FIELD REPORT

Passive Sampling Deployment and Retrieval

River Operable Unit, Bradford Island

Cascade Locks, OR

Sample Dates: January 27 – February 1, 2020 (Deployment); March 2 – 5, 2020 (Retrieval)



Prepared by:

U.S. Army Corps of Engineers Seattle District June 10, 2020



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1.0 Introduction

The purpose of the field report is to document the activities conducted during sample deployment and retrieval of low density polyethelyne (PE) passive samplers at the River Operable Unit (OU) of Bradford Island. This document provides a summary of those activities, copies of field documentation kept during the deployment and retrieval, notable observations, and any field deviations to the approved final Quality Assurance Project Plan (QAPP) (USACE, 2020).

2.0 Project Background

The US Army Corps of Engineers (USACE) conducted a Remedial Investigation and Feasibility Study for the in water portion of Bradford Island, known as the River OU, in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) Executive Order 12580. As part of the Feasibility Study process, USACE evaluated risk to human health and the environment from exposure to the water and sediment in the River OU. Based on the unacceptable risks identified for the River OU, USACE determined remedial action is necessary in order to reduce risk to human health and the environment.

A limited passive sampling study was conducted in winter 2017/2018 along the north shore of Bradford Island to identify potential remaining sources of polychlorinated biphenyl (PCB) source material at former debris piles. Porewater concentrations from this study ranged from approximately 1 to 9 ng/L total PCBs. These concentrations are not indicative of PCB source material detections. Given the limited number of samplers deployed during this effort, USACE has identified the need for more robust passive sampling to further try to identify the presence of PCB source material along the northern shoreline.

3.0 Project Objectives

As described in the Final Work Plan (USACE, 2019) and QAPP (USACE, 2020), the goal of this study is to support remedial design in the River OU by identifying areas along the northern shoreline of Bradford Island that may still be serving as a primary source of PCB contamination to fish and other aquatic receptors and to identify those areas that may not be an ongoing source of PCBs. Measuring concentrations of PCBs in water at the sediment-water interface (porewater and near-bottom water) will be used to identify source areas.

The two primary goals of this study are:

1) Identify locations along the northern and eastern tip of Bradford Island that are potential source areas.

2) Use passive sampling results as a line of evidence to eliminate source areas along the northern and eastern tip of Bradford Island.

To support these overall goals, Data Quality Objectives (DQOs) were developed through a systematic planning process. This section presents the DQOs for the passive sampler program.

The DQO process defines criteria that will be used to establish the final data collection design. Based on the study goals listed above, the DQOs were developed to support the selection of sampling and analysis methods and an overall study design that leads to data appropriate to answer the study questions. The DQOs developed for the passive sampler study are provided below:

DQO-1: Identify locations that are ongoing sources of PCBs at Bradford Island.

DQO-2: Identify locations that may not be ongoing sources of PCBs at Bradford Island.

DQO-3: Identify locations that may represent an area of groundwater upwelling at Bradford Island.

4.0 Sampling Activities

4.1 PE Deployment

Sample deployment occurred January 27th through February 1st, 2020.

Sample deployment was performed from the *Redlinger* USACE survey vessel. Staff from Seattle District present for field deployment included Kristen Kerns, Bill Gardiner, Katie Richwine, and Dan Carlson. Contractors present from Texas Technical University included Danny Reible and Alex Smith.

Prior to deployment activities, an updated bathymetric survey was conducted on the morning of January 27th by the *Redlinger* USACE survey vessel for the northern and eastern tip of Bradford Island. (Maps and 2D images from the bathymetric survey are provided in Appendix A)

PE sheets were contained within a metal mesh envelop with two metal grommets on opposing corners. The PEs were attached with zip ties to the underside of a ten pound weighted bag. A temperature sensor was also attached with zip ties adjacent to the PE sheet. On the opposite side of the weighted bag a rope line with a buoy was attached (Photo 1). Rope lengths were measured and cut in the field based on depths provided from the bathymetric survey. Buoys were numbered with the sample location ID number to aid in retrieval.



Photo 1. Samplers (left) and buoys (right)

Temperature sensors were pre-programmed prior to field deployment to begin recording hourly temperature measurement's as of January 26, 2020.

In order to control placement of the samplers, a deployment apparatus with a release mechanism was lowered in conjunction with the sampler and buoy line (Photo 2). The deployment apparatus had an additional 30 pounds of weight attached in order to ensure vertical descent through the water column. The deployment apparatus was lowered in conjunction with the sampler and buoy line until it reached the river bottom. A separate line connected to a release trigger was used to separate the buoy line from the deployment apparatus once the sampler was determined to be on station.



Photo 2. Deployment apparatus

Attached to the deployment apparatus was an underwater camera (RIDGID / SeeSnake Max rM200). The camera allowed for real time visual inspection and recording of the river bottom. Visual information provided by the camera allowed for the field staff to adjust placement of the sampler if large boulders or rocks were visible in the field of view. Screenshots of the river bottom for a subset of sample location are provided in Section 5.0. A full set of images will be provided in the data evaluation report.

In addition to the sediment bed PE and temperature sensors, water column samplers were also deployed at five individual stations (See Table 1). At each of these five stations, a PE contained in a mesh envelope as well as a temperature sensor were attached with zip ties along the same buoy line attached to a sediment bed sampler. These water column samplers were attached approximately five feet up the line from the sediment bed.

Surface Water Sampler	Location ID
PE and Temperature Sensor	80, 110, 156
PE Only	5, 40,
Temperature Sensor Only	17, 38

 Table 1. Surface Water PE and Temperature Sensor Locations

Samplers were deployed at pre-determined locations presented in the Final QAPP. In order to deploy samplers as these pre-determined locations, GPS was used to guide the sampling vessel to the pre-loaded sample location coordinates. The boat captain signaled to the field staff when the vessel arrived on station. The field staff would lower the deployment apparatus and sampler through the water column and verify with the camera that river bottom conditions were suitable for release of the sampler. If large boulders or rocks were visible with the camera, the vessel would begin moving in a 5 ft radius from the location coordinates to search for more suitable substrate. If no suitable substrate was visible, the vessel would move out and search a 10 ft radius. If no suitable substrate was found within the 10 ft radius, the location was abandoned.

