

Summary - SQV Sediment Screening 2011, Bremerton, WA

Sample Location: Various inshore sediment sites located along the quay wall and pier areas within NBK Bremerton & PSNS&IMF

CIA Puget Sound inside Sinclair Inlet along Operable Unit B (OU-B) :

(i) Outside [OOU] 1500 ft grid & (ii) Marine [OUBM] 500 ft grid, near/at Naval Shipyard (NSY) Puget Sound, Bremerton, Washington (USA)

Sampling Dates: 27 - 29 April 2011

Sample Type: Sediment (wet), surface grabs, core sections, composite

Analysis: Poly-Chlorinated Biphenyls (PCBs) & Polynuclear Aromatic Hydrocarbons (PAHs) by Enzyme-Linked Immuno Sorbent Assay (ELISA) Methods

ImmunoAssay Application: EPA Methods: 4020 (PCB) & 4035 (PAH) - For Soils (Modified for Marine Sediments)

Analysis Dates: (i) 31 May - 3 June 2011 for PAHs; (ii) 23 - 25 May 2011 for PCBs

Analyst: Joel M. Guerrero, Scientist (Environmental Chemistry), U.S. Navy Space & Naval Warfare Systems Center (SPAWARSSYSCEN) Pacific, Advanced Systems & Applied Sciences Division, Applied Systems & Environmental Sciences Branch (Code 71751), (619) 553-4169

Analysis Location: Building 111, Rapid Sediment Characterization (RSC) Laboratory, Room 122 (Bayside), (619) 553-2765

POCs: Dr. James M. Leather, Scientist (Marine Geochemistry), SPAWARSSYSCEN, Pacific [SSC-Pacific], Code 71751: (619) 553-6240

Joel M. Guerrero, Scientist (Environmental Chemistry), SPAWARSSYSCEN Pacific [SSC-Pacific], Code 71751: (619) 553-4169

Method Summary: The ImmunoAssay (IA) test kits used for this method are commercially available (RaPID™ Assay, Statagic Diagnostics Inc., www.sdx.com). In general, the IA method is performed using a sample extract. The sample and an enzyme conjugate are added to an antibody. The enzyme conjugate "competes" with the contaminant of interest (PCB/PAH) present in the sample for binding to the antibody. The assay test is interpreted by comparing the response produced by the sample test to the response produced by testing a range of kit-supplied standards simultaneously.

Sample Preparation Procedures:

(1) *Pre-processing*: mix wet sediment thoroughly with clean sampler spoons. using filter paper (grade 13V) and heavy-duty lab towels, about 20-30 grams of wet sample are dewatered and/or air-dried to reduce sediment moisture content (at least less than 30%). observe and record other sediment meta data (i.e. color, grain size, smell, oil sheen, debris, shell hash, etc.)

(2) *Sub-sampling*: weigh and record 5-10 grams of "dry" (at least 70% or more) sediment using top loading balance. transfer into 50 ml centrifuge tubes (pre-cleaned/sterile).

(3) *Extraction*: add 20 ml of methanol (MeOH, Aldrich 99.9+% capillary GC grade). cap centrifuge tube tight. vortex slurry for 1-2 seconds to loosen particles and break-up large sediment clumps. shake the mixture vigorously and continuously for at least 1 hour in a rotator/shaker set at maximum amplitude (400 rpm).

(4) *Separation*: check the tube cap again for a tight seal. centrifuge the slurry for at least 10-15 minutes (EIC/Sorvall) at 3000 rpm. transfer/pour MeOH extract into a syringeless filter vial and filter through (GFC/Whatman, 0.45 um pore size) into amber, teflon-lined vial. record extract color. cap and seal the vial, keep dark and cool (2-8 degrees C).

(5) *Dilution*: pipet (using eppendorf) 25-50 mL of MeOH extract into glass test tube (pre-cleaned with screw cap) containing 5-80 ml of sample diluent (reagent buffer saline solution having preservatives and stabilizers without any detectable PCBs). cap test tubes and vortex to mix.

(6) *Assay*: pre-label and prepare polystyrene test tubes (allow for field/sample/extract duplicates for each assay run). perform immunoassay (IA) procedures by following SDI standard soil methods for pcbs/pahs.

ImmunoAssay (IA) ELISA Protocols: The sample (with the *unknown contaminant concentration* ; ex. PCB) is analyzed by the addition of an enzyme conjugate (labeled PCB). This is followed by addition of paramagnetic particles with anti-bodies specific to "both" PCBs. In relatively proportional concentrations, both the sample PCBs and the "labeled" PCBs (conjugate) compete for the binding sites on the magnetic particles. After an incubation period, a magnetic field is applied to hold (in-place) the magnetic particles having the sample PCB and its "labeled" PCB analog to bind with the antibodies. Any unbound reagents are decanted and washed repeatedly. PCBs in the mixture are detected with the addition of an enzyme substrate (color solution) containing a chromagen which specifically react to the "labelled" PCBs. After another incubation, the reaction is stopped and stabilized by addition of acid (stopping solution). Since the labelled PCBs and sample PCBs are in competition (proportionally) with the binding sites, the color developed at the end of reaction is inversely proportional to the concentration of PCBs in the sample. This color response is measured by a spectrophotometer (set at 450 nm) and compared to the responses taken from a calibrated series of known pcb standards (kit-supplied) to determine the equivalent PCB (as Aroclor 1254) concentration of the sample.

Calculations: The dry-weight corrected organic contaminant (OC) concentration in sediment is calculated (according to eq. 1 and eq. 2) by multiplying the IA result by factors that are introduced by the sample pre-processing procedures (collection, extraction, extract dilution steps above).

$$OC_{conc} = IA \times (V_{MeOH} / W_{drysed}) \times df \quad (eq.1)$$

$$df = (V_{ext} + V_{dil}) / V_{ext} \quad (eq.2)$$

where:

OC_{conc} : PCB/PAH sediment concentration (mg/kg)

IA : ImmunoAssay result (mg/L)

V_{MeOH} : Volume of methanol (extractant)

W_{drysed} : Weight of dry sediment

df : Dilution factor

V_{ext} : Volume of dilution extract

V_{dil} : Volume of diluent

Colorimetry: Absorbance values at $\lambda = 450$ nm were measured/recorded using a field-portable/lab benchtop HACH Model DR/2010 direct-reading spectrophotometer (HACH Co., Loveland, CO). This analyzer is a microprocessor-controlled, single-beam instrument with a Littrow Prism monochromator design which uses an ultra-violet (UV) enhanced silicon photodiode for detection. It is manually programmed to display results in raw absorbances. The HACH DR/2010 is calibrated at the start of each assay run. It is zeroed for absorbance measurements and a series of assay method calibrations are performed using a contaminant-free 0 (zero) standard, a range of 3 standard concentrations, and a control. Method/equipment blanks and marine sediment reference materials [NRCC HS-1(PCB)] are also used for standardization. Measurements of raw absorbance data are serially down-loaded to a laptop computer using a Windows™ application HACHLink™ data acquisition software. Serial data, collected as text files, are transferred and copied into a spreadsheet program (Excel™) for reduction. A calibration curve (with $R^2 = 0.9$) is generated for each assay run

