46	66	190	220	170	44	140	150	41	43	54
Metals, mg/kg															
Arsenic	5.78	4.16	7.50	4.07	2.56	3.83	8.70	12.2	11.1	10.9	9.18	8.26	10.9	ND<1.32	7.47
Cadmium	0.656	0.187	0.532	0.232	0.227	0.259	0.339	0.561	0.503	0.325	0.342	0.585	0.612	ND<0.658	0.719
Chromium (total)	43.7	21.0	46.4	30.2	17.2	28.0	40.6	53.3	54.4	47.9	51.5	64.7	65.2	13.5	45.4
Copper	52.7	22.4	44.2	31.9	17.4	27.4	40.7	85.3	73.0	50.0	58.4	65.1	83.2	6.98	48.4
Lead	23.6	14.3	50.7	23.9	23.2	19.7	43.8	47.9	45.6	28.7	33.9	52.6	57.7	3.97	26.8
Nickel	29.7	11.1	19.7	14.8	10.3	15.4	28.5	33.9	33.0	31.9	33.8	28.1	34.9	6.74	27.2
Selenium	ND<0.746	ND<0.667	ND<0.725	0.748	ND<0.649	ND<0.676	0.761	1.11	ND<0.761	ND<0.769	1.04	ND<0.805	ND<0.769	ND<3.29	ND<0.820
Silver	0.301	ND<0.133	0.270	0.206	0.201	ND<0.135	0.192	0.310	0.256	0.169	0.169	0.245	0.239	ND<0.658	0.879
Zinc	99.6	51.4	92.3	65.5	43.8	80.6	94.6	130	124	93.9	103	117	148	34.5	111
Mercury	0.200	0.164	0.452	0.259	0.119	0.211	0.395	0.895	0.503	0.246	0.329	0.582	0.746	0.032	0.191
Pesticides, ug/kg															
4,4'-DDD	ND<1.5	ND< 1.3	ND<1.5	ND<1.4	ND<1.3	ND< 1.3	ND<1.5	ND<1.6	ND<1.6	ND<1.5	ND<1.4	ND<1.6	ND< 1.5	ND<1.3	ND<1.6
4,4'-DDE	4.6	5.2	19	8.9	1.4	6.9	ND<1.5	7.6	4.7	ND<1.5	4.5	9.5	6.4	27	10
4,4'-DDT	2.7	2.6	11	5.0	ND<1.3	1.5	ND<1.5	4.7	ND<1.6	ND<1.5	ND<1.4	6.5	5.9	11	ND<1.6
Aldrin	ND<1.5	ND< 1.3	ND<1.5	ND<1.4	ND<1.3	ND< 1.3	ND<1.5	ND<1.6	ND<1.6	ND<1.5	ND<1.4	ND<1.6	ND< 1.5	ND<1.3	ND<1.6
Alpha-BHC	ND<1.5	ND< 1.3	ND<1.5	ND<1.4	ND<1.3	ND< 1.3	ND<1.5	ND<1.6	ND<1.6	ND<1.5	ND<1.4	ND<1.6	ND< 1.5	ND<1.3	ND<1.6
Beta-BHC	ND<1.5	ND< 1.3	ND<1.5	ND<1.4	ND<1.3	ND< 1.3	ND<1.5	ND<1.6	ND<1.6	ND<1.5	ND<1.4	ND<1.6	ND< 1.5	ND<1.3	ND<1.6
Chlordane	ND<15	ND<13	ND<15	ND<14	ND<13	ND<13	ND<15	ND<16	ND<16	ND<15	ND<14	ND<16	ND<15	ND<13	ND<16
Delta-BHC	ND<1.5	ND< 1.3	ND<1.5	ND<1.4	ND<1.3	ND< 1.3	ND<1.5	ND<1.6	ND<1.6	ND<1.5	ND<1.4	ND<1.6	ND< 1.5	ND<1.3	ND<1.6
Dieldrin	ND<1.5	ND< 1.3	ND<1.5	ND<1.4	ND<1.3	ND< 1.3	ND<1.5	ND<1.6	ND<1.6	ND<1.5	ND<1.4	ND<1.6	ND< 1.5	ND<1.3	ND<1.6