Several locations had to be abandoned due to inability to find an acceptable surface to release the sampler given the presence of large boulders and rocks. Abandoned locations because of the presence of rocks and boulders were: 4, 10, 11, 92, 111, 125, 130, 134, 141, 150, 152, 153, and 236.

Deployments were successfully achieved for the target coordinates at 161 locations (138 of the 161 were successfully recovered; 23 samplers were not recovered). Those sample location IDs, along with the date of deployment, are identified in Table 2.

Date	Sample IDs for Deployed Locations
January 27, 2020	1, 6, 7, 8, 13, 14, 15, 21
January 28, 2020	5, 9 , 12, 16, 19, 20, 22, 23, 24, 26, 27, 28, 29, 30, 33, 34, 35, 36 , 37, 40,
	41, 42, 43, 44, 45, 48, 49, 50, 51, 52, 53, 57, 58, 59, 64, 65, 66, 67, 72, 73,
	78, 79, 82, 83, 94, 95, 102, 109, 116, 126
January 29, 2020	2, 3, 17, 18, 25, 31, 32, 38, 39, 46, 47, 54, 55, 56, 60, 61, 62, 63, 68, 69,
	70, 71, 74, 75, 76 , 77, 80, 81, 88, 89 , 93, 96, 101, 103, 108, 110, 115, 120
January 30, 2020	84, 85 , 86, 87, 90, 91 , 97, 98, 99 , 100 , 104 , 105, 106, 107, 112, 113, 114,
	121, 122, 123, 157, 159 , 164, 165, 168, 179, 180
January 31, 2020	117, 118, 119, 127, 128, 129 , 131, 132, 133, 135, 140, 146, 147, 148, 149,
	154 , 155, 156, 223 , 224, 225 , 230 , 231, 237 , 238, 242, 243, 259
February 1, 2020	137, 139, 182, 184, 188, 190, 200, 202 , 204, 207

Table 2. Sample deployment location IDs and dates (**bold** numbers are those that were subsequently not recovered – see Section 4.2).

Throughout the deployment, "Time Zero" PE samplers were brought into the field and sent back periodically to Texas Technical University's (TTU's) laboratory to evaluate performance reference compound (PRC) loss during deployment. The results of this evaluation to determine the "Time Zero" PE losses will be presented in the data report.

4.2 PE Retrieval

Sample retrieval occurred March 2nd through 5th, 2020.

Sample retrieval was performed from the *Redlinger* USACE survey vessel. Staff from Seattle District present for field deployment included Kristen Kerns, Bill Gardiner, and Dan Carlson. Alex Smith from Texas Technical University was also present for PE sampler processing.

Samplers were retrieved from the deck of the *Redlinger* USACE survey vessel by approaching buoys visible at the water surface and retrieving them with a boat hook (Photo 3). Once samplers were on deck, the sampler was disassembled. Temperature sensors and PEs were removed from the weighted bag. Temperature sensors were stored in a plastic bag. PE sheets were retained in their metal mesh envelopes, rinsed of any significant debris or sediment, and wrapped with aluminum foil before being placed in a cooler with blue ice (Photo 4).



Photo 3. Sampler retrieval



Photo 4. PE sample processing after retrieval

During retrieval of the samplers, several of the weighted bags were retrieved without PE samplers attached. Where the PE was zip tied to the wire of the weighted bag, the metal appeared corroded and broken apart. It is possible that electrolysis between the metal of the weighted bag and the grommets resulted in corrosion and subsequent loss of PE sheets. No temperature sensors were lost, but one sensor stopped logging before deployment (ID 20742713). Table 3 provides a summary of those samplers that were successfully retrieved with both PE and temperature sensors. Of the 161 samplers deployed, 138 were retrieved, with an overall recovery rate of 85%.

Date	Sample IDs for Retrieved Locations
March 2, 2020	1, 2, 3, 5, 6, 7, 8, 12, 13, 14, 15, 16, 17,
	18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28,
	29, 30, 31, 33, 34, 35, 37, 38, 39, 40, 41,
	42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52,
	53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63,
	64, 65, 66, 67, 68, 69, 70, 133, 140, 146,
	155, 156, 164, 165, 168, 179, 180, 182,
	184, 188, 190, 200, 204, 207, 238
March 3, 2020	32, 71, 72, 73, 74, 77, 78, 79, 80, 81, 82,
	83, 84, 86, 87, 88, 90, 93, 94, 95, 96, 97,
	98, 101, 102, 103, 105, 106, 107, 108,
	109, 110, 112, 113, 114, 116, 117, 118,
	119, 121, 122, 123, 126, 131, 132, 135,
	137, 139, 147, 148, 149, 224, 231, 242,
	243, 259

Table 3. Sample retrieval location IDs and date	s
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All field notes and photos from the sampling deployment and retrieval are provided in Appendices B and C, respectively.

5.0 Significant Observations

Fine sandy sediment was noted to be most abundant at the northwestern corner of the site (Photo 5). The more eastern portions of the site were dominated by cobbles and gravel of various sizes (Photo 6, 7, and 8). Boulders were most common at the eastern portion of the site, especially near the eastern tip of the island (Photos 9 and 10). Clams and crayfish were visible at many deployment locations (Photos 11 and 12). The depths displayed in the below photos are inaccurate; the actual depths for each location are listed on the table within Appendix B.