Field ID		Grab № Core ID	RSC LABEL ID	tPCB _{RSC} (µg/Kg)	Q	Stdev	%RSD	tPAH _{RSC} (µg/Kg)	Q	Stdev	%RSD
PS03 Mooring E Pier D	0 - 10 cm surface grab	G1	SQV001	253				29133			
		G2	SQV002	340				32203		2514	7.81%
		G3	SQV003	353				24507			
		G4	SQV004	341				19162			
		G5	SQV005	308				16379			
		G6	SQV006	#148.739247411853	J			1404	J		
	0 - 25 cm core section	0 - 3 cm	SQV008-1	677				20080			
		3 - 6 cm	SQV008-2	739		1	0.12%	33271		2890	8.69%
		6 - 9 cm	SQV008-3	527				18391			
		9 - 13 cm	SQV008-4	431				14855			
		13 - 19 cm	SQV008-5	662				13037			
		19 - 25 cm	SQV008-6	701				26292			
PS09 DD4 Btwn Piers 3&4	0 - 10 cm surface grab	1	SQV009	521				30503		4252	13.94%
		2	SQV010	277				19983			
		3	SQV011	400				30982			
		4	SQV012	485				18509			
		5	SQV013	326				10715			
		6	SQV014	247				10595			
	0 - 25 cm core section	0 - 3 cm	SQV016-1	341				11416			
		3 - 6 cm	SQV016-2	318				10294			
		6 - 9 cm	SQV016-3	409				12641			
		9 - 13 cm	SQV016-4	475				11574			
		13 - 19 cm	SQV016-5	434				9054			
		19 - 25 cm	SQV016-6	558				12377			
PS10 DD2 Btwn Piers 4&5	0 - 10 cm surface grab	1	SQV017	641		58	9.00%	26907		5529	20.55%
		2	SQV018	232				8189			
		3	SQV019	434				15478			
		4	SQV020	460				17024			
		5	SQV021	235				10557			
		6	SQV022	209				11021			
	0 - 25 cm core section	0 - 3 cm	SQV023-1	455		178	39.19%	10292			
		3 - 6 cm	SQV023-2	293				6313			
		6 - 9 cm	SQV023-3	312				1645			
		9 - 13 cm	SQV023-4	383				11394			
		13 - 19 cm	SQV023-5	415				8855			
		19 - 25 cm	SQV023-6	450				11282			
PS10.1 DD1 Btwn Piers 5&6	0 - 10 cm surface grab	1	SQV024	346				24902			
		2	SQV025	485				16915			
		3	SQV026	267				11117			
		4	SQV027	310				10555			
		5	SQV028	281				11388			
		6	SQV029	#139.720348654068	J			5963			
	0 - 25 cm core section	0 - 3 cm	SQV030-1	302				8284			
		3 - 6 cm	SQV030-2	335				9408			
		6 - 9 cm	SQV030-3	351				10329			
		9 - 13 cm	SQV030-4	363				12070			
		13 - 19 cm	SQV030-5	413				8448			
		19 - 25 cm	SQV030-6	617				12088			

Definitions:

Stdev : Standard Deviation from duplicate assay analyses (n=2)

% RSD : Percent Relative Standard Deviation whereby; $[(\text{stdev}/\text{mean}) * 100]$

Data Qualifier (Q) : **U** = not detected, (measured value ≤ MDL); **J** = Estimated, (MDL ≤ measured value ≤ RDL);

E = Exceed dilution range, estimated; **Blank** = detected

Label: **tPCB_{RSC}** = Total poly-chlorinated biphenyl concentration [as Aroclor 1254] (µg/Kg *ppb*) - result from ELISA Analysis

tPAH_{RSC} = Total poly-aromatic hydrocarbon concentration [as Phenanthrene] (µg/Kg / *ppb*) - result from ELISA Analysis

SQV = Sediment Quality Verification; **M** = Middle; **E** = East; **N** = North; **S** = South; **W** = West

Field ID	Grab № Core ID	RSC LABEL ID	tPCB _{RSC} (µg/Kg)	Q Stdev %RSD			tPAH _{RSC} (µg/Kg)	Q Stdev %RSD		
				Q	Stdev	%RSD		Q	Stdev	%RSD
PS11 DD3 Btwn Piers 6&7	0 - 10 cm surface grab	1	SQV031	311			17350			
		2	SQV032	309			9969			
		3	SQV033	286			10663			
		4	SQV034	347			20385			
		5	SQV035	237			8635			
		6	SQV036	238	30	12.81%	8380			
	0 - 25 cm core section	0 - 3 cm	SQV037-1	239			6843			
		3 - 6 cm	SQV037-2	355			10192	1607	15.77%	
		6 - 9 cm	SQV037-3	220			8253			
		9 - 13 cm	SQV037-4	334			6829			
		13 - 19 cm	SQV037-5	296			8082			
		19 - 25 cm	SQV037-6	299			7662			
PS08 DD5 RMTS	0 - 10 cm surface grab	1	SQV038	283			7351			
		2	SQV039	326			26297	2713	10.32%	
		3	SQV040	290			10350			
		4	SQV041	322			11670			
		5	SQV042	296			7450			
		6	SQV043	210			5723			
	0 - 25 cm core section	0 - 3 cm	SQV044-1	360			12738			
		3 - 6 cm	SQV044-2	343			11186			
		6 - 9 cm	SQV044-3	358			12854			
		9 - 13 cm	SQV044-4	555			12065			
		13 - 19 cm	SQV044-5	573	215	37.58%	8752			
		19 - 25 cm	SQV044-6	546			8180			
PS06 DD6 Ent. OF18	0 - 10 cm surface grab	1	SQV1000	316			6068			
		2	SQV1001	297			5501			
		3	SQV1002	308			8627			
		4	SQV1003	179			2025			
		5	SQV1004	373			7432			
		6	SQV1005	342			9074			
	0 - 25 cm core section	0 - 3 cm	SQV1006-1	268			7768			
		3 - 6 cm	SQV1006-2	304			7134			
		6 - 9 cm	SQV1006-3	297			7590			
		9 - 13 cm	SQV1006-4	323			5599			
		13 - 19 cm	SQV1006-5	439			7443			
		19 - 25 cm	SQV1006-6	663	28	4.28%	8950			
PS07 West DD6 Finger Pier	0 - 10 cm surface grab	0 - 3 cm	SQV1007-1	196			6871			
		3 - 6 cm	SQV1007-2	303			7107			
		1	SQV1008	268	42	11.37%	20532	800	3.90%	
		2	SQV1009	372			8439			
		3	SQV1010	307			7051			
		4	SQV1011	268			5156			
	0 - 25 cm core section	5	SQV1012	315			965			
		6	SQV1013	281			5046			
		0 - 3 cm	SQV1014-1	308			6377			
		3 - 6 cm	SQV1014-2	306			5503			
		6 - 9 cm	SQV1014-3	278			4981			
		9 - 13 cm	SQV1014-4	259			6258	1056	16.88%	
		13 - 19 cm	SQV1014-5	490			6056			
		19 - 25 cm	SQV1014-6	294			6532			

Definitions:

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Label: tPCB_{RSC} = Total poly-chlorinated biphenyl concentration [as Aroclor 1254] (µg/Kg *ppb*) - result from ELISA Analysis

tPAH_{RSC} = Total poly-aromatic hydrocarbon concentration [as Phenanthrene] (µg/Kg / *ppb*) - result from ELISA Analysis

