Lower Duwamish Waterway Group

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

LOWER DUWAMISH WATERWAY BASELINE SEEP DATA REPORT

FINAL

Prepared for

Lower Duwamish Waterway Group

For submittal to

US Environmental Protection Agency

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Maps

Acronyms

95UCL	95% upper confidence limit (on the mean)
AOC	Administrative Order on Consent
ARI	Analytical Resources, Inc.
Axys	Axys Analytical Services, Ltd.
COC	chain of custody
cPAH	carcinogenic polycyclic aromatic hydrocarbon
CV-AFS	cold vapor-atomic fluorescence spectrometry
DCM	dichloromethane
DF	detection frequency
DL	detection limit
DO	dissolved oxygen
DOC	dissolved organic carbon
ECD	electron capture detector
Ecology	Washington State Department of Ecology
EMPC	estimated maximum possible concentration
EPA	US Environmental Protection Agency
FNU	Formazin Nephelometric Unit
GC	gas chromatography
HPAH	high-molecular-weight polycyclic aromatic hydrocarbon
HpCDD	heptachlorodibenzo-*p*-dioxin
HRGC	high-resolution gas chromatography
HRMS	high-resolution mass spectrometry
HxCDD	hexachlorodibenzo-*p*-dioxin

ICP	inductively coupled plasma
ID	identification
LDW	Lower Duwamish Waterway
LPAH	low-molecular-weight polycyclic aromatic hydrocarbon
MS	mass spectrometry
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PCP	pentachlorophenol
PeCDF	pentachlorodibenzofuran
ppt	parts per thousand
QAPP	quality assurance project plan
RL	reporting limit
RM	river mile
SIM	select ion monitoring
SM	Standard Method
SVOC	semivolatile organic compound
TCDF	tetrachlorodibenzofuran
TEQ	toxic equivalent
TOC	total organic carbon
TSS	total suspended solids
UCT-KED	universal cell technology-kinetic energy discrimination

1 Introduction

This data report presents the results of the seep reconnaissance performed in May 2018 and the baseline chemical analyses of seep water samples collected in June 2018 in the Lower Duwamish Waterway (LDW). These data were collected as part of the third amendment to the Administrative Order on Consent (AOC) (EPA 2016) as outlined in the *Pre-Design Studies Work Plan* (Windward and Integral 2017).

The objective of the seep study, per the third amendment to the AOC (EPA 2016), was to collect and analyze seep samples to aid the Washington State Department of Ecology (Ecology) in source identification and in assessing the sufficiency of source control. Following reconnaissance to assess accessibility and flow rates, seep sample locations were selected, and seep samples were collected, where possible, from areas where existing groundwater data were insufficient to determine whether groundwater may be a significant ongoing source of contamination to the LDW.

The seep reconnaissance, sampling, and analysis were conducted per the seep quality assurance project plan (QAPP), which includes details regarding project organization, sampling design, analytical methods, and data validation (Windward 2018). The QAPP was approved by the US Environmental Protection Agency (EPA) on March 8, 2018 (EPA 2018). In addition to presenting the data collected, this seep data report discusses any deviations from the QAPP.

The remainder of this data report is organized into the following sections:

- Section 2 – Field Methods
- Section 3 – Analytical Methods
- Section 4 – Results of Chemical Analyses
- Section 5 – References

The text is supported by the following appendices:

- Appendix A – Field Forms, Field Notes, Photos, and COCs
- Appendix B – Data Tables (complete results for all samples in Excel)
- Appendix C – Memorandum: Dioxin / furan analysis of near-outfall, bank, and seep samples
- Appendix D – Laboratory Reports and Data Validation Report

2 Field Methods

The field methods used in the seep reconnaissance effort and the collection of individual seep samples during the seep water sampling effort are described in the QAPP (Windward 2018) and summarized in the following sections. Section 2.1 describes the field methods used in the seep reconnaissance effort and reconnaissance measurement collection methods and results. Section 2.2 describes collection methods and results for seeps sampled during the June 2018 sampling effort. Section 2.3 describes the seep sample identification scheme used during the seep sampling effort. Section 2.4 describes field deviations from the QAPP.

2.1 SEEP RECONNAISSANCE METHODS, LOCATIONS, AND FIELD RESULTS

The objective of the seep reconnaissance was to assess the location, accessibility, flow rate, and conductivity of new and select known seeps. The reconnaissance was performed during daytime low tides on May 15 through 18, 2018. Known seeps had been evaluated and screened in the QAPP based on previous sampling efforts, location, and nearby groundwater and sediment data. Attempts were made to assess the 49 seeps identified for reconnaissance in the QAPP. However, seeps SP-01, SP-34, SP-37, SP-46, and SP-63 were not accessible during the reconnaissance, and no seeps were observed at the locations identified for SP-07, SP-40, SP-44, SP-58, SP-67, and SP-81 (Map 1). In addition, six new seeps were identified during the reconnaissance: SP-83, SP-84, SP-85, SP-86, SP-87, and SP-88.

Table 2-1 presents the location of each seep evaluated during the reconnaissance and the date and time each seep was visited.

Table 2-1. Reconnaissance seep location information

Seep ID	Location (approx. RM)	Date	Time	Able to assess seep?	Coordinates			
					X	Y	Latitude	Longitude
SP-01	2.2 E	5/17/2018	11:26	blocked by barge	-	-	-	-
SP-05	2.6 E	5/17/2018	10:54	yes	1271817	199460	47.537012	-122.325647
SP-06	2.6 E	5/15/2018	13:46	yes	1272090	199157	47.536196	-122.32452
SP-07	2.6 E	5/15/2018	13:55	no seep present	-	-	-	-
SP-24	4.2 E	5/16/2018	13:03	yes	1277566	192937	47.519436	-122.301873
SP-27	5.0 E	5/16/2018	10:36	yes	1278732	190039	47.511553	-122.296931
SP-28	4.9 E	5/16/2018	13:46	yes	1278356	190350	47.512386	-122.298479
SP-29	4.9 W	5/16/2018	14:07	yes	1278153	190076	47.511626	-122.299276
SP-30	4.9 W	5/16/2018	10:48	yes	1278513	189896	47.511149	-122.297808
SP-31	4.9 W	5/16/2018	11:10	yes	1278373	189993	47.511409	-122.298382