Photo 5. Sandy sediment at river bottom in northwestern corner of the site (sample location 12)



Photo 6. Heterogeneous gravel mixture at river bottom (sample location 108)



Photo 7. Cobbles and gravel at river bottom (sample location 110)



Photo 8. Cobbles and gravel at river bottom (general area near sample location 225)



Photo 9. Large cobbles and boulders at river bottom (general area near sample location 225)



Photo 10. Boulder and gravel at river bottom (sample location 148)



Photo 11. Clams visible throughout the site (sample location 135)



Photo 12. A crayfish at river bottom (adjacent to sample location 121)

Directionality of river currents were generally from west to east as a result of the spillway being closed. Flow velocity was variable throughout the day.

6.0 Safety

All sampling activities were conducted under the Bonneville Project Health and Safety Plan (USACE, 2012). Personal protective equipment included nitrile gloves, steel-toed rubber boots, and appropriate field work clothing were worn by all personnel.

7.0 Decontamination of Equipment and Waste Disposal

Sample deployment/retrieval equipment was regularly rinsed with site water when visible sediment was present.

Solid waste, including nitrile gloves and aluminum foil, was collected in garbage bags and disposed of in commercial waste receptacles.

8.0 Sample Packaging and Shipping

All PE samples were shipped via overnight FedEx to TTU's laboratory in Lubbock, Texas. Samples were shipped in coolers with blue ice.

Temperature sensors were stored in plastic bags and hand carried back to the USACE Seattle District office.

9.0 Field Deviations from the QAPP

During deployment, several primary sample locations along the eastern tip were not attempted due to the reoccurring presence of large boulders and the need to abandon stations at adjacent locations in the immediate area. Instead, secondary locations identified in the QAPP were used for deployment. No other deviations from the QAPP were noted.

Any laboratory deviations encountered will be documented in the Final Data Report.

References

United States Army Corps of Engineers (USACE). 2012. *Bonneville Project Safety Program*. March.

United States Army Corps of Engineers (USACE). 2019. Final Work Plan for Passive Sampling at River OU, Bradford Island, Cascade Locks, Oregon. September 30, 2019.

United States Army Corps of Engineers (USACE). 2020. Final Quality Assurance Project Plan for Passive Sampling at River OU, Bradford Island, Cascade Locks, Oregon. January 23, 2020.

APPENDIX A: Project Bathymetric Maps and 2D Images





















APPENDIX B: Field Notes

SAMPLE	TTU ID	HOBO SERIAL	DATE	TIME	DATE		DEPLOYMENT	DEPLOYMENT	WATER DEPTH	DEPLOY
ID	NUMBER	NUMBER	DEPLOYED	DEPLOYED	RETRIEVED	TIME RETRIEVED	LATITUDE	LONGITUDE	(ft)	OBSERV
1	1-6	2802	27-Jan-20	1440	2-Mar-20	1132	45 38 33.8784 N	121 56 22.5888 W	22	sand
6	1-7	8965	27-Jan-20	1504	2-Mar-20	1140	45 38 33.8712 N	121 56 22.092 W	13	sand
7	1-5	8958	27-Jan-20	1452	2-Mar-20	1152	45 38 33.6125 N	121 56 22.1545 W	27.7	sand, vegetati
8	1-4	2789	27-Jan-20	1517	2-Mar-20	1153	45 38 33.8714 N	121 56 21.5149 W	14	sand, rocks
14	1-2	2783	27-Jan-20	1523	2-Mar-20	1203	45 38 33.7358 N	121 56 21.169 W	13.9	sand
