

Lower Duwamish Waterway Group

Port of Seattle / City of Seattle / King County / The Boeing Company

MEMORANDUM

To: Allison Hiltner, US Environmental Protection Agency
Ronald Timm, Washington State Department of Ecology

From: Lower Duwamish Waterway Group

Subject: Validated LDW Sediment Data for ENR-AC Pilot

Date: January 15, 2015

Attachments: Data CD (which includes field forms)

INTRODUCTION

This memorandum presents the validated surface and subsurface sediment data for samples collected from the Lower Duwamish Waterway (LDW) to be used in the selection of plot areas for the enhanced natural recovery (ENR)/activated carbon (AC) pilot study (EPA and Ecology 2014). For this effort, samples were collected and analyzed for polychlorinated biphenyls (PCBs) in select areas within the LDW to determine if PCB concentrations were within the targeted range for the study.

This memorandum presents the validated data as well as any deviations from the quality assurance project plan (QAPP) (Windward 2014), which was prepared in accordance with guidance from the US Environmental Protection Agency (EPA) (2002) and Washington State Department of Ecology (Ecology) (2008).

These data will be discussed with EPA and Ecology on January 21, 2015, as part of the final selection process to determine the study areas.

METHODS AND QAPP DEVIATIONS

All methods and procedures outlined in the QAPP (Windward 2014) were followed in the collection and analysis of these samples, with the following exceptions.

Core Acceptance Criteria

Core acceptance criteria include an estimated recovery of greater than 75% for each core (Windward 2014). According to the QAPP, if the sample acceptance criteria are not achieved in the first core, the sample will be set aside and up to two additional core drives will be advanced at locations within 10 m of the proposed location. Following consultation with LDWG and EPA/Ecology, the sediment cores from LDW-PILOT2A (56.2% recovery), LDW-PILOT2B (65.5% recovery) and LDW-PILOT3B (67.6% recovery) were accepted for analysis because recovery was less than 75% after three attempts.

Core Depth

In the subtidal and scour mitigation candidate plot areas, the objective was to collect subsurface sediment samples from the 0-to-2-ft depth interval (Windward 2014). After four attempts at location LDW-PILOT2B, the highest recovery (65.5% recovery) obtained captured sediment only from the 0-to-1.88-ft depth. Following consultation with LDWG and EPA/Ecology, the core sediment from LDW-PILOT2B was accepted for analysis using the 0-to-1.5-ft depth interval.

Sampling Location

In accordance with the QAPP, a global positioning system (GPS) was used to position the sampling vessel such that the GPS-receiver, mounted to the winch arm directly over the grab sampler, was within 1 to 2 m of the intended sampling location (Windward 2014). At the time of sampling, a barge was occupying most of Area 1. The target surface sediment location LDW-PILOT1A-SS2 could not be safely accessed because it was blocked by the barge's anchor line.

In addition, surface sediment location LDW-PILOT3A-SS4 and core sediment locations LDW-PILOT1A-SC1, LDW-PILOT2A-SC1 and LDW-PILOT8A-SC1 were slightly off-target due to drift resulting from wind and current. Surface sediment was collected 9.6 ft (2.9 m) from the target coordinate at LDW-PILOT1A-SS2. EPA oversight was present at the time of sampling and accepted the change of location. Surface sediment was collected 6.9 ft (2.1 m) off-target at location LDW-PILOT3A-SS4; core sediment was collected 6.8 ft (2.1 m) off-target at location LDW-PILOT1A-SC1, 7.0 ft (2.1 m) off-target at location LDW-PILOT2A-SC1, and 7.3 ft (2.2 m) off-target at location LDW-PILOT8A-SC1.

DATA QUALIFIERS

In accordance with the QAPP, the laboratory results were validated by Laboratory Data Consultants, Inc. (LDC) at a summary level (EPA 2A). The following is a summary of the validation findings. When multiple dilutions were analyzed, LDC selected the best technical result from the available dilutions and qualified the lesser technically acceptable results with an "R" (rejected). Of the 80 total organic carbon results, 31 were qualified as estimated (J) due to the percent recovery of the associated matrix spike being outside of the established control limits. Six Aroclor-1248 results were qualified by Analytical Resources, Inc. (ARI) with "Y" indicating a raised reporting limit due to chromatographic interference. LDC qualified those six results as not detected (U) at the level of the raised reporting limit. One Aroclor-1254 result was qualified as estimated (J) because the percent recovery of the associated matrix spike was outside of the established control limits.

RESULTS

Table 1 and Figures 1a-1c present the results of the individual surface sediment samples, including the calculated total PCB values expressed in units of both dry weight basis and organic carbon normalized units. Table 2 and Figures 1a-1c present the same types of results for subsurface sediment samples. Table 3 presents the average total PCB values for surface sediment in the study areas grouped by plot type.