Endosulfan I	ND<1.5	ND< 1.3	ND<1.5	ND<1.4	ND<1.3	ND< 1.3	ND<1.5	ND<1.6	ND<1.6	ND<1.5	ND<1.4	ND<1.6	ND< 1.5	ND<1.3	ND<1.6
Endosulfan II	ND<1.5	ND< 1.3	ND<1.5	ND<1.4	ND<1.3	ND< 1.3	ND<1.5	ND<1.6	ND<1.6	ND<1.5	ND<1.4	ND<1.6	ND< 1.5	ND<1.3	ND<1.6
Endosulfan Sulfate	ND<1.5	ND< 1.3	ND<1.5	ND<1.4	ND<1.3	ND< 1.3	ND<1.5	ND<1.6	ND<1.6	ND<1.5	ND<1.4	ND<1.6	ND< 1.5	ND<1.3	ND<1.6
Endrin	ND<1.5	ND< 1.3	ND<1.5	ND<1.4	ND<1.3	ND< 1.3	ND<1.5	ND<1.6	ND<1.6	ND<1.5	ND<1.4	ND<1.6	ND< 1.5	ND<1.3	ND<1.6
Endrin Aldehyde	ND<1.5	ND< 1.3	ND<1.5	ND<1.4	ND<1.3	ND< 1.3	ND<1.5	ND<1.6	ND<1.6	ND<1.5	ND<1.4	ND<1.6	ND< 1.5	ND<1.3	ND<1.6
Endrin Ketone	ND<1.5	ND< 1.3	ND<1.5	ND<1.4	ND<1.3	ND< 1.3	ND<1.5	ND<1.6	ND<1.6	ND<1.5	ND<1.4	ND<1.6	ND< 1.5	ND<1.3	ND<1.6
Gamma-BHC	ND<1.5	ND< 1.3	ND<1.5	ND<1.4	ND<1.3	ND< 1.3	ND<1.5	ND<1.6	ND<1.6	ND<1.5	ND<1.4	ND<1.6	ND< 1.5	ND<1.3	ND<1.6
Heptachlor	ND<1.5	ND< 1.3	ND<1.5	ND<1.4	ND<1.3	ND< 1.3	ND<1.5	ND<1.6	ND<1.6	ND<1.5	ND<1.4	ND<1.6	ND< 1.5	ND<1.3	ND<1.6
Heptachlor Epoxide	ND<1.5	ND< 1.3	ND<1.5	ND<1.4	ND<1.3	ND< 1.3	ND<1.5	ND<1.6	ND<1.6	ND<1.5	ND<1.4	ND<1.6	ND< 1.5	ND<1.3	ND<1.6
Methoxychlor	ND<1.5	ND< 1.3	ND<1.5	ND<1.4	ND<1.3	ND< 1.3	ND<1.5	ND<1.6	ND<1.6	ND<1.5	ND<1.4	ND<1.6	ND< 1.5	ND<1.3	ND<1.6
Toxaphene	ND<30	ND<27	ND<29	ND<29	ND<26	ND<27	ND<31	ND<31	ND<31	ND<31	ND<29	ND<32	ND<31	ND<26	ND<32
Total Pesticides	7.3	7.8	30	13.9	1.4	7.6	ND<31	12.3	4.7	ND<31	4.5	16	14.3	38	10
PCBs, ug/kg															
Aroclor 1016	ND<15	ND<13	ND<15	ND<14	ND<13	ND<13	ND<15	ND<16	ND<16	ND<15	ND<14	ND<16	ND<15	ND<13	ND<16
Aroclor 1221	ND<15	ND<13	ND<15	ND<14	ND<13	ND<13	ND<15	ND<16	ND<16	ND<15	ND<14	ND<16	ND<15	ND<13	ND<16
Aroclor 1232	ND<15	ND<13	ND<15	ND<14	ND<13	ND<13	ND<15	ND<16	ND<16	ND<15	ND<14	ND<16	ND<15	ND<13	ND<16
Aroclor 1242	ND<15	ND<13	ND<15	ND<14	ND<13	ND<13	ND<15	ND<16	ND<16	ND<15	ND<14	ND<16	ND<15	ND<13	ND<16
Aroclor 1248	ND<15	ND<13	ND<15	ND<14	ND<13	ND<13	ND<15	ND<16	ND<16	ND<15	ND<14	ND<16	ND<15	ND<13	ND<16
Aroclor 1254	ND<15	ND<13	ND<15	ND<14	ND<13	ND<13	ND<15	ND<16	ND<16	ND<15	ND<14	ND<16	ND<15	ND<13	ND<16