Seep ID	Location (approx. RM)	Date	Time	Able to assess seep?	Coordinates			
					X	Y	Latitude	Longitude
SP-32	4.8 W	5/16/2018	10:10	yes	1277821	190190	47.511921	-122.300628
SP-33	4.8 E	5/16/2018	13:36	yes	1277742	190519	47.512817	-122.300975
SP-34	4.6 W	5/16/2018	11:37	not accessible[a]	-	-	-	-
SP-35	4.6 E	5/16/2018	11:49	yes	1277196	190699	47.513283	-122.303197
SP-36	4.5 W	5/16/2018	12:09	yes	1276627	190831	47.513614	-122.305511
SP-37	4.5 E	5/16/2018	12:22	not accessible[a]	-	-	-	-
SP-38	4.4 W	5/16/2018	12:33	yes	1276484	191359	47.515053	-122.306128
SP-40	4.0 W	5/15/2018	12:06	no seep present	-	-	-	-
SP-42	3.9 W	5/15/2018	12:24	yes	1275910	193788	47.521683	-122.308641
SP-43	3.8 W	5/15/2018	12:43	yes	1275804	194471	47.523547	-122.309122
SP-44	3.4 W	5/15/2018	13:14	no seep present	-	-	-	-
SP-45	3.3 W	5/15/2018	11:44	yes	1274199	196708	47.529595	-122.31579
SP-46	3.2 W	5/15/2018	11:30	not accessible[a]	-	-	-	-
SP-47	3.1 W	5/15/2018	11:10	yes	1273621	197230	47.530995	-122.318172
SP-49	3.0 W	5/15/2018	10:44	yes	1273036	197744	47.532374	-122.320577
SP-50	2.9 W	5/15/2018	10:21	yes	1272891	197849	47.532654	-122.321176
SP-51	2.8 W	5/15/2018	10:01	yes	1272387	198346	47.53399	-122.323252
SP-57	2.0 W	5/18/2018	12:02	yes	1269541	201139	47.541492	-122.33499
SP-58	2.1 W	5/18/2018	12:24	no seep present	-	-	-	-
SP-59	2.1 W	5/18/2018	12:10	yes	1269560	200783	47.540517	-122.334886
SP-63	2.2 E	5/17/2018	11:12	blocked by barge	-	-	-	-
SP-65	1.0 W	5/17/2018	13:30	yes	1266766	206178	47.555155	-122.346625
SP-66	0.9 W	5/17/2018	13:55	yes	1266514	206252	47.555345	-122.347653
SP-67	0.8 W	5/17/2018	15:40	no seep present	-	-	-	-
SP-68	0.7 W	5/17/2018	14:49	yes	1265898	207431	47.558542	-122.350239
SP-70	0.2 W	5/17/2018	14:40	yes	1266029	210059	47.565753	-122.34992
SP-72	0.2 E	5/18/2018	13:40	yes	1267088	210735	47.567664	-122.345684
SP-73	0.6 E	5/17/2018	14:26	yes	1267245	208409	47.561297	-122.344864
SP-74	0.7 E	5/17/2018	14:14	yes	1267393	208023	47.560246	-122.344235
SP-77	1.1 E	5/17/2018	13:17	yes	1268186	205972	47.554668	-122.340861
SP-78	1.4 E	5/18/2018	13:03	yes	1268629	204281	47.550055	-122.338934

Seep ID	Location (approx. RM)	Date	Time	Able to assess seep?	Coordinates			
					X	Y	Latitude	Longitude
SP-79	1.5 E	5/18/2018	12:49	yes	1268713	204089	47.549533	-122.338577
SP-81	1.7 E	5/17/2018	12:34	no seep present	-	-	-	-
SP-83	2.2 E	5/17/2018	11:25	yes	1270757	201593	47.542802	-122.330105
SP-84	1.7 E	5/17/2018	12:39	yes	1269599	203350	47.547556	-122.334931
SP-85	1.7 E	5/17/2018	12:51	yes	1269590	203197	47.547137	-122.334955
SP-86	0.8 W	5/17/2018	15:24	yes	1265956	206989	47.557335	-122.349972
SP-87	2.1 W	5/18/2018	12:20	yes	1269562	200704	47.540301	-122.334873
SP-88	0.2 E	5/18/2018	13:44	yes	1267098	210691	47.567543	-122.345641

[a] Field crew was unable to safely access the location due to deep, soft silt and mud.

ID – identification

RM – river mile

At the seeps for which reconnaissance was possible, flow rates were estimated and conductivity, temperature, pH, dissolved oxygen (DO), and turbidity were measured. Salinity was calculated from conductivity and temperature. Measurements were gathered by collecting seep water in a beaker using a glass funnel and tubing (i.e., the shoreline embankment method described in the QAPP (Windward 2018)). The results of these measurements (Table 2-2) were used to propose seep sample locations and, in coordination with EPA and Ecology, to select seeps to be sampled during the June sampling event.

Table 2-2. Reconnaissance measurement field results

Seep ID	Approximate Flow Rate (mL/s)	Conductivity (mS/cm)	Temperature (°C)	pH	DO (mg/L)	Turbidity (FNU)	Salinity (ppt)
SP-05	7	19.7	14.4	6.72	8.14	50.4	15.1
SP-06	4	15.1	19.7	9.01	8.14	48.9	9.9
SP-24	17	6.1	16.0	6.44	5.67	7.10	4.1
SP-27	60	12.4	14.4	7.16	9.40	13.2	9.1
SP-28	11	1.1	16.0	7.51	9.31	32.5	0.7
SP-29	43	2.7	15.7	6.44	2.35	32.0	1.7
SP-30	30	13.8	13.7	6.85	6.73	2.35	10.4
SP-31	60	20.3	14.4	6.99	8.13	2.32	15.6
SP-32	75	4.2	15.5	7.13	8.73	1.47	2.8
SP-33	15	5.2	15.9	6.58	4.87	17.8	3.5
SP-35	100	7.7	14.6	7.03	7.98	80.7	5.4
SP-36	25	9.1	13.9	6.68	4.68	15.3	6.7
SP-38	30	3.5	15.1	7.28	7.92	9.00	2.3

Seep ID	Approximate Flow Rate (mL/s)	Conductivity (mS/cm)	Temperature (°C)	pH	DO (mg/L)	Turbidity (FNU)	Salinity (ppt)
SP-42	50	1.2	15.5	9.02	8.33	7.38	8.4
SP-43	100	2.8	13.5	7.90	7.73	1.10	1.9
SP-45	60	10.7	14.8	8.02	6.88	19.7	7.7
SP-47	100	13.0	14.3	8.30	8.02	45.4	9.6
SP-49	60	18.2	14.6	7.75	9.88	19.4	13.7
SP-50	25	16.4	14.8	7.33	8.82	39.2	12.2
SP-51	33	19.5	15.1	4.27	8.55	50.0	14.6
SP-57	100	14.0	13.9	7.62	9.59	5.05	10.5
SP-59	60	16.4	13.8	7.03	8.51	4.59	12.5
SP-65	4	27.9	14.5	7.48	7.66	65.0	22.0
SP-66	5	13.7	16.1	7.63	8.07	8.50	9.7
SP-68	13	18.3	24.0	8.55	9.46	18.6	11.1
SP-70	125	23.4	15.4	7.49	8.04	3.50	17.7
SP-72	43	18.6	13.2	8.11	7.93	4.10	14.6
SP-73	23	16.8	25.9	8.87	9.59	15.8	9.7
SP-74	3	5.7	17.2	7.14	8.07	5.80	3.8
SP-77	38	12.9	14.2	6.81	5.50	12.4	9.6
SP-78	117	16.9	14.4	7.70	8.45	6.00	12.7
SP-79	23	19.2	15.2	6.95	4.40	9.10	14.4
SP-83	33	8.0	14.1	7.23	8.97	35.0	5.7
SP-84	30	4.7	15.4	6.73	5.75	14.3	3.1
SP-85	150	20.2	14.1	6.92	7.52	4.28	15.7
SP-86	100	18.1	16.3	7.13	7.92	8.90	13.2
SP-87	6	7.8	14.3	6.94	6.81	15.8	5.5
SP-88	60	20.3	12.8	8.16	7.98	3.30	16.2

DO – dissolved oxygen
FNU – Formazin Nephelometric Unit
ID – identification
ppt – parts per thousand

2.2 SEEP SAMPLING LOCATIONS AND COLLECTION METHODS

Based on the results of the seep reconnaissance, 31 seeps were chosen for sampling and chemical analysis (Map 2). Table 2-3 presents the seeps selected for sampling, along with the sampling date and time and seep coordinates. Five of the selected seeps could not be sampled, as indicated in Table 2-3.