Table 1. Surface sediment results

Sample ID	Sampling Date	PCBs											Conventionals		
		Aroclor 1016 (µg/kg dw)	Aroclor 1221 (µg/kg dw)	Aroclor 1232 (µg/kg dw)	Aroclor 1242 (µg/kg dw)	Aroclor 1248 (µg/kg dw)	Aroclor 1254 (µg/kg dw)	Aroclor 1260 (µg/kg dw)	Aroclor 1262 (µg/kg dw)	Aroclor 1268 (µg/kg dw)	Total PCB Aroclors (µg/kg dw)	Total PCB Aroclors (mg/kg OC)	TOC (% dw)	Total Solids (% ww)	
		Area 1A													
LDW-PILOT1A-SS1	10/27/2014	9.4 U	9.4 U	9.4 U	9.4 U	65	78	65	9.4 U	9.4 U	208	14.6	1.43	59.41	
LDW-PILOT1A-SS2	10/27/2014	9.8 U	9.8 U	9.8 U	9.8 U	160	160	120	9.8 U	9.8 U	440	26	1.70	50.20	
LDW-PILOT1A-SS3	10/29/2014	9.2 U	9.2 U	9.2 U	9.2 U	64	98	77	9.2 U	9.2 U	239	6.81	3.51	46.39	
LDW-PILOT1A-SS4	10/27/2014	9.4 U	9.4 U	9.4 U	9.4 U	48	70	54	9.4 U	9.4 U	172	6.83	2.52	47.60	
Area 1B															
LDW-PILOT1B-SS1	10/27/2014	9.7 U	9.7 U	9.7 U	9.7 U	62	84	79	9.7 U	9.7 U	225	23.3	0.965	46.20	
LDW-PILOT1B-SS2	10/29/2014	9.4 U	9.4 U	9.4 U	9.4 U	63	110	84	9.4 U	9.4 U	260	7.6	3.41	44.56	
LDW-PILOT1B-SS3	10/29/2014	9.7 U	9.7 U	9.7 U	9.7 U	70	110	76	9.7 U	9.7 U	260	9.2	2.82	43.34	
LDW-PILOT1B-SS4	10/27/2014	9.9 U	9.9 U	9.9 U	9.9 U	58	84	71	9.9 U	9.9 U	213	9.42	2.26	45.48	
Area 2A															
LDW-PILOT2A-SS1	10/27/2014	9.7 U	9.7 U	9.7 U	9.7 U	37	54	41	9.7 U	9.7 U	132	14.1	0.934	63.62	
LDW-PILOT2A-SS2	10/28/2014	9.1 U	9.1 U	9.1 U	9.1 U	29	43	29	9.1 U	9.1 U	101	7.11	1.42 J	68.03	
LDW-PILOT2A-SS3	10/28/2014	9.9 U	9.9 U	9.9 U	9.9 U	52	85	220	9.9 U	9.9 U	360	31	1.18 J	55.40	
LDW-PILOT2A-SS4	10/27/2014	9.0 U	9.0 U	9.0 U	9.0 U	58	86	56	9.0 U	9.0 U	200	7.63	2.62	58.63	
Area 2B															
LDW-PILOT2B-SS1	10/27/2014	9.7 U	9.7 U	9.7 U	9.7 U	55	69	53	9.7 U	9.7 U	177	7.14	2.48	51.57	
LDW-PILOT2B-SS2	10/28/2014	9.2 U	9.2 U	9.2 U	9.2 U	46	54	40	9.2 U	9.2 U	140	6.97	2.01 J	59.48	
LDW-PILOT2B-SS3	10/28/2014	9.6 U	9.6 U	9.6 U	9.6 U	92	110	70	9.6 U	9.6 U	270	24	1.14 J	53.08	
LDW-PILOT2B-SS4	10/28/2014	9.5 U	9.5 U	9.5 U	9.5 U	98	150	100	9.5 U	9.5 U	350	14	2.44 J	48.60	
Area 3A															
LDW-PILOT3A-SS1	10/27/2014	9.4 U	9.4 U	9.4 U	9.4 U	54	85	62	9.4 U	9.4 U	201	12.6	1.60	40.50	
LDW-PILOT3A-SS2	10/27/2014	9.1 U	9.1 U	9.1 U	9.1 U	25	38	26	9.1 U	9.1 U	89	4.9	1.80	60.79	
LDW-PILOT3A-SS3	10/27/2014	9.8 U	9.8 U	9.8 U	9.8 U	33	65	46	9.8 U	9.8 U	144	6.99	2.06 J	52.41	
LDW-PILOT3A-SS4	10/27/2014	9.4 U	9.4 U	9.4 U	9.4 U	45	72	55	9.4 U	9.4 U	172	5.39	3.19 J	44.09	