SQV = Sediment Quality Verification; **M** = Middle; **E** = East; **N** = North; **S** = South; **W** = West

Assay Duplicates

Field ID			RSC	tPCB (µg/Kg)				
			LABEL ID	1	2	Mean	Stdev	%RSD
PS03 Mooring E Pier D	0 - 10 cm surface grab	1	SQV001	253		253		
		2	SQV002	340		340		
		3	SQV003	353		353		
		4	SQV004	341		341		
		5	SQV005	308		308		
		6	SQV006	149		149		
	0 - 25 cm core section	0 - 3 cm	SQV008-1	677	739	677		
		3 - 6 cm	SQV008-2	738	739	739	1	0.12%
		6 - 9 cm	SQV008-3	527		527		
		9 - 13 cm	SQV008-4	431		431		
		13 - 19 cm	SQV008-5	662		662		
		19 - 25 cm	SQV008-6	701		701		
PS09 DD4 Btwn Piers 3&4	0 - 10 cm surface grab	1	SQV009	521		521		
		2	SQV010	277		277		
		3	SQV011	400		400		
		4	SQV012	485		485		
		5	SQV013	326		326		
		6	SQV014	247		247		
	0 - 25 cm core section	0 - 3 cm	SQV016-1	341		341		
		3 - 6 cm	SQV016-2	318		318		
		6 - 9 cm	SQV016-3	409		409		
		9 - 13 cm	SQV016-4	475		475		
		13 - 19 cm	SQV016-5	434		434		
		19 - 25 cm	SQV016-6	558		558		
PS10 DD2 Btwn Piers 4&5	0 - 10 cm surface grab	1	SQV017	601	682	641	58	9.00%
		2	SQV018	232		232		
		3	SQV019	434		434		
		4	SQV020	460		460		
		5	SQV021	235		235		
		6	SQV022	209		209		
	0 - 25 cm core section	0 - 3 cm	SQV023-1	329	581	455	178	39.19%
		3 - 6 cm	SQV023-2	293		293		
		6 - 9 cm	SQV023-3	312		312		
		9 - 13 cm	SQV023-4	383		383		
		13 - 19 cm	SQV023-5	415		415		
		19 - 25 cm	SQV023-6	450		450		
PS10.1 DD1 Btwn Piers 5&6	0 - 10 cm surface grab	1	SQV024	346		346		
		2	SQV025	485		485		
		3	SQV026	267		267		
		4	SQV027	310		310		
		5	SQV028	281		281		
		6	SQV029	140		140		
	0 - 25 cm core section	0 - 3 cm	SQV030-1	302		302		
		3 - 6 cm	SQV030-2	335		335		
		6 - 9 cm	SQV030-3	351		351		
		9 - 13 cm	SQV030-4	363		363		
		13 - 19 cm	SQV030-5	413		413		
		19 - 25 cm	SQV030-6	617		617		

Definitions:

Mean: Arithmetic Mean

Stdev: Standard Deviation from duplicate assay analyses (n=2)

% RSD: Percent Relative Standard Deviation whereby; $[\{stdev/mean\} * 100]$

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Assay Duplicates

Field ID			RSC LABEL ID	tPCB (µg/Kg)		Mean	Stdev	%RSD
				1	2			
PS11 DD3 Btwn Piers 6&7	0 - 10 cm surface grab	1	SQV031	311		311		
		2	SQV032	309		309		
		3	SQV033	286		286		
		4	SQV034	347		347		
		5	SQV035	237		237		
		6	SQV036	216	259	238	30	12.81%
	0 - 25 cm core section	0 - 3 cm	SQV037-1	239		239		
		3 - 6 cm	SQV037-2	355		355		
		6 - 9 cm	SQV037-3	220		220		
		9 - 13 cm	SQV037-4	334		334		
		13 - 19 cm	SQV037-5	296		296		
		19 - 25 cm	SQV037-6	299		299		
PS08 DD5 RMTS	0 - 10 cm surface grab	1	SQV038	283		283		
		2	SQV039	326		326		
		3	SQV040	290		290		
		4	SQV041	322		322		
		5	SQV042	296		296		
		6	SQV043	210		210		
	0 - 25 cm core section	0 - 3 cm	SQV044-1	360		360		
		3 - 6 cm	SQV044-2	343		343		
		6 - 9 cm	SQV044-3	358		358		
		9 - 13 cm	SQV044-4	555		555		
PS06 DD6 Ent. OF18	0 - 10 cm surface grab	1	SQV1000	316		316		
		2	SQV1001	297		297		
		3	SQV1002	308		308		
		4	SQV1003	179		179		
		5	SQV1004	373		373		
		6	SQV1005	342		342		
	0 - 25 cm core section	0 - 3 cm	SQV1006-1	268		268		
		3 - 6 cm	SQV1006-2	304		304		
		6 - 9 cm	SQV1006-3	297		297		
		9 - 13 cm	SQV1006-4	323		323		
PS07 West DD6 Finger Pier	0 - 10 cm surface grab	13 - 19 cm	SQV1006-5	439		439		
		19 - 25 cm	SQV1006-6	683	643	663	28	4.28%
		0 - 3 cm	SQV1007-1	196		196		
		3 - 6 cm	SQV1007-2	303		303		
	0 - 25 cm core section	0 - 3 cm	SQV1008	268	402	268	42	11.37%
		3 - 6 cm	SQV1009	342		342		
		6 - 9 cm	SQV1010	307		307		
		9 - 13 cm	SQV1011	268		268		
		13 - 19 cm	SQV1012	315		315		
		19 - 25 cm	SQV1013	281		281		
	0 - 25 cm core section	0 - 3 cm	SQV1014-1	308		308		
		3 - 6 cm	SQV1014-2	306		306		
		6 - 9 cm	SQV1014-3	278		278		
		9 - 13 cm	SQV1014-4	259		259		
		13 - 19 cm	SQV1014-5	490		490		
		19 - 25 cm	SQV1014-6	294		294		

Definitions:

Mean: Arithmetic Mean

Stdev: Standard Deviation from duplicate assay analyses (n=2)

% RSD: Percent Relative Standard Deviation whereby; $[(\text{stdev}/\text{mean}) * 100]$

Label: SQV = Sediment Quality Verification; M = Middle; E = East; N = North; S = South; W = West

Assay Duplicates

Field ID			RSC LABEL ID	tPCB (µg/Kg)				
				1	2	Mean	Stdev	%RSD
PS16 Pier 7	Bulk Drum 0 - 10 cm	Middle	SQV-M	18780	12797	15788	4230	26.79%
		North	SQV-N	34259		34259		
		South	SQV-S	8876		8876		
		East	SQV-E	24363	39569	31966	10752	33.64%
		West	SQV-W	11370		11370		
PSNS 096		Stormwater Drainage Basin	SQV0001	877	937	907	43	4.72%
PSNS 015			SQV0002	220		220		
PSNS 008			SQV0003	627		627		

Definitions:

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Field Duplicates

Field ID			t PCB (µg/Kg)				
			SQV1006	SQV1007	Mean	Stdev	%RSD
PS06 Ent. DD6 OF18	0 - 25 cm <i>core section</i>	0 - 3 cm	268	196	232	51	21.99%
		3 - 6 cm	304	303	303	1	0.19%