Table 2-3. Location information for seeps identified for sampling

Seep ID	Location (approx. RM)	Date	Time	Able to sample seep?	X	Y	Latitude	Longitude
SP-01	2.2 E	6/15/2018	11:33	yes	1270793	201470	47.542467	-122.32995
SP-05	2.6 E	6/14/2018	14:08	yes	1271817	199460	47.537012	-122.325647
SP-06	2.6 E	6/13/2018	9:53	yes	1272090	199157	47.536196	-122.32452
SP-24	4.2 E	6/13/2018	12:35	yes	1277566	192937	47.519436	-122.301873
SP-27	5.0 E	na	na	no flow	na	na	na	na
SP-28	4.9 E	na	na	could not access during tidal window and upland access not possible	na	na	na	na
SP-30	4.9 W	6/12/2018	12:06	yes	1278513	189896	47.511149	-122.297808
SP-32	4.8 W	6/12/2018	9:19	yes	1277821	190190	47.511921	-122.300628
SP-33	4.8 E	6/13/2018	12:17	yes	1277742	190519	47.512817	-122.300975
SP-35	4.6 E	6/12/2018	10:56	yes	1277196	190699	47.513283	-122.303197
SP-38	4.4 W	6/12/2018	10:27	yes	1276484	191359	47.515053	-122.306128
SP-42	3.9 W	6/12/2018	12:05	yes	1275910	193788	47.521683	-122.308641
SP-43	3.8 W	6/12/2018	13:00	yes	1275804	194471	47.523547	-122.309122
SP-45	3.3 W	6/15/2018	13:45	yes	1274199	196708	47.529595	-122.31579
SP-47	3.1 W	6/15/2018	13:16	yes	1273621	197230	47.530995	-122.318172
SP-49	3.0 W	na	na	conductivity > 30 mS/cm and unsafe sampling conditions	na	na	na	na
SP-51	2.8 W	na	na	conductivity > 30 mS/cm	na	na	na	na
SP-57	2.0 W	6/14/2018	10:41	yes	1269541	201139	47.541492	-122.33499
SP-63	2.2 E	na	na	not accessible (barge)	na	na	na	na
SP-66	0.9 W	6/15/2018	13:25	yes	1266514	206252	47.555345	-122.347653
SP-70	0.2 W	6/15/2018	11:13	yes	1266029	210059	47.565753	-122.34992
SP-73	0.6 E	6/14/2018	13:08	yes	1267245	208409	47.561297	-122.344864
SP-74	0.7 E	6/14/2018	13:14	yes	1267393	208023	47.560246	-122.344235
SP-77	1.1 E	6/15/2018	12:10	yes	1268186	205972	47.554668	-122.340861
SP-78	1.4 E	6/14/2018	12:04	yes	1268629	204281	47.550055	-122.338934
SP-79	1.5 E	6/14/2018	9:50	yes	1268713	204089	47.549533	-122.338577
SP-83	2.2 E	6/15/2018	12:08	yes	1270757	201593	47.542802	-122.330105
SP-84	1.7 E	6/14/2018	9:53	yes	1269599	203350	47.547556	-122.334931
SP-86	0.8 W	6/15/2018	12:19	yes	1265956	206989	47.557335	-122.349972

Seep ID	Location (approx. RM)	Date	Time	Able to sample seep?	X	Y	Latitude	Longitude
SP-87	2.1 W	6/14/2018	11:11	yes	1269562	200704	47.540301	-122.334873
SP-88	0.2 E	6/15/2018	10:52	yes	1267098	210691	47.567543	-122.345641

ID – identification na – not applicable (no sample collected) RM – river mile

Seep water was collected in a glass beaker, either directly from the seep or using a glass funnel and tubing to direct the water into a beaker. Conductivity, temperature, pH, DO, and turbidity were measured in the field using a probe placed into the beaker. Salinity was calculated from conductivity and temperature. The results of these measurements are presented in Table 2-4.

Table 2-4. Seep sampling field measurements results

Seep ID	Conductivity (mS/cm)	Temperature (°C)	pH	DO (mg/L)	Turbidity (FNU)	Salinity (ppt)
SP-01	24.6	17.7	6.95	5.61	7.01	17.7
SP-05	27.3	15.6	7.25	4.14	1.59	20.9
SP-06	24.6	15.2[a]	7.99	97.1	11.5	18.8
SP-24	16.9	16.2	7.68	7.10	3.51	12.2
SP-30	19.5	17.0	6.79	3.74	5.30	13.9
SP-32	22.5	16.6	2.62	69.5	4.46	16.5
SP-33	18.8	19.5	7.85	8.29	35.3	12.7
SP-35	12.1	17.6	7.51	7.78	63.5	8.2
SP-38	19.5	17.4	7.70	5.93	2.16	13.8
SP-42	5.0	19.3[a]	4.76	89.6	3.88	3.0
SP-43	18.9	15.3	6.99	5.97	2.76	14.0
SP-45	23.9	21.7	7.18	9.89	16.1	15.6
SP-47	28.1	18.7	7.40	9.34	8.70	20.0
SP-57	26.5	14.8	7.96	8.78	2.68	20.7
SP-66	27.1	18.7	8.30	8.44	2.54	19.2
SP-70	27.6	15.6	5.90	8.86	2.18	21.1
SP-73	26.0	20.9	6.02	9.37	13.7	17.4
SP-74	14.8	18.7	7.53	9.23	8.59	9.9
SP-77	20.7	15.5	7.52	2.71	1.49	15.4
SP-78	27.7	15.5	7.64	8.19	3.30	21.3
SP-79	23.3	14.4	3.44[b]	4.89	12.3	18.2
SP-83	23.0	17.2	7.43	7.98	4.02	16.6
SP-84	26.3	16.3	7.79	8.13	0.930	19.7
SP-86	29.9	17.6	6.93	7.23	2.25	22.0

Seep ID	Conductivity (mS/cm)	Temperature (°C)	pH	DO (mg/L)	Turbidity (FNU)	Salinity (ppt)
SP-87	20.7	14.7	7.21	4.96	6.63	15.8
SP-88	28.0	15.1	not measured[c]	7.91	0.650	21.7

[a] Temperature was recorded in degrees Fahrenheit in the field.

[b] At 10:40 (after measuring this seep), it was noted that the water quality meter was reading pH at low levels. At this time, the pH meter was recalibrated. The pH readings taken for this seep were biased low by approximately 4 pH units; this pH value is likely around 7.4.