Sample ID	Sampling Date	PCBs											Conventionals	
		Aroclor 1016 (µg/kg dw)	Aroclor 1221 (µg/kg dw)	Aroclor 1232 (µg/kg dw)	Aroclor 1242 (µg/kg dw)	Aroclor 1248 (µg/kg dw)	Aroclor 1254 (µg/kg dw)	Aroclor 1260 (µg/kg dw)	Aroclor 1262 (µg/kg dw)	Aroclor 1268 (µg/kg dw)	Total PCB Aroclors (µg/kg dw)	Total PCB Aroclors (mg/kg OC)	TOC (% dw)	Total Solids (% ww)
		Area 3B												
LDW-PILOT3B-SS1	10/27/2014	9.5 U	9.5 U	9.5 U	9.5 U	140 U	120	96	9.5 U	9.5 U	220	13	1.65 J	39.18
LDW-PILOT3B-SS2	10/27/2014	9.6 U	9.6 U	9.6 U	9.6 U	12 U	14	12	9.6 U	9.6 U	26	4.7	0.552	57.97
LDW-PILOT3B-SS3	10/27/2014	9.9 U	9.9 U	9.9 U	9.9 U	9.9 U	9.9 U	9.9 U	9.9 U	9.9 U	9.9 U	1.5 U	0.653	63.42
LDW-PILOT3B-SS4	10/27/2014	10 U	10 U	10 U	10 U	43	65	41	10 U	10 U	149	4.13	3.61 J	38.84
Area 4A														
LDW-PILOT4A-SS1	10/27/2014	9.6 U	9.6 U	9.6 U	9.6 U	92	100	70	9.6 U	9.6 U	260	24	1.09 J	65.52
LDW-PILOT4A-SS2	10/27/2014	9.6 U	9.6 U	9.6 U	9.6 U	17	25	12	9.6 U	9.6 U	54	nc	0.261 J	76.17
LDW-PILOT4A-SS3	10/27/2014	9.9 U	9.9 U	9.9 U	9.9 U	110	140	80	9.9 U	9.9 U	330	26	1.28 J	63.32
LDW-PILOT4A-SS4	10/27/2014	8.9 U	8.9 U	8.9 U	8.9 U	57	90	50	8.9 U	8.9 U	197	10.9	1.81 J	63.17
Area 4B														
LDW-PILOT4B-SS1	10/27/2014	9.1 U	9.1 U	9.1 U	9.1 U	430	330	180	9.1 U	9.1 U	940	45	2.08 J	60.74
LDW-PILOT4B-SS2	10/27/2014	10 U	10 U	10 U	10 U	74	100	37	10 U	10 U	210	17	1.26 J	61.82
LDW-PILOT4B-SS3	10/28/2014	9.6 U	9.6 U	9.6 U	9.6 U	20	21	10	9.6 U	9.6 U	51	6.0	0.846 J	57.80
LDW-PILOT4B-SS4	10/28/2014	9.8 U	9.8 U	9.8 U	9.8 U	720	660	260	9.8 U	9.8 U	1,640	109	1.51 J	63.47
Area 6A														
LDW-PILOT6A-SS1	10/28/2014	9.3 U	9.3 U	9.3 U	9.3 U	160	200	100	9.3 U	9.3 U	460	28	1.64 J	48.76
LDW-PILOT6A-SS2	10/28/2014	9.0 U	9.0 U	9.0 U	9.0 U	75	83	44	9.0 U	9.0 U	202	10.4	1.94 J	60.54
LDW-PILOT6A-SS3	10/28/2014	9.3 U	9.3 U	9.3 U	9.3 U	100	130	57	9.3 U	9.3 U	290	13	2.18 J	66.90
LDW-PILOT6A-SS4	10/28/2014	9.2 U	9.2 U	9.2 U	9.2 U	640	670	220	9.2 U	9.2 U	1,530	80.5	1.90 J	54.75
Area 6B														
LDW-PILOT6B-SS1	10/29/2014	9.3 U	9.3 U	9.3 U	9.3 U	1,100	1,400	420	9.3 U	9.3 U	2,900	180	1.59	59.06
LDW-PILOT6B-SS2	10/29/2014	9.4 U	9.4 U	9.4 U	9.4 U	700	570	200	9.4 U	9.4 U	1,470	116	1.27	59.80
LDW-PILOT6B-SS3	10/29/2014	9.1 U	9.1 U	9.1 U	9.1 U	390	610	250	9.1 U	9.1 U	1,250	76.7	1.63	61.42
LDW-PILOT6B-SS4	10/29/2014	9.4 U	9.4 U	9.4 U	9.4 U	180	180 J	90	9.4 U	9.4 U	450 J	68 J	0.658	77.75
Area 7A														
LDW-PILOT7A-SS1	10/29/2014	9.7 U	9.7 U	9.7 U	9.7 U	65	130	72	9.7 U	9.7 U	270	10	2.70	46.53
LDW-PILOT7A-SS2	10/29/2014	9.4 U	9.4 U	9.4 U	9.4 U	43	83	43	9.4 U	9.4 U	169	8.94	1.89	52.96