Aroclor 1260	ND<15	ND<13	ND<15	ND<14	ND<13	ND<13	ND<15	ND<16	ND<16	ND<15	ND<14	ND<16	ND<15	ND<13	ND<16
Aroclor 1262	ND<15	ND<13	ND<15	ND<14	ND<13	ND<13	ND<15	ND<16	ND<16	ND<15	ND<14	ND<16	ND<15	ND<13	ND<16
Semi-Volatile Organics, ug/kg															
2,4,5-Trichlorophenol	ND<15	ND<13	ND<15	ND<14	ND<13	ND<13	ND<15	ND<16	ND<16	ND<15	ND<14	ND<16	ND<15	ND<26	ND<33
2,4,6-Trichlorophenol	ND<15	ND<13	ND<15	ND<14	ND<13	ND<13	ND<15	ND<16	ND<16	ND<15	ND<14	ND<16	ND<15	ND<26	ND<33
2,4-Dichlorophenol	ND<15	ND<13	ND<15	ND<14	ND<13	ND<13	ND<15	ND<16	ND<16	ND<15	ND<14	ND<16	ND<15	ND<26	ND<33
2,4-Dimethylphenol	ND<15	ND<13	ND<15	ND<14	ND<13	ND<13	ND<15	ND<16	ND<16	ND<15	ND<14	ND<16	ND<15	ND<26	ND<33
2,4-Dinitrophenol	ND<75	ND<67	ND<73	ND<72	ND<65	ND<67	ND<77	ND<79	ND<79	ND<77	ND<72	ND<81	ND<77	ND<130	ND<160
2-Chlorophenol	ND<15	ND<13	ND<15	ND<14	ND<13	ND<13	ND<15	ND<16	ND<16	ND<15	ND<14	ND<16	ND<15	ND<26	ND<33
2-Methylphenol	ND<15	ND<13	ND<15	ND<14	ND<13	ND<13	ND<15	ND<16	ND<16	ND<15	ND<14	ND<16	ND<15	ND<26	ND<33
2-Nitrophenol	ND<15	ND<13	ND<15	ND<14	ND<13	ND<13	ND<15	ND<16	ND<16	ND<15	ND<14	ND<16	ND<15	ND<26	ND<33
3/4-Methylphenol	ND<15	ND<13	ND<15	ND<14	ND<13	ND<13	ND<15	ND<16	ND<16	ND<15	ND<14	ND<16	ND<15	ND<26	ND<33
4-Chloro-3-Methylphenol	ND<15	ND<13	ND<15	ND<14	ND<13	ND<13	ND<15	ND<16	ND<16	ND<15	ND<14	ND<16	ND<15	ND<26	ND<33
4-Nitrophenol	ND<15	ND<13	ND<15	ND<14	ND<13	ND<13	ND<15	ND<16	ND<16	ND<15	ND<14	ND<16	ND<15	ND<26	ND<33
4,6-Dinitro-2-Methylphe	ND<75	ND<67	ND<73	ND<72	ND<65	ND<67	ND<77	ND<79	ND<79	ND<77	ND<72	ND<81	ND<77	ND<130	ND<160
Pentachlorophenol	ND<75	ND<67	ND<73	ND<72	ND<65	ND<67	ND<77	ND<79	ND<79	ND<77	ND<72	ND<81	ND<77	ND<130	ND<160
Phenol	ND<15	ND<13	ND<15	ND<14	ND<13	ND<13	ND<15	ND<16	ND<16	ND<15	ND<14	ND<16	ND<15	ND<26	ND<31
Total Phenols	ND<75	ND<67	ND<73	ND<72	ND<65	ND<67	ND<77	ND<79	ND<79	ND<77	ND<72	ND<81	ND<77	ND<130	ND<160
Dimethyl Phthalate	ND<15	ND<13	ND<15	ND<14	ND<13	ND<13	ND<15	ND<16	ND<16	ND<15	ND<14	ND<16	ND<15	ND<13	ND<16
Diethyl Phthalate	ND<15	47	ND<15	ND<14	ND<13	ND<13	ND<15	ND<16	ND<16	ND<15	ND<14	ND<16	ND<15	ND<13	ND<16
Di-n-Butyl Phthalate	ND<15	ND<13	ND<15	ND<14	ND<13	ND<13	ND<15	ND<16	ND<16	ND<15	ND<14	ND<16	ND<15	15	ND<16
Butyl Benzyl Phthalate	ND<15	ND<13	ND<15	ND<14	ND<13	ND<13	ND<15	ND<16	ND<16	ND<15	ND<14	ND<16	ND<15	22	ND<16
Bis(2-Ethylhexyl) Phtha	24	41	39	51	ND<13	44	ND<15	21	140	170	65	120	170	14	83
Di-n-Octyl-Phthalate	ND<15	ND<13	ND<15	ND<14	ND<13	ND<13	ND<15	ND<16	ND<16	ND<15	ND<14	ND<16	ND<15	ND<13	ND<16
Total Phthalates	24	88	39	51	ND<13	44	ND<15	21	140	170	65	120	170	51	83
Semi-Volatile Organics, ug/kg															
Naphthalene	ND<12	ND<11	ND<12	ND<11	ND<10	ND<11	ND<12	20	15	ND<12	ND<12	110	32	ND<26	ND<33
Acenaphthylene	ND<12	ND<11	12	ND<11	ND<10	ND<11	ND<12	ND<13	ND<13	ND<12	ND<12	19	ND<12	ND<26	ND<33
Acenaphthene	ND<12	ND<11	ND<12	ND<11	ND<10	ND<11	ND<12	ND<13	ND<13	ND<12	ND<12	61	21	ND<26	ND<33
Fluorene	ND<12	ND<11	ND<12	ND<11	ND<10	ND<11	ND<12	ND<13	ND<13	ND<12	ND<12	46	17	ND<26	ND<33
Phenanthrene	ND<12	15	15	17	ND<10	ND<11	ND<12	31	16	ND<12	ND<12	130	57	ND<26	ND<33
Anthracene	ND<12	14	34	19	ND<10	16	ND<12	20	22	ND<12	22	100	44	ND<26	ND<33
Fluoranthene	19	20	28	82	ND<10	16	ND<12	56	24	27	70	210	92	ND<26	ND<33
Pyrene	65	47	250	240	41	110	38	130	130	130	340	760	290	ND<26	ND<33
Benzo(a)anthracene	18	18	39	42	18	20	ND<12	43	31	18	47	120	54	ND<26	ND<33
Chrysene	38	37	130	78	19	50	ND<12	70	71	31	85	220	100	ND<26	ND<33
Benzo(b)fluoranthene	43	68	180	100	31	89	ND<12	78	130	42	120	270	140	ND<26	ND<33
Benzo(k)fluoranthene	35	56	160	84	32	69	ND<12	68	110	36	92	220	100	ND<26	ND<33
Benzo(a)pyrene	35	49	160	70	25	69	ND<11	67	91	32	88	190	100	ND<26	ND<33
Indeno(1,2,3-cd)pyrene	ND<12	18	46	23	ND<10	21	ND<12	18	34	ND<12	26	45	24	ND<26	ND<33
Dibenz(a,h)anthracene	ND<12	ND<11	21	ND<11	ND<10	ND<11	ND<12	ND<13	15	ND<12	12	22	ND<12	ND<26	ND<33
Benzo(g,h,i) perylene	12	21	52	27	ND<10	28	ND<12	21	35	14	33	50	30	ND<26	ND<33
Total PAHs	266	364	1130	782	166	488	38	622	724	330	935	2570	1100	ND<26	ND<33

Notes:

NA = Not applicable

ND = Not detected at indicated reporting limit.

1. Reporting limit is based on wet weight.

Appendix B

Bioassay SOPs

Table B-1.
Summary of Toxicity Test Methodology and
QA/QC Requirements for Solid-Phase Sediment Toxicity Tests

Marine Amphipod – *Eohaustorius estuarius*

Test organism	Marine Amphipod – *Eohaustorius estuarius*
Test organism source	Northwest Aquatic Laboratory
Test organism age at initiation	NA - Field collected
Test duration	10-days
Test solution renewal	None
Feeding	None
Test chamber	1L glass jar
Sediment depth/ volume	2-cm/ 125 ml
Overlying water volume	900 ml
Test temperature	15 ± 1°C
Dilution water	Seawater collected offshore SIO Pier in La Jolla, CA Diluted to 30ppt with deionized water prior to testing.
Test concentrations	Undiluted sediment
Number of organisms/chamber	20
Number of replicates	5
Photoperiod	Continuous light (24hr.)
Aeration	Continuous (1-2 bubbles per second)
Test Protocol	ASTM 1999, EPA 1994
Test acceptability criteria	≥ 90% mean survival in controls
Reference toxicant	Cadmium chloride

Table B-1.
Summary of Toxicity Test Methodology and
QA/QC Requirements for Solid-Phase Sediment Toxicity Tests

Marine Amphipod – *Eohaustorius estuarius*

Test organism	Marine Amphipod – *Eohaustorius estuarius*
Test organism source	Northwest Aquatic Laboratory
Test organism age at initiation	NA - Field collected
Test duration	10-days
Test solution renewal	None
Feeding	None
Test chamber	1L glass jar
Sediment depth/ volume	2-cm/ 125 ml
Overlying water volume	900 ml
Test temperature	15 ± 1°C
Dilution water	Seawater collected offshore SIO Pier in La Jolla, CA Diluted to 30ppt with deionized water prior to testing.
Test concentrations	Undiluted sediment
Number of organisms/chamber	20
Number of replicates	5
Photoperiod	Continuous light (24hr.)
Aeration	Continuous (1-2 bubbles per second)
Test Protocol	ASTM 1999, EPA 1994
Test acceptability criteria	≥ 90% mean survival in controls
Reference toxicant	Cadmium chloride

Table B-2.
Summary of Toxicity Test Methodology and
QA/QC Requirements for Solid-Phase Sediment Toxicity Tests

Marine Amphipod – *Ampelisca abdita*

Test organism	Marine amphipod – *Ampelisca abdita*
Test organism source	Brezina and Associates
Test organism age at initiation	NA - Field collected
Test duration	10-days
Test solution renewal	None
Feeding	None
Test chamber	1L glass jar
Sediment depth/ volume	2-cm/ 125 ml
Overlying water volume	900 ml
Test temperature	15 ± 1°C
Dilution water	Seawater collected offshore SIO Pier in La Jolla, CA diluted to 30ppt with deionized water prior to testing.
Test concentrations	Undiluted sediment
Number of organisms/chamber	20
Number of replicates	5
Photoperiod	Continuous light (24hr.)
Aeration	Continuous (1-2 bubbles per second)
Test Protocol	ASTM 1999, EPA 1994
Test acceptability criteria	≥ 90% mean survival in controls
Reference toxicant	Cadmium chloride

Table B-3.
Summary of Toxicity Test Methodology and
QA/QC Requirements for Solid-Phase Sediment Toxicity Tests