[c] The pH sensor was not working; no pH value was recorded for this seep.

DO – dissolved oxygen
FNU – Formazin Nephelometric Unit
ID – identification
ppt – parts per thousand

After field measurements had been recorded, seep water was collected in the beaker and transferred into the appropriate sample bottles. Per the QAPP, if the turbidity was greater than 25, water was first directed into a stainless steel bowl, where suspended sediment was allowed to settle for 5 minutes before the seep water was transferred to the sample bottles (Windward 2018). This process was followed at seeps SP-33 and SP-35.[1]

Table 2-5 presents a comparison of the field measurements from the reconnaissance to those from the sampling event. In order to calculate these statistics, the pH results collected during the sampling event at seeps SP-32, SP-42, and SP-47 were not included; these values were low (less than 5), likely due to a pH calibration issue.

Table 2-5. Comparison of seep field measurements

Parameter	Range of Results		Mean Result		Median Result	
	Recon.	Sampling	Recon.	Sampling	Recon.	Sampling
Conductivity (mS/cm)	1.1–27.9	5–29.9	12.8	22.4	13.8	23.6
Temperature (°C)	12.8–25.9	14.4–21.7	15.4	17.0	14.7	16.8
pH	4.27–9.02	5.9–8.3	7.3	7.3	7.2	7.5
DO (mg/L)	2.35–9.88	2.71–97.1	7.6	16.2	8.0	8.1
Turbidity (FNU)	1.1–80.7	0.65–63.5	19.3	8.7	12.8	4.0
Salinity (ppt)	0.7–22	3–22	9.6	16.4	9.7	17.0

DO – dissolved oxygen
FNU – Formazin Nephelometric Unit
ppt – parts per trillion

2.3 SAMPLE PROCESSING AND IDENTIFICATION

Once collected, samples were labeled and processed in accordance with the QAPP (Windward 2018). Unique alphanumeric identifications (IDs) were assigned to each seep sample and recorded on the seep collection form (Appendix A). Each sample ID included the following:

[1] A stainless steel bowl was also used at seep SP-42. See Section 2.4 for details.

- Project area ID (i.e., LDW) and two-digit year
- Sample type (i.e., SP for seep)
- Sample location ID (see Section 4)

For example, the seep sample collected from SP-30 was identified as LDW18-SP-30.

All relevant information for each sample—including ID, date, time, and location—was recorded on the seep collection form (Appendix A). Copies of field logbooks, reconnaissance field forms, sample collection field forms, photos, and chain of custody forms (COCs) are presented in Appendix A.

2.4 FIELD DEVIATIONS FROM THE QAPP

There were three field deviations from the QAPP (Windward 2018). These field deviations did not affect the data quality of the chemical analyses.

The water quality probes were not calibrated for all necessary parameters every day. Per the QAPP, the water quality probes were to be calibrated daily for conductivity, DO, pH, and turbidity. During the reconnaissance event, the probe was calibrated daily for conductivity and twice for pH (on May 15 and 16). The probe was not calibrated for DO and turbidity during the May reconnaissance event, but all four parameters were calibrated before and after the reconnaissance event. During the June seep sampling event, the probe was calibrated daily for conductivity and pH with one exception: The probe was not calibrated for pH on June 12. The probe sensors for pH, conductivity, and DO were calibrated prior to and following the June sampling event.

At seep SP-42, the funnel was reset in the seep prior to collecting water for the last sample bottle. The resetting of the funnel appeared to make the seep water more turbid than it had been before resetting the funnel. Based on visual inspection, the turbidity appeared to be greater than 25 NTU. Suspended sediment was allowed to settle for five minutes in a stainless steel bowl before the last sample bottle was filled.

In accordance with the QAPP, at least two photos were taken at each seep during the reconnaissance and sampling efforts, with the exception of seep SP-74 during the sampling effort, where no photos were taken.

3 Analytical Methods

The methods and procedures used to prepare and chemically analyze seep samples are described briefly in this section and in detail in the QAPP (Windward 2018). This section also discusses laboratory deviations from the QAPP.

3.1 ANALYTICAL METHODS

Seep samples were analyzed according to the methods presented in Table 3-1. Analytical Resources, Inc. (ARI) analyzed the seep samples for polychlorinated biphenyl (PCB) Aroclors, polycyclic aromatic hydrocarbons (PAHs), semivolatile organic compounds (SVOCs), metals, mercury, total organic carbon (TOC), dissolved organic carbon (DOC), and total suspended solids (TSS). Axys Analytical Services, Ltd. (Axys) performed dioxin/furan analyses. Seeps were not analyzed for PCB congeners, in accordance with the QAPP. The QAPP (Section 4.4.2) required analysis for PCB congeners for a given sample only if PCB Aroclors were not detected at a reporting limit (RL) greater than 39 ng/L (Windward 2018). With an RL of 10 to 12 ng/L PCB, Aroclors were not detected in any of the seep samples, so no PCB congener analyses were required.

Table 3-1. Analytical methods for seep analyses

Analyte	Method	Reference	Extraction Solvent	Laboratory
TSS	gravimetric	SM 2540 D-97	na	ARI
TOC	high-temperature combustion	SM 5310 B-00	na	ARI
DOC	high-temperature combustion	SM 5310 B-00	na	Axys
Metals	ICP-MS	EPA 6020A UCT-KED	na	ARI
Mercury	CV-AFS	EPA 7470A	na	ARI
PAHs	GC/MS	EPA 3510C/ EPA 8270D-SIM	DCM	ARI
PCB Aroclors	GC/ECD	EPA 3310-C Mod EPA 8082A	hexane	ALS
SVOCs	GC/MS	EPA 3510C/ EPA 8270D	DCM	ARI
Dioxins/ furans	HRGC/ HRMS	EPA 1613B	DCM/hexane	Axys

ARI – Analytical Resources, Inc.
Axys – Axys Analytical Services Ltd.
CV-AFS – cold vapor-atomic fluorescence spectrometry
DCM – dichloromethane
DOC – dissolved organic carbon
ECD – electron capture data
EPA – US Environmental Protection Agency
GC – gas chromatography
MS – mass spectrometry
na – not applicable
PAH – polycyclic aromatic hydrocarbon
PCB – polychlorinated biphenyl
SIM – select ion monitoring
SM – Standard Method
SVOC – semivolatile organic compound
TOC – total organic carbon

HRGC – high-resolution gas chromatography
HRMS –high-resolution mass spectrometry
ICP – inductively coupled plasma
TSS – total suspended solids
UCT-KED – universal cell technology-kinetic energy discrimination

3.2 LABORATORY DEVIATIONS FROM THE QAPP

Because of instrument issues at the laboratory that occurred during the initial analysis, 17 seep samples were re-analyzed for TOC and DOC outside of holding time.

4 Results of Chemical Analyses

This section summarizes the results of the chemical analyses and data validation of seep samples. The complete chemistry dataset is presented in Appendix B (in Excel).