Sample ID	Sampling Date	PCBs											Conventionals	
		Aroclor 1016 (µg/kg dw)	Aroclor 1221 (µg/kg dw)	Aroclor 1232 (µg/kg dw)	Aroclor 1242 (µg/kg dw)	Aroclor 1248 (µg/kg dw)	Aroclor 1254 (µg/kg dw)	Aroclor 1260 (µg/kg dw)	Aroclor 1262 (µg/kg dw)	Aroclor 1268 (µg/kg dw)	Total PCB Aroclors (µg/kg dw)	Total PCB Aroclors (mg/kg OC)	TOC (% dw)	Total Solids (% ww)
		LDW-PILOT7A-SS3	10/29/2014	9.6 U	9.6 U	9.6 U	9.6 U	65	130	71	9.6 U	9.6 U	270	14
LDW-PILOT7A-SS4	10/29/2014	9.2 U	9.2 U	9.2 U	9.2 U	68	130	70	9.2 U	9.2 U	270	10	2.61	45.28
Area 7B														
LDW-PILOT7B-SS1	10/29/2014	9.8 U	9.8 U	9.8 U	9.8 U	64	130	94	9.8 U	9.8 U	290	10	2.89	46.14
LDW-PILOT7B-SS2	10/29/2014	9.2 U	9.2 U	9.2 U	9.2 U	43	80	48	9.2 U	9.2 U	171	6.79	2.52	54.25
LDW-PILOT7B-SS3	10/29/2014	9.5 U	9.5 U	9.5 U	9.5 U	54	110	78	9.5 U	9.5 U	240	12	1.94	52.13
LDW-PILOT7B-SS4	10/29/2014	9.9 U	9.9 U	9.9 U	9.9 U	63	140	87	9.9 U	9.9 U	290	11	2.57	46.08
Area 8A														
LDW-PILOT8A-SS1	10/28/2014	8.9 U	8.9 U	8.9 U	8.9 U	27	66	57	8.9 U	8.9 U	150	20.3	0.738 J	69.37
LDW-PILOT8A-SS2	10/28/2014	9.8 U	9.8 U	9.8 U	9.8 U	28	66	57	9.8 U	9.8 U	151	nc	0.410 J	71.30
LDW-PILOT8A-SS3	10/28/2014	9.1 U	9.1 U	9.1 U	9.1 U	9.1 U	21	13	9.1 U	9.1 U	34	nc	0.203 J	77.62
LDW-PILOT8A-SS4	10/28/2014	9.8 U	9.8 U	9.8 U	9.8 U	15	28	18	9.8 U	9.8 U	61	9.8	0.622 J	71.98
Area 8B														
LDW-PILOT8B-SS1	10/28/2014	9.8 U	9.8 U	9.8 U	9.8 U	28	53	27	9.8 U	9.8 U	108	10.7	1.01 J	70.68
LDW-PILOT8B-SS2	10/28/2014	9.8 U	9.8 U	9.8 U	9.8 U	9.8 U	21	13	9.8 U	9.8 U	34	nc	0.454 J	72.94
LDW-PILOT8B-SS3	10/28/2014	9.8 U	9.8 U	9.8 U	9.8 U	9.8 U	35	20	9.8 U	9.8 U	55	9.7	0.566 J	72.47
LDW-PILOT8B-SS4	10/28/2014	9.4 U	9.4 U	9.4 U	9.4 U	30	54	37	9.4 U	9.4 U	121	11.9	1.02 J	66.37
Area 9A														
LDW-PILOT9A-SS1	10/29/2014	9.5 U	9.5 U	9.5 U	9.5 U	160	450	100	9.5 U	9.5 U	710	42	1.70	58.45
LDW-PILOT9A-SS2	10/29/2014	9.7 U	9.7 U	9.7 U	9.7 U	45	120	60	9.7 U	9.7 U	230	16	1.40	56.23
LDW-PILOT9A-SS3	10/29/2014	9.8 U	9.8 U	9.8 U	9.8 U	84	280	82	9.8 U	9.8 U	450	29	1.54	50.89
LDW-PILOT9A-SS4	10/29/2014	9.3 U	9.3 U	9.3 U	9.3 U	920	2,100	230	9.3 U	9.3 U	3,300	150	2.18	59.18
Area 9B														
LDW-PILOT9B-SS1	10/29/2014	9.0 U	9.0 U	9.0 U	9.0 U	81	200	36	9.0 U	9.0 U	320	25	1.29	68.91
LDW-PILOT9B-SS2	10/29/2014	9.5 U	9.5 U	9.5 U	9.5 U	160	750	86	9.5 U	9.5 U	996	53.8	1.85	58.50
LDW-PILOT9B-SS3	10/29/2014	9.8 U	9.8 U	9.8 U	9.8 U	71	280	73	9.8 U	9.8 U	420	24	1.74	58.40
LDW-PILOT9B-SS4	10/29/2014	9.1 U	9.1 U	9.1 U	9.1 U	120	430	67	9.1 U	9.1 U	620	49	1.27	66.36

Note: Depth range for all samples was 0 to 10 cm.

dw – dry weight

ID – identification

J – estimated concentration

nc – not calculated (TOC concentration was outside of the acceptable range of 0.5 to 4.0%)