13	1-1	2764	27-Jan-20	1532	2-Mar-20	1200	45 38 33.9613 N	121 56 21.0515 W	20	no camera
21	1-3	2807	27-Jan-20	1539	2-Mar-20	1209	45 38 33.5884 N	121 56 20.7118 W	8.7	no camera
15	1-8	2734	27-Jan-20	1545	2-Mar-20	1207	45 38 33.836 N	121 56 20.6106 W	8.8	rocks, sand
20	2-1	2740	28-Jan-20	807	2-Mar-20	1220	45 38 33.8667 N	121 56 20.0733 W	10	rock, cobble
22	2-2	2732	28-Jan-20	803	2-Mar-20	1226	45 38 33.5045 N	121 56 19.7808 W	11	sand
23	2-3	2736	28-Jan-20	811	2-Mar-20	1224	45 38 33.8491 N	121 56 19.6207 W	16	no camera
28	2-4	2775	28-Jan-20	815	2-Mar-20	1234	45 38 33.451 N	121 56 19.09 W	15	sand
27	2-5	2739	28-Jan-20	824	2-Mar-20	1231	45 38 33.8632 N	121 56 19.0814 W	18	cobble, rock
35	2-7	2735	28-Jan-20	827	2-Mar-20	1456	45 38 33.5013 N	121 56 18.3104 W	18	sand, cobble
29	2-6	2738	28-Jan-20	831	2-Mar-20	1235	45 38 33.8301 N	121 56 18.6364 W	20	sand, cobble
34	2-8	2773	28-Jan-20	837	2-Mar-20	1445	45 38 33.8397 N	121 56 18.1123 W	24	rock, cobble
42	3-2	8949	28-Jan-20	846	2-Mar-20	1454	45 38 33.4074 N	121 56 17.4896 W	13	
43	3-4	2782	28-Jan-20	944	2-Mar-20	1453	45 38 33.4268 N	121 56 16.7529 W	10	vegetation
41	3-3	2777	28-Jan-20	947	2-Mar-20	1441	45 38 33.8373 N	121 56 17.1247 W	25	rock, cobble
44	3-6	2803	28-Jan-20	950	2-Mar-20	1440	45 38 33.8287 N	121 56 16.5964 W	25	sand
50	3-5	2815	28-Jan-20	955	2-Mar-20	1451	45 38 33.5022 N	121 56 16.0662 W	18	rock
49	3-7	2762	28-Jan-20	1001	2-Mar-20	1439	45 38 33.8157 N	121 56 16.135 W	25	cobble, sand
51	3-8	2814	28-Jan-20	1005	2-Mar-20	1449	45 38 33.5615 N	121 56 15.4322 W	27	
52	4-1	8943	28-Jan-20	1009	2-Mar-20	1438	45 38 33.835 N	121 56 15.5655 W	30	cobble
58	4-3	8947	28-Jan-20	1014	2-Mar-20	1448	45 38 33.5657 N	121 56 14.7912 W	30	rock, cobble
57	4-2	2794	28-Jan-20	1018	2-Mar-20	1436	45 38 33.8075 N	121 56 14.9691 W	33	
65	4-5	8927	28-Jan-20	1052	2-Mar-20	1422	45 38 33.5293 N	121 56 14.2104 W	13	cobble
										adjacent to tre
66	4-8	2774	28-Jan-20	1059	2-Mar-20	1420	45 38 33.6125 N	121 56 13.6527 W	30	shoreline into
59	4-4	2809	28-Jan-20	1107	2-Mar-20	1419	45 38 33.808 N	121 56 14.4269 W	32	
64	5-5	8946	28-Jan-20	1110	2-Mar-20	1418	45 38 33.8437 N	121 56 13.9161 W	34	cobble
67	5-6	2765	28-Jan-20	1123	2-Mar-20	1416	45 38 33.8477 N	121 56 13.1168 W	32	cobble
72	5-7	2792	28-Jan-20	1126	3-Mar-20	1132	45 38 33.8085 N	121 56 12.4527 W	32	rock, cobble
73	5-1	2800	28-Jan-20	1130	3-Mar-20	1135	45 38 33.8319 N	121 56 11.7673 W	33	no camera
78	5-2	2796	28-Jan-20	1136	3-Mar-20	1124	45 38 33.9381 N	121 56 11.1461 W	22	rock, boulder
79	5-3	8938	28-Jan-20	1145	3-Mar-20	1121	45 38 34.126 N	121 56 10.6513 W	32	sand, next to o
82	5-4	2779	28-Jan-20	1150	3-Mar-20	1138	45 38 34.0664 N	121 56 10.2594 W	27	no camera
83	4-6	2786	28-Jan-20	1245	3-Mar-20	1140	45 38 34.1731 N	121 56 9.8714 W	27	rocks, cobble
										buoy submerg
94	4-7	8939	28-Jan-20	1249	3-Mar-20	1228	45 38 34.0553 N	121 56 8.7812 W	37	underwater
95	5-8	2812	28-Jan-20	1254	3-Mar-20	1236	45 38 34 N	121 56 8.3257 W	37	no camera
102	6-1	2727	28-Jan-20	1258	3-Mar-20	1225	45 38 34 N	121 56 7.9152 W	38	tree branches
116	6-3	2757	28-Jan-20	1307	3-Mar-20	1211	45 38 33.9636 N	121 56 6.3754 W	30	buoy submerg
109	6-2	2756	28-Jan-20	1302	3-Mar-20	1208	45 38 33.942 N	121 56 6.7329 W	24	rock, sand