4.1 CHEMISTRY RESULTS FOR SEEP SAMPLES

This section summarizes the results of chemical and conventional parameter analysis of the seep samples. Table 4-1 presents a summary of the detection frequencies, minimum and maximum detected concentrations, and minimum and maximum RLs for the non-detected results. Seep-specific results are presented in Table 4-2 (for samples LDW18-SP-01 through LDW18-SP-47) and Table 4-3 (for samples LDW18-SP-57 through LDW18-SP-88). Samples were filtered prior to all analyses (as indicated by a D for dissolved), except TOC and TSS analyses. Samples for SVOCs, PCB Aroclors, PAHs, and organochlorine pesticide analyses were filtered through a 1-µm glass fiber filter and samples for metals (including mercury) analyses were filtered using a 0.45-µm polyvinylidene difluoride filter. Pursuant to the QAPP, a subset of seep samples were initially analyzed for dioxins/furans (Windward 2018). Archives of all seep samples were kept for potential analysis of dioxins/furans pending additional data evaluation, which is included herein as Appendix C. The results of the additional dioxin/furan analyses will be presented in an addendum to this data report when they are available.

Table 4-1. Summary of chemical and conventional results in seep samples

Analyte	Unit	Detection Frequency	Minimum Detected Concentration	Maximum Detected Concentration	Range of RLs
Metals[a]					
Arsenic	**µg/L**	**27/27**	**0.510 J**	**4.64**	**na**
Cadmium	**µg/L**	**2/27**	**0.160 J**	**0.390 J**	**0.100–1.00**
Chromium	**µg/L**	**27/27**	**0.638**	**11.7**	**na**
Copper	**µg/L**	**14/27**	**1.80 J**	**3.44**	**2.50–5.00**
Lead	**µg/L**	**1/27**	**1.72**	**1.72**	**0.100–2.00**
Mercury	µg/L	0/27	nd	nd	0.100
Silver	µg/L	0/27	nd	nd	0.200–2.00
Zinc	**µg/L**	**20/27**	**4.41 J**	**33.5 J**	**20.0–40.0**
PAHs					
2-Methylnaphthalene	**µg/L**	**2/27**	**0.040**	**0.864**	**0.001–0.010**
Acenaphthene	**µg/L**	**11/27**	**0.004 J**	**6.70**	**0.010**
Acenaphthylene	**µg/L**	**3/27**	**0.003 J**	**0.040**	**0.010**
Anthracene	**µg/L**	**6/27**	**0.001 J**	**0.062**	**0.010**
Benzo(a)anthracene	**µg/L**	**3/27**	**0.0009 J**	**0.005 J**	**0.010**
Benzo(a)pyrene	µg/L	0/27	nd	nd	0.010
Benzo(b)fluoranthene	**µg/L**	**3/27**	**0.0006 J**	**0.0007 J**	**0.010**
Benzo(g,h,i)perylene	µg/L	0/27	nd	nd	0.010

Analyte	Unit	Detection Frequency	Minimum Detected Concentration	Maximum Detected Concentration	Range of RLs
Benzo(j)fluoranthene	µg/L	0/27	nd	nd	0.010
Benzo(k)fluoranthene	µg/L	0/27	nd	nd	0.010
Total benzofluoranthenes	**µg/L**	**3/27**	**0.00060 J**	**0.00070 J**	**0.010**
Chrysene	**µg/L**	**6/27**	**0.0009 J**	**0.005 J**	**0.010**
Dibenzo(a,h)anthracene	µg/L	0/27	nd	nd	0.010
Dibenzofuran	**µg/L**	**1/27**	**0.60 J**	**0.60 J**	**1.0**
Fluoranthene	**µg/L**	**23/27**	**0.002 J**	**0.313**	**0.010**
Fluorene	**µg/L**	**5/27**	**0.013**	**0.732**	**0.002–0.010**
Indeno(1,2,3-cd)pyrene	µg/L	0/27	nd	nd	0.010
Naphthalene	**µg/L**	**21/27**	**0.002 J**	**0.919**	**0.002–0.010**
Phenanthrene	µg/L	0/27	nd	nd	0.002–0.250
Pyrene	**µg/L**	**23/27**	**0.001 J**	**0.107**	**0.010**
Total HPAHs	**µg/L**	**24/27**	**0.0010 J**	**0.43 J**	**0.01**
Total LPAHs	**µg/L**	**23/27**	**0.002 J**	**8.13**	**0.010–0.037**
Total PAHs	**µg/L**	**26/27**	**0.003 J**	**8.43 J**	**0.01**
cPAH TEQ - mammal (half DL)	**µg/L**	**6/27**	**0.0082 J**	**0.0091 J**	**0.0091**
Phthalates					
Bis(2-ethylhexyl)phthalate	**µg/L**	**5/27**	**0.60 J**	**1.4 J**	**3.0**
Butyl benzyl phthalate	µg/L	0/27	nd	nd	1.0
Dimethyl phthalate	µg/L	0/27	nd	nd	1.0
Other SVOCs					
1,2,4-Trichlorobenzene	µg/L	0/27	nd	nd	1.0
1,2-Dichlorobenzene	µg/L	0/27	nd	nd	1.0
1,4-Dichlorobenzene	µg/L	0/27	nd	nd	1.0
2,4-Dimethylphenol	µg/L	0/27	nd	nd	3.0
4-Methylphenol	µg/L	0/27	nd	nd	2.0
Benzoic acid	µg/L	0/27	nd	nd	20.0
Benzyl alcohol	µg/L	0/27	nd	nd	2.0
Hexachlorobenzene	µg/L	0/27	nd	nd	1.0
n-Nitrosodiphenylamine	µg/L	0/27	nd	nd	1.0
Pentachlorophenol	µg/L	0/27	nd	nd	10.0
Phenol	µg/L	0/27	nd	nd	1.0
PCBs					
Total PCB Aroclors	µg/L	0/27	nd	nd	0.010–0.012
Dioxin/furan					
Dioxin/furan TEQ - mammal (half DL)	**pg/L**	**4/13**	**0.741 J**	**0.838 J**	**0.732–0.782**
Conventionals					
DOC	**mg/L**	**27/27**	**0.81**	**4.40 J**	**na**
TOC	**mg/L**	**7/27[b]**	**2.9**	**5.79**	**0.87–2.24**

Analyte	Unit	Detection Frequency	Minimum Detected Concentration	Maximum Detected Concentration	Range of RLs
TSS	**mg/L**	**27/27**	**3**	**206**	**na**

Bold indicates analytes that had at least one detection.

[a] Seep samples with high levels of dissolved solids were analyzed at a dilution to reduce matrix interference, resulting in elevated RLs.