OC – organic carbon

PCB – polychlorinated biphenyl

TOC – total organic carbon

ww – wet weight

U – not detected at given concentration

Table 2. Subsurface sediment results

Sample ID	Depth Range	Sampling Date	PCBs											Conventionals		
			Aroclor 1016 (µg/kg dw)	Aroclor 1221 (µg/kg dw)	Aroclor 1232 (µg/kg dw)	Aroclor 1242 (µg/kg dw)	Aroclor 1248 (µg/kg dw)	Aroclor 1254 (µg/kg dw)	Aroclor 1260 (µg/kg dw)	Aroclor 1262 (µg/kg dw)	Aroclor 1268 (µg/kg dw)	Total PCB Aroclors (µg/kg dw)	Total PCB Aroclors (mg/kg OC)	TOC (% dw)	Total Solids (% ww)	
Area 1A																
LDW-PILOT1A-SC1	0 – 2 ft	10/30/2014	9.7 U	9.7 U	9.7 U	9.7 U	110	150	93	9.7 U	9.7 U	350	23	1.54	51.03	
Area 1B																
LDW-PILOT1B-SC1	0 – 2 ft	10/30/2014	9.2 U	9.2 U	9.2 U	9.2 U	74	110	76	9.2 U	9.2 U	260	18	1.48	44.99	
Area 2A																
LDW-PILOT2A-SC1	0 – 2 ft	10/31/2014	9.1 U	9.1 U	9.1 U	9.1 U	55	130	63	9.1 U	9.1 U	250	20	1.23	59.99	
Area 2B																
LDW-PILOT2B-SC1	0 – 1.5 ft	10/31/2014	9.5 U	9.5 U	9.5 U	9.5 U	190 U	240	150	9.5 U	9.5 U	390	20	2.00	52.85	
Area 3A																
LDW-PILOT3A-SC1	0 – 1.5 ft	11/4/2014	8.9 U	8.9 U	8.9 U	8.9 U	13 U	38	20	8.9 U	8.9 U	58	7.8	0.747	70.11	
Area 3B																
LDW-PILOT3B-SC1	0 – 1.5 ft	11/4/2014	9.2 U	9.2 U	9.2 U	9.2 U	71	160	73	9.2 U	9.2 U	300	13	2.32	59.03	
Area 4A																
LDW-PILOT4A-SC1	0 – 2 ft	11/4/2014	9.7 U	9.7 U	9.7 U	9.7 U	2,600	3,000	440	9.7 U	9.7 U	6,000	290	2.07	57.17	
Area 4B																
LDW-PILOT4B-SC1	0 – 2 ft	11/4/2014	9.5 U	9.5 U	9.5 U	9.5 U	960	1,800	280	9.5 U	9.5 U	3,000	140	2.13	58.31	
Area 6A																
LDW-PILOT6A-SC1	0 – 2 ft	11/4/2014	9.7 U	9.7 U	9.7 U	9.7 U	1,200	1,400	260	9.7 U	9.7 U	2,900	140	2.04	58.74	
Area 6B																
LDW-PILOT6B-SC1	0 – 2 ft	11/4/2014	9.6 U	9.6 U	9.6 U	9.6 U	480 U	450	260	9.6 U	9.6 U	710	24	3.01	52.41	
Area 7A																
LDW-PILOT7A-SC1	0 – 2 ft	11/3/2014	9.4 U	9.4 U	9.4 U	9.4 U	47	100	44	9.4 U	9.4 U	190	7.4	2.56	53.79	
Area 7B																
LDW-PILOT7B-SC1	0 – 2 ft	11/3/2014	9.0 U	9.0 U	9.0 U	9.0 U	50	98	57	9.0 U	9.0 U	205	7.19	2.85	55.30	
Area 8A																
LDW-PILOT8A-SC1	0 – 1.5 ft	11/3/2014	9.0 U	9.0 U	9.0 U	9.0 U	81 U	420	170	9.0 U	9.0 U	590	70	0.837 J	70.56	
Area 8B																
LDW-PILOT8B-SC1	0 – 1.5 ft	11/3/2014	8.8 U	8.8 U	8.8 U	8.8 U	54	140	53	8.8 U	8.8 U	250	nc	0.480 J	69.89	

Sample ID	Depth Range	Sampling Date	PCBs											Conventionals		
			Aroclor 1016 (µg/kg dw)	Aroclor 1221 (µg/kg dw)	Aroclor 1232 (µg/kg dw)	Aroclor 1242 (µg/kg dw)	Aroclor 1248 (µg/kg dw)	Aroclor 1254 (µg/kg dw)	Aroclor 1260 (µg/kg dw)	Aroclor 1262 (µg/kg dw)	Aroclor 1268 (µg/kg dw)	Total PCB Aroclors (µg/kg dw)	Total PCB Aroclors (mg/kg OC)	TOC (% dw)	Total Solids (% ww)	
Area 9A																
LDW-PILOT9A-SC1	0 – 1.5 ft	11/3/2014	9.9 U	9.9 U	9.9 U	9.9 U	1,000	2,700	340	9.9 U	9.9 U	4,000	190	2.13	56.00	
Area 9B																
LDW-PILOT9B-SC1	0 – 1.5 ft	11/3/2014	9.7 U	9.7 U	9.7 U	9.7 U	580 U	2,500	420	9.7 U	9.7 U	2,900	110	2.68	57.54	

dw – dry weight

ID – identification

J – estimated concentration

OC – organic carbon

nc – not calculated (TOC concentration was outside of the acceptable range of 0.5 to 4.0%)

PCB – polychlorinated biphenyl

TOC – total organic carbon

ww – wet weight

U – not detected at given concentration

Table 3. Surface sediment total PCB concentrations averaged by area

Area	Concentration of Total PCBs ($\mu\text{g}/\text{kg dw}$)			Concentration of Total PCBs ($\text{mg}/\text{kg OC}$)		
	Subarea A	Subarea B	Entire Area	Subarea A	Subarea B	Entire Area
Subtidal Areas subject to potential scour						
1	260	240	250	14	12	13
2	200	230	220	15	13	14
5	na	na	na	na	na	na
Intertidal Areas						
3	150	100	130	7.5	5.7	6.6
8	99	80	89	nc	nc	nc
9	1200	590	880	59	38	49
Subtidal Areas						
4	210	710	460	nc	44	nc
6	620	1,500	1,100	33	110	72
7	240	250	250	11	9.9	10