ATIONS, ETC.	RETRIEVAL NOTES, OBSERVATIONS, ETC.
on	
e eroded from river	
liff face	
ed 3 ft	buoy line tangled with Sampler 93
od undorwator	
eu unuel waler	

SAMPLE	TTUID	HOBO SERIAL	DATE	TIME	DATE		DEPLOYMENT	DEPLOYMENT	WATER DEPTH	DEPLOY
ID	NUMBER	NUMBER	DEPLOYED	DEPLOYED	RETRIEVED	TIME RETRIEVED	LATITUDE	LONGITUDE	(ft)	OBSERV
										buoy submerg
126	6-4	No hobo attached	28-Jan-20	1312	3-Mar-20	1325	45 38 33.76 N	121 56 5.1732 W	30	underwater
										PE water colu
										attached to be
5	7-1 <i>,</i> SW6-5	2816	28-Jan-20	1410	2-Mar-20	1147	45 38 33.9636 N	121 56 6.3754 W	43	riverbed; sand
12	6-7	2748	28-Jan-20	1417	2-Mar-20	1205	45 38 34.1729 N	121 56 21.8227 W	32	sand
16	6-8	2772	28-Jan-20	1424	2-Mar-20	1218	45 38 34.1611 N	121 56 21.359 W	31	
19	7-5	8921	28-Jan-20	1428	2-Mar-20	1223	45 38 34.1713 N	121 56 20.7812 W	23.2	
24	7-2	2811	28-Jan-20	1432	2-Mar-20	1229	45 38 34.178 N	121 56 20.3227 W	24.1	significant rip
26	7-3	2798	28-Jan-20	1436	2-Mar-20	1233	45 38 34.1791 N	121 56 19.8421 W	28	no camera
30	7-4	8936	28-Jan-20	1441	2-Mar-20	1413	45 38 34.1562 N	121 56 19.2726 W	25	cobble
33	7-6	2787	28-Jan-20	1444	2-Mar-20	1411	45 38 34.1519 N	121 56 18.8247 W	32	
37	7-7	2760	28-Jan-20	1447	2-Mar-20	1410	45 38 34.1621 N	121 56 18.338 W	30	sand, cobble
										PE water colu
										attached to bu
40	7-8, SW8-1	2801	28-Jan-20	1452	2-Mar-20	1405	45 38 34.1764 N	121 56 17.8124 W	29.2	riverbed; sand
45	8-2	2767	28-Jan-20	1456	2-Mar-20	1403	45 38 34.1451 N	121 56 17.3528 W	30	sand, cobble
48	8-3	2806	28-Jan-20	1500	2-Mar-20	1402	45 38 34.1333 N	121 56 16.8606 W	33.3	sand, cobble
53	8-4	2797	28-Jan-20	1505	2-Mar-20	1400	45 38 34.1791 N	121 56 15.2634 W	35	sand, cobble
56	9-2	2795	29-Jan-20	918	2-Mar-20	1357			33.7	sand, cobble
60	9-3	2769	29-Jan-20	940	2-Mar-20	1356	45 38 34.1588 N	121 56 14.1406 W	32.5	no camera; st
63	10-5	2743	29-Jan-20	948	2-Mar-20	1355	45 38 34.1403 N	121 56 13.5444 W	36.5	no camera; st
68	9-4	2770	29-Jan-20	952	2-Mar-20	1416	45 38 34.1454 N	121 56 12.9487 W	37	no camera; st
71	9-5	2793	29-Jan-20	955	3-Mar-20	1129	45 38 34.1386 N	121 56 12.3997 W	33	no camera; st
74	9-6	8942	29-Jan-20	958	3-Mar-02	1127	45 38 34.1387 N	121 56 11.8191 W	36	no camera; st
77	9-7	2804	29-Jan-20	1006	3-Mar-20	1122	45 38 34.132 N	121 56 11.249 W	36.1	cobble, rock, s
88	9-8	8952	29-Jan-20	1015	3-Mar-20	1143	45 38 34.2523 N	121 56 9.3453 W	37	rock, sand
93	10-2	2761	29-Jan-20	1028	3-Mar-20	1228	45 38 34.2415 N	121 56 8.5343 W	40	
96	10-3	2818	29-Jan-20	1034	3-Mar-20	1222	45 38 34.2344 N	121 56 8.1504 W	40	boulders, sma
101	10-4	8948	29-Jan-20	1040	3-Mar-20	1220	45 38 34.2598 N	121 56 7.6827 W	37	cobble
103	10-6	2721	29-Jan-20	1045	3-Mar-20	1216	45 38 34.2247 N	121 56 7.3508 W	37	boulders, sand
108	11-1	8951	29-Jan-20	1048	3-Mar-20	1214	45 38 34.2253 N	121 56 6.9157 W	30	cobble
					0					PF water colu
										temp sensor a
		2810 (2705 - water								line ~5ft abov
110	10-7 5\//10-8		29-Jan-20	1055	3-Mar-20	1204	15 38 31 2333 N	121 56 6 497 W	30	houlders rock
2	11_5	2750	29-Jan-20	1210	2-Mar-20	1125	45 38 34.2535 N	121 56 22 2880 W	30	sand
2	12.2	2733	29-Jan 20	1210	2-Ividi-20	1127	45 30 34.1305 N	121 50 22.5009 W	40	boulder
5	15-2	6917	29-Jan-20	1242	2-11/101	1157	45 56 54.4765 N	121 30 22.1239 W	55	tomp concor a
		2722 (2707 water								line ~Eft abov
17	0.0		20 Jan 20	1011	2 140+ 20	1015	4E 20 24 E000 N		<u>л1</u> г	
1/	8-8		29-Jan-20	1341	Z-IVIAr-20	1215	45 38 34.5809 N	121 50 19.881/ W	41.5	boulders, sand
18	11-4	2/14	29-Jan-20	1345	2-IVIar-20	1228	45 38 34.59/4 N	121 56 19.3242 W	41.6	boulders, sand
25	12-1	2/4/	29-Jan-20	1348	2-IVIar-20	1350	45 38 34.4438 N	121 50 18.054 W	30.3	boulders, COb
31	12-2	2/19	29-Jan-20	1351	2-Mar-20	1348	45 38 34.4246 N	121 56 18.121 W	31.8	poulders, sand

1ENT NOTES, ATIONS, ETC.	RETRIEVAL NOTES, OBSERVATIONS, ETC.
ed 3-4ft	
nn sampler oy line ~5ft above	
ар	
nn sampler	
oy line ~5ft above , cobble	
ong current	
and	
	Buoy line tangled with Sampler 94
l area of sand	
nn sampler & ttached to buoy riverbed;	
, little sand	
ttached to buoy e riverbed;	
1-	
ne	