Notes:

Mean: Arithmetic Mean

Stdev: Standard Deviation from full method extraction duplicate analyses (n=2)

% RSD: Percent Relative Standard Deviation whereby; $[(\text{Stdev}/\text{Mean}) * 100]$

for 1 & 2: Analyte values taken from the mean of **all** assay duplicates

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Summary - OUB Marine Sediment Monitoring 2010 Sample Splits, Bremerton, WA

Sample Location: Various offshore sediment sites located inside Sinclair Inlet along Operable Unit B (OUB) :

(i) Pierside & Quaywall [PQ] locations adjacent to outfall 18A/B & (ii) Drydock # 6 [DD6], inside Naval Shipyard (NSY) Puget Sound, Bremerton, Washington (USA)

Sampling Dates: 15-Jul-10 (DD6) and 27-Jul-10 (PQ)

Sample Type: Sediment (wet), grab, composite

Analysis: Poly-Chlorinated Biphenyls (PCBs) & Polynuclear Aromatic Hydrocarbons (PAHs) by Enzyme-Linked Immuno Sorbent Assay (ELISA) Methods

ImmunoAssay Application: EPA Methods: 4020[mod] (PCB) & 4035[mod] (PAH) - For Soils (Modified for Marine Sediments)

Analysis Dates: (i) 13-Sep-10 for PAHs; (ii) **Oct. 2010 for PCBs**

Analyst: Joel M. Guerrero, Scientist (Environmental Chemistry), U.S. Navy Space & Naval Warfare Systems Center (SPAWARSSYSCEN) Pacific,

Advanced Systems & Applied Sciences Division, Applied Systems & Environmental Sciences Branch (Code 71751), (619) 553-4169

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POCs: **Dr. James M. Leather**, Scientist (Marine Geochemistry), SPAWARSSYSCEN, Pacific [SSC-Pacific], Code 71751: (619) 553-6240

Joel M. Guerrero, Scientist (Environmental Chemistry), SPAWARSSYSCEN Pacific [SSC-Pacific], Code 71751: (619) 553-4169

Method Summary: The ImmunoAssay (IA) test kits used for this method are commercially available (RaPID™ Assay, Statagics Diagnostics Inc.,

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to an antibody. The enzyme conjugate "competes" with the contaminant of interest (PCB/PAH) present in the sample

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Sample Preparation Procedures:

(1) **Pre-processing:** mix wet sediment thoroughly with clean sampler spoons. using filter paper (grade 13V) and heavy-duty lab towels, about 20-30 grams of wet sample are dewatered and/or air-dried to reduce sediment moisture content (at least less than 30%). observe and record other sediment meta data (i.e. color, grain size, smell, oil sheen, debris, shell hash, etc.)

(2) **Sub-sampling:** weigh and record 5 grams of "dry" (at least 70% or more) sediment using top loading balance. transfer into 50 ml centrifuge tubes (pre-cleaned/sterile).

(3) **Extraction:** add 10 ml of methanol (MeOH, Aldrich 99.9+% capillary GC grade). cap centrifuge tube tight. vortex slurry for 1-2 seconds to loosen particles and break-up large sediment clumps. shake the mixture vigorously and continuously for at least 1 hour in a rotator/shaker set at maximum amplitude (400 rpm).

(4) **Separation:** check the tube cap again for a tight seal. centrifuge the slurry for at least 10-15 minutes (EIC/Sorvall) at 3000 rpm. transfer/pour MeOH extract into a syringeless filter vial and filter through (GFC/Whatman, 0.45 um pore size) into amber, teflon-lined vial. record extract color. cap and seal the vial, keep dark and cool (2-8 degrees C).

(5) **Dilution:** pipet (using eppendorf) 25 µL of MeOH extract into glass test tube (pre-cleaned with screw cap) containing 5-50 ml of sample diluent (reagent buffer saline solution having preservatives and stabilizers without any detectable PCBs).

cap test tubes and vortex to mix.
(6) **Assay:** pre-label and prepare polystyrene test tubes (allow for field/sample/extract duplicates for each assay run). perform immunoassay (IA) procedures by following SDI standard soil methods for pcbs/pahs.

ImmunoAssay (IA) ELISA Protocols: The sample (with the *unknown contaminant concentration*; ex. PCB) is analyzed by the addition of an enzyme conjugate (labeled PCB). This is followed by addition of paramagnetic particles with anti-bodies specific to "both" PCBs.

In relatively proportional concentrations, both the sample PCBs and the "labeled" PCBs (conjugate) compete for the binding sites on the magnetic particles.

After an incubation period, a magnetic field is applied to hold (in-place) the magnetic particles having the sample PCB and its "labeled" PCB analog to bind with the antibodies. Any unbound reagents are decanted and washed repeatedly. PCBs in the mixture are detected with the addition of an enzyme substrate (color solution) containing a chromogen which specifically react to the "labelled" PCBs. After another incubation, the reaction is stopped and stabilized by addition of acid (stopping solution). Since the labelled PCBs and sample PCBs are in competition (proportionally) with the binding sites, the color developed at the end of reaction is inversely proportional to the concentration of PCBs in the sample.

This color response is measured by a spectrophotometer (set at 450 nm) and compared to the responses taken from a calibrated series of known pcb standards (kit-supplied) to determine the equivalent PCB (as Aroclor 1254) concentration of the sample.

Calculations: The dry-weight corrected organic contaminant (OC) concentration in sediment is calculated (according to eq. 1 and eq. 2) by multiplying the IA result by factors that are introduced by the sample pre-processing procedures (collection, extraction, extract dilution steps above).

$$OC_{conc} = IA \times (V_{MeOH} / W_{drysed}) \times df \quad (eq.1)$$

$$df = (V_{ext} + V_{dil}) / V_{ext} \quad (eq.2)$$

where:

OC_{conc}: PCB or PAH dry weight sediment concentration (µg/Kg)

IA: ImmunoAssay result (mg/L)

V_{MeOH}: Volume of methanol (extractant)

W_{drysed}: Weight of dry sediment

df: Dilution factor

V_{ext}: Volume of dilution extract

V_{dil}: Volume of diluent

Colorimetry: Absorbance values at λ = 450 nm were measured/recorded using a field-portable/lab benchtop HACH Model DR/2010 direct-reading spectrophotometer (HACH Co., Loveland, CO). This analyzer is a microprocessor-controlled, single-beam instrument with a Littrow Prism monochromator design which uses an ultra-violet (UV) enhanced silicon photodiode for detection.

It is manually programmed to display results in raw absorbances. The HACH DR/2010 is calibrated at the start of each assay run.