dw – dry weight

na – not analyzed

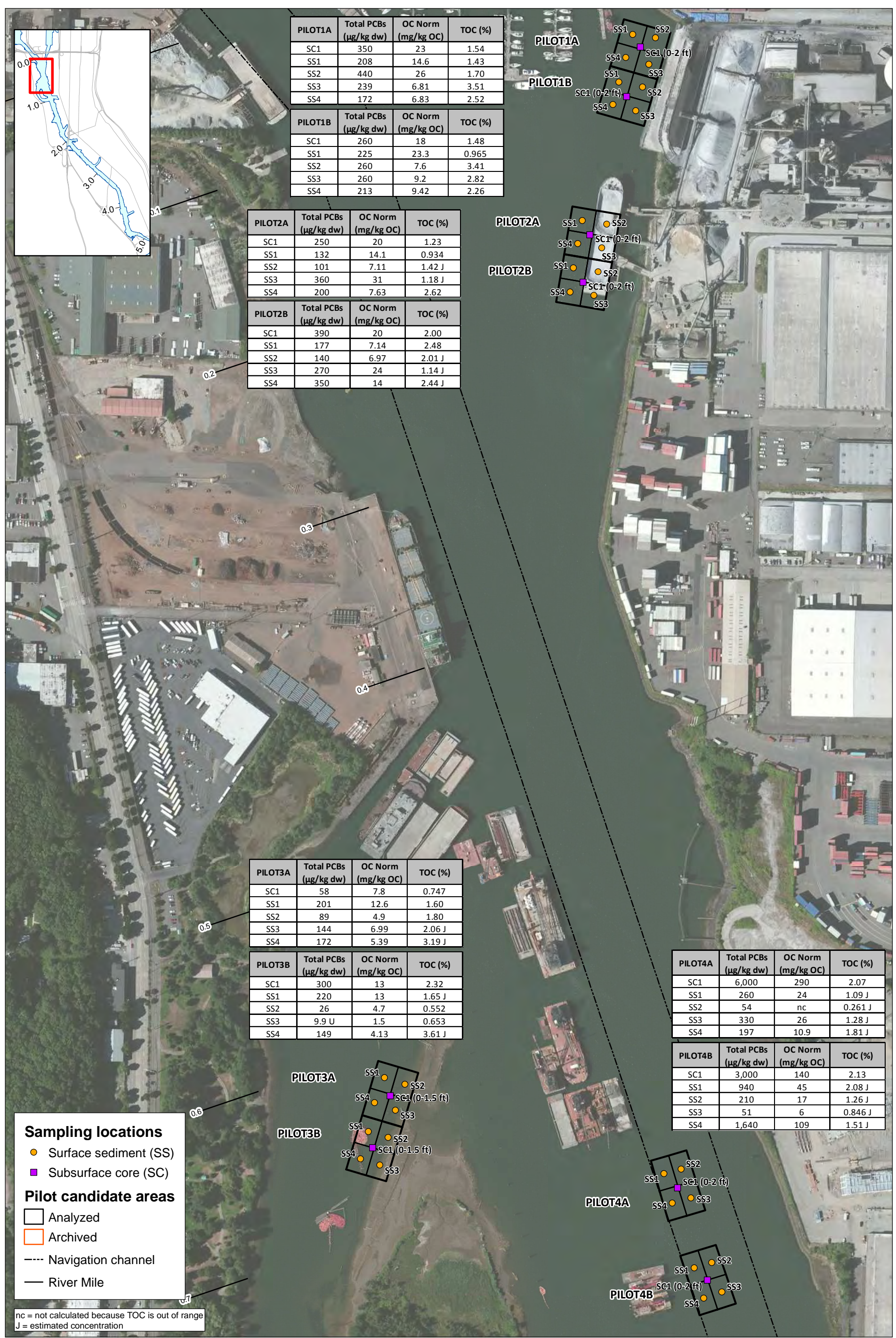
nc – not calculated (TOC concentration was outside of the acceptable range of 0.5 to 4.0%)

OC – organic carbon

PCB – polychlorinated biphenyl

REFERENCES

- Ecology. 2008. Sediment sampling and analysis plan appendix: guidance on the development of sediment sampling and analysis plans meeting the requirements of the sediment management standards (chapter 173-204 WAC). Ecology Publication No. 03-09-043. Washington State Department of Ecology, Olympia, WA.
- EPA. 2002. Guidance for quality assurance project plans. QA/G-5. EPA/240/R-02/009. Office of Environmental Information, US Environmental Protection Agency, Washington, DC.
- EPA, Ecology. 2014. Second Amendment to the Administrative Order on Consent for remedial investigation/feasibility study (AOC) for the Lower Duwamish Waterway (LDW), CERCLA-10-2001-0055. US Environmental Protection Agency, Region 10, Seattle, WA; State of Washington Department of Ecology, Olympia, WA.
- Windward. 2014. Quality assurance project plan: enhanced natural recovery/activated carbon candidate plot surface and subsurface sediment sampling for PCB analyses for the Lower Duwamish Waterway. Final. Windward Environmental LLC, Seattle, WA.