SAMPLE	TTU ID	HOBO SERIAL	DATE	TIME	DATE		DEPLOYMENT	DEPLOYMENT	WATER DEPTH	DEPLOY
ID	NUMBER	NUMBER	DEPLOYED	DEPLOYED	RETRIEVED	TIME RETRIEVED	LATITUDE	LONGITUDE	(ft)	OBSERV
32	12-3	2737	29-Jan-20	1355	3-Mar-20	903	45 38 34.4429 N	121 56 17.5978 W	33.9	boulders, sand
		2718 (2729 - water								temp sensor a
38	12-4	, column)	29-Jan-20	Did not record	2-Mar-20	1340	45 38 34.4053 N	121 56 17.1388 W	32.8	line ~5ft abov
		,								temp sensor a
		8960 (Did not record								line ~5ft abov
39	12-5	- water column)	29-Jan-20	1407	2-Mar-20	1339	45 38 34.3901 N	121 56 16.5305 W	31.2	rocks. sand
46	12-6	8924	29-Jan-20	1410	2-Mar-20	1337	45 38 34.4861 N	121 56 16.0394 W	33.7	rocks. sand
47	12-7	2749	29-Jan-20	1415	2-Mar-20	1336	45 38 34.5207 N	121 56 15.5146 W	33	cobble. sand
54	12-8	8925	29-Jan-20	1420	2-Mar-20	1334	45 38 34.5345 N	121 56 14.941 W	35.4	rocks. sand
55	13-1	8918	29-Jan-20	1425	2-Mar-20	1333	45 38 34.4841 N	121 56 14.4361 W	35	
61	11-8	2704	29-Jan-20	1504	2-Mar-20	1331	45 38 34.4828 N	121 56 13.8597 W	39.3	sand
62	8-6	2754	29-Jan-20	1507	2-Mar-20	1330	45 38 34.4543 N	121 56 13.256 W	38.9	sand, cobble
										buoy 3ft unde
69	8-7	2744	29-Jan-20	1511	2-Mar-20	1354	45 38 34.4465 N	121 56 12.7041 W	38	cobble
70	11-7	2750	29-Jan-20	1515	2-Mar-20	1017	45 38 34.4664 N	121 56 12.158 W	37.7	sand, cobble
										PE water colu
										temp sensor a
		2752 (2728 - water								line ~5ft abov
80	13-5, SW13-6	column)	29-Jan-20	1529	3-Mar-20	1113	45 38 34.4652 N	121 56 10.4875 W	41.9	some sand
81	13-7	2730	29-Jan-20	1533	3-Mar-20	1118	45 38 34.4255 N	121 56 10.1532 W	40.4	sand, cobble
84	13-8	2755	30-Jan-20	845	3-Mar-20	1110	45 38 34.425 N	121 56 9.6314 W	43	sand, rocks
87	14-1	8937	30-Jan-20	850	3-Mar-20	1107	45 38 34.4907 N	121 56 9.1866 W	42.1	sand, cobble
90	14-2	2751	30-Jan-20	914	3-Mar-20	1102	45 38 34.5276 N	121 56 8.7457 W	42.8	
97	14-4	2745	30-Jan-20	918	3-Mar-20	1149	45 38 34.5007 N	121 56 8.0356 W	47.4	cobble, clams,
107	14-7	2788	30-Jan-20	940	3-Mar-20	1022	45 38 34.4725 N	121 56 6.8849 W	38.3	cobbles, clams
114	15-1	2766	30-Jan-20	958	3-Mar-20	950	45 38 34.486 N	121 56 6.1256 W	36.8	rocks, clams
121	15-2	2820	30-Jan-20	1004	3-Mar-20	953	45 38 34.5309 N	121 56 5.5622 W	38.7	rocks, clams
123	15-3	2746	30-Jan-20	1105	3-Mar-20	914	45 38 34.4341 N	121 56 5.2109 W	40	rocks, cobbles
86	14-3	8959	30-Jan-20	1321	3-Mar-20	1010	45 38 34.76 N	121 56 8.7803 W	44.7	cobbles, clams
98	15-7	8963	30-Jan-20	1332	3-Mar-20	1002	45 38 34.7909 N	121 56 7.8361 W	45	cobbles, clams
105	16-1	8962	30-Jan-20	1344	3-Mar-20	958	45 38 34.7409 N	121 56 7.0615 W	47.6	sand, cobbles,
106	16-2	2706	30-Jan-20	1347	3-Mar-20	956	45 38 34.7599 N	121 56 6.6852 W	46.1	sand, cobbles,
112	16-3	2776	30-Jan-20	1352	3-Mar-20	947	45 38 34.763 N	121 56 6.2746 W	45.4	sand, cobbles,
										buoy submerg
113	16-4	8940	30-Jan-20	1401	3-Mar-20	917	45 38 34.6963 N	121 56 5.7728 W	45	rocks
122	16-5	2768	30-Jan-20	1415	3-Mar-20	912	45 38 34.7479 N	121 56 5.3733 W	47.5	cobbles, clams
164	16-8	8926	30-Jan-20	1500	2-Mar-20	1129	45 38 34.1989 N	121 56 22.8248 W	64.9	sand
165	17-1	8955	30-Jan-20	1504	2-Mar-20	1125	45 38 34.5463 N	121 56 22.6126 W	72.9	sand
168	17-2	2771	30-Jan-20	1509	2-Mar-20	1143	45 38 34.8472 N	121 56 22.3366 W	73	sand
180	16-6	8966	30-Jan-20	1514	2-Mar-20	1238	45 38 34.8115 N	121 56 18.9262 W	48.5	sand, clams/cl
179	16-7	2805	30-Jan-20	1518	2-Mar-20	1211	45 38 35.0645 N	121 56 19.2949 W	53.5	sand, clams/cl
224	17-3	2781	31-Jan-20	758	3-Mar-20	940	45 38 34.8911 N	121 56 9.849 W	47	cobbles, clams
									1	
231	17-7	2778	31-Jan-20	826	3-Mar-20	932	45 38 34.9615 N	121 56 8.3946 W	47	rocks, cobbles

IENT NOTES,	RETRIEVAL NOTES,
ATIONS, ETC.	OBSERVATIONS, ETC.
ttached to buoy	
e riverbed	
ttached to buoy	
e riverbed; tree,	
rwater; sand,	
nn sampler &	
ttached to buoy	
e nverbeu, rocks,	
clamshells	
/clamshells	
/clamshalls	
/clamshells	
clams/clamshells	
clams/clamshells	
ed underwater.	
/clamshells	
amshells	
amshells	
/clamshells	
dame/damehalle	
ciams/ciamsnells	