[b] Twenty TOC results were flagged as non-detect due to detected TOC concentrations in the equipment blank. This issue is discussed in more detail in Section 4.2.

cPAH – carcinogenic polycyclic aromatic hydrocarbon
DL – detection limit
DOC – dissolved organic carbon
HPAH – high-molecular-weight polycyclic aromatic hydrocarbon
J – estimated concentration
LPAH – low-molecular-weight polycyclic aromatic hydrocarbon
na - not applicable
nd – not detected
PAH – polycyclic aromatic hydrocarbon
PCB – polychlorinated biphenyl
RL – reporting limit
SVOC – semivolatile organic compound
TEQ – toxic equivalent
TOC – total organic carbon
TSS – total suspended sediment

Table 4-2 Chemical and conventional results for seeps SP-01 to SP-47

Analyte	Fraction	unit	Seep Sample (LDW18-SP-)													
			01	05	06	24	24-FD	30	32	33	35	38	42	43	45	47
Metals (µg/L)[a]																
Arsenic	D	µg/L	**1.13**	**1.15**	**2.36**	**0.510 J**	**0.535 J**	**1.37**	**1.18 J**	**1.14**	**1.67 J**	**1.42 J**	**1.44**	**0.690 J**	**0.925 J**	**0.835 J**
Cadmium	D	µg/L	0.500 U	0.500 U	0.500 U	0.500 U	0.500 U	0.500 U	0.500 U	0.500 U	0.500 U	0.500 U	0.100 U	0.500 U	0.500 U	0.500 U
Chromium	D	µg/L	**4.78 J**	**5.62**	**4.46 J**	**2.09 J**	**2.08 J**	**3.07**	**3.35**	**2.81**	**3.93**	**3.14**	**0.638**	**3.41 J**	**4.15 J**	**5.86**
Copper	D	µg/L	2.50 U	2.50 U	2.50 U	**1.86 J**	**2.08 J**	2.50 U	5.00 U	**2.15 J**	5.00 U	5.00 U	**1.80 J**	2.50 U	**3.42**	**2.98**
Lead	D	µg/L	1.00 U	1.00 U	1.00 U	0.500 U	0.500 U	0.500 U	0.500 U	**1.72**	0.500 U	0.500 U	0.100 U	1.00 U	1.00 U	1.00 U
Mercury	D	µg/L	0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	0.100 U
Silver	D	µg/L	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	2.00 U	1.00 U	2.00 U	2.00 U	0.200 U	1.00 U	1.00 U	1.00 U
Zinc	D	µg/L	**8.64 J**	**7.22 J**	20.0 U	**4.41 J**	**4.94 J**	**7.48 J**	40.0 U	**4.49 J**	**33.5 J**	**8.55 J**	**7.41 J**	**12.9 J**	**5.49 J**	**7.20 J**
PAHs (µg/L)																
2-Methylnaphthalene	D	µg/L	0.003 U	0.002 U	0.002 U	0.001 U	0.010 U	0.004 U	0.002 U	**0.040**	0.002 U	0.001 UJ	0.001 UJ	0.001 U	0.002 U	0.003 U
Acenaphthene	D	µg/L	**0.517**	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	**1.38**	**0.008 J**	**0.011 J**	0.010 UJ	0.010 U	0.010 U	0.010 U
Acenaphthylene	D	µg/L	**0.003 J**	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	**0.017**	0.010 U	0.010 UJ	0.010 UJ	0.010 U	0.010 U	0.010 U
Anthracene	D	µg/L	**0.012**	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	**0.062**	0.010 U	**0.001 J**	0.010 UJ	0.010 U	0.010 U	0.010 U
Benzo(a)anthracene	D	µg/L	**0.001 J**	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	**0.005 J**	0.010 U	0.010 UJ	0.010 UJ	0.010 U	0.010 U	0.010 U
Benzo(a)pyrene	D	µg/L	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 UJ	0.010 UJ	0.010 U	0.010 U	0.010 U
Benzo(b)fluoranthene	D	µg/L	**0.0006 J**	0.010 U	0.010 U	**0.0006 J**	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 UJ	0.010 UJ	0.010 U	0.010 U	0.010 U
Benzo(g,h,i)perylene	D	µg/L	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 UJ	0.010 UJ	0.010 U	0.010 U	0.010 U
Benzo(j)fluoranthene	D	µg/L	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 UJ	0.010 UJ	0.010 U	0.010 U	0.010 U
Benzo(k)fluoranthene	D	µg/L	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 UJ	0.010 UJ	0.010 U	0.010 U	0.010 U
Total benzofluoranthenes	D	µg/L	**0.00060 J**	0.010 U	0.010 U	**0.00060 J**	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 UJ	0.010 UJ	0.010 U	0.010 U	0.010 U
Chrysene	D	µg/L	**0.003 J**	**0.001 J**	0.010 U	**0.0009 J**	0.010 U	0.010 U	0.010 U	**0.005 J**	0.010 U	0.010 UJ	0.010 UJ	0.010 U	0.010 U	0.010 U
Dibenzo(a,h)anthracene	D	µg/L	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 UJ	0.010 UJ	0.010 U	0.010 U	0.010 U
Dibenzofuran	D	µg/L	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	**0.60 J**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Fluoranthene	D	µg/L	**0.070**	**0.004 J**	**0.003 J**	**0.003 J**	**0.007 J**	**0.009 J**	**0.004 J**	**0.313**	**0.002 J**	**0.009 J**	**0.003 J**	0.010 U	**0.005 J**	**0.003 J**
Fluorene	D	µg/L	**0.013**	0.010 U	0.010 U	0.010 U	**0.019**	0.008 U	0.010 U	**0.732**	0.010 U	0.002 UJ	0.010 UJ	0.010 U	0.002 U	0.003 U
Indeno(1,2,3-cd)pyrene	D	µg/L	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 UJ	0.010 UJ	0.010 U	0.010 U	0.010 U
Naphthalene	D	µg/L	**0.007 J**	**0.002 J**	**0.003 J**	**0.002 J**	**0.006 J**	0.003 U	0.002 U	**0.230**	0.002 U	0.003 UJ	0.002 UJ	0.010 U	**0.003 J**	**0.003 J**
Phenanthrene	D	µg/L	0.038 U	0.006 U	0.004 U	0.003 U	0.046 U	0.037 U	0.004 U	0.250 U	0.003 U	0.010 UJ	0.003 UJ	0.010 U	0.007 U	0.008 U
Pyrene	D	µg/L	**0.036**	**0.003 J**	**0.001 J**	**0.002 J**	**0.002 J**	**0.002 J**	**0.002 J**	**0.107**	**0.001 J**	**0.002 J**	**0.002 J**	0.010 U	**0.002 J**	**0.002 J**
Total HPAHs	D	µg/L	**0.11 J**	**0.008 J**	**0.0040 J**	**0.007 J**	**0.009 J**	**0.01 J**	**0.006 J**	**0.43 J**	**0.0030 J**	**0.01 J**	**0.005 J**	0.010 U	**0.007 J**	**0.005 J**
Total LPAHs	D	µg/L	**0.55 J**	**0.002 J**	**0.003 J**	**0.002 J**	**0.03 J**	0.037 U	0.010 U	**2.42**	**0.008 J**	**0.01 J**	0.010 UJ	0.010 U	**0.003 J**	**0.003 J**
Total PAHs	D	µg/L	**0.66 J**	**0.01 J**	**0.007 J**	**0.009 J**	**0.03 J**	**0.01 J**	**0.006 J**	**2.85 J**	**0.01 J**	**0.02 J**	**0.005 J**	0.010 U	**0.01 J**	**0.008 J**
cPAH TEQ - mammal (half DL)	D	µg/L	**0.0082 J**	**0.0090 J**	0.0091 U	**0.0086 J**	0.0091 U	0.0091 U	0.0091 U	**0.0091 J**	0.0091 U	0.0091 UJ	0.0091 UJ	0.0091 U	0.0091 U	0.0091 U
Phthalates (µg/L)																
Bis(2-ethylhexyl)-phthalate	D	µg/L	3.0 U	3.0 U	**0.60 J**	3.0 U	**0.60 J**	3.0 U	3.0 U	**0.70 J**	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	**0.60 J**
Butyl benzyl phthalate	D	µg/L	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Dimethyl phthalate	D	µg/L	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U