PILOT1A	Total PCBs (µg/kg dw)	OC Norm (mg/kg OC)	TOC (%)
SC1	350	23	1.54
SS1	208	14.6	1.43
SS2	440	26	1.70
SS3	239	6.81	3.51
SS4	172	6.83	2.52

PILOT1B	Total PCBs (µg/kg dw)	OC Norm (mg/kg OC)	TOC (%)
SC1	260	18	1.48
SS1	225	23.3	0.965
SS2	260	7.6	3.41
SS3	260	9.2	2.82
SS4	213	9.42	2.26

PILOT2A	Total PCBs (µg/kg dw)	OC Norm (mg/kg OC)	TOC (%)
SC1	250	20	1.23
SS1	132	14.1	0.934
SS2	101	7.11	1.42 J
SS3	360	31	1.18 J
SS4	200	7.63	2.62

PILOT2B	Total PCBs (µg/kg dw)	OC Norm (mg/kg OC)	TOC (%)
SC1	390	20	2.00
SS1	177	7.14	2.48
SS2	140	6.97	2.01 J
SS3	270	24	1.14 J
SS4	350	14	2.44 J

PILOT3A	Total PCBs (µg/kg dw)	OC Norm (mg/kg OC)	TOC (%)
SC1	58	7.8	0.747
SS1	201	12.6	1.60
SS2	89	4.9	1.80
SS3	144	6.99	2.06 J
SS4	172	5.39	3.19 J

PILOT3B	Total PCBs (µg/kg dw)	OC Norm (mg/kg OC)	TOC (%)
SC1	300	13	2.32
SS1	220	13	1.65 J
SS2	26	4.7	0.552
SS3	9.9 U	1.5	0.653
SS4	149	4.13	3.61 J

PILOT4A	Total PCBs (µg/kg dw)	OC Norm (mg/kg OC)	TOC (%)
SC1	6,000	290	2.07
SS1	260	24	1.09 J
SS2	54	nc	0.261 J
SS3	330	26	1.28 J
SS4	197	10.9	1.81 J

PILOT4B	Total PCBs (µg/kg dw)	OC Norm (mg/kg OC)	TOC (%)
SC1	3,000	140	2.13
SS1	940	45	2.08 J
SS2	210	17	1.26 J
SS3	51	6	0.846 J
SS4	1,640	109	1.51 J

Sampling locations

- Surface sediment (SS)
- Subsurface core (SC)

Pilot candidate areas

- Analyzed
- Archived
- Navigation channel
- River Mile

nc = not calculated because TOC is out of range
 J = estimated concentration

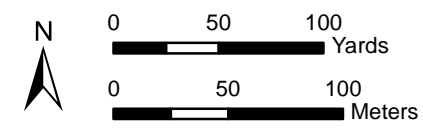
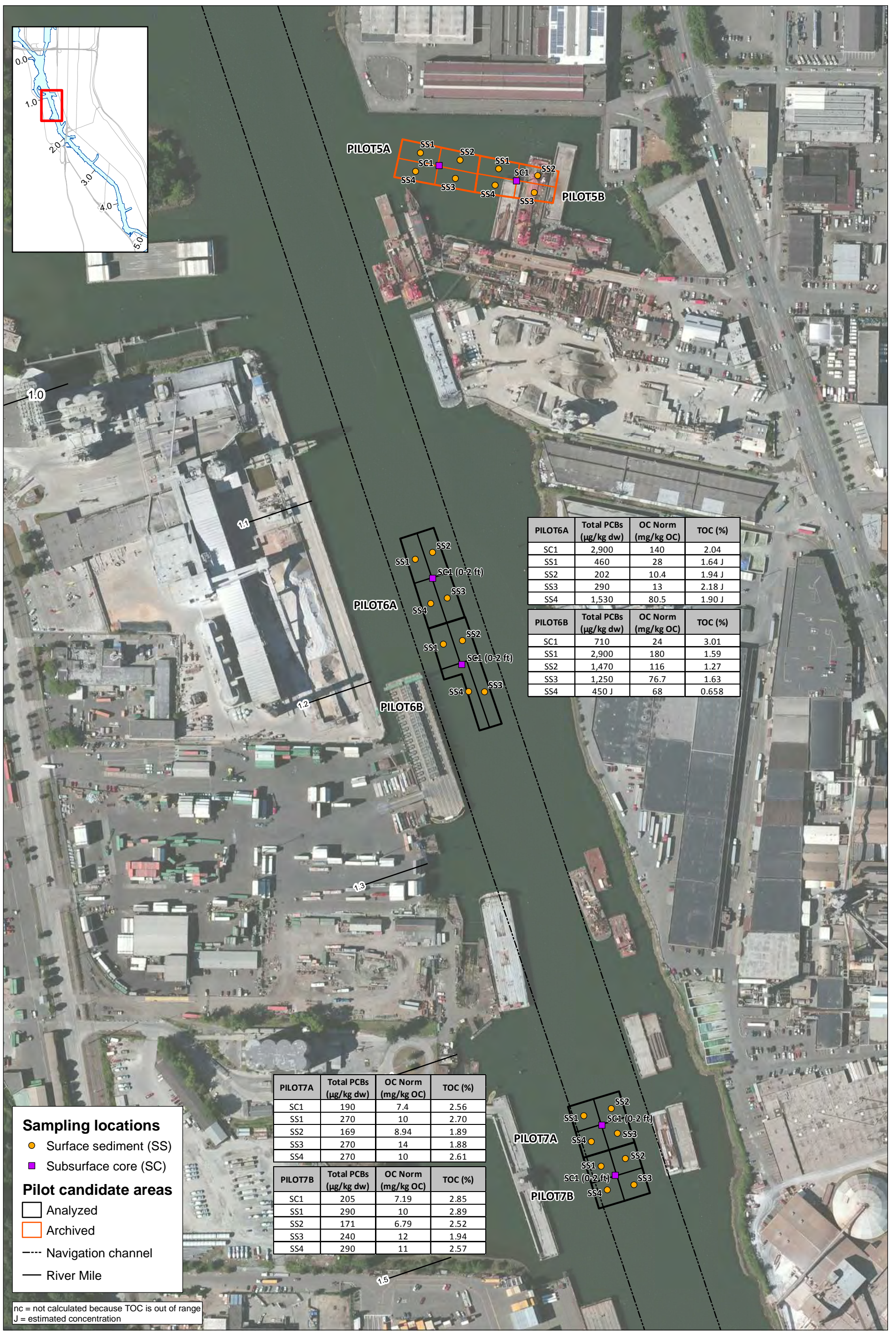
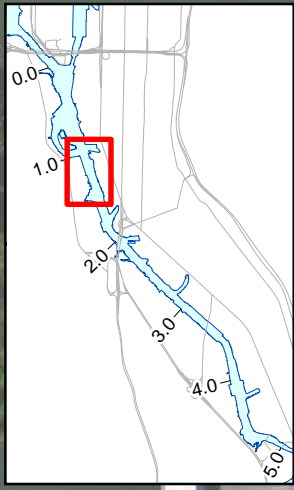