SAMPLE	TTU ID	HOBO SERIAL	DATE	TIME	DATE		DEPLOYMENT	DEPLOYMENT	WATER DEPTH	DEPLOY
ID	NUMBER	NUMBER	DEPLOYED	DEPLOYED	RETRIEVED	TIME RETRIEVED	LATITUDE	LONGITUDE	(ft)	OBSERV
										sand, small ro
238	18-2	2808	31-Jan-20	904	2-Mar-20	930	45 38 35.1073 N	121 56 7.295 W	47	clams/clamshe
242	18-3	2715	31-Jan-20	912	3-Mar-20	925	45 38 35.0612 N	121 56 6.8543 W	51	sand, cobble
243	18-4	8957	31-Jan-20	915	3-Mar-20	920	45 38 35.0242 N	121 56 6.4536 W	51	cobbles, clams
										no camera; ha
										off bow of boa
										space for boat
117	18-5	8920	31-Jan-20	1054	3-Mar-20	1429	45 38 33.5358 N	121 56 6.1463 W	10	onto target lo
118	18-6	2709	31-Jan-20	1059	3-Mar-20	1427	45 38 33.4326 N	121 56 6.1046 W	13	cobbles, clams
119	18-7	2731	31-Jan-20	1105	3-Mar-20	1424	45 38 33.2299 N	121 56 5.8561 W	10	cobbles, clams
										buoy submerg
259	17-8	2813	31-Jan-20	1200	3-Mar-20	1357	45 38 32.0522 N	121 56 4.4748 W	42.4	gravel and san
										PE water colu
										temp sensor a
		8934 (2708 - water								line ~5ft abov
156	19-5, SW19-6	column)	31-Jan-20	1206	2-Mar-20	1112	45 38 32.3335 N	121 56 4.6638 W	40	cobbles, sand,
146	19-4	8919	31-Jan-20	1216	2-Mar-20	1114	45 38 32.5446 N	121 56 4.5469 W	45.4	cobbles, clams
131	20-2	2785	31-Jan-20	1329	3-Mar-20	1344	45 38 33.2353 N	121 56 4.9238 W	30.8	cobbles, clams
										gravel, cobble
147	19-8	2790	31-Jan-20	1340	3-Mar-20	1337	45 38 32.8714 N	121 56 4.4044 W	48.4	clams/clamshe
155	19-7	2713	31-Jan-20	1345	2-Mar-20	1155	45 38 32.5995 N	121 56 4.1786 W	39.6	cobbles, clams
132	20-3	2773	31-Jan-20	1350	3-Mar-20	1342	45 38 33.5271 N	121 56 4.7409 W	30	cobbles, clams
133	20-4	2799	31-Jan-20	1355	2-Mar-20	1324	45 38 33.8711 N	121 56 4.681 W	31.8	cobbles, clams
135	20-6	2726	31-Jan-20	1410	3-Mar-20	910	45 38 34.5386 N	121 56 4.2996 W	42.1	gravel, clams/
140	20-1	8945	31-Jan-20	1436	2-Mar-20	1103	45 38 33.2129 N	121 56 4.4488 W	45	cobbles, clams
148	20-5	8944	31-Jan-20	1442	3-Mar-20	1335	45 38 33.0729 N	121 56 4.046 W	49	cobbles, clams
149	21-1	8923	31-Jan-20	1503	3-Mar-20	1329	45 38 33.3502 N	121 56 3.6963 W	51.6	cobbles, clams
139	20-7	8935	1-Feb-20	803	3-Mar-20	1339	45 38 33.3913 N	121 56 4.2871 W	40	cobbles, clams
137	22-5	2725	1-Feb-20	837	3-Mar-20	1321	45 38 34.2278 N	121 56 4.0963 W	Did not record	cobbles, sand,
										No camera; PE
										originally mar
182	22-4	2748	1-Feb-20	926	2-Mar-20	1326	45 38 34.8021 N	121 56 18.4626 W	40	155
										No camera; PE
										originally mar
184	22-1	8914	1-Feb-20	936	2-Mar-20	1324	45 38 34.7551 N	121 56 17.9341 W	40	152
										No camera; PE
										originally mar
188	22-7	8932	1-Feb-20	940	2-Mar-20	1321	45 38 34.7909 N	121 56 17 W	40	124
										No camera; Pl
										originally marl
190	22-6	8954	1-Feb-20	942	2-Mar-20	1320	45 38 34.7834 N	121 56 16.5146 W	37	136

MENT NOTES, ATIONS, ETC.	RETRIEVAL NOTES, OBSERVATIONS, ETC.
cks,	
ells	
/clamshells	
nd deployment	
t due to limited	
to manuever	
ation	
/clamshells	
/clamshells	
ed underwater;	
d	
nn sampler &	
ttached to buoy	
e riverbed;	
clams/clamshells	
/clamshells	
/clamshells	Tangled with sample 129 buoy line
5,	
ells	
/clamshells	
	Discrepancy in location with Bravo's
/clamshells	coordinates
/clamshells	
clamshells	
/clamshells	
/clamshells	
/clamshells	
/clamshells	
clams/clamshells	
sampler	
ed for location	
sampler	
ed for location	
sampler	
ed for location	
sampler	
ed for location	