It is zeroed for absorbance measurements and a series of assay method calibrations are performed using a contaminant-free 0 (zero) standard, a range of 3 standard concentrations, and a control. Method/equipment/reagent blanks and marine sediment standard reference materials (SRMs)

[NRCC (i) HS-1(PCB) & (ii) HS-5 (PAH)] are also used for standardization. Measurements of raw absorbance data are serially down-loaded to a laptop computer using a Windows™ application HACHLink™ data acquisition software. Serial data, collected as text files, are transferred and copied into a spreadsheet program (Excel™) for reduction. A calibration curve (with R² = 0.9) is generated for each assay run

ImmunoAssay (IA) Results

Field ID SAMPLE LABEL	tPCB _{RSC}				tPAH _{RSC}			
	(µg/Kg)	Q	Stdev	%RSD	(µg/Kg)	Q	Stdev	%RSD
PQ1					15741		1370	8.70%
PQ2					22877		1025	4.48%
DD6-1/4 Comp					3245		155	4.77%
DD6-7					2727		22	0.80%

Definitions:

Stdev: Standard Deviation from replicate XRF measurements ($\bar{x} \pm 3$)

% RSD: Percent Relative Standard Deviation whereby; $[\frac{stdev}{mean}] * 100$

Data Qualifier (Q): **U** = not detected, (measured value $\leq$ MDL); **J** = Estimated, (MDL $\leq$ measured value $\leq$ RDL); **Blank** = detected

Label: **tPCB_{RSC}** = Site calibrated total poly-chlorinated biphenyl concentration [as Aroclor 1254] (µg/Kg *ppb*) - result from ELISA Analysis

tPAH_{RSC} = Site calibrated total poly-aromatic hydrocarbon concentration [as Phenanthrene] (µg/Kg / *ppb*) - result from ELISA Analysis

PQ = Pierside -Quaywall stations adjacent to Outfall 18A&B; **DD6-x** = Drydock # 6 - (1-7); **Comp** = composite sample

SAMPLE LABEL	Fe (mg/Kg)							tPAH (µg/Kg)				
	1	2	3	4	Mean	Stdev	%RSD	1	2	Mean	Stdev	%RSD
PQ1	37556	37378	36431	35205	36642	1078	2.94%	14773	16710	15741	1370	8.70%
PQ2	61275	55344	58078	55537	57559	2773	4.82%	23601	22152	22877	1025	4.48%
DD6-1/4 Comp	15263	15602			15432	240	1.55%	3135	3354	3245	155	4.77%
DD6-7	17478	17184	15554	16200	16739	1037	6.19%	2711	2742	2727	22	0.80%

Definitions:

Mean: Arithmetic Mean

Stdev: Standard Deviation from replicate XRF scan analyses ($n \geq 2$)

% RSD: Percent Relative Standard Deviation whereby; $[\{stdev/mean\} * 100]$

Label: **PQ** = Pierside -Quaywall stations adjacent to Outfall 18A&B; **DD6-x** = Drydock # 6 - (1-7); **Comp** = composite sample

OUB PAH & PCB Results

SAMPLE LABEL	tPAH (µg/Kg)				Fe (mg/Kg)			
		Q	Stdev	%RSD		Q	Stdev	%RSD
OUBM-G 1	3451				29822			
OUBM-G 2	2843				38254			
OUBM-G 3	2432				29089			
OUBM-G 4	2460				35879			
OUBM-G 5	2742				36398			
OUBM-G 6	3167				34525			
OUBM-G 7	2326				35376			
OUBM-G 8	2727				36093			
OUBM-G 9	2524				35458			
OUBM-G 10	2007				27710			
OUBM-G 11	2940				32956			
OUBM-G 11 DUP	2900				35454			
OUBM-G 12	2631				34139			
OUBM-G 13	2651				36079			
OUBM-G 14	2755				24675			
OUBM-G 15	2073				34019			
OUBM-G 16	2333				34962			
OUBM-G 17	2138				36715			
OUBM-G 18	1862				25937			
OUBM-G 19	2199				31209			
OUBM-G 20	2372				36755			
OUBM-G 21	2173				29478			
OUBM-G 22	2539				36398			
OUBM-G 23	3056				35905			
OUBM-G 24	3838				33981			
OUBM-G 25	2958				36458			
OUBM-G 26	2931				36938			
OUBM-G 27	2501				36659			
OUBM-G 28	3882				36553			
OUBM-G 29	3822				38459			
OUBM-G 30	3344				35292			
OUBM-G 31	3198				35409			
OUBM-G 32	3330				36404			
OUBM-G 33	7567				34724			
OUBM-G 34	4392				36185			
OUBM-G 35	3564				36327			
OUBM-G 36	3828				35648			
OUBM-G 37	4317				36145			
OUBM-G 38	2518				41095			
OUBM-G 39	9099				27460			
OUBM-G 40	5147				35932			
OUBM-G 41	9654				36132			

Definitions:

Stdev: Standard Deviation from duplicate assay analyses (n=2)

% RSD: Percent Relative Standard Deviation whereby; $[\{\text{stdev}/\text{mean}\} * 100]$

Q: Data Qualifiers: **U** = None-Detect, **J** = Estimated, **E** = Outside Linear Range, **Blank** = Detect

Label: **OUBM** = Operable Unit B Marine; **OOUB** = Outside Operable Unit B; **DUP** = Field duplicate

OUB PAH & PCB Results

SAMPLE LABEL	tPAH (mg/Kg)				Fe (mg/Kg)			
		Q	Stdev	%RSD		Q	Stdev	%RSD
OUBM-G 42	4862				36572			
OUBM-G 42 DUP	5237				37850			
OUBM-G 43	4724				39695			
OUBM-G 44	3969				36020			
OUBM-G 45	4965				37247			
OUBM-G 46	2327				26962			
OUBM-G 47	4366				35571			
OUBM-G 48	2949				35494			
OUBM-G 49	2980				34477			
OUBM-G 50	5560				36272			
OUBM-G 51	2514				35316			
OUBM-G 52	5754				37373			
OUBM-G 53	2967				36474			
OUBM-G 54	3620				35278			
OUBM-G 55	5123				36280			
OUBM-G 56	4276				39060			
OUBM-G 57	5776				37584			
OUBM-G 58	4216				35835			
OUBM-G 59	4365				36252			
OUBM-G 60	8415				38807			
OUBM-G 61	11121				41367			
OUBM-G 62	4817				35598			
OUBM-G 63	6131				37562			
OUBM-G 64	8015				37221			
OUBM-G 65	8024				33958			
OUBM-G 66	5030				36179			
OUBM-G 67	9360				38486			
OUBM-G 68	5484				35067			
OUBM-G 68 DUP	6720				36882			
OUBM-G 69	4994				27942			
OUBM-G 70	3685				33815			
OUBM-G 71	2074				20633			
PQ1	15741				36642			
PQ2	22877				57559			
DD6-1/4 Comp	3245				30568	**		
DD6-7	2727				32368			
						** Ave RSC Fe conc from DD6 stations: 1&4		

Definitions:

Stdev: Standard Deviation from duplicate assay analyses (n=2)

% RSD: Percent Relative Standard Deviation whereby; $[(\text{stdev}/\text{mean}) * 100]$

Q: Data Qualifiers: **U** = None-Detect, **J** = Estimated, **E** = Outside Linear Range, **Blank** = Detect

Label: **OUBM** = Operable Unit B Marine; **OOUB** = Outside Operable Unit B; **DUP** = Field duplicate

PQ = Pierside/Quaywall stations adjacent to Outfall 18; **DD6** = Drydock # 6; **Comp** = Composite sample