Figure 1a. Total PCB results from the LDW ENR/AC Pilot Study - RM 0.0 to 0.7



PILOT6A	Total PCBs ($\mu\text{g}/\text{kg dw}$)	OC Norm ($\text{mg}/\text{kg OC}$)	TOC (%)
SC1	2,900	140	2.04
SS1	460	28	1.64 J
SS2	202	10.4	1.94 J
SS3	290	13	2.18 J
SS4	1,530	80.5	1.90 J

PILOT6B	Total PCBs ($\mu\text{g}/\text{kg dw}$)	OC Norm ($\text{mg}/\text{kg OC}$)	TOC (%)
SC1	710	24	3.01
SS1	2,900	180	1.59
SS2	1,470	116	1.27
SS3	1,250	76.7	1.63
SS4	450 J	68	0.658

PILOT7A	Total PCBs ($\mu\text{g}/\text{kg dw}$)	OC Norm ($\text{mg}/\text{kg OC}$)	TOC (%)
SC1	190	7.4	2.56
SS1	270	10	2.70
SS2	169	8.94	1.89
SS3	270	14	1.88
SS4	270	10	2.61

PILOT7B	Total PCBs ($\mu\text{g}/\text{kg dw}$)	OC Norm ($\text{mg}/\text{kg OC}$)	TOC (%)
SC1	205	7.19	2.85
SS1	290	10	2.89
SS2	171	6.79	2.52
SS3	240	12	1.94
SS4	290	11	2.57

Sampling locations

- Surface sediment (SS)
- Subsurface core (SC)

Pilot candidate areas

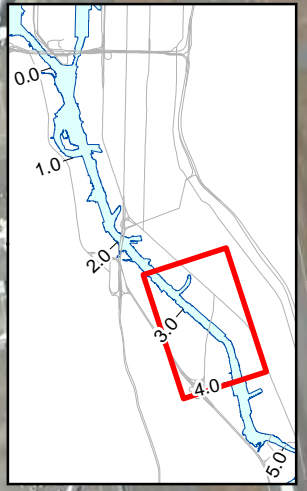
- Analyzed
- Archived
- Navigation channel
- River Mile

nc = not calculated because TOC is out of range
J = estimated concentration

Figure 1b. Total PCB results from the LDW ENR/AC Pilot Study - RM 0.8 to 1.5

PILOT8A	Total PCBs ($\mu\text{g}/\text{kg dw}$)	OC Norm ($\text{mg}/\text{kg OC}$)	TOC (%)
SC1	590	70	0.837 J
SS1	150	20.3	0.738 J
SS2	151	nc	0.410 J
SS3	34	nc	0.203 J
SS4	61	9.8	0.622 J

PILOT8B	Total PCBs ($\mu\text{g}/\text{kg dw}$)	OC Norm ($\text{mg}/\text{kg OC}$)	TOC (%)
SC1	250	nc	0.480 J
SS1	108	10.7	1.01 J
SS2	34	nc	0.454 J
SS3	55	9.7	0.566 J
SS4	121	11.9	1.02 J



PILOT9A	Total PCBs ($\mu\text{g}/\text{kg dw}$)	OC Norm ($\text{mg}/\text{kg OC}$)	TOC (%)
SC1	4,000	190	2.13
SS1	710	42	1.70
SS2	230	16	1.40
SS3	450	29	1.54
SS4	3,300	150	2.18

PILOT9B	Total PCBs ($\mu\text{g}/\text{kg dw}$)	OC Norm ($\text{mg}/\text{kg OC}$)	TOC (%)
SC1	2,900	110	2.68
SS1	320	25	1.29
SS2	996	53.8	1.85
SS3	420	24	1.74
SS4	620	49	1.27

Sampling locations

- Surface sediment (SS)
- Subsurface core (SC)

Pilot candidate areas

- Analyzed
- Archived
- Navigation channel
- River Mile

nc = not calculated because TOC is out of range
 J = estimated concentration

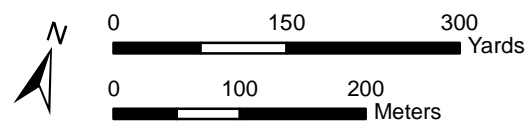


Figure 1c. Total PCB results from the LDW ENR/AC Pilot Study - RM 2.5 to 4.0