Table 4-2 Chemical and conventional results for seeps SP-01 to SP-47

Analyte	Fraction	unit	Seep Sample (LDW18-SP-)													
			01	05	06	24	24-FD	30	32	33	35	38	42	43	45	47
Other SVOCs (µg/L)																
1,2,4-Trichlorobenzene	D	µg/L	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dichlorobenzene	D	µg/L	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,4-Dichlorobenzene	D	µg/L	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
2,4-Dimethylphenol	D	µg/L	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U
4-Methylphenol	D	µg/L	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
Benzoic acid	D	µg/L	20.0 U	20.0 U	20.0 U	20.0 U	20.0 U	20.0 U	20.0 U	20.0 U	20.0 U	20.0 U	20.0 U	20.0 U	20.0 U	20.0 U
Benzyl alcohol	D	µg/L	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
Hexachloro-benzene	D	µg/L	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
n-Nitrosodiphenyl-amine	D	µg/L	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
PCP	D	µg/L	10.0 U	10.0 U	10.0 U	10.0 U	10.0 U	10.0 U	10.0 U	10.0 U	10.0 U	10.0 U	10.0 U	10.0 U	10.0 U	10.0 U
Phenol	D	µg/L	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
PCBs (µg/L)																
Total PCB Aroclors	D	µg/L	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Dioxin/furan (pg/L)																
Dioxin/furan TEQ – mammal (half DL)	D	pg/L	0.746 U EMPC	na	na	0.740 U EMPC	0.767 U EMPC	na	na	na	na	na	0.756 U EMPC	na	na	na
Conventionals (mg/L)																
DOC	D	mg/L	**2.52 J**	**1.57**	**1.29**	**2.71**	**2.81**	**1.26**	**1.39**	**3.81**	**1.71**	**1.68**	**1.76**	**0.81**	**3.87 J**	**2.86 J**
TOC	T	mg/L	**1.77 UJ**	1.33 UJ	1.65 U	**3.61**	**3.65**	2.24 U	1.67 U	**5.79**	**3.33**	1.89 U	**3.37**	**0.87 U**	1.81 UJ	1.63 UJ
TSS	T	mg/L	**41**	**11 J**	**8 J**	**33 J**	**22 J**	**47**	**4**	**36 J**	**29**	**7**	**56**	**3**	**82**	**206**

Bold indicates detected results.

[a] Seep samples with high levels of dissolved solids were analyzed at a dilution to reduce matrix interference, resulting in elevated RLs.

cPAH – carcinogenic polycyclic aromatic hydrocarbon
D – dissolved
DF – detection frequency
DL – detection limit
DOC – dissolved organic carbon
EMPC – estimated maximum possible concentration
J – estimated concentration
HPAH – high-molecular-weight polycyclic aromatic hydrocarbon
LPAH – low-molecular-weight polycyclic aromatic hydrocarbon
na – not analyzed
PAH – polycyclic aromatic hydrocarbon
PCP – pentachlorophenol
PCB – polychlorinated biphenyl
RL – reporting limit
SVOC – semivolatile organic compound
T – total
TEQ – toxic equivalent
TOC – total organic carbon
TSS – total suspended solids
U – not detected at given concentration

Table 4-3 Chemistry and conventional results for seeps SP-57 to SP-88

Analyte	Fraction	unit	Seep Sample (LDW18-SP-)												
			57	66	70	73	74	77	78	79	83	84	86	87	88
Metals (µg/L)[a]															
Arsenic	D	µg/L	**1.48**	**2.67**	**1.58 J**	**1.57**	**0.925 J**	**0.640 J**	**0.805 J**	**1.27**	**1.14**	**1.67**	**4.48**	**0.720 J**	**4.64**
Cadmium	D	µg/L	**0.160 J**	0.500 U	1.00 U	0.500 U	0.500 U	0.500 U	0.500 U	0.500 U	0.500 U	0.500 U	0.500 U	0.500 U	**0.390 J**
Chromium	D	µg/L	**5.71**	**5.00**	**6.56 J**	**2.98 J**	**5.62**	**5.11**	**5.60**	**5.72**	**5.96**	**5.33**	**4.99 J**	**3.57 J**	**11.7**
Copper	D	µg/L	**1.84 J**	**3.44**	5.00 U	**3.34**	**2.11 J**	2.50 U	**2.00 J**	2.50 U	**3.17**	**2.30 J**	5.00 U	**2.08 J**	5.00 U
Lead	D	µg/L	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	2.00 U	1.00 U	1.00 U
Mercury	D	µg/L	0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	0.100 U
Silver	D	µg/L	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	2.00 U
Zinc	D	µg/L	**6.54 J**	20.0 U	**12.1 J**	20.0 U	**9.93 J**	20.0 U	**10.5 J**	20.0 U	**6.58 J**	**4.44 J**	**12.7 J**	**6.37 J**	40.0 U
PAHs (µg/L)															
2-Methylnaphthalene	D	µg/L	0.001 U	0.002 U	0.002 U	0.002 U	0.002 U	**0.864**	0.003 U	0.002 U	0.001 U	0.002 U	0.002 U	0.007 U	0.002 U
Acenaphthene	D	µg/L	**0.004 J**	0.010 U	0.010 U	0.010 U	**0.027**	**6.70**	**0.007 J**	**0.026**	0.010 U	0.010 U	0.010 U	**0.060**	**0.004 J**
Acenaphthylene	D	µg/L	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	**0.040**	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Anthracene	D	µg/L	0.010 U	**0.001 J**	0.010 U	0.010 U	0.010 U	**0.017**	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	**0.003 J**	0.010 U
Benzo(a)anthracene	D	µg/L	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	**0.0009 J**	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Benzo(a)pyrene	D	µg/L	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Benzo(b)fluoranthene	D	µg/L	0.010 U	**0.0007 J**	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Benzo(g,h,i)perylene	D	µg/L	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Benzo(j)fluoranthene	D	µg/L	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Benzo(k)fluoranthene	D	µg/L	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Total benzofluoranthenes	D	µg/L	0.010 U	**0.00070 J**	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Chrysene	D	µg/L	0.010 U	**0.001 J**	0.010 U	0.010 U	0.010 U	**0.001 J**	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Dibenzo(a,h)anthracene	D	µg/L	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Dibenzofuran	D	µg/L	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Fluoranthene	D	µg/L	**0.003 J**	**0.005 J**	**0.002 J**	**0.005 J**	**0.008 J**	**0.221**	**0.005 J**	**0.009 J**	**0.002 J**	0.010 U	0.010 U	**0.007 J**	0.010 U
Fluorene	D	µg/L	0.002 U	0.002 U	0.010 U	0.002 U	0.010 U	**0.450**	0.002 U	0.002 U	0.010 U	0.010 U	0.010 U	**0.028**	0.002 U
Indeno(1,2,3-cd)pyrene	D	µg/L	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Naphthalene	D	µg/L	**0.003 J**	**0.003 J**	**0.002 J**	**0.003 J**	**0.003 J**	**0.919**	**0.003 J**	**0.004 J**	**0.002 J**	**0.003 J**	**0.003 J**	**0.068**	**0.004 J**
Phenanthrene	D	µg/L	0.003 U	0.007 U	0.002 U	0.006 U	0.005 U	0.165 U	0.006 U	0.006 U	0.005 U	0.003 U	0.003 U	0.018 U	0.002 U
Pyrene	D	µg/L	**0.002 J**	**0.002 J**	0.010 U	**0.002 J**	**0.003 J**	**0.079**	**0.006 J**	**0.008 J**	**0.001 J**	**0.001 J**	0.010 U	**0.003 J**	0.010 U
Total HPAHs	D	µg/L	**0.005 J**	**0.009 J**	**0.0020 J**	**0.007 J**	**0.01 J**	**0.30 J**	**0.01 J**	**0.02 J**	**0.0030 J**	**0.0010 J**	0.010 U	**0.01 J**	0.010 U
Total LPAHs	D	µg/L	**0.007 J**	**0.004 J**	**0.002 J**	**0.003 J**	**0.03 J**	**8.13**	**0.01 J**	**0.03 J**	**0.002 J**	**0.003 J**	**0.003 J**	**0.16 J**	**0.008 J**
Total PAHs	D	µg/L	**0.01 J**	**0.01 J**	**0.004 J**	**0.01 J**	**0.04 J**	**8.43 J**	**0.02 J**	**0.05 J**	**0.005 J**	**0.004 J**	**0.003 J**	**0.17 J**	**0.008 J**
cPAH TEQ - mammal (half DL)	D	µg/L	0.0091 U	**0.0086 J**	0.0091 U	0.0091 U	0.0091 U	**0.0086 J**	0.0091 U	0.0091 U	0.0091 U	0.0091 U	0.0091 U	0.0091 U	0.0091 U
Phthalates (µg/L)															
Bis(2-ethylhexyl)-phthalate	D	µg/L	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	**1.4 J**	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U
Butyl benzyl phthalate	D	µg/L	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Dimethyl phthalate	D	µg/L	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U