OUB PAH & PCB Results

SAMPLE LABEL	tPAH (mg/Kg)			Fe (mg/Kg)		
	Q	Stdev	%RSD	Q	Stdev	%RSD
OOUB-G 1						
OOUB-G 2						
OOUB-G 3						
OOUB-G 4						
OOUB-G 5						
OOUB-G 6						
OOUB-G 7						
OOUB-G 8						
OOUB-G 9						
OOUB-G 10						
OOUB-G 11						
OOUB-G 12						
OOUB-G 12 DUP						
OOUB-G 13						
OOUB-G 14						
OOUB-G 14 DUP						
OOUB-G 15						
OOUB-G 16						
OOUB-G 17						
OOUB-G 18						
OOUB-G 19						
OOUB-G 20						
OOUB-G 21						
OOUB-G 22						
OOUB-G 23						
OOUB-G 23 DUP						
OOUB-G 24						
OOUB-G 25						
OOUB-G 26						
OOUB-G 27						
OOUB-G 28						
OOUB-G 29						
OOUB-G 30						
OOUB-G 31						
OOUB-G 32						

Definitions:

Stdev: Standard Deviation from duplicate assay analyses (n=2)

% RSD: Percent Relative Standard Deviation whereby; $[\{stdev/mean\} * 100]$

Q: Data Qualifiers: **U** = None-Detect, **J** = Estimated, **E** = Outside Linear Range, **Blank** = Detect

Label: **OUBM** = Operable Unit B Marine; **OOUB** = Outside Operable Unit B; **DUP** = Field duplicate

GPS (decimal degrees): NAD 83		SAMPLE Field ID	Fe (mg/Kg)			Cu (mg/Kg)			Zn (mg/Kg)			Pb (mg/Kg)			tPCB (µg/Kg)			tPAH (µg/Kg)		
Latitude N°	Longitude W°		2003 ^a	2007 ^b	2010 ^b	2003 ^a	2007 ^b	2010 ^b	2003 ^a	2007 ^b	2010 ^b	2003 ^a	2007 ^b	2010 ^b	2006	2007	2010	2006	2007	2010
47.529360	122.696182	OOUB-G 1	29430	29275	29108	63	47	12	260	48	70	102	23	31	287	43		1220	1600	1219
47.527462	122.690796	OOUB-G 2	18540	22139	21350	23	40	25	42	29	47	13	46	29	32	32		897	980	1127
47.531110	122.687993	OOUB-G 3	19670	23275	22911	36	41	7	53	31	65	13	16	24	33	47		1159	1012	1198
47.529211	122.682608	OOUB-G 4	20400	23378	23715	21	40	25	52	36	66	12	16	29	28	22		997	962	1482
47.532859	122.679804	OOUB-G 5	20640	35478	32484	74	89	78	91	98	136	31	53	78	66	342		1620	2622	1847
47.536506	122.677001	OOUB-G 6	20180	33322	36991	78	108	109	100	121	159	39	66	103	147	104		2998	2727	2206
47.534607	122.671614	OOUB-G 7	22070	35993	35016	92	114	89	110	162	168	45	92	88	96	110		2003	3001	3206
47.540154	122.674196	OOUB-G 8	20710	34263	33979	100	152	125	102	144	155	46	83	104	93	107		1970	2553	2117
47.538254	122.668811	OOUB-G 9	20700	35113	34531	86	145	110	109	139	166	41	80	84	100	107		2896	3374	2596
47.543801	122.671392	OOUB-G 10	21490	33502	34905	79	101	106	101	106	163	44	59	117	139	103		2346	2402	2680
47.541902	122.666006	OOUB-G 11	21920	30939	35059	85	99	91	94	133	156	44	54	96	131	115		2535	3762	2478
47.541902	122.666006	OOUB-G 11 DUP	na	34539	na	na	95	na	na	129	na	na	82	na	na	106	na	na	3481	na
47.539835	122.660619	OOUB-G 12	18590	22037	19230	33	41	9	51	51	51	16	7	19	40	37		1145	1457	2149
47.539835	122.660619	OOUB-G 12 DUP	na	na	19794	na	na	25	na	na	63	na	na	25	na	na		na	na	1318
47.545549	122.663200	OOUB-G 13	22630	38297	35692	69	104	76	114	161	155	49	96	79	142	104		2541	3361	2535
47.543649	122.657814	OOUB-G 14	20770	33328	33187	73	75	77	116	121	148	40	78	91	104	87		1904	3339	3163
47.543649	122.657814	OOUB-G 14 DUP	na	na	34720	na	na	96	na	na	157	na	na	97	na	na		na	na	2869
47.541749	122.652427	OOUB-G 15	19930	33460	35899	79	97	75	96	114	159	39	57	93	141	109		2824	2902	2563
47.541749	122.652427	OOUB-G 15 DUP	na	33463	na	na	91	na	na	140	na	na	83	na	na	108	na	na	3172	na
47.539847	122.647042	OOUB-G 16	18890	33785	34340	76	149	113	114	168	201	39	60	86	142	96		3946	4507	4807
47.547296	122.655008	OOUB-G 17	22330	37087	36398	75	129	94	97	108	157	46	113	87	145	92		2849	3078	3305
47.545396	122.649622	OOUB-G 18	22560	37195	34458	88	118	112	100	149	157	44	84	73	99	71		2167	3238	3008
47.543494	122.644236	OOUB-G 19	20530	32413	33270	69	93	98	101	120	163	43	96	90	77	126		2258	3010	2552
47.550942	122.652201	OOUB-G 20	22780	38005	36255	63	125	111	84	136	137	34	72	94	82	95		2030	2944	2589
47.549042	122.646816	OOUB-G 21	23070	36853	34477	75	104	76	102	136	131	47	76	97	96	109		2315	3237	2237
47.547141	122.641429	OOUB-G 22	22800	36340	35295	65	110	89	92	121	155	43	68	87	58	87		1845	3137	2361
47.545241	122.636044	OOUB-G 23	18430	32038	26768	62	119	44	79	104	126	31	53	74	77	71		2350	2669	1636
47.545241	122.636044	OOUB-G 23 DUP	na	na	27379	na	na	66	na	na	154	na	na	64	na	na		na	na	2187
47.550788	122.638622	OOUB-G 24	23680	36144	34147	84	124	89	102	111	159	49	105	75	76	98		2282	3184	2067
47.548887	122.633236	OOUB-G 25	21410	29953	25922	60	24	31	87	436	102	32	63	53	55	58		2197	2267	2059
47.546986	122.627851	OOUB-G 26	16100	18576	19847	16	19	25	40	41	60	9	8	11	12	14		929	915	917
47.554434	122.635814	OOUB-G 27	22560	35392	33798	58	106	82	87	111	152	34	84	81	56	85		1960	2738	2825
47.552533	122.630428	OOUB-G 28	22543	34476	33937	69	81	42	99	117	134	39	80	94	77	64		2321	2832	2426
47.550632	122.625042	OOUB-G 29	21557	29620	28026	42	19	18	79	64	113	27	36	57	48	50		2014	2585	1744
47.548729	122.619657	OOUB-G 30	16690	19655	18060	15	20	25	42	35	45	11	15	25	22	30		845	1228	999
47.556179	122.627619	OOUB-G 31	22660	36897	33356	62	55	51	96	90	116	39	103	91	65	0		2510	3079	2748
47.559826	122.624811	OOUB-G 32	21010	28709	25539	45	62	25	76	73	107	31	74	61	65	81		2228	4247	2202