SAMPLE	TTU ID	HOBO SERIAL	DATE	TIME	DATE		DEPLOYMENT	DEPLOYMENT	WATER DEPTH	DEPLOYMENT NOTES,	RETRIEVAL NOTES,
ID	NUMBER	NUMBER	DEPLOYED	DEPLOYED	RETRIEVED	TIME RETRIEVED	LATITUDE	LONGITUDE	(ft)	OBSERVATIONS, ETC.	OBSERVATIONS, ETC.
										No camera; PE sampler	
										originally marked for location	
200	22-2	2724	1-Feb-20	949	2-Mar-20	1318	45 38 34.8494 N	121 56 13.69 W	37	138	
										No camera; placement of	
										sampler felt like it potentially	
204	22-3	2791	1-Feb-20	1007	2-Mar-20	1315	45 38 34.8433 N	121 56 12.6074 W	39.7	was placed on rock	
207	21-4	8961	1-Feb-20	1011	2-Mar-20	1313	45 38 35.0573 N	121 56 11.8782 W	Did not record	No camera	
36	3-1	8930	28-Jan-20	850	2-Mar-20	1442 - NO PE	45 38 33.8426 N	121 56 17.5978 W	25		PE lost
9	6-6	8915	28-Jan-20	1414	2-Mar-20	1157 NO PE	45 38 33.76 N	121 56 5.1732 W	42	rock	PE lost
75	13-3	2716	29-Jan-20	1521	2-Mar-20	1507 NO PE	45 38 34.4872 N	121 56 11.6662 W	39	cobble	PE lost
76	13-4	2711	29-Jan-20	1524	3-Mar-20	1016 - NO PE	45 38 34.4718 N	121 56 11.0214 W	40.3	sand, cobble	PE lost
89	10-1	2780	29-Jan-20	1022	3-Mar-20	1145 - NO PE	45 38 34.2515 N	121 56 8.9511 W	40	rock, sand	PE lost
										sampler possibly deployed on	
115	11-2	2720	29-Jan-20	1100	3-Mar-20	1201 - NO PE	45 38 34.2242 N	121 56 6.1103 W	31	top of boulder	PE lost
120	11-3	8964	29-Jan-20	1103	3-Mar-20	1157 NO PE	45 38 34.2199 N	121 56 5.7009 W	37	cobble	PE lost
100	14-5	8929	30-Jan-20	927	3-Mar-20	1030 - NO PE	45 38 34.3549 N	121 56 7.5797 W	40	cobble, clams/clamshells	PE lost
										cobble, clams/clamshells,	
104	14-6	8941	30-Jan-20	933	3-Mar-20	1027 - NO PE	45 38 34.4914 N	121 56 7.1229 W	42.7	crayfish	PE lost
157	15-4	2717	30-Jan-20	1238	2-Mar-20	1107 - NO PE	45 38 32 N	121 56 4.8723 W	12.7	no camera	PE lost
										buoy submerged underwater;	
159	15-5	2742	30-Jan-20	1242	3-Mar-20	NO SAMPLER/PE	45 38 31.7726 N	121 56 4.7157 W	7.6	no camera	Sampler and PE lost
85	15-6	2741	30-Jan-20	1314	3-Mar-20	1013 - NO PE	45 38 34.6875 N	121 56 9.4139 W	45	cobbles, clams/clamshells	PE lost
91	14-8	8931	30-Jan-20	1327	3-Mar-20	1148 - NO PE	45 38 34.8182 N	121 56 8.4543 W	43	buoy submerged underwater	PE lost
99	15-8	2710	30-Jan-20	1338	3-Mar-20	1000 - NO PE	45 38 34.7459 N	121 56 7.391 W	45.9	cobbles, clams/clamshells	PE lost
										minimal sand, cobbles,	
223	17-4	2712	31-Jan-20	803	2-Mar-20	1503 - NO PE	45 38 35.0749 N	121 56 9.5147 W	46	clams/clamshells	PE lost
225	17-5	8953	31-Jan-20	813	3-Mar-20	938 - NO PE	45 38 35.0774 N	121 56 9.0966 W	46	boulders	PE lost
230	17-6	8956	31-Jan-20	817	3-Mar-20	934 - NO PE	45 38 35.0421 N	121 56 8.7926 W	48	cobbles, clams/clamshells	PE lost
127	19-1	2817	31-Jan-20	1111	3-Mar-20	NO SAMPLER/PE	45 38 33.5606 N	121 56 5.212 W	30	rocks, clams/clamshells	Sampler and PE lost
										rocks, clams/clamshells,	PE lost; tangled with buoy line for
129	18-8	8922	31-Jan-20	1120	3-Mar-20	1344 - NO PE	45 38 33.0926 N	121 56 5.5341 W	16	boulders	sample 131
				-							Sampler, PE, and buoy lost: no buoy
128	19-2	2758	31-Jan-20	1126	NO BUOY VISIBLE	NO SAMPLER/PE	45 38 33.2971 N	121 56 5.2939 W	30	sand. cobbles. clams/clamshells	visible
237	18-1	8928	31-Jan-20	852	2-Mar-20	1459 - NO PE	45 38 35.0255 N	121 56 7.583 W	47	cobbles. clams/clamshells	PE lost
130	19-3	2763	31-Jan-20	1152	2-Mar-20	1118 - NO PE	45 38 32.5367 N	121 56 5.0355 W		placed at coordinates for station	
									Did not record	142; cobbles, clams/clamshells	PE lost
154	21-2	8950	31-Jan-20	1450	3-Mar-20	1333 - NO PE	45 38 32.784 N	121 56 3.8588 W	54.2	cobbles	PE lost
202	21-3	8916	1-Feb-20	1004	2-Mar-20	1317 - NO PE	45 38 34.7949 N	121 56 13.1916 W	38	No camera	PE lost
										Abandon - boulders present	
										throughout 10ft radius around	
125		Abandon	29-Jan-20						Abandon	target	
4		Abandon	29-Jan-20						Abandon		

SAMPLE	TTU ID	HOBO SERIAL	DATE		DATE	DEPLOYMENT	DEPLOYMENT	WATER DEPTH	DEPLOYN
ID	NUMBER	NUMBER	DEPLOYED	DEPLOYED	RETRIEVED	LATITUDE	LONGITUDE	(π)	OBSERV
									Abandon - bou
									throughout 10
10		Abandon	29-Jan-20			 		Abandon	target
									Abandon - bou
									throughout 10
11		Abandon	29-Jan-20			 		Abandon	target
									Abandon - bou
									present throug
92		Abandon	30-Jan-20					Abandon	around target
									Abandon, bou
									throughout 10
111		2791	30-Jan-20					Abandon	target
									Abandon, bou
									throughout 10
236		Abandon	31-Jan-20					Abandon	target
									Abandon, bou
									present throug
130		Abandon	31-Jan-20					Abandon	around target
									Abandon, bou
									throughout 10
141		Abandon	31-Jan-20					Abandon	target
									Abandon, bou
									throughout 10
134		Abandon	31-Jan-20					Abandon	target
153		Abandon	31-Jan-20					Abandon	Abandon, bou
152		Abandon	1-Feb-20					Abandon	present throug
150		Abandon	1-Feb-20					Abandon	Abandon, bou

Notes:

- PE lost for station upon retrieval

- Station abandoned during deployment attempt

/IENT NOTES, ATIONS, ETC.	RETRIEVAL NOTES, OBSERVATIONS, ETC.
ulders present	
ft radius around	
ulders present	
ft radius around	
ulders and rock	
ghout 10ft radius	
lders present	
ft radius around	
lders present	
ft radius around	
lders and rock	
ghout 10ft radius	
lders present	
ft radius around	
lders present	
ft radius around	
lders present	
ghout 10ft radius	
lders present	

APPENDIX C: Sampling Event Photos



Redlinger Survey Boat



Retrieval of buoy lines and passive samplers





Disassembly of a retrieved sampler



Retrieved LDPE samplers inside metal mesh envelope



Packaging LDPE sampler in aluminum foil for laboratory