Table 4-3 Chemistry and conventional results for seeps SP-57 to SP-88

Analyte	Fraction	unit	Seep Sample (LDW18-SP-)												
			57	66	70	73	74	77	78	79	83	84	86	87	88
Other SVOCs (µg/L)															
1,2,4-Trichlorobenzene	D	µg/L	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dichlorobenzene	D	µg/L	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,4-Dichlorobenzene	D	µg/L	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
2,4-Dimethylphenol	D	µg/L	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U
4-Methylphenol	D	µg/L	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
Benzoic acid	D	µg/L	20.0 U	20.0 U	20.0 U	20.0 U	20.0 U	20.0 U	20.0 U	20.0 U	20.0 U	20.0 U	20.0 U	20.0 U	20.0 U
Benzyl alcohol	D	µg/L	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
Hexachloro-benzene	D	µg/L	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
n-Nitrosodiphenyl-amine	D	µg/L	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
PCP	D	µg/L	10.0 U	10.0 U	10.0 U	10.0 U	10.0 U	10.0 U	10.0 U	10.0 U	10.0 U	10.0 U	10.0 U	10.0 U	10.0 U
Phenol	D	µg/L	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
PCBs (µg/L)															
Total PCB Aroclors	D	µg/L	0.010 U	0.010 U	0.010 U	0.010 U	0.012 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Dioxin/furan (pg/L)															
Dioxin/furan TEQ – mammal (half DL)	D	pg/L	0.748 U EMPC	**0.741 J**	0.732 U	na	na	0.741 U EMPC	**0.838 J**	0.744 U EMPC	na	na	**0.750 J**	**0.747 J**	0.782 U EMPC
Conventionals (mg/L)															
DOC	D	mg/L	**1.39**	**1.57 J**	**1.23 J**	**3.03 J**	**2.33 J**	**4.40 J**	**1.61 J**	**1.76 J**	**1.49 J**	**1.42 J**	**1.84 J**	**1.21 J**	**1.25 J**
TOC	T	mg/L	**1.31 UJ**	1.43 UJ	0.94 UJ	**2.90 J**	2.24 UJ	**5.51 J**	1.63 UJ	1.73 UJ	1.24 UJ	1.26 UJ	1.49 UJ	1.07 UJ	1.12 UJ
TSS	T	mg/L	**10 J**	**9**	**5**	**39 J**	**28 J**	**9 J**	**7 J**	**21 J**	**10**	**9 J**	**22**	**16 J**	**7**

Bold indicates detected results.

[a] Seep samples with high levels of dissolved solids were analyzed at a dilution to reduce matrix interference, resulting in elevated RLs.

cPAH – carcinogenic polycyclic aromatic hydrocarbon
D – dissolved
DL – detection limit
DOC – dissolved organic carbon
EMPC – estimated maximum possible concentration
J – estimated concentration
HPAH – high-molecular-weight polycyclic aromatic hydrocarbon
LPAH – low-molecular-weight polycyclic aromatic hydrocarbon
na – not analyzed
PAH – polycyclic aromatic hydrocarbon
PCP – pentachlorophenol
PCB – polychlorinated biphenyl
RL – reporting limit
SVOC – semivolatile organic compound
T – total
TEQ – toxic equivalent
TOC – total organic carbon
TSS – total suspended solids
U – not detected at given concentration

4.2 DATA VALIDATION RESULTS

Independent data validation was performed by Ecochem. Full validation was performed on a minimum of 10% of the data or a single sample delivery group, as specified in the QAPP (Windward 2018). A summary-level validation review was conducted on the remaining data. All data presented in this report were determined to be acceptable for use as qualified.

The data validation report, which is presented in Appendix D, includes detailed information regarding all data qualifiers. The two issues that resulted in the highest number of qualified results are summarized here.

- Seventeen samples for TOC and DOC were analyzed outside of holding time. The resulting data was J-flagged as estimated.
- The equipment blank contained detectable concentrations of TOC, fluorene, phenanthrene, naphthalene, 2-methylnaphthalene, 1,2,3,7,8-pentachlorodibenzofuran (PeCDF), total heptachlorodibenzo-*p*-dioxin (HpCDD), total hexachlorodibenzo-*p*-dioxin (HxCDD), total tetrachlorodibenzofuran (TCDF) and total PeCDF. Sample results less than five times the equipment blank concentration were qualified as not detected; analytes qualified as not detected included TOC (20 samples), fluorene (10 samples), phenanthrene (26 samples), naphthalene (5 samples), 2-methylnaphthalene (25 samples), 1,2,3,7,8-PeCDF (1 sample), total HpCDD (11 samples), total HxCDD (13 samples), total TCDF (5 samples) and total PeCDF (2 samples).

5 References

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