^a Analyses by Energy Dispersive X-Ray Fluorescence (EDXRF) Spectroscopy; ^b Analyses by Field Portable X-Ray Fluorescence (FPXRF) Spectroscopy; **na** = data not available, field duplicate not collected

Fe = XRF estimated Iron concentration; **Cu** = XRF estimated Copper concentration; **Zn** = XRF estimated Zinc concentration; **Pb** = XRF estimated Lead concentration; **mg/Kg** = ppm; **µg/Kg** = ppb

tPCB = Immunoassay estimated total Poly-chlorinated biphenyl concentration (as Aroclor 1254); **tPAH** = Immunoassay estimated total Poly-aromatic hydrocarbon concentration (as Phenanthrene)

OUBM = Operable Unit B Marine; **OOUB** = Outside Operable Unit B; **G xx** = Grid number (1-32); **DUP** = Field duplicate; **GPS** = Global Positioning System; **NAD 83** = North American Datum of 1983

GPS (decimal degrees): NAD 83		SAMPLE Field ID	Fe (mg/Kg)			Cu (mg/Kg)			Zn (mg/Kg)			Pb (mg/Kg)			tPCB (µg/Kg)			tPAH (µg/Kg)		
Latitude N°	Longitude W°		2003 ^a	2007 ^b	2010 ^b	2003 ^a	2007 ^b	2010 ^b	2003 ^a	2007 ^b	2010 ^b	2003 ^a	2007 ^b	2010 ^b	2006	2007	2010	2006	2007	2010
47.545999	122.670367	OUBM-G 1	21580	37816	29822	99	163	95	137	193	170	52	80	77	201	211		3054	10612	3451
47.545496	122.668489	OUBM-G 2	22070	37457	38254	94	90	116	96	125	164	48	54	94	133	97		2339	3385	2843
47.547271	122.669639	OUBM-G 3	20950	31179	29089	71	110	71	106	131	142	33	65	73	73	124		1894	2759	2432
47.546771	122.667743	OUBM-G 4	22810	36371	35879	87	117	96	99	137	162	45	111	96	102	81		2301	3496	2460
47.546259	122.665859	OUBM-G 5	23370	38592	36398	78	137	96	102	127	160	49	100	83	142	93		3497	3565	2742
47.548052	122.667009	OUBM-G 6	24750	34044	34525	106	126	101	129	165	168	59	100	99	85	88		1969	3089	3167
47.547547	122.665131	OUBM-G 7	24110	38174	35376	78	90	89	108	132	156	43	74	101	83	83		2267	3473	2326
47.547044	122.663242	OUBM-G 8	24090	36975	36093	105	128	106	115	96	168	50	99	115	132	97		1892	3497	2727
47.546546	122.661360	OUBM-G 9	24470	34488	35458	108	109	89	138	103	147	66	55	97	110	72		2537	3020	2524
47.546546	122.661360	OUBM-G 9 DUP	na	36949	na	na	52	na	na	99	na	na	98	na	na	79	na	na	2589	na
47.548821	122.664380	OUBM-G 10	23010	30648	27710	63	55	34	89	101	128	31	51	63	57	85		1747	3146	2007
47.548322	122.662497	OUBM-G 11	24500	33993	32956	65	115	70	87	94	124	31	50	75	120	101		1984	3446	2940
47.548322	122.662497	OUBM-G 11 DUP	na	na	35454	na	na	63	na	na	150	na	na	94	na	na		na	na	2900
47.547821	122.660613	OUBM-G 12	23450	32273	34139	46	49	82	76	102	154	25	53	96	123	77		1842	3043	2631
47.547321	122.658726	OUBM-G 13	23090	35446	36079	80	90	63	110	106	136	51	91	99	147	99		1878	3280	2651
47.549999	122.663743	OUBM-G 14	22480	25988	24675	69	50	12	104	82	89	43	33	36	93	47		2177	2134	2755
47.549598	122.661758	OUBM-G 15	28310	na	34019	58	na	66	88	na	123	28	na	63	72	na		1420	na	2073
47.549095	122.659874	OUBM-G 16	24500	34954	34962	51	69	69	83	84	152	28	38	63	103	90		1813	2827	2333
47.548594	122.657989	OUBM-G 17	24230	36549	36715	68	113	88	97	119	150	36	72	89	160	102		2512	3083	2138
47.550875	122.661021	OUBM-G 18	21920	28003	25937	57	55	44	76	70	110	31	74	68	115	88		2206	8193	1862
47.550373	122.659135	OUBM-G 19	23980	36059	31209	62	112	80	91	227	150	30	66	62	99	114		1572	3869	2199
47.549871	122.657253	OUBM-G 20	24130	33659	36755	66	60	69	92	96	185	39	75	85	131	92		2409	3556	2372
47.551663	122.658601	OUBM-G 21	22500	32168	29478	78	83	51	85	103	129	31	41	54	56	71		2077	2668	2173
47.551152	122.656508	OUBM-G 22	21230	37264	36398	79	136	127	103	123	151	48	83	94	172	114		1930	4014	2539
47.550642	122.654613	OUBM-G 23	22760	35379	35905	92	90	137	102	97	176	45	72	103	138	100		3007	4418	3056
47.552983	122.657642	OUBM-G 24	21750	37427	33981	114	170	137	131	178	178	44	74	104	124	120		2837	5908	3838
47.552418	122.655481	OUBM-G 25	25020	37517	36458	134	215	150	181	178	203	80	112	85	177	823		2646	4241	2958
47.551876	122.653474	OUBM-G 26	23240	37543	36938	138	166	163	147	195	261	66	84	111	99	129		2557	5004	2931
47.551423	122.652004	OUBM-G 27	23350	38719	36659	83	138	116	106	184	169	41	89	101	122	337		2058	4123	2501
47.551423	122.652004	OUBM-G 27 DUP	na	37777	na	na	117	na	na	136	na	na	147	na	na	138	na	na	4444	na
47.553726	122.655034	OUBM-G 28	21250	36994	36553	122	198	193	134	215	213	42	84	102	189	297		3260	7416	3882
47.553223	122.653127	OUBM-G 29	23830	39295	38459	146	268	206	166	250	248	102	115	138	120	177		2613	5066	3822
47.552690	122.651081	OUBM-G 30	23180	40223	35292	108	186	119	120	522	178	49	167	82	214	149		3355	4924	3344
47.552199	122.649375	OUBM-G 31	23250	40236	35409	83	123	99	101	152	169	45	114	98	128	119		2278	4663	3198
47.551675	122.647472	OUBM-G 32	23480	38001	36404	87	82	89	105	139	167	41	99	124	161	108		2594	3605	3330
47.554514	122.652314	OUBM-G 33	22790	37475	34724	135	219	163	168	191	204	64	126	121	129	200		3464	8121	7567
47.553901	122.650717	OUBM-G 34	23648	38552	36185	138	191	187	250	252	206	104	92	115	388	184		4417	5012	4392
47.553468	122.648533	OUBM-G 35	22100	36900	36327	80	168	122	93	149	208	43	107	116	325	2640		3694	5600	3564
47.552928	122.646792	OUBM-G 36	24440	41644	35648	105	212	148	133	169	190	56	127	102	98	131		2504	6458	3828

^a Analyses by Energy Dispersive X-Ray Fluorescence (EDXRF) Spectroscopy; ^b Analyses by Field Portable X-Ray Fluorescence (FPXRF) Spectroscopy; na = data not available, field duplicate not collected