Marine Polychaete – *Neanthes arenaceodentata*

Test organism	Marine Polychaete – *Neanthes arenaceodentata*
Test organism source	Dr. Donald Reish at CSU Long Beach
Test organism age at initiation	NA
Test duration	10-days
Overlying water renewal	Every 3rd day
Feeding	1ml of Tetramin slurry as needed (100 ml seawater: 1g Tetramin)
Test chamber	1L glass jar
Sediment depth/ volume	2-cm/ 125 ml
Overlying water volume	900 ml
Test temperature	20 ± 1°C
Dilution water	Seawater collected offshore SIO Pier in La Jolla, CA diluted to 30ppt with deionized water prior to testing.
Test concentrations	Undiluted sediment
Number of organisms/chamber	10
Number of replicates	5
Photoperiod	16 hours light/8 hours dark
Aeration	Continuous (1-2 bubbles per second)
Test Protocol	ASTM 2000
Test acceptability criteria	≥ 90% mean survival in controls
Reference toxicant	Cadmium chloride

Table B-4.
Summary of Toxicity Test Methodology and
QA/QC Requirements for Sediment Suspended-Phase Toxicity Tests

Bivalve Embryo Development - Mediterranean mussel
Mytilus galloprovincialis

Test organism	Mediterranean mussel - *Mytilus galloprovincialis*
Test organism source	Mission Bay
Test duration	48-hours
Test solution renewal	None
Feeding	None
Test initiation date and time	Within 36 hours of elutriate preparation
Test chamber	30-ml glass scintillation vial
Test solution volume	10-ml
Test temperature	15 ± 1°C
Dilution water	Seawater collected offshore SIO Pier in La Jolla, CA diluted to 30ppt with deionized water prior to testing.
Test concentrations (% sample)	100, 50, 10, control
Number of organisms/chamber	250-300
Number of replicates	5
Photoperiod	16 hours light/8 hours dark
Aeration	None
Test Protocol	ASTM 1998, EPA/USACE 1991
Test acceptability criteria	≥ 70% of embryos with normal development based on initial density.
Reference toxicant	Copper chloride

Table B-6.
Summary of Toxicity Test Methodology and
QA/QC Requirements for Sediment Suspended-Phase Toxicity Tests

Inland Silverside Minnow - *Menidia beryllina*

Test organism	Inland silverside - *Menidia beryllina*
Test organism source	Aquatic Biosystems
Test organism age at initiation	14 days post-hatch
Test duration	96-hours
Test solution renewal	None
Feeding	*Artemia* nauplii twice daily
Test initiation date and time	Within 36 hours of elutriate preparation
Test chamber	1L glass jar
Test solution volume	500 ml
Test temperature	25 ± 1°C
Dilution water	Seawater collected offshore SIO Pier in La Jolla, CA diluted to 30ppt with de-ionized water prior to testing.
Test concentrations (% sample)	100, 50, 10, control
Number of organisms/chamber	10
Number of replicates	4
Photoperiod	16 hours light/8 hours dark
Aeration	None
Test Protocol	EPA/USACE 1991, EPA 2002
Test acceptability criteria	≥ 90% mean survival in controls
Reference toxicant	Copper chloride

Table B-7.
Summary of Toxicity Test Methodology and
QA/QC Requirements for 28-day Bioaccumulation Tests

Test organisms	Marine clam *Macoma nasuta*, and marine polychaete *Nereis virens*
Test organism source	Brezina and Associates
Test organism age at initiation	Adult (field caught)
Test duration	28-days + 24 hr depuration period
Test solution renewal	Continuous flow-through
Feeding	None
Test chamber	10-gallon glass tanks
Sediment depth/ volume	2 inches
Overlying water volume	Approx. 7 gallons
Test temperature	15 ± 2°C
Dilution water	34 ppt. seawater collected offshore SIO Pier in La Jolla, CA
Test concentrations	Undiluted sediment
Number of organisms/chamber	35 (*Macoma*), 10 (*Nereis*)
Number of replicates	5
Photoperiod	16 hours light/8 hours dark
Aeration	Yes
Test Protocol	EPA/USACE 1991
Reference toxicant	None