Fe = XRF estimated Iron concentration; Cu = XRF estimated Copper concentration; Zn = XRF estimated Zinc concentration; Pb = XRF estimated Lead concentration; mg/Kg = ppm; µg/Kg = ppb

tPCB = Immunoassay estimated total Poly-chlorinated biphenyl concentration (as Aroclor 1254); tPAH = Immunoassay estimated total Poly-aromatic hydrocarbon concentration (as Phenanthrene)

OUBM = Operable Unit B Marine; OUBB = Outside Operable Unit B; G xx = Grid number (1-71); DUP = Field duplicate; GPS = Global Positioning System; NAD 83 = North American Datum of 1983

GPS (decimal degrees): NAD 83		SAMPLE Field ID	Fe (mg/Kg)			Cu (mg/Kg)			Zn (mg/Kg)			Pb (mg/Kg)			tPCB (µg/Kg)			tPAH (µg/Kg)		
Latitude N°	Longitude W°		2003 ^a	2007 ^b	2010 ^b	2003 ^a	2007 ^b	2010 ^b	2003 ^a	2007 ^b	2010 ^b	2003 ^a	2007 ^b	2010 ^b	2006	2007	2010	2006	2007	2010
47.552471	122.644868	OUBM-G 37	23940	43628	36145	98	237	135	132	183	178	55	135	94	232	153		5176	7358	4317
47.551974	122.642975	OUBM-G 38	24810	39643	41095	97	207	203	131	175	383	63	91	132	60	107		2083	3850	2518
47.555704	122.651510	OUBM-G 39	23940	32111	27460	181	195	111	425	316	385	94	169	168	313	230		43927	19895	9099
47.555249	122.649740	OUBM-G 40	22910	37471	35932	99	229	202	142	198	210	55	126	85	298	185		3261	13284	5147
47.554723	122.648188	OUBM-G 41	23620	39587	36132	89	203	174	125	203	239	47	90	134	212	154		5300	10507	9654
47.554349	122.646332	OUBM-G 42	24680	38768	36572	100	176	145	129	196	209	52	122	102	143	161		2696	12214	4862
47.554349	122.646332	OUBM-G 42 DUP	na	na	37850	na	na	188	na	na	208	na	na	105	na	na		na	na	5237
47.553169	122.642232	OUBM-G 43	22260	37415	39695	106	165	183	148	217	440	49	135	138	83	139		2459	7556	4724
47.552742	122.640352	OUBM-G 44	23080	38492	36020	85	145	98	113	164	181	46	80	88	99	112		2432	4968	3969
47.555496	122.645872	OUBM-G 45	21930	36468	37247	114	254	208	151	175	223	60	121	124	260	170		22583	11985	4965
47.554419	122.641615	OUBM-G 46	25040	30620	26962	133	117	32	286	149	135	92	67	46	230	70		2123	3424	2327
47.554419	122.641615	OUBM-G 46 DUP	na	31694	na	na	110	na	na	141	na	na	81	na	na	90	na	na	12026	na
47.554026	122.639574	OUBM-G 47	24050	37328	35571	84	80	96	125	151	170	45	78	99	68	99		2307	4947	4366
47.553516	122.637726	OUBM-G 48	20340	37854	35494	70	108	101	90	180	149	34	91	72	78	86		2326	6078	2949
47.555648	122.641314	OUBM-G 49	24290	33202	34477	146	138	148	250	218	218	107	97	111	256	129		7236	6717	2980
47.555302	122.638806	OUBM-G 50	21510	40519	36272	92	127	106	113	174	174	38	92	85	106	113		2719	6110	5560
47.554792	122.636993	OUBM-G 51	20520	37689	35316	65	112	77	95	124	162	36	91	98	81	122		3190	4407	2514
47.556573	122.638131	OUBM-G 52	27713	42756	37373	247	219	180	417	339	360	171	159	186	215	203		7098	10881	5754
47.556573	122.638131	OUBM-G 52 DUP	na	42373	na	na	265	na	na	360	na	na	171	na	na	195	na	na	9926	na
47.556071	122.636253	OUBM-G 53	22770	38825	36474	74	38	94	112	154	170	45	59	89	304	129		2776	6132	2967
47.555569	122.634371	OUBM-G 54	22050	35235	35278	68	85	78	105	109	168	41	71	111	82	114		2597	5600	3620
47.557826	122.637648	OUBM-G 55	24410	39019	36280	133	198	157	188	322	248	65	141	118	264	239		20968	8714	5123
47.557416	122.635459	OUBM-G 56	22900	40232	39060	122	168	172	166	239	300	61	116	147	290	228		7331	12488	4276
47.556847	122.633624	OUBM-G 57	22200	39232	37584	100	172	122	177	235	231	87	119	118	139	200		2733	8549	5776
47.556286	122.631713	OUBM-G 58	20670	35743	35835	71	81	81	104	150	148	41	34	80	153	151		3673	5740	4216
47.558623	122.634773	OUBM-G 59	23720	40897	36252	152	252	158	280	366	192	117	183	105	169	200		4143	16033	4365
47.558113	122.632735	OUBM-G 60	20910	43902	38807	126	351	211	291	931	345	75	488	188	281	301		28403	21452	8415
47.557612	122.631082	OUBM-G 61	19750	42003	41367	75	233	178	191	375	337	167	153	140	224	280		14017	23252	11121
47.557119	122.629118	OUBM-G 62	21600	36596	35598	67	108	62	109	117	147	48	71	106	183	194		4237	8738	4817
47.559928	122.634028	OUBM-G 63	21620	39159	37562	192	368	202	253	386	221	107	174	96	173	315		19148	11440	6131
47.559398	122.632145	OUBM-G 64	22820	37953	37221	149	248	167	279	292	286	113	126	127	301	222		7382	13548	8015
47.558876	122.630153	OUBM-G 65	22700	35831	33958	118	175	133	197	315	348	70	73	129	169	179		3123	6521	8024
47.558397	122.628376	OUBM-G 66	21580	35546	36179	87	115	65	249	166	185	66	106	114	12965	168		7825	10888	5030
47.560671	122.631606	OUBM-G 67	24050	44563	38486	211	1618	283	283	863	382	140	378	211	245	441		7180	29692	9360
47.560111	122.629596	OUBM-G 68	21280	35958	35067	129	280	171	558	347	292	67	146	125	111	213		3552	7684	5484
47.560111	122.629596	OUBM-G 68 DUP	na	na	36882	na	na	176	na	na	290	na	na	122	na	na		na	na	6720
47.559680	122.627567	OUBM-G 69	21770	28078	27942	79	89	79	117	107	225	50	79	85	173	158		5193	12468	4994
47.559174	122.625754	OUBM-G 70	21710	37878	33815	69	88	60	103	144	136	43	100	85	103	130		2792	6725	3685
47.560409	122.625120	OUBM-G 71	18630	22211	20633	49	31	25	61	49	84	27	13	43	89	52		1974	5505	2074

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OUBM = Operable Unit B Marine; **OOUB** = Outside Operable Unit B; **G xx** = Grid number (1-71); **DUP** = Field duplicate; **GPS** = Global Positioning System; **NAD 83** = North American Datum of